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US Programs Affecting Food and Agricultural Marketing

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US Programs Affecting Food and Agricultural Marketing

Springer

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Preface

Government policies and programs must constantly adjust to change, or they become a drag on markets and on the firms that operate within them. If US policies and programs affecting food and agricultural marketing do not adjust in a dynamic manner, it is likely that neither farmers nor consumers will fully realize the efficiency increasing gains that result from innovations that are constantly occurring in the food value chain. Armbruster and Knutson have spent many years studying markets and the policies and programs under which they operate. Both served in the position of the chief economist within the Agricultural Marketing Service (AMS) of the US Department of Agriculture (USDA). At the time, AMS had the responsibility for administering most of USDA's marketing programs. It is because of their personal interests in seeing that marketing policies and programs adjust to change that this book is written. But today, a number of policies and programs affect food and agricultural marketing other than just the traditional marketing system-focused ones. Therefore, this book addresses that broader perspective more appropriate in this age of global food and agricultural markets.

The distinction between policies and programs is important. Policy is a guiding principle that leads to a course of action or set of programs. Programs implement policies. Policies and programs exist in both the public and private sectors. People in both the public and private sectors resist change. In government, policies typically change when elections result in shifts in the political party in power, when there is a crisis, or when market evolution finally makes it obvious that adjustment is needed. In the private sector, policies typically change with changes in management, when there is a crisis, or when market evolution makes it obvious that adjustment is needed. Private sector programs tend to adjust to profit opportunities, while considering the risk involved. Firms that resist change may find themselves at a competitive disadvantage and lose market share. This creative destruction process does not operate in the public sector where program changes occur more slowly and depend on leadership by public servants and political appointees, as well as cooperation from producers and marketing firms in many cases.

Decisions needed to be made on which policies and programs to analyze. In making these decisions, the focal point was on the government policies and programs that most directly shape contemporaneous marketing practices and decisions of farmers, agribusiness firms, and consumers throughout the food value chain. Consideration was given to interest group concerns about existing marketing policies and programs, as well as to evolving societal values and consumer expectations of the food system. Therefore, this book not only explains the changes in marketing policies and programs that have occurred and indicates where further policy adjustments may be needed, but also explores where new programs may be needed or existing program functions may be better performed by the private sector.

The individual chapter authors provide expertise based on their research and advisory roles related to the program areas they analyze. The evaluation is conducted utilizing specified economic criteria and drawing on the author's own research and that of their peers, as well as government agency and private sector information and expertise. Each chapter was reviewed by at least two agricultural economist peers from academic, government agency, or industry backgrounds. This process contributed to more accurate, up-to-date, and thorough assessments of the state of existing policies and programs, their impacts on economic efficiency in the markets and potential updates in them to better match today's market needs.

Darien, IL, USA — Walter J. Armbruster
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We must single out James MacDonald of ERS for his guidance in framing our analytic framework based on efficiency criteria, drawing on his long tenure in researching and teaching the concepts involved in this area. Richard Heifner, author of Chap. 3 on the history of government involvement in the marketing system, also contributed significantly to framing the efficiency criteria. Kenneth C. Clayton, now retired from AMS, provided early encouragement and guidance. We also owe a large debt of gratitude to the numerous individuals who provided review comments on the chapters.

Our thanks go to Walt's wife Helen and Ron's wife Sharron for their support as we worked on this interesting and challenging project.

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Part I
Market Evolution, Policy History, and Consumer Expectations

This part sets the stage for the following parts by describing the evolution of the food and agriculture marketing systems, policies, and programs. It documents the history of public sector marketing policies, programs, and institutions, including the foundation programs designed in the early- and mid-1900s. In a contemporary context, it recognizes that many new demands are being placed on existing programs. It discusses the increased scope, complexity, and globalization of the food value chain; the changes in technology that brought about these changes; and the need for policy and program adjustments. Part I also sets forth the criteria by which marketing policies and programs will be evaluated in the remaining chapters.

In Chap. 1, Armbruster and Knutson set the stage for the remainder of the book. They briefly review the major stages of market evolution from local spot markets to the complex food value chains. The chapter ends with a discussion of the criteria that the authors use to evaluate marketing policies and programs in Chaps. 4 through 18.

In Chap. 2, Kinsey analyzes the evolution of consumer expectations for food markets. Beginning with satisfying basic food needs, these expectations have evolved to the point where consumers "want it all." More than ever, some consumers seek foods produced in a manner that reflects their social values and suits their lifestyles.

In Chap. 3, Heifner describes the evolution of U.S. policies and programs affecting food and agricultural marketing. In the process, insight is provided into the forces leading to policy and program changes.

Chapter 1
Evolution of Agricultural and Food Markets

Walter J. Armbruster and Ronald D. Knutson

Abstract The marketing of agricultural and food products takes place within the framework of a set of federal policies and programs which influence the production and terms of trade throughout the marketing system. This chapter traces the history of agricultural markets and policies affecting food and agricultural marketing. It then builds on previous studies, recognizing that the changing forces of globalization, multinational firm structures, consumerism, and societal values are creating challenges to the existing policies and programs. It subsequently introduces the need for dynamic adjustment of policies and programs to accommodate, facilitate, and regulate market changes in spite of limited public resources and the need for the private sector to pay a larger share of program costs. It concludes with identification of the criteria used to evaluate the consequences of current policies/programs and options for change.

The marketing of agricultural and food products takes place within the framework of a set of federal policies and programs. These policies and programs influence the production and terms of trade throughout the agricultural and food marketing system. The expectations for the performance of the food marketing system have changed markedly since the first federal marketing programs were enacted during the period 1883–1949. During that time, federal government actions emphasized making markets more competitive and improving the market position of farmers. Policy focused on putting farmers in a more competitive market situation by taking

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antitrust action against monopolies and anticompetitive behavior; regulating trade practices; improving information on production and market prices; establishing grades and standards by which products could be identified and traded; facilitating generic commodity advertising promotion and research; protecting food safety; and creating cooperatives and marketing orders that could countervail the market power of food processors and manufacturers. These policy actions were justified by competitive norms which specified a diffused market structure. Most of the policies were implemented through programs in the US Department of Agriculture (USDA).

In the post-World War II period, market concentration continued to increase, particularly in food processing, manufacturing, and retailing; and vertically integrated structures developed that linked producers more closely to food processors and manufacturers. In response to food price inflation in the early 1960s, the performance of the food marketing system was evaluated by the National Commission on Food Marketing (1966). That evaluation focused on market subsectors, in an industrial organization framework. The Commission placed substantial emphasis on economies of scale and the effects of increased market concentration and vertical integration in food manufacturing and retailing. Following up on the work of the Commission, a series of NC 117 research studies on the organization and performance of the US food system was produced under the leadership of Marion at the University of Wisconsin (Marion 1986).[1] This research placed greater emphasis on measures of market performance, market control, pricing, and market information issues. In the early 1980s, several of the participants in one or more of the NC 117 studies became involved in the first effort to assess the performance of the US agricultural marketing policy programs. A central conclusion of that study, under the leadership of Ambruster, Henderson, and Knutson (1983), was that there was a need to update marketing policies to address issues such as increasingly thin markets, providing contract information, need for increased mandatory reporting of market transactions, and improving the degree of consumer information.

This book builds on the previous studies, but recognizes that: (1) Globalization has made commodity and food markets increasingly trade dependent, and most of the leading market competitors have become multinational in scope. (2) Consumerism has changed the food system goal from satisfying basic nutrition needs to fulfilling consumers' desires and diverse needs for safe, nutritious, convenient, and high-quality food products on a year-around basis. (3) Societal values encompassing environmental impacts of the food production and marketing system, production practices, and interest group preferences influence food and agricultural marketing. (4) Dynamic adjustment of policies and programs affecting food and agricultural marketing to adjust to market changes is expected in spite of limited public resources, and therefore the private sector must pay a larger share of program costs.

[1] The North Central Regional Research Project NC 117 led by Bruce W. Marion, financed through the USDA, involved many of the agricultural economics professionals who were engaged in marketing research during the period 1974 through 2000.

Considering the explicit nature of the demands of globalization, consumerism, societal values, and dynamism, the criteria for evaluation of the performance of policies and programs affecting food and agricultural marketing must be encompassing. As a result, the policies and programs are evaluated according to an explicit set of criteria. The chapter authors in this book draw on their policy and program knowledge, their own and other researchers' findings, and insights of program administrators and staff.

Agricultural and Food Market Evolution

As markets change, policies and programs designed to serve those markets must adapt. Change-oriented USDA Agricultural Marketing Service (AMS) Administrator Erwin Peterson often admonished his staff in the mid-1970s: "If we (AMS) are running our programs the same tomorrow as today, we are falling behind the pace of industry developments and societal expectations." At the time, AMS was administering most of the programs evaluated in the 1983 study, which is not true in 2012 for this study.

Many of the current federal policies affecting food and agricultural marketing were initiated during 1920–1940 (Heifner 2011). Clearly, the US food and agricultural marketing system has changed significantly since these policies and programs were developed. The performance of these policies affecting food and agricultural marketing is dependent on their ability to adjust to the changes in the food and agricultural marketing system. Prior to evaluating how well policies affecting food and agricultural marketing have adjusted in Chaps. 2 and 3, this chapter highlights a number of the major changes that have occurred in the marketing system since the inception of these programs.

Decentralized Local Open Markets

Throughout much of the eighteenth and nineteenth centuries the markets were decentralized with open, spot-market trading in local markets. As long as markets were local, buyers and sellers could evaluate supplies, product quality, and prices much as occurs today in farmers markets. Yet, farmers did not have the information needed to evaluate the broader regional and national market performance. This led to the forerunners of the National Agricultural Statistics Service.

Central Markets

The development of big cities led to central markets where sellers and buyers converged. Distant farmers often accessed these markets by rail transportation.

Large meat packers and milk processors developed dominant positions in perishable product markets. Farmers lacked knowledge of the quantities being supplied to markets and product prices. Disputes arose over the quality of products sent and delivered to these central markets. A clear need developed for market information and product grading systems. Unsanitary conditions in meat packing plants and issues of foodborne disease transmission led to meat inspection laws, milk sanitation and pasteurization regulations, and food adulteration laws. Antitrust laws were enacted to curb the market power of railroads, meat packers, and other centers on monopoly influences. Farmers organized cooperatives as countervailing forces to offset a portion of these monopolistic elements. It was in this period (1920–1940) that many of the current farmer-oriented federal marketing programs originated.

Direct Marketing

As truck transportation systems improved and farm-to-market roads developed during and following World War II, an increasing proportion of farm sales reverted to private treaty sales directly from farms to buyers, much like the previous era's decentralized local open markets. Buyers often located selling points in rural areas. The effect was for an increasing proportion of sales to bypass central markets. This made the collection of market news information more decentralized, difficult, and expensive. As a result, AMS market news service programs were expanded.

Forward Pricing and Vertical Integration

The most pervasive departure from the decentralized marketing system was the development of formal vertical integration arrangements between farmers, processors, and retailers (Breimyer 1983). With vertical integration, products no longer moved by competitive spot market bidding from one market stage to another. Forward pricing became increasingly prominent. Livestock was priced on a grade-and-yield basis. Whether accomplished by contract or ownership, marketing stages increasingly were completely eliminated. Integration developed in poultry (chicken, turkey, and eggs) and packaged leafy greens to the point where the only pricing point is the sales to supermarket and restaurant chains or to large food-service operators. The terms of contracts and contract integration in chicken, for example, have become highly controversial with larger producers becoming linked through a variety of specified production, unit pricing, and nonprice mechanisms to the food industry. Proposals have been made for public sector development of model contracts or for the reporting of diverse contract terms. The fact that such proposals have never received serious consideration is but one indication of the shift in marketing policy emphasis away from producers.

Consumerism

While meat inspection, pasteurization, adulteration, and ingredient labeling laws have a history extending through most of the twentieth century, consumer activism became a pervasive force with the advent of pesticides and highly processed convenience and snack foods. Consumers' expectations regarding food have successively evolved beyond having basic life-sustaining nutrition which was safe and taste pleasing, with processing to preserve or convert basic ingredient products into useful forms. Their interests now also include ingredient labeling, unblemished external appearance, convenience, and nutrition labeling and increasingly information about health characteristics, organic production, local foods, environmental sustainability, and animal welfare. Consumerism was a major force in the formation of the Environmental Protection Agency (EPA), the development of nutritional labeling regulations, and the enactment of the 2010 Food Safety Modernization Act.

Globalization

Globalization accelerated in the 1970s with the opening of markets to satisfy ever-growing world food needs and has been fostered by the development of networks of food retailers extending across countries. As international trade and travel expanded, preventing the introduction of invasive species and pathogens became more important. The introduction of pests increases production costs, jeopardizes food supplies, and may threaten the very existence of industry segments. As international tensions have grown more recently, issues of food terrorism have complicated the challenges facing those responsible for protecting the integrity of the food supply in both the public and private sectors. Consequently, a number of federal policies and programs, which were not initially thought of as marketing programs, have significant implications for food and agricultural marketing.

Value-Chain Marketing

Satisfying the ever-increasing production, processing, retailing, globalization, and regulatory demands brings both challenges and opportunities. The challenges lie in a single multinational firm coordinating its horizontal, vertical, and conglomerate operations for multiple product lines. The opportunities lie in setting up value-chain systems that satisfy highly diverse consumer product demands within and across countries and markets. These consumer demands are for an ever-increasing variety of products having distinct production, product development, processing, packaging, taste, and convenience characteristics for which consumers have the willingness and the ability to pay. Some of the most recent demands include organic, free-range, and hormone-free production in ways that are perceived to enhance animal well-being. During this period of changing consumer demands, the greatest adjustment flexibility has been demonstrated by local farm stands, farmers markets, and intermediated local foods market channels (Low and Vogel 2011). Increasingly, questions arise as to the appropriate role for public sector policies and programs in the value-chain marketing era. Agribusinesses involved in developing and servicing these value-chain systems are focused on assuring safe food supplies, certifying production characteristics, and verifying that products meet buyer expectations and quality standards. This value-chain-oriented business environment creates challenges as well as offers opportunities for federal programs which affect food and agricultural marketing.

Criteria for Evaluating Performance

A uniqueness of this book, compared with the 1983 publication, is that the current chapter authors have been asked to analyze each set of policies affecting food and agricultural marketing according to a common, specified set of market efficiency and nonmarket benefits criteria. The economic foundation for measuring marketing efficiency lies in the concept of Pareto optimality. A market is Pareto efficient if, through a reallocation of resources, it is impossible to make one person better off without making another person worse off. Therefore, if it is possible, through resource reallocation, to improve the welfare of one person without decreasing the welfare of another, the market is not performing efficiently. Put differently, markets are operating efficiently when maximum welfare is being achieved from the available resources. The failure of markets to efficiently allocate resources occurs when higher levels of welfare can be achieved from the standpoint of society as a whole. Market failures lead to gaps between price and marginal cost, and between marginal social cost and marginal private cost (MacDonald 2011), which may be reduced or eliminated by changes in marketing policy.

The application of the Pareto-related efficiency criteria to the performance of agricultural markets is explained and illustrated in the series of chapters authored by leading economic efficiency researchers (e.g., Just 1987; MacDonald 1987; Milon 1987) in the book Economic Efficiency in Agricultural and Food Marketing edited by Kilmer and Armbruster (1987). This and related economic literature (e.g., Kilmer and Armbruster 1984) indicates that analysis of market efficiency requires analysis of technical efficiency, allocative efficiency, and dynamic efficiency. These three measures of market efficiency, defined in the following terms, are used throughout this book to evaluate the economic performance of the various policies affecting food and agricultural marketing:

1. Technical efficiency exists when production occurs at minimum cost, for given resource prices and levels of output. In a market context, technical efficiency exists when total product costs cannot be reduced by shifting production among firms. Viewed in this multi-firm context, the achievement of technical efficiency

captures economies of scale in production and marketing (French 1967). In today's context, the achievement of technical efficiency may require that firms reach through the value chain to specify how farm products are produced, handled, or processed.

2. Allocative efficiency is achieved by the allocation of scarce resources among alternative products, production activities, and uses to maximize welfare. When a market fails to allocate resources efficiently, there is said to be market failure. This may occur because of imperfect knowledge, monopolistic competition, concentrated market power, or externalities. The criterion for evaluation of allocative efficiency is that product price is equal to marginal cost. Monopolistic and oligopolistic seller, as well as monopsonistic and oligopsonistic buyer, market structures create barriers to contestability that directly contradict the purely competitive norm where firm numbers are sufficiently large and homogeneous that no single firm can influence the market equilibrium. When externalities are involved, price is evaluated relative to social marginal cost. Social marginal cost reflects full economic cost, or marginal cost plus the added cost borne by society due to the existence of externalities (MacDonald 2011). A large literature driven by resource economics addresses externalities in considerable depth, and is applicable to food and agricultural marketing, especially in the application of willingness-to-pay studies often used to evaluate consumer demand for nonmarket social values.
3. Dynamic efficiency measures how well markets innovate to adjust/adapt to change over time. A system achieves dynamic efficiency not only through competition and creative destruction but also through its ability to adapt to value-chain modifications and to meet new demands on the marketing system resulting from changing consumer preferences and new technology. Dynamic efficiency becomes critically important when technology and/or consumer preferences are changing rapidly, as they have over the last several decades (Ward 1987). Policies to address dynamic efficiency include those affecting innovation like public funding of research on production, processing, and marketing of food products, as well as protection of intellectual property rights through, for example, the extension of patent rights to new life forms. But once again, the trade-offs are very real between dynamic efficiency and policies put in place to achieve technical and allocative efficiency goals.

In addition to the market efficiency criteria, authors have in appropriate cases addressed the implications of policies involving government intervention into markets which are "extra-market," or not based on departures from the economically rigorous Pareto optimality criteria discussed above. These extra-market interventions address social values which increasingly impact food markets and hence agricultural markets at the upstream level. The nonmarket social values include "distributive justice," or redistribution of wealth and economic benefits generated by the private sector; those driven by various interest groups focused on organics, animal well-being, and similar welfare sorts of issues; and "merit goods" such as food safety, nutrition, and health. The distributive justice values may be addressed by social programs that effectively transfer wealth from one population segment to another (Polanyi 1944; Hirschman 1970). The interest group issues and merit goods are addressed through government regulations prohibiting certain actions or practices in the private sector (Heifner 2011), or by providing policy incentives to change private sector behavior. Measuring the nonmarket benefits of the distributive justice, interest group issues, and merit goods policy interventions is imprecise and difficult in practice due to lack of well-defined, measureable goals.

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Chapter 2
Expectations and Realities of the Food System

Jean Kinsey

Abstract Food and agriculture is an industrial sector with complex supply chains and electronically aided information and logistics systems. The center of decision-making has shifted from farmers to processors to retailers as mega-sized supermarkets introduced price competition and drove down the price local and global suppliers could charge. Economies of scale necessitated technical and dynamic efficiencies through horizontal mergers and acquisitions and vertical coordination all along the supply chain. Vastly heterogeneous consumers present food preferences that not only vary by culture, income, and taste, but by social responsibility mores. Positioning food and health as a single thought changes the priorities for food choice. Altogether, the food system is a web of international laboratories, producers, processors, logistics companies, retailers, cooks, and consumers. Government oversight of its safety practices, trade agreements, information and advertising, competitiveness, and sustainability comprises another vast web, one of state and federal agencies, inspectors, and activities. Public policy serves to promote a healthy agricultural sector and a healthy population through food security programs and economic safety nets.

Introduction

Providing for the health and welfare of its population with abundant, safe, and affordable food has long been the goal of the food and agricultural system in the United States. Corresponding goals are ensuring that farmers receive an income

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sufficient to encourage adequate production and support economically viable rural communities. The food system is a combination of private enterprises—from farm input suppliers, through food processing and retailing companies, on to consumers—and public policies that monitor and incentivize production. Public policies reward farmers with support prices, guaranteed markets, crop insurance, export markets, and protective regulations. The system includes infrastructure for energy, communication, price information, market coordination, financing opportunities, and tax benefits. Transportation of large-scale crop and livestock production to distant markets depends on publically provided air, sea, river, and land transportation. Barges and railroads played a key role in the development of large-scale farming. Technology and innovation that enabled the move from agrarian to commercial agriculture came primarily from public investment in basic and applied research until about the mid-1990s when much of the innovative research shifted to private laboratories. The food and agricultural system also delivered relatively safe food due to credible regulations by USDA (meat, poultry, and processed eggs) and FDA (all other food). The development of national and international food brands also contributed greatly to food safety, since large companies work hard to prevent any food safety scandal that would diminish the value of their brand. Food safety is, however, an ongoing challenge with new processes and products, increased imports, globally sourced ingredients, multiple types of final products and retail outlets. In the last century public education about food preservation, cooking skills, nutrition, and healthy eating proliferated in public schools and youth programs such a 4-H. These efforts helped ensure that consumers benefit from this elaborate and technically efficient production system; in turn they would demand and utilize the food produced, encouraging the development of commercial agriculture. Thus, the full supply chain of food production, processing, marketing, and utilization developed to ensure the nutritional health and productivity of the population as well as the health of agricultural industries and rural communities.

Government programs and regulations almost always lag behind technology and private market innovation in the real world but in agriculture, there has been a close coordination between government support and the success of the sector. Realizing large economies of scale that were encouraged by government price supports, protective tariffs and quotas, coordinated markets (marketing orders, cooperatives), and technical innovation, the cost of producing food declined throughout the twentieth century and farmers soon produced more than adequate food for the US population. In fact, the portion of consumers' incomes spent on food declined steadily leveling out at about 12–13% in the 2000s. Surplus food was used in government food distribution programs for the poor, for school lunch/breakfast programs, and to improve the US trade balance with a steady stream of commodity exports.

Some argue that the largess of the food and agricultural programs led to an over abundance of food at prices so low that we have ended up with an unhealthy, obese population. Others argue that government support of basic crops and livestock at the expense of fruits and vegetables has skewed agricultural output towards food high in carbohydrates and fat and relatively low in other essential nutrients. Although this may be a contributing factor in people's health, food processors and manufacturers can take a lot of credit for adding variety, texture, and flavor to basic foods and delivering them in convenient and affordable forms such that overeating is hard to resist.

As consumers' need for basic nutrition and desire for convenience and flavor is met, they upgrade their preferences to include variety, prestige, and sensitivity to social and environmental causes, promoting health and vigor and preventing disease. This leads to a plethora of subindustry sectors with everyone in the food supply chain trying to meet heterogeneous consumer demands. Since price remains important, meeting these diverse demands in a cost-effective way remains a priority. Consumers want it all and the food systems, led by retailers, compete fiercely to deliver at the lowest possible cost.

The first part of this chapter defines the food system as it has developed in the United States and globally, illustrating the trends in production, distribution, and consumption by types of food, sources, and market shares. The supply chain for various foods determines the efficiency with which food is delivered to consumers. Government support and regulations determine, in large part, the size of each channel and its value to producers and consumers. Part two of this chapter explores changes in consumer preferences across income categories and how they determine the direction agricultural producers and food processors take.

Food Supply Chain: Who's in Control?

In the 1910, 1920, and1930s, the farm sector dominated the decisions about what was produced. It was also the focus of public policy, which was aimed at incentivizing agricultural production and providing food security for the nation. The Agricultural Adjustment Act of 1933 provided financial support for farmers so they could purchase the needed inputs and "to protect the consumers' interest by readjusting farm production at such level as will not increase the percentage of the consumers' retail expenditures for agricultural commodities, or products derived there from…," (National Agricultural Law Center 2009). The path of food between farm and fork was largely taken for granted and in many circles there is still astonishing little appreciation or knowledge of the many processes and logistic steps involved in moving food to final consumption. By the middle of the twentieth century food processors (manufacturers) exerted a strong influence over the food supply chain as they began to process commodities, create food products for the mass market, and introduce commercial convenience into the supply chain. National and international brands such as General Mills, Kraft, Nestlé, and Sunkist became trusted partners in feeding families. Their need for consistent and reliable quality and quantity ingredients introduced a new model of contract farming and enhanced the returns to larger, well-managed farming operations. As food processing began to concentrate regionally (e.g., flour milling in the Midwest) and firms grew in size, they needed help to distribute products across the nation. With the development of interstate highways and nationwide markets in the 1960s, wholesalers became prominent players in the food supply chain. They are the link between grower shippers (in the case of fresh produce), other first line handlers, food manufacturers, and the retail sector. Initially, they provided the capital for inventory in the system. They acted as the brokers connecting food from a growing number of food manufacturers to a growing number of grocery stores and foodservice places. Simultaneously, some large regional retail food companies such as A&P and Kroger developed their own distribution centers bypassing the full line wholesalers. They were the technical and logistics forerunners of the very large self-distributing supermarkets and super stores such as Wal-Mart.

The food industry was a leader in developing the now ubiquitous Uniform Product Codes (bar codes) and in the development of electronic data interchange (EDI) in 1972. Although the bar code, along with scanners and computers, led to giant leaps in technical efficiency and inventory management, many retail food stores did not adopt the scanning technology until well into the 1990s and most retail food stores did not exploit the power of the data they were collecting. Capturing detailed data on customer purchases in real time, coordinating inventory orders with venders, and implementing customer loyalty programs came much later. In a 2003 survey of US retail food stores, 85% of the largest supermarkets (in chains with more than 750 stores) were using customer loyalty programs, but less than one quarter of other retail food stores were so engaged (Kinsey et al. 2003). In a 2007 survey of retail food stores between 34 and 48% of stores in chains with more than ten stores reported using vendor-managed inventory; only 43% of the largest supermarkets reported using scanner data for automatic inventory refill (Chung et al. 2010).

In the middle 1980s Wal-Mart demonstrated the ability to reduce the inventory held in their general merchandise stores by building massive computerized databases (based on EDI sales data), analyzing sales by categories and items, building their own proprietary warehouses (called distribution centers) and taking deliveries from manufacturers only in the amounts needed for the next few days or weeks. They were able to cut operating costs below other retailers. Traditional food retailers sought to blunt the advances of Wal-Mart into the food business by collaborating through the Food Marketing Institute in 1992 to develop an upgraded electronic system dubbed "Efficient Consumer Response (ECR)" (Food Marketing Institute 1995). Working perfectly, it would mimic the "just-in-time" inventory management system instituted by the automobile industry. It never achieved that goal, but it did bring the retail food companies into the new age of information rich, computerized decision-making and ordering. ECR was soon replaced by a new slogan—Cooperative Planning, Forecasting and Replenishment (CPFR)—but the goal was the same. It was the dawning of the age of dynamic efficiency in the food supply chain and the rise of powerful retailers. By the mid-1990s, retailers with information age technologies became the dominant parties in the food supply chain. Superior information about consumer sales gave them new buying power that rewarded large-scale operations, enabled them to determine what inventory they needed on a flow basis, and kept store inventories as lean as possible. Pushing inventory back up the supply chain became a strategy for lowering costs and for controlling turnover of products on the shelves. Tracking consumer purchases and responding by demanding the best selling products from all food suppliers put retailers in the position of the gatekeeper of the food supply chain by the turn of the twenty-first century. The largest chains could well hold monopsony power; they compete fiercely with each other on retail price at the local level and bargain hard with global suppliers for the lowest cost product. By 2002 the top ten supermarket chains with 13,912 stores (6%) had 50% of all retail food store sales totaling $570 billion (Supermarket News 2003). In 2010, twenty buyers are estimated to control roughly two thirds of the value of groceries sold nationally (Cook 2011).

Regardless of the type of food or the production practices used (organic, genetically modified crops, commercial), or the position of the food business in the supply chain, there is a consistent trend towards bigger companies and larger market share. This trend is consistent with technical and dynamic efficiency even though a counter trend towards small, local production has received considerable attention. Small production units serve local and unique customers quite well but cannot realize the economies of scale that large units enjoy and often become hobbies or niche operations. Many eventually merge with larger companies or go out of business; they are rarely economically sustainable.

Food System from Laboratory to Consumption

The US food and fiber sector comprised 4.8% of the Gross Domestic Product (GDP), 18% of the employment, 4% of imported goods, and 11% of exports in 2011 (USDA ERS 2011a). The food industry is integral to national security as well as essential for the health and welfare of the nation's people. The scope of the food industry stretches from scientific laboratories in universities, life science companies, and government agencies, through small and large producers, a labyrinth of commodity markets, packers, shippers, processors, manufacturers and distributors, and on to more than 225,000 retail food stores and 960,000 foodservice establishments. The food industry must be considered as a whole system from the science of breeding and genetics to the consuming of food. Unlike most industrialized goods, food can be handled or consumed by the final consumer in various states of processing from seeds to ripe fruit, from raw to cooked, from fresh and natural to preserved and manufactured, from local gardens to foreign imports. Figure 2.1 illustrates the complexity and size of the food system as it integrates with the world market. Each major sector of the supply chain of the food industry is presented, herein, in terms of its contribution to the national economy.

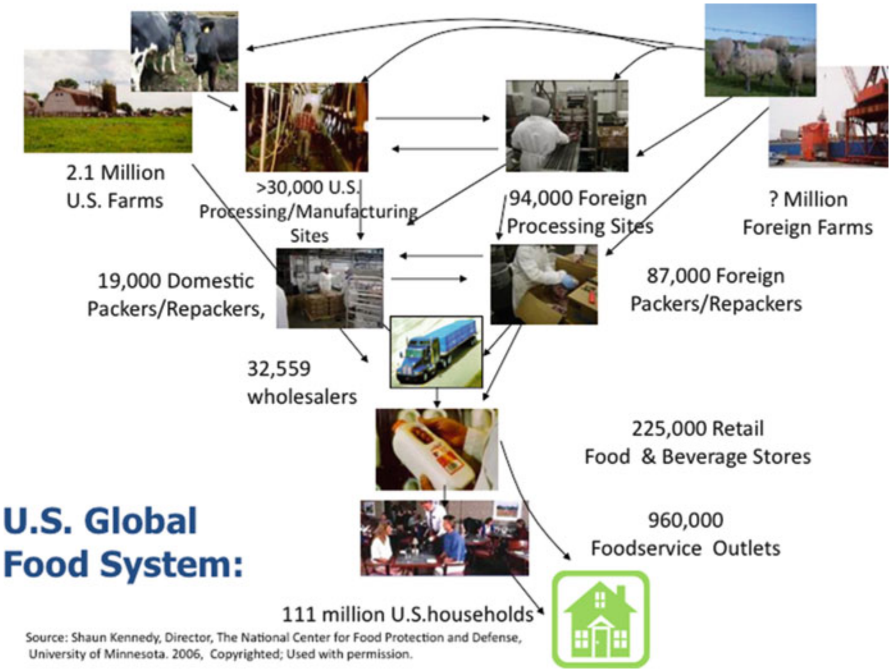

Fig. 2.1 Global food system

Retail

Retail sales revenue in the food industry was over $1.2 trillion a year in 2010, more than 24% of all US retail sales, making it the largest of any retail sector including automobiles. Food expenditures for food-at-home in retail food stores are higher than in foodservice establishments ($625.3 B. vs. $544.4 B. in 2010). Sales have been growing faster in the foodservice sector. The share of consumers' food dollar spent in foodservice establishments wavers between 43 and 49%. Consumers in the United States spend about 6% of their *disposable income* on food in a retail food store and 12–14% on food overall, less than in any other country in the world (USDA ERS 2010a). Data from the Bureau of Labor Statistics indicates that households spend 5% of their total *expenditures* on food away from home and 8% on food at home (purchased in a grocery store of some type) (U.S. Dept. Labor 2011).

There are more than 210,000 traditional and nontraditional food retailers including supercenters. There are another 22,000 nontraditional retail food stores including convenience stores. Together they employ 2.8 million people, almost 2% of all employment (in 2010) (U.S. Dept. Labor 2010). Traditional retail food stores and supercenters capture 90% of the sales. General merchandise discounters entered the retail food business in order to bring more customers into their stores more frequently even though the profit margins on food are only 1–2%—much lower than on general merchandise. Consumers shop for groceries 1.7 times per week on average and go to general merchandise stores only once every 2 weeks (Food Mktg Inst 2010). Sales in non-traditional retail food stores are also increasing faster than in traditional supermarkets. Non-traditional stores are those that focus on specific target markets such as those with organic foods, limited assortments of private label products, or require membership. Traditional supermarkets with undifferentiated products and services have high costs and are struggling to survive the competition from big-box stores who do not necessarily depend on food sales to drive their profits. Competition also comes from other types of retailers: restaurants with drive-up/pick-up windows, farmers-markets, drug stores, and online shopping.

Retail food stores have traditionally operated on high volume sales of undifferentiated products, selling mostly national brands of food and consumer packaged goods, items that can be purchased in almost every grocery store. Their core competency has been selling high volumes of low margin goods at competitive prices. At least it was, until Wal-Mart undercut almost everyone's ability to compete on price. Wal-Mart was able to do this with a business model where low or no margin food was sold in the same stores with high margin general merchandise. In addition, they could use their buying power to bargain hard with their vendors to supply them with the fastest selling varieties and sizes at predetermined times, locations, quantities, and cost. Wal-Mart's economies of scale swamped the competition and allowed them to sell food products at about a 15% lower price than other retail food stores. Now, the retail food store business is about competing with some differentiating feature whether it is a unique store label, a special service, or exquisitely prepared deli food.

On the foodservice side there are over 960,000 restaurants and commercial foodservice places (hospitals, prisons, schools, caterers, etc.). Eating and drinking places (commercial bars, full-service and fast food restaurants) garner about 77% of all foodservice sales. The rest of the commercial foodservice industry is comprised of lodging places with eating facilities and a variety of managed services such as those for airlines, colleges, and hospitals. In addition, there are noncommercial foodservice businesses that include public schools and colleges, hospitals, nursing homes, and the military. The $544 billion sales in 2010 made up 4% of the US GDP. Foodservice is a labor-intensive industry with 9.3 million foodservice employees—6% of the total US workforce—the largest US employer outside of the government (U.S. Dept. of Labor 2010). The fastest growing segments of foodservice are coffee bars and casual dining or limited service places.

More than 40% of food expenditures for takeout food are spent at limited service restaurants. Another 40% is divided among carryout places (15%), full service restaurants (11%) and food delivery (14%). Grocery stores capture another 6% of this takeout market (Mills 1998). The rapid rise in takeout food from restaurants and delis of all types indicate a dramatic trend in the lifestyle and preferences of consumers.

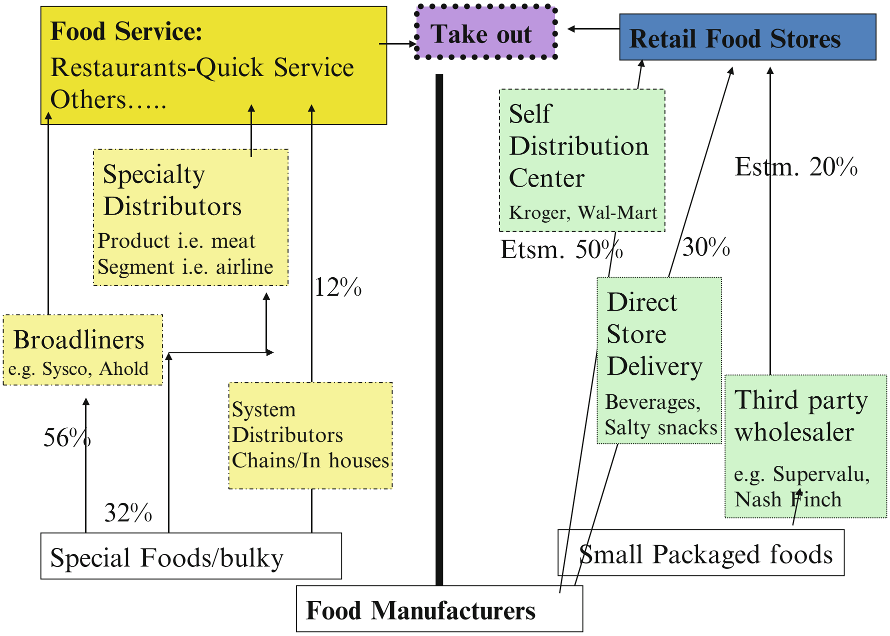

Fig. 2.2 Food wholesale distribution

Wholesale/Distribution

Following the supply chain back to primary producers the wholesale food and distribution sector come next. Brokers, traditional wholesalers, self-distributing retailers, and logistics companies occupy this sector employing about 942,000 people in 2010, 0.7% of all employment (see Fig. 2.2). There are two distinct channels of wholesale food distribution, one for retail food stores and the other for foodservice; they are developing in opposite directions. On the retail food store side, the third-party full-line wholesalers are diminishing, as the larger retail food chains become "self-distributing chains" following the early model of A&P and competition from Wal-Mart. When a retail chain owns its own distribution center (DC) that distributor aggregates orders across all their own stores and buys directly from food processors often on prearranged contracts. Self-distributing chains also contract with third-party logistics companies who take no ownership of product but locate (called sourcing), pick up, and deliver product that match specified standards. There it is resorted, stored for as short a time as possible, sometimes cross-docked and hauled to individual stores, eliminating the need for a third-party wholesaler. The remaining wholesalers are serving a smaller number of smaller retail food chains and independents (those with ten or fewer stores) and are largely regional businesses. At least 50% of product movement is through self-distributing centers; Wal-Mart alone sells roughly 30% of all products that move through food and general merchandise stores in the US. Manufacturers deliver about one-third of food products directly to stores. This is called direct store delivery (DSD) and is used primarily by beverage and salty snack companies.

While third-party wholesalers in the retail food distribution channel are struggling, parallel operations in the foodservice channel, called "broadliners," are growing. They have more than 50% of the food and sundry delivery business to foodservice establishments while the system distributors (analogous to the self-distributing retail chains) have only 12% and specialty distributors with bakery, meats, and fresh produce deliver the remaining 32%. Different trends in the distribution sectors of the food supply chain can be attributed to the nature of the retail customers they serve. Food delivered to a retail store reflects the fact that it will be resold in small units: a few cans, a few ounces, or a few boxes each. The food delivered to a foodservice establishment is delivered in large containers ready to be used in cooking large volumes of food by the immediate purchaser.

In the restaurant business, every final consumer has an individual order; food service is all about tailoring each customer's order, providing innovative variety, memorable experiences, and individual attention. Seventy percent of the eating and drinking places are single-unit (independent) operators. They need third-party, full-service "broadliners" or specialty distributers to supply their needs for food as well as utensils and dinnerware. Most do not have the scale of operation to establish an exclusive distribution channel with food vendors. The exceptions are the quick service (fast food) restaurants, where consistent quality of food is a virtue and system distributors dominate. The large chain (mostly quick service) restaurants develop dedicated suppliers known as system distributors. These are analogous to the self-distributing supermarket chains that buy directly from a food (ingredient) provider who arranges for delivery.

One of the challenges in the distribution of food is the speed necessary to deliver fresh product. Other challenges are the maintenance of sanitation, food safety, and the proper temperature of various food products. Food safety is paramount in this business and maintaining a proper "cold-chain" is essential to both the quality and safety of food products. This means that food distribution centers and transportation vehicles have up to four temperature zones: ambient, chilled down to 50° Fahrenheit, refrigerated, and frozen. These special handling requirements put special demands and liabilities on the logistics companies and their employees.

Food Manufacturing and Processing

Next in the food supply chain are some 30,000 processing and manufacturing sites in the United States and at least another 94,000 foreign sites. These are the plants that take raw ingredients like potatoes or chickens and make potato chips, chicken nuggets, and chicken noodle soup. In 2009 the value of shipments from all food manufacturing facilities was $628.5 billion, about 14% of all US manufacturing sales. They employed 1.3 million people, about 13% of all manufacturing employment (U.S. Dept. of Labor 2010; U.S. Census Bureau 2012).

Issues for this sector of the food industry are the rise in private label products and growing consumer preferences for fresh and natural/organic products. Historically, this sector was dominated by national and international brands. Private labels now make up more than 19% of sales and 23% of unit volume sold in retail food stores (The Food Institute Report 2011). This is up from less than 10% at the turn of the twenty-first century. Mergers of retail food chains and the development of the self-distributing retail chains with significant buying power forced many a food manufacturer to produce and package food under private label brands alongside their own brand. Concentration was enhanced in this segment of the supply chain as large retailers demanded special attention, dedicated supplier relationships, vendor logistics plans, and cost reduction (USDA ERS 2010d). Economies of scale grew throughout the food system as competition forced costs down.

Major food manufactures participate in the growing demand for organic foods. They have created packaged food products from organically grown ingredients and/or have purchased smaller start-up organic food companies. Examples are General Mills purchasing Cascadian Farms and Groupe Danone purchasing Stony Brook Farms. This has enabled organic foods to penetrate a large share of the market, but it has also produced a backlash among organic food aficionados who deem this to be an industrialization of organic food and counter to the values and purposes of the organic food movement. The newest wave of demands is for "natural food" and "locally grown" food or food that has not traveled too many miles between the primary production site and the consumer. This concern is discussed in terms of "food miles" or the "carbon footprint." The later is partially a response to global warming and calls for reduction in carbon output. It is partially a reaction against global food sourcing and a desire to have more control over, and knowledge of, the food we eat. It is, however, a source of concern for food manufacturers as processed food is sometimes demonized for its alleged effects on health by delivering excess sodium, sugar, calories, allergens, and misunderstood chemicals.

The enduring value of food processing and manufacturing is still, and will remain, the preservation of food for its safe and economical storage, transport, and convenience. These continuing virtues of food manufacturing guarantee the importance of this segment of the food supply chain even though it has many challenges related to shifting consumer preferences and increased concerns about the healthiness of processed food, particularly about foods that bear little resemblance to their original form. In their success at creating foods that have extremely long shelf lives, which are convenient to store and use and are inexpensive, food manufactures have become vulnerable to criticism for selling "artificial food." This has led to a serious examination of the composition of many processed foods, and changes, where feasible, by the food manufacturers themselves. This reconfiguration of ingredients and processes for some foods will disrupt efficient systems and lead to some higher prices, but it is what many consumers and public health advocates are demanding with an implicit willingness to pay for "better" food. This is, in effect, an internalization of some externalities and driving the marginal product costs and marginal social costs closer together. It should lead to better allocative efficiency in the food system.

Farms

Ninety-eight percent of the 2.1 million farms in the United States are family owned. The definition of a farm is any place that sells at least $1,000 of farm products a year. There are five categories of farms distinguished by their level of sales and contribution to total output. First, small farms with sales of less than $250,000 per year are divided into two categories: (1) those where the owners consider farming to be their primary occupation and (2) residential farms, where owners' primary occupation is off-farm. Residential farms, sometimes called hobby farms, make up 45% of all farms but contribute only 4% of the total output. Small commercial farms, where the occupants consider farming to be their primary occupation make up 25% of all farms and contribute 11% of the output. Second is the large, commercial, family owned farms selling more than $250,000 a year in farm products. They make up only 9% of the number of farms but contribute 66% of total output. The remaining 2% of farms are owned by corporations, which can also be families, or cooperatives. This 2% of farms produce 18% of US agricultural output (USDA ERS 2010c). Though the total number of farms declined dramatically in the last century, the total acres in farm production grew and then declined. For a number of reasons including urbanization, farmed acres declined about 20% since 1945 (Dimitri and Effland 2005). The importance of the farming sector to the food industry is clearly not measured by the less than 2% of US employment or the less than 1% contribution to GDP. Farms are the foundation of the rest of the food economy and they are the basis for a nation of healthy, well-fed people. Farming is one business that no nation will go without; all people have to eat and every nation strives to be able to feed its own people. Farm production, therefore, is supported heavily by government subsidies. Sixty-two percent of government payments of about $27 billion in 2009 went to the 12% of the largest farms measured by gross receipts (USDA ERS 2011b).

The Volume of Food

The quantity of food produced and sold through the US food system is illustrated in Fig. 2.3. The flow of food commodities to export, animal feed, and food processors illustrates the magnitude of food and its complex paths to our tables. The figures are approximated using USDA, ERS food availability data (USDA ERS 2011). All quantities are converted to billions of pounds. The first observation is that about one-third of the 1,259.3 billion pounds of crop production is used for animal feed which leads to 152 billion pounds of animal products being produced for human consumption. Eighteen percent of crops are exported as bulk commodities. This export market has been a source of economic growth and stability for the country and the producers. The technically efficient commodity production and distribution system is facilitated by several public policies including foreign trade agreements, foreign aid, and government support prices and crop insurance that yield competitive prices

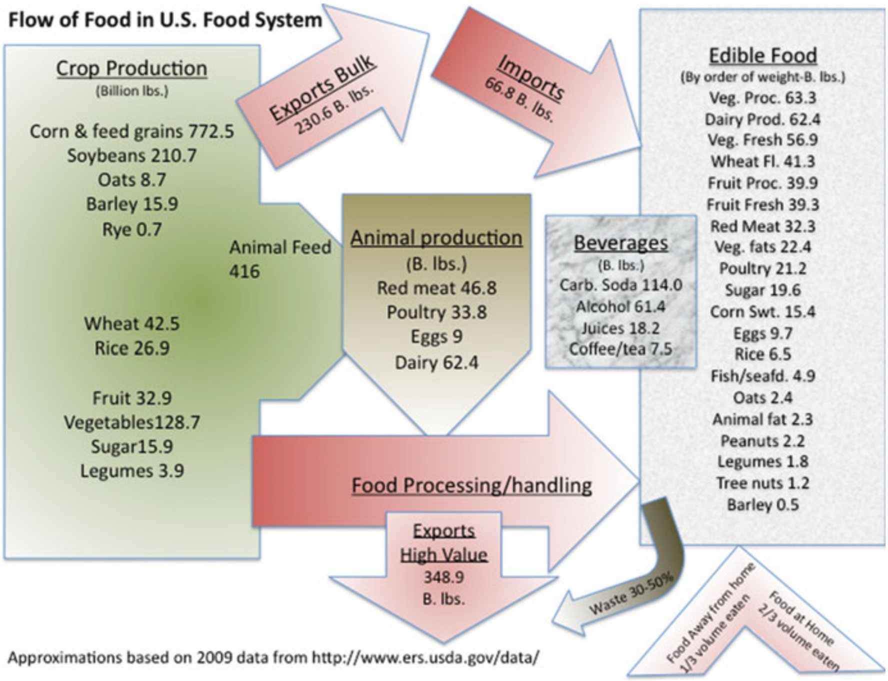

Fig. 2.3 Flow of food in the US food system

on the world market. When the food demand for these commodities was not sufficient to justify their production, the federal government purchased them and stored them for future use. Some grains are deliberately stockpiled for future food security.

The other half of the crop production is destined for food processing and manufacturing. Of the various groups of commodities only the fruits and vegetables have significant portions consumed raw (fresh/natural) and even they are subjected to washing, sorting, waxing, storing, and transportation through the commercial supply chain. An increasing portion of food and agricultural exports are processed, high value products. Food imports are increasingly important for year around consumption of fresh fruits and vegetables. The NAFTA trade agreement enhanced our ability to import fruits and vegetables from Mexico and South America. Year around access to tropical and other fruits and vegetables is now common in US supermarkets.

It is often exclaimed that we lose 30–50% of the food produced along the supply chain, somewhere between field and fork. This seems like a big number and an incredible waste. However, of interest on Fig. 2.3 is the fact that the 664.1 billion pounds of beverages and edible food is 65% of the total crop production minus bulk exports (1028.7 billion pounds). This implies a 1/3 loss between production and retail, ignoring imports and exports. Some of this loss is due to field trimming and storing. Other loses come in manufacturing as raw animal products are trimmed of fat and bone, hides, hair, and internal organs and raw plants are peeled, cooked, dried, and stored. Inevitably, spoilage occurs, especially in the transport and storage of raw products (Buzby et al. 2009; Kantor et al. 1997). Without the advanced methods of harvesting and storage and transportation available in the United States this loss would be even greater as is witnessed in many developing countries. Other losses occur after the retailer or restaurateur sells the food. In restaurants and catering operations public health laws demand that any uneaten food not be re-cycled to other human beings. In homes, consumers often throw out a portion of the food they buy because it spoils before they cook it or they just don't like it. This post retail loss has also been estimated to be at least 30% (Kantor et al. 1997).

Animal Products

Notwithstanding the growing popularity of being a vegetarian, only 2% of the more than 10,000 respondents to a US diet and health survey reported being a vegetarian in 2008 (Center for Disease Control 2008). Animal products are prized for their taste and nutritional value, especially the complete proteins they supply to the diet. They have provided a substantial part of the US diet for decades and an increasing portion of diets in emerging economies. US households spend almost 23% of their food-at-home budget on animal products including 7% on dairy (Blisard et al. 2003). The meat and seafood departments were rated the highest for increased traffic and sales in 2011 by industry surveys reported in Progressive Grocer (2011). Over half of the agricultural cash receipts in the United States are in the livestock and poultry sector, often exceeding $100 billion per year (USDA ERS 2009). The livestock sector contributes 45% of the total value added to the economy by all the crop and livestock production (USDA ERS 2011a). Trade in this sector, excluding fish and seafood, accounts for 11% of agricultural exports and 4% of agricultural imports (USDA ERS 2011a). Sixteen percent of the value and 75% of the volume of fish and seafood in the United States are imported, primarily from Canada followed by China, Thailand, and Chile (Jerardo 2008). The value of these imports increased 60% between 1998 and 2007 (Brooks et al. 2009).

The highest recorded per capita availability (consumption) of red meat was in 1971 when each American had 136.1 pounds of red meat available and 181.5 pounds of red meat, plus poultry plus fish and seafood. By 2009 total per capita availability of these sources of protein was 190.9 pounds, 5% greater that 1971 with the per capita availability of red meat down 22%, poultry up 104%, and fish and seafood up 37% (USAD ERS 2011). The fall in red meat consumption has been attributed to numerous health warnings tying red meat consumption to heart disease, obesity, and cancer and to price increases relative to poultry.

Major changes in this sector include consolidation in response to economies of scale that comes with new technology, vertical integration, downstream contracts, and feedback from consumers and retailers. Buhr and Ginn (2011) report that 85% of hogs and 57% of cattle are purchased on some sort of forward contract. In addition to allowing producers to reduce price risk, contracts with food manufacturers and large retailers facilitate information about changing consumer preferences. An increasing demand for social responsibility on the part of food firms includes concerns for animal welfare, excessive use of antibiotics, environmental pollution, and food safety. Larger retailers such as McDonald's and Wal-Mart enforce social responsibility and food quality and safety standards with their suppliers. For example, McDonald's reports that 60% of their global suppliers comply with their antibiotics policy (Buhr et al. 2011). McDonald's says it purchases 1% of the pork produced in the United States and they, along with other foodservice companies such as Burger King and Chipotle Mexican Grill, are asking suppliers to stop using small gestation stalls for hogs and adopt sustainable animal welfare practices (Tomson and Jargon 2012). Given the large volume of product large retailers purchase, they act as gatekeepers representing consumer interests. This encourages suppliers to consolidate to achieve the economies of scale needed to meet these demands.

Technology developments in packaging and processing methods led to a major shift in the meat supply chain. "Boxed beef" which is case-ready meat products prepared at the packing plant, rather than at the retail store, led to efficiencies in distribution and wholesaling, greater food safety, and lower retail costs. It was a signature breakthrough in this industry negating most retail butcher operations and developing dedicated supply chains for specific retailers.

Other technological advances include genomics and genetic markers that allow animals and meat products to be traced from retailers back to the producing farm and even to a specific animal. This has allowed food safety incidents to be traced to their source and identified in order to help prevent the spread of disease.

Ward (2010) writes "one of the driving forces in market structure was the need to be a low-cost slaughterer and processor." Although the meat industry is not particularly concentrated by industrial standards, considerable concentration has taken place in the processing sector. Buhr and Ginn (2011) provide an instructive graph (Fig. 2.4) representing a simplified supply chain with the level of concentration of various sectors of the meat industry using the Herfindahl–Hirschman Indexes (HHI). The HHI is defined as the sum of the squared market shares of the top four firms in the sector where a score of less than 1,000 is considered to represent "unconcentrated firms." By this measure, only the crop genetics sector is highly concentrated, with meat packing and retailing reaching up into the moderately concentrated range.

Fruits and Vegetables

Fresh fruits and vegetable consumption soared with the advent of numerous health messages about the healthfulness of these foods relative to meats, fats and oil, refined grains, and processed foods in general. Table 2.1 shows that the per capita availability (consumption) of fresh fruits increased 11.5% and fresh vegetables increased 8.6%, while processed fruits and vegetables declined 10.3 and 9.2% per capita respectively between 1990 and 2009. Adjusting for the increase in the population, fresh fruits and vegetable available on the market increased 35 and 29% respectively. Households spend about 11% of their retail food dollar on fruits and vegetables (Blisard et al. 2003). The fresh produce department was rated the second highest for increased traffic and sales in 2011 by industry surveys reported in Progressive Grocer (2011).

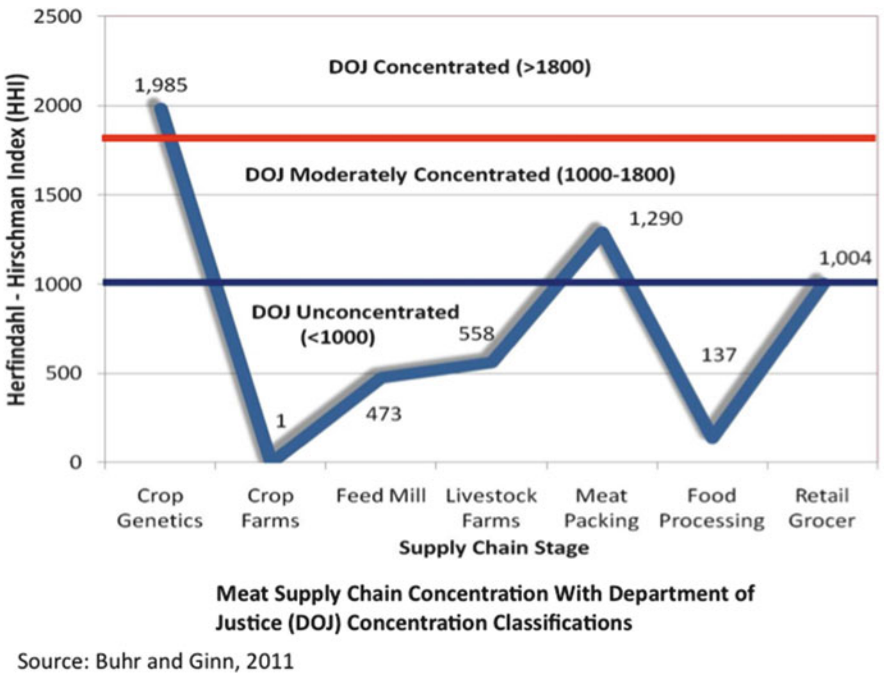

Fig. 2.4 Meat supply chain concentration

Rising incomes and international trade agreements such as NAFTA have also supported an increase in fresh fruit and vegetable consumption. It is consistent with the trend toward organic food and local food, even though these products command less than 5% of market sales. Fresh fruits and vegetables are being demanded for healthy school lunches. They became available to users of food stamps at Farmer's Markets and to recipients of federal food aid via the Women, Infants and Children Program (WIC) over the past 5 years. Fresh produce is the leading edge of food trends for healthy and prestigious diets.

All is not perfect, however, in the fresh produce market. Incidents of microbial contamination in products like cantaloupe, spinach, and sprouts continue to remind us that, because it is fresh, there is no "kill step" for contaminants and that sometimes even washing is not enough to make them safe. Fresh produce is perishable. It needs extra care in handling and transport to ensure it is clean, safe, and chilled to a proper storage temperature throughout the supply chain. Shipping is also specialized by types of products so that fruits producing ethylene (tomatoes, avocados, bananas) do not damage leafy greens and those requiring temperatures above 50° Fahrenheit (bananas) are not damaged in a colder environment (Cook 2011).

Food retailers and foodservice channels demand consistently large volumes of high quality fresh produce; it is often a point of differentiation for retail stores seeking customers who demand the best fresh produce. Defying the natural seasonality of fresh fruits and vegetables, consumers and retailers demand year around supply

Table 2.1 Change in food available for consumption in the United States, 1990–2009, per capita and total pounds of edible food on the market

Food type	2009 per capita consumption Pounds	Change in per capita consumption 1990–2009 ±Pounds/capita	Percent change in total edible food Percent change
Crops			
Wheat	134.6	−1.4	21.7
Rice	21.2	5.2	62.9
Rye	3.3	−0.2	15.9
Oats	7.7	−3.1	−13.1
Barley	1.8	0.6	84.4
Fruit—fresh	128.0	11.5	35.1
Fruit—processed	130.0	−10.3	13.9
Vegetables—fresh	185.0	8.6	28.9
Vegetables—processed	206.0	−9.2	17.7
Vegetable fats	73.0	15.0	54.7
Salad/cooking oil (olive/rapeseed)	52.0	27.0	155.6
Sugar	64.0	0.0	22.9
Corn sweeteners	50.0	0.0	22.9
Peanuts (in-shell)	7.0	1.0	43.4
Tree nuts	4.0	1.5	96.7
Legumes—dry beans	6.1	−0.6	11.9
Animal products			
Red meat	105.0	−7.0	15.2
Poultry	69.0	13.0	51.4
Fish/seafood	16.0	1.0	31.1
Eggs	31.7	1.7	29.9
Dairy (fluid products)	203.0	−30.0	7.1
Animal fat	7.7	2.2	72.1
Beverages			
Coffee/tea	258.4	−11.2	18.0
Alcoholic beverages	203.2	−17	13.0
Carbonated soft drinks[a]	371.2	1.6 (to 2003)	23.9

Source: based on data from http://www.ers.usda.gov, 2009 and 1990
[a]Latest data for soft drinks is for 2003: 46.4 gallons = 371.2 pounds

of the full range of known produce. This has led to contracts with "preferred suppliers" and to consolidation among grower-shippers who are the gatekeepers for their retail customers. Grower-shippers monitor the product quality and safety, traceability mechanisms, Good Agricultural Practices (GAP), and environmental responsibility at this first-handler stage of the supply chain. They procure produce locally and internationally as the season and market demands. There were 3,214 total shippers in the United States in 2011 (Cook 2011). They tend not to be publically traded companies and operate regionally, specializing in particular types of produce. Multinationals specializing in bananas such as Dole are the exceptions.

The value added to the US economy by the fruit and vegetable sector was $56.6 billion in 2010; one third of the value of all crop production and 18% of the total value added by crops and livestock. Fruits and vegetables, including juices and processed product, comprised 13% of the value of agricultural exports and 23% of the imports in 2011. By volume, 32% of fruits and nuts and 8% of vegetables were imported between 2000 and 2005 (Jerardo 2008). Major export partners are Canada and Mexico; Mexico supplies about two-thirds of imported fresh vegetables and two-thirds of the value of imported fresh fruit followed by Chile at 26% (Cook 2011; Brooks et al. 2009).

Government policies have not provided direct price supports to growers of fruits and vegetables, but there is a long-standing practice of state and/or federal "marketing orders." Marketing orders are legal instruments authorized by the US Congress through the Agricultural Marketing Agreement Act of 1937. They function like a legalized cartel of producers and shippers of like products, such as pears or almonds. The members contribute self-assessed funds to administer the marketing order and agree to abide by decisions taken each year that will control the size, quality, and quantity of produce that can be offered for sale in the upcoming season. The end game is to manage the volatility of the market and growers' income by controlling the supply and keeping the price sufficiently high to reward growers and keep them in the business. Some of these marketing orders have close relationships with nonprofit cooperative companies. Sunkist is the largest marketing cooperative in the fruit and vegetable industry; they control a large portion of the market for citrus fruit in the United States having started as the California Fruit Grower Exchange in 1893 and taking the Sunkist name in 1908 (Sunkist 2012). Paggi and Nicholson (Chap. 6) provide much more detail on marketing orders and their role in the food industry.

Since many fruits are perennial crops, marketing orders help to smooth out incomes in times of bad weather or blight. They may also hold the price of fresh produce higher than would otherwise be the case and are at least partially responsible for the high cost of fresh produce relative to most other foods. Marketing orders also fund research and development leading to new varieties and innovations in harvesting, storage and technology as well as generic advertising for their commodity—the most famous of which is the dairy industry's "Got Milk" campaign.

Innovation in genomics of fruits and vegetables raises the promise of producing disease prevention or even cures. This will depend on consumers' acceptance of genetically modified fruits and vegetables and a proven efficacy of the alleged medical benefits. Such futuristic innovations could turn already healthy and delicious foods into super-foods for health and strength.

Trends in Food Availability

About one-third of the volume of the available, edible foods and beverages and 47% of the retail sales are through the food-away-from-home channel. Two-thirds of the volume and 53% of the sales go through the food-at-home channel. Table 2.1

presents the per capita pounds of food available for US consumers in 2009 and the change in that figure since 1990. This has often been referred to as per capita *consumption*, but it is more truly the amount of food available at the retail juncture of the food supply chain. Consistent with the discussion above, it has historically been known that this per capita (consumption) availability number is roughly 30% more than the food reportedly consumed in individual food consumption survey data.

The last column on Table 2.1 illustrates the percentage change in the amount of food on the market in 2009 vs. 1990. Since the population grew by 307.4 million people or 23% over that time the amount of edible food would also be expected to grow by 23% if the per capita availability were distributed the same in both years. However, a change in food production, imports, exports, and consumer demand over the years leads to a different mix of food being available. Nine of the categories increased less than the change in the population, consistent with declines in the per capita availability. Only one category—oats—declined overall. The lesson from this table is that one cannot infer the percentage change in the edible food market from the per capita data. The three largest decreases in *per capita availability* are in alcoholic beverages, milk and dairy products, and processed fruits. The largest increases are in fresh fruit, poultry, and vegetable fats—especially olive and canola oils. In the *market*, the largest increases are in rice, barley, tree nuts, and animal fat.

As consumers' preferences change over time, they signal food retailers who signal food manufacturers and ultimately producers about how much of which foods they will purchase. The market works through the exchange of information to allocate resources to the right foods—eventually. The next section explores how changes in consumer expectations help to drive changes in the food system.

Trends in Consumer Expectations Drive Food Production

Evolving consumer preferences and public policy, which adjusts to these changes, combine to drive expectations of the food production and marketing system.

Sustainable Consumer Preferences

Consumer preferences and expectations for food types and quality evolve as consumers, individually or as a society, experience improved nutrition, good tasting food, and acquire resources to explore additional food amenities. This progression in food preferences follows a pattern similar to Maslow's Hierarchy of psychological needs (Maslow 1943). As illustrated in Fig. 2.5 the base of the food hierarchy represents the daily necessities of life. The needs are for basic nutrition (starches, sugars, fats, protein, water) that is safe, life sustaining, and readily available. In the United States, availability is mostly a function of convenience and affordability, although about 4% of people are estimated to live in a "food dessert," with over 80% of them in rural areas (Ver Ploeg and Williams 2011).

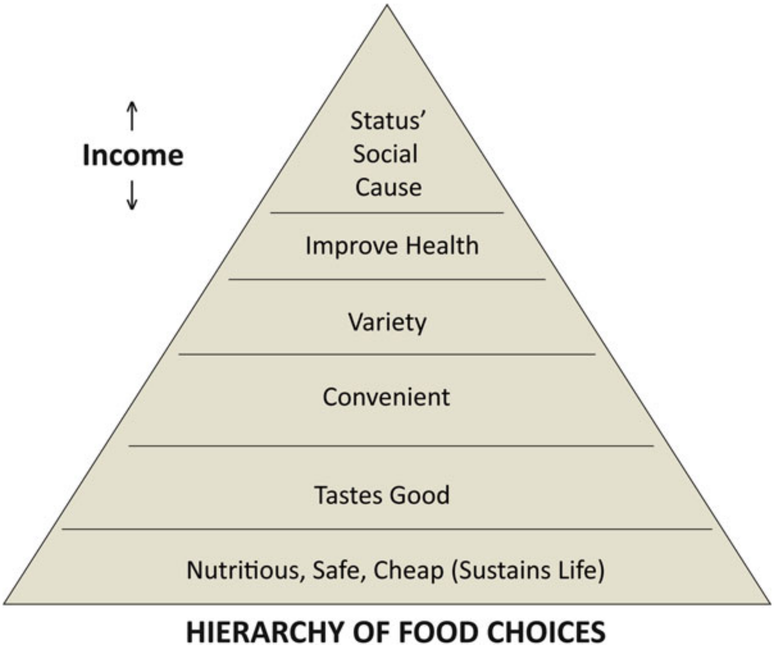

Fig. 2.5 Hierarchy of food choice

Convenience

The preference for convenience permeates food choices at all levels of the pyramid and cuts across all cultures. Faced with immediate hunger, time pressed schedules, and limited cooking facilities or skill, convenience trumps all. The quest for convenience has led to the development and acceptance of "fast food" and quick service restaurants. Processed food is shelf stable and convenient for long distance transportation, long-term storage for home, office and restaurant consumption, to say nothing of the needs of the military, outer-space travel and disaster emergency supplies. Consumers have largely outsourced the tasks of food preparation to major food manufacturers or restaurants. Half of all restaurant food is taken-out (The Food Institute Report 2006). Twelve percent of casual dining restaurants and 70% of McDonald's business is takeout food (The Food Institute, Report 2007a, b). Food retailer, Safeway, reported that 8% of its sales were for precooked meals in 2006 (The Food Institute 2006). Clearly many are asking someone else to cook their food and are relying on its safety and integrity. Meeting the desire for convenience has led to the ubiquitous presence of food for sale in all types of stores and public places, and to eating while meeting, talking, and walking—a characteristic American habit. Eating is often one of several activities coupled with working, watching TV, and interacting with the Internet, e-mail, or telephones. It has allegedly led to the demise of the "family meal" where everyone in a household shares a meal together and eats the same type of food, on a regular basis. A study by the Hartman Group

(2011) found that consumers prefer to eat in front of the computer, TV, or video game than at the dining room table. Still, about half of people and families report eating dinner at home almost every evening.

Safety

We have come to take for granted that food is, by definition, safe. That is, it does not make us ill in the short run or the long run. The Center for Disease Control's (CDC) FoodNet is a system whereby state health departments' laboratories report incidents to a central location. It tracks short run illnesses caused by food borne microbiological contamination. Although new estimates show a decrease in the number of foodborne illnesses (to 48 million ill people and 3,000 deaths per year), with vigorous reporting of foodborne illness outbreaks, the public becomes aware of these events in real time (Center for Disease Control 2011).

Media coverage of foodborne illness events in the US benefits public health by alerting consumers to stop eating and discard contaminated foods, but it also erodes the confidence that consumers have in the safety of their food supply. That confidence went from about 70% in the late 1990s to about 30% by 2008 (Kinsey et al. 2009). This erosion of confidence contributed to the passing of new food safety legislation in 2011, the Food Safety Modernization Act. PL 111-353 (Food and Drug Admin 2011). Studies of consumer's expectations about who along the food supply chain should be responsible for food safety show that food processors/manufacturers are expected to be the primary responsible parties followed by government (Degeneffe et al. 2009; Kinsey 2006).

Long-run chronic illnesses, which are attributed to (over) consumption, present a dilemma for public policy and for individuals. Looking at the pyramid of food preferences good taste spars with convenience for one of the most important choice criteria. Repeated choice of the same food depends on it tasting good (flavor, texture, odor, mouth feel). Most processed foods use some combination of salt, sugar, and/or fat to enhance taste and/or to extend the shelf life of a product. Some will argue that the intense and repeated use of salt, fat, and sugar makes foods taste so good that they are habit forming and that their repeated consumption has led to obesity, cardio-vascular diseases, diabetes, and shortened life spans (Kessler 2009). Retraining the American palette to expect and accept foods and beverages with less salt and sweetener is under way by many food companies at this writing, but it progresses slowly. Many food manufacturers are engaged in reformulating products with less sodium as public health concerns, and in some cases local laws, are demanding this change. The National Salt Reduction Initiative (2011) has enlisted the cooperation of companies such as Target and Campbell Soup and several restaurants, to cut the sodium content in prepared food by 20% by 2015. In addition many local school districts have banned the sale of sugared drinks in their school's vending machines to try and reduce obesity among children.

There is widespread concern and criticism of the foods in the American diet. Slowly, a variety of foods, which claim to be "healthier," are penetrating the available ood supply. As a stream of media stories about the impact of particular nutrients and food ingredients on human health continues, consumers dietary habits change. Some of these stories are grounded in sound science and some are grounded in marketing strategies; either way they penetrate the consciences of food consumers and alter their choices.

Health: Obesity

Studies about how food and agricultural policies relate to the dilemma of obesity and food-related diseases, other than foodborne illness, are relatively new in the literature, but there are studies about policies related to obesity (Muth 2010) and to sweeteners (Runge 2010; Todd and Zhen 2010). Sugar prices have been kept relatively high through trade barriers (tariffs) on imported sugar for many years. Thus, food and beverage manufacturers sought cheaper alternative sweeteners and found them in high fructose corn syrup (HFCS). Public policies that supported the farm price of corn and/or farm incomes not only made feed for animals and meat more affordable but also made HFCS more affordable. A recent controversy about whether HFCS metabolizes differently than cane or beet sugar, and thus contributes to greater obesity, goes on at this writing. Historically, the USDA grading of meat and the milk marketing orders rewarded the production of high fat meat and milk. This has changed as consumer demand for lower fat products grew widespread, but it illustrates how food and agricultural policies that were appropriate in the last century need to be updated in the face of changing consumer needs and lifestyles.

A widely held opinion among the public and health advocates is that government should "subsidize" fruit and vegetable production in order to make more fresh fruits and vegetables available at more affordable prices. Compared to government support for many other commodities (corn, soybeans, grains, dairy, sugar) fruits and vegetables have not received much incentive to increase production or to lower retail prices. This sentiment comes mostly from healthy diet and nutrition advocates and the USDA dietary guidelines and not from the producers themselves. But the pressure to increase fresh produce consumption by individuals and for school lunch programs as well as other federal food programs puts the spotlight on produce availability and affordability.

Variety

As consumers' incomes increase their preference for variety also increases. Through travel, eating in restaurants, and media exposure they discover new types of food. This tendency is evident even in very poor countries where poor family's diets can be monolithic and repetitive. As soon as incomes start to rise and animal proteins become available they begin to replace staple grains and starches (Jensen and Miller 2011). As soon as modern supermarkets enter the economy, consumers shift from local roadside markets to more convenient and attractive new foods inside the supermarket (Minten and Reardon 2008). An illustrative story comes from a Chinese graduate student who told the author in 2002 that her mother in Beijing had switched from the street markets to the supermarket because the food in the supermarket was safer, more readily available, more reliable and, it was a “feast for the eyes.”

In the US food manufacturers have responded to this preference for variety with multiple new and “improved” products every year. There was an annual average of 21,519 new food and beverage products introduced between 2006 and 2009 (USDA ERS 2010b) with 20,143 in 2011 (The Food Institute Report 2011). This practice also serves to meet the needs of an increasingly diverse population and a diverging set of preferences. To add to this trend, individual supermarket companies have increased “store brand” foods in order to build store loyalty. While this certainly increases variety and choice overall, and may reduce price, extensive brand and packaging extensions proliferate shelf facings in stores and can lead to shoppers’ confusion and increase shopping time. Studies by Iyengar and Lepper (2000) show that as the number of choices of the same product (jam or chocolates) increases from 6 to 24, consumers spend more time to make a decision. With too many choices, only a small percentage make a purchase at all. They conclude that having “too much” choice hampers motivation to purchase. Store brand sales rose from about 15% in 2007 to over 25% in the larger US supermarkets by 2010 (Kroger 2010). Some of the largest retailers—Wal-Mart, Target, Costco, Aldi, and Trader Joes—heavily promote their own store brands.

Extreme Health

As scientific information (legitimate and popular) becomes available and consumers discover that diet composition directly influences their day-to-day health and vigor, the desire for food as preventative medicine gains importance in food production, distribution, and demand. Producers seek seed and meat varieties that allow them to claim special health benefits as a competitive advantage. Examples are eggs high in omega-3 or high lysine corn. It includes new forms of fortification with health enhancing ingredients such as probiotics, vitamin D, and extra calcium in foods where it does not naturally exist such as in orange juice. High energy and vitamin-enriched drinks further promise to deliver vitality. Scientific discoveries have led to biofortification through genomics and selective breeding that enhances the micronutrient benefits of foods in both developing and high-income countries. All these developments lead to new forms of food production and processing aimed at making people healthier, reducing suffering, and cutting health care costs.

Status

At the top of the hierarchy of food preferences are “status and social causes.” It is at this level that much of the recent rhetoric about problems with the established commercial, global food system takes place. It is also where status-seeking consumers gravitate as (formerly) premium products expand their market share and move from elite shops to the mass market and no longer have “snob” appeal. Jeff Gordinier (2011) writes about the “connoisseur culture” in which only the newest and most expensive products are considered acceptable; "old favorites" are eschewed. Among these trendsetters, artisanal and hand crafted foods are considered necessary for self-esteem and social prestige. This behavior resembles the "conspicuous consumption" explored by Thorstein Veblen in (1899). But then and now, these trendy foods (and other goods) tend to gravitate into the mass market and are, thus, worth watching in terms of future consumer demand.

Needless to say, moving up this hierarchy is correlated with rising incomes, but loss of confidence in the safety and healthfulness of food (short term and long term), as well as the government's apparent inability to ensure it, plays no small part in consumers moving up the hierarchy of preferences regardless of income. The migration of food preferences is also encouraged by global supplies, a growing distrust of large, multinational food companies, and by the desire to gain control of the most important consumable in their lives—their food.

For a whole variety of reasons a growing core of socially conscious advocates and consumers are asking the food system to deliver not only all of the traditional characteristics of food articulated in the hierarchy but they are asking that food be the vehicle through which environmental sustainability, fair wages, animal welfare, and authentic life experiences can be delivered. It is the set of preferences that are responsible for the growth of demand for organic foods, for "humane" treatment of animals and fish, for fair wages for farmers in developing countries, and for a variety of "sustainability practices" from reusable cloth grocery bags to no-till agriculture.

Increasing demands for organic and/or local or regional fresh foods have changed the way supermarkets procure and merchandise food. Although the portion of food sales comprised of organic and/or local foods is still small (2–3% of US food sales), it is a growing global trend (Dimitri and Oberholtzer 2009; Martinez et al. 2010). Tesco, a major supermarket in the United Kingdom, is contracting with farmers throughout the British Isles for items such as garlic and vegetables that it can sell as "local" (Rohwedder 2011). Wal-Mart, the largest supermarket in the United States, if not the world, has sought organic products for its very large customer base. The adoption of organic production and distribution by very large companies has disappointed many of the original organic food advocates because it counters one of the basic tenants of organic agriculture—the survival of small farms who are dedicated to environmentally sustainable practices and generally lack economies of scale.

"Local" food may or may not be organic, more nutritious, or safe. Advocates for local food claim that it is fresher, tastier, healthier, more "natural," more trusted, and good for the local economy. It is acknowledged, however, that local food is usually more expensive and research shows that it does not necessarily have a smaller carbon footprint (King et al. 2010). More than half of "local food" sales of $4.8 billion were conducted through a third-party distributor in 2008 (Prepared Foods 2012). To the extent that more and more consumers demand food from local regions, prepared with fewer ingredients, delivered with minimal packaging, and produced in an environmentally sustainable fashion, they are signaling the demand for less technical efficiency (low cost) and a preference for nonmarket social values. They say they are willing to pay more to achieve status, meet social/environmental goals, and the (perceived) assurance of healthier, better tasting food. This, of course, leaves the poor and hungry portion of the population (about 1 in 6 adults and 1 in 3 children) with the possibility of even less affordable food. Therefore, public programs to provide nutritious food for those who cannot afford to buy status and social causes with their food will become ever more important. However, one can hope that this trend will raise the overall healthfulness of foods on the market.

Public Policy and Consumer Food Preferences

Implications for public policy involve recognizing that consumers today are not of one mind or one culture and their preferences can move up and down the pyramid of preferences as incomes and information change. The demographics of the US population are skewing towards the elderly and the non-white. The income distribution has changed. The top 20% of households (arrayed by income from lowest to highest) earned over half of all the income in the United States in 2009; their income rose 55% since 1980. The bottom 40% of households earned only 11% of all income and their incomes rose an average of 3% since 1980. The top 1% of households earned 8.3% of all the income in 1970 while in 2009, they earned 18.9% (DeNovas-Walt et al. 2010). This top 1% also had 43% of all the financial wealth and 35% of the net worth in the United States in 2007 (Domhoff 2011). The median household income ($49,445 in 2011) fell from its 2008 high of $55,303. In real terms the 2011 median income is about equal to what it was in 1997 (U.S. Census Bureau 2012). With this lack of economic progress by middle income households one will expect that food preferences will not rise up through the preference pyramid as rapidly and may actually regress to lower levels. This can explain the rise in store brands, the shrinking of package size, and other attempts to hold down food prices.

Income distribution is important for food policy because it means people in the bottom 40% of the income distribution have less than 12% of all the spending power; and many of these households have incomes below the poverty line ($22,314 for a family of four in 2011). The income eligibility for Supplemental Nutrition Assistance Program (SNAP formerly known as food stamps) is 130% of the poverty level. For a household of four persons that qualifying income was $29,008 in 2011; all of the four person households in the bottom quintile and part of those in the second income quintile of households would be eligible for SNAP (subject to asset tests.)

The poverty rate in 2010 was 15.1% of households, up from 12.5% in 2007. More than one-third of all children were living in poverty. This high rate of poverty is partly attributed to a concurrent recession and unemployment but it also illustrates a dramatic change in the gap between the richest and the poorest households in the United States. The richest 20% spent an average of $10,780 on food at, and away from, home in 2009; this was 7% of their income. The poorest 20% spent an average of $3,501 on food at, and away from, home; this was 36% of their earned income (Henderson 2011). The proportion of income spent on food rose since 2005 across all income categories. For the top 20% the increase was 0.2% points and for the lowest 20% the increase was 4.5% points. This implies that food prices will be more important for food choices and that less money will be available to spend on other consumer goods—not a recipe for national economic growth.

Food Assistance Programs

Food programs that provide food and nutrition to the poor, which may be viewed as investments in human capital and economic growth, will be in high demand as the numbers in poverty increase (USDA ERS 2011c; USDA ERS 2012). In 2010 the federal government spent $98.4 billion on food assistance programs that make up almost two-thirds of USDA's entire budget. SNAP (food stamps) expenditures went from $56.6 billion in 2009 to $68.2 billion in 2010 comprising 72% of the food assistance program expenditures. Pressures from congress to cut federal budgets will likely reduce these expenditures at a time when they are needed more than ever. Food insecurity was the highest in 2009 since it was first measured in 1995. Fifteen percent of households have difficulty providing enough food for all their members some time during the year. About 5.7%, or 6.8 million households, had severe food insecurity (hunger) (Nord et al. 2011). Federal food programs like SNAP and WIC provide funds to qualifying households to purchase food at their local food stores. Eligible households of two with an income below $18,947 per year could receive $367 per month to purchase food (not ready to eat). If there were four persons in the household they could receive $668 per month.

SNAP and other food programs that distribute food to the poor, hungry, and malnourished combine allocative and dynamic efficiency. Clearly they respond to changing economic conditions and allocate food to people who need it—food that would not otherwise be purchased or consumed. This activity improves the welfare of the recipient and saves other costs to the whole community. To the extent that it pulls more supply from the food system (increases demand) it optimizes the efficient allocation of produced food. Because the SNAP program distributes cash and consumers purchase from traditional stores, there is a community multiplier effect of about 1.84. For every $5.00 spent in SNAP money, about $9.20 in community spending is generated through additional employment and business (Hanson 2010). About 66% of those eligible to participate in SNAP do so (Leftin and Wolkwitz 2009).

Food programs also increase revenue to producers and reduce expenditures on other public services such as health care, special education, and psychological counseling. A study conducted for Second Harvest Heartland in Minnesota found that hunger costs Minnesota upwards of $1.62 billion a year or between $800 and $1,131 per taxpayer (Mykerezi et al. 2010). If hunger could be eliminated for a cost of $243.25 million, the return on this investment would be almost sevenfold[1] (Second Harvest Heartland 2009). Thinking about expenditures on reducing hunger as an investment in human capital and economic productivity could help to change attitudes and priorities analogous to the drive to invest in early childhood education.

Charitable organizations like Feeding America collect both money and food that is distributed to food shelves where it is available—free—to hungry people. These

[1] A study by Second Harvest Heartland (a member of Feeding America) estimated that it would cost $243.25 million to obtain the food for 125 million meals that were not eaten in Minnesota in 1 year due to a lack of money (http://www.2harvest.org/shh/press_releases/2009/Missing%20-%20125%20Million%20Meals%20for%20Low-Income%20Minnesotans.pdf).

programs help alleviate hunger and help to maintain some level of healthiness in their participants. Clearly demand for these programs increases with the poverty level. It is estimated that Feeding America, only one of several charitable feeding programs, provided about $678.8 million of food to poor people in 2010 (Feeding America 2010) The economic return to these programs is estimated to be between $1.56 and $2.73 for each $1.00 invested depending on how much of the donated food would have been otherwise wasted (Mykerezi et al. 2010).

In 2010 the WIC program served 9.2 million people, over half of all infants and one-quarter of children up to age four. This program is widely recognized as one of the most efficient food delivery programs in that it is linked to health care and advice with measurable results for mothers and children. Although it highly encourages breast-feeding, WIC funding purchases between 57 and 68% of the infant formula sold in the United States. Federal expenditures in 2010 were $6.7 billion up from $5.5 billion in 3 years (Oliveira and Frazao 2009; USDA ERS 2010c). Substantial changes in recent years to the foods that participants can purchase with WIC vouchers include providing more whole grains and cash for fresh fruits and vegetables. It is estimated that out of $4.6 billion food purchased by WIC participants, farm revenue increased by $1.3 billion in 2008 (Hanson and Oliveira 2009). WIC is the third largest Federal food and nutrition program; it comprises about 10% of the food and nutrition budget. It is a good investment in the future health and welfare of the nation's children. It exhibits a dynamic efficiency, as the size and composition of the program changes with demographic and economic conditions.

Food and nutrition assistance is legislated under the Farm Bill. It is in farmers' interest to have (poor) people able to purchase the food they need and, in turn, to maintain public (government) support for agriculture. Investment in good health and welfare makes good economic sense. This logic extended to the National School Lunch Act of 1946 and the Child Nutrition Act of 1966 that added school breakfasts (Gunderson 2009). Federal Expenditures for these two programs was $12.6 billion in 2010 and served an average of 42.7 million children per day. Children from families whose income is below 130% of the poverty level are eligible for free school lunches while those from families with incomes between 130 and 185% of the poverty level are eligible for reduced price lunches. More than half of school lunches are served free (55.7%) and 74.6% of breakfasts are served free. With only about 35% of children paying for their lunches, schools are dependent on federal allotments to prepare and serve food, an allotment that is criticized for being too little for healthy meals in school. This meal is sometimes the only food children from very poor families have on a school day, and thus, extremely helpful in reducing hunger.

There are, however, several regulations affecting school lunches that are roundly criticized for poor nutrition. They require too many calories, they use preprepared, ready-to heat/eat foods high in fat and sugar, they facilitate obesity, etc. The dietary guidelines for school lunches and breakfasts are under scrutiny with room for improvement. In January 2011 USDA's Food and Nutrition Service (FNS) proposed new rules to revise the meal patterns and nutrition requirements for the National School Lunch Program and the School Breakfast Program to align them with the 2005 *Dietary Guidelines for Americans*, as required by the Richard B. Russell

National School Lunch Act (USDHHS 2011). The proposed changes are based on recommendations from the National Academies' Institute of Medicine (IOM) set forth in the report *School Meals: Building Blocks for Healthy Children* (Institute of Medicine 2009). This proposed rule would increase the availability of fruits, vegetables, whole grains, and fat-free and low-fat fluid milk in school meals; reduce the levels of sodium and saturated fat in meals; and help to meet the nutritional needs of school children within their calorie requirements. Implementation of this proposed rule would result in more nutritious school meals that improve the dietary habits of school children and protect their health (Federal Register 2011). Three months later, USDA's FNS published a final rule allowing institutions receiving funds under the Child Nutrition Programs to purchase unprocessed locally grown foods for use in schools. Additional federal funding to purchase and prepare high quality foods is not, however, forthcoming and parents are being charged more for their children's meals. The additional charge to the one-third of parents who actually pay for school lunches must cover the additional cost of all the meals served. This is a reallocation of the resource base which can be considered an investment in the future health of individuals, neighborhoods, and the economy.

These changes signal new demands by parents and public health and nutritional professionals. Old mandates are changing to improve the nutritional quality and appeal of school meals. This is part of a surging recognition for increasing the consumption of fruits and vegetables and decreasing the consumption of fats, sugars, and high caloric foods largely devoid of other nutrients. It also moves food and agricultural policy closer to nutrition/health-based criteria and away from maximizing production yields on basic commodities. This may not seem like the best technical efficiency, but it is a move toward dynamic efficiency that produces a healthier population and saves long-term health care costs. By diversifying the land use and the market rewards, it may also help sustain the agricultural environment.

Information

Besides prolific food labeling, advertising, and public media stories, the Internet stands ever ready to give us both food facts and fictions. Consumers tend to trust their friends and neighbors and the "citizen expert" more than food professionals or government authorities in most cases. They seek credible assurance that food ingredients and additives are genuine, safe, and efficacious and that labeling and advertising claims are truthful. Food companies are quick to add health claims (even before proven) in order to boost sales. This often raises consumer expectations beyond what any food can deliver which, in turn, leads to mistrust in the food system and in public policy. Regulatory agencies that have the responsibility for truth-in-information about food need the authority and the funding to police the efficacy of the messages and the behavior of the "speakers." These agencies include the U.S. Food and Drug Administration, Department of Trade and Commerce, and the Department of Agriculture. Lusk (Chap. 13) provides a thorough discussion on consumer information and labeling.

Traceability

Being able to trace food to its origins is part of new regulations in the Bioterrorism Preparedness and Response Act of 2002 (Public Law 2002) and the Food Safety Modernization Act of 2011 (Public Law 2011). Numerous food safety events have sharpened the need for rapid tracking capability. However, complex processed foods use multiple global suppliers that change with ingredient prices and seasons. Some realistic method of traceability and international standards and protocols to assure ingredient safety needs to be devised and implemented. Some argue that big branded food companies have every incentive to check on this safety themselves; their reputation is at risk. This is true, but much of the food we eat does not carry a national/international brand name and someone needs to have the authority to identify and curtail unsafe food from entering the system or to remove it quickly. Counterfeit food and substandard products have been under investigation by Interpol-Europol in Europe to determine the extent to which food is counterfeited or diluted for profit (Rothschild 2012). As prices rise, substituting inferior ingredients is not an uncommon practice. When there are truly bad actors in the industry, when decisions deliberately taken are harmful to people's health and welfare, they need to be held accountable criminally and/or civilly as the case dictates. When they are not, confidence in the food system erodes and peoples' health is at risk. Hooker and Souza-Monteiro (Chap. 10) discuss food safety and traceability in detail, while Nganje (Chap. 11) covers quality assurance for imports and trade using risk-based surveillance to help identify potential problem shipments for detailed inspection.

Conclusion

The biggest changes in the food and agricultural system over the past half century are the globalization of supplies and the consolidation of many small inefficient firms into large production units. Food and agriculture is now categorized as an industrial sector with complex supply chains and electronically aided information and logistics systems. The center of decision-making shifted from farmers to processors to retailers as economies of scale dictated horizontal mergers and acquisitions and the vertical integration of large retailers with logistics companies. Contract arrangements between retailers and processors and processors and producers created virtual, if not corporate, vertical integration. Possession of detailed data about consumers and their purchases gave retailers insight into consumer trends and the advantage in deciding what foods should be produced and sold. The advent of mega-sized supermarkets introduced retail price competition into otherwise monopolistic or oligopolistic market places and drove down the price both local and global suppliers could charge. Technical and dynamic efficiencies in the system moved from the farm down through the whole supply chain. A backlash against the industrialization of food and agriculture arose through concerns about damage to the environment, to human health and moral obligations to poorer citizens of the world as well as to animals used for food. Since food is a very intimate and personal part of everyone's life, many began to seek more information about its source, its processes, and its effect on their health and the health of their surroundings. This has forced many large companies to adopt social responsibility platforms and practices so as not to offend their consumers in the face of abundant competition.

Consumers have become vastly more heterogeneous with food preferences that not only vary by culture, income, and taste, but by preferences for social responsibility. Positioning food and health in a single thought and linking them into a single decision-making framework changes the priorities for food choice for much of the population. Increasing exposure to international cuisine and rising incomes introduces desire for variety in diets.

Altogether, the food system is an incredibly complex web of international laboratories, producers, processors, logistics companies, retailers, cooks, and consumers. Government oversight of its safety practices, trade agreements, information and advertising, competitiveness, and sustainability comprises another vast web, one of state and federal agencies, inspectors, and activities. Public policy can serve to promote a healthy agricultural sector and a healthy population through food security and safety programs and economic safety nets. Together, this provides a strong infrastructure and helps to ensure an efficient and dynamic production and distribution of food.

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Chapter 3
A History of Government's Role in the Food and Agricultural Marketing System

Richard G. Heifner

Abstract The Federal Government's involvement in the marketing of agricultural and food products began in the nineteenth century, grew rapidly in the early twentieth century, and continues to evolve. Federal programs affecting food and agricultural marketing have addressed consumers' concerns about food safety and farmers' concerns about fair pricing in the marketplace. Regulation of the railroads and competition in the agricultural product processing began in the late 1800s. The Meat Inspection and Pure Food and Drug Acts of 1906 initiated a series of regulatory steps continuing to this day to reduce food-borne illness. Beginning in 1915, Federal market news, grades and standards, support for cooperatives, and marketing orders increased farmers' marketing power. The Farmer-to-Consumer Direct Marketing Act was passed in 1976. Programs have been modified in recent decades to address new food safety problems, increased demand for organic and locally grown foods, and renewed concerns about concentration in agricultural markets. Future programs will be affected by tight federal budgets, continuing changes in technology, high concentration in agricultural markets, and new challenges in preventing food-borne disease.

This chapter traces government actions affecting food and agricultural markets beginning in the nineteenth century. It should be noted at the outset that the government's primary role in food and agricultural marketing, as in other areas of commerce, is to enforce property rights and contracts. In the USA, this function is shared by the state and federal courts and law enforcement agencies. Since the time of Adam Smith, economists have recognized that high levels of economic efficiency are attained in markets where private firms are allowed considerable freedom to pursue their own self interests. This implies that government should intervene only when markets fail to allocate resources efficiently. Stiglitz lists eight sources of market

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failures that may justify government activity in the marketplace (Stiglitz 1986). Three of these, failure of competition, information failures, and the existence of public goods provide justification for most food and agricultural marketing programs.

Competition fails when one or a few dominant firms in an industry are able to distort prices to their advantage without competitors entering the market. Agricultural product markets are vulnerable to such failures because the products of many producers typically funnel through one or a few buyers. Perishability exacerbates the problem in markets for livestock products and produce. The measures taken in the late 1800s to regulate railroads were the first major federal government actions affecting food and agricultural markets. Regulation of competition in meat packing soon followed. Later programs, such as support for cooperatives and marketing orders, were intended to increase the marketing power of farmers acting in groups when buyers were few.

Information failures occur when market participants lack the information about quantity, price, quality, and safety necessary to make sound decisions, particularly when the distribution of such information between sellers and buyers is asymmetrical. Market information often has the characteristics of a public good—once produced it can be provided to additional individuals at near zero cost and it is nearly impossible to deny others its use. The setting of grades and standards and provision of market news fall into this category. Provision of grading and inspection services may or may not, depending on whether and how much the broader public benefits. Information failures led to the initiation of market news programs, government grading and quality standards, and food safety programs early in the twentieth century. Changes in technology, tastes, marketing practices, and organization of the food processing industries have required continual modification and strengthening of these programs throughout the twentieth century and up to the present.

Table 3.1 provides a chronology of major programs aimed specifically at problems in food and agricultural markets. Not every program is included for lack of space. Some programs with major effects on markets, but aimed primarily at other problems, particularly the farm price and income support programs, are not covered. Also neglected are programs affecting farm input markets and food retailing.

1880–1900: The Regulation of Competition Begins

During the late 1800s the westward expansion of agriculture and the expanding railroads led to large-scale long-distance movement of agricultural products. Although the railroads tended to compete with each other for the long hauls, many were the sole carriers for short hauls in the areas they served. This enabled them to charge higher rates for the short hauls than for the long hauls. Farmers' dissatisfaction with such practices helped lead to the formation of the National Grange in 1867. The Grange grew rapidly in power and helped pass laws in several Midwest states to regulate the services and rates of businesses serving farmers, primarily the railroads and elevators. Most of these state laws were declared unconstitutional by

Table 3.1 A chronology of significant government actions affecting food and agricultural marketing

Year	Event
1862	Bureau of Chemistry established in the Department of Agriculture (USDA) to analyze foods
1884	Bureau of Animal Industry created in USDA to keep diseased animals out of the food supply
1887	Interstate Commerce Act regulated railroads
1890	Sherman Antitrust Act prohibited anticompetitive combinations and practices
1906	Meat Inspection Act required all meat animals to be inspected before slaughter
1906	Pure Foods and Drugs Act prohibited commerce in adulterated and misbranded foods and drugs
1913	Gould Amendment required food packages to show weight, measure, or numerical count
1914	Clayton Antitrust Act clarified policy with respect to the organization and control of industry
1915	First USDA Market News report issued (Strawberries in Hammond, LA)
1916	Standard Container Act authorized packaging standards for fruits and vegetables
1916	Grain Standards Act authorized grain and oilseed standards and required their use for exports
1918	Market News reporting began for most commodities
1921	Packers and Stockyards Act prohibited unfair practices in livestock markets
1922	Capper-Volstead Cooperative Marketing Act partly exempted cooperatives from antitrust laws
1922	Grain Futures Act provided for regulation of futures markets
1930	Perishable Agricultural Commodities Act prohibited unfair trading practices in produce markets
1936	Commodity Exchange Act established the Commodity Exchange Authority within USDA
1936	Robinson Patman Act clarified the meaning of price discrimination
1937	Agricultural Marketing Agreement Act provided authority for federal marketing orders
1938	Food, Drug, and Cosmetic Act prohibited adding poisons to foods and mandated food standards
1946	Agricultural Marketing Act broadened USDA's research and extension activities in marketing
1954	Miller Pesticide Amendment spelled out procedures for setting limits on pesticide residues
1958	Food Additives Amendment required makers of new food additives to establish safety
1967	Fair Packaging and Labeling Act required specified consumer product labeling
1967	Wholesome Meat Act regulates meat inspection and requires states to have equivalent programs
1968	Poultry and meat inspection merged under USDA's Agricultural Research Service
1970	Environmental Protection Agency established and takes over the setting of pesticide tolerances
1974	Commodity Futures Trading Commission Act established the CFTC as an independent agency
1980	Staggers Rail Act gave railroads more flexibility in competing for traffic
1981	Amendments to Agricultural Marketing Act required user fees
1982	Futures Trading Act legalized options trading in agricultural commodities
1990	Nutrition Labeling and Education Act required nutrition labeling
1990	Organic Foods Production Act provided for national standards for organic products
1996	HACCP System implemented by FSIS to reduce microbial infections of raw products
1999	Livestock Mandatory Reporting Act provided for mandatory reporting of livestock prices
2002	Farm Security and Rural Investment Act regulated swine contracting

the US Supreme Court. Since much of the movement crossed state lines and regulations differed among states, a uniform set of federal regulations was found to be needed. This led to the passage of the Interstate Commerce Act of 1887, the first time that Congress asserted its Constitutional authority to regulate commerce between the states. It also was the first time that Congress created an independent agency, the Interstate Commerce Commission (ICC), to regulate commerce. Although additional laws in the early 1900s added to ICC's powers, it was not very effective in curtailing anticompetitive behavior in its early years.

By the 1890s American industry was changing shape. Large corporations began to dominate many industries. One of the first areas where concentration in farm product processing became an issue was in meat packing. The westward expansion of the railroads, the development of refrigerator cars, and economies of scale in meat packing led packers to concentrate in major Midwestern cities such as Cincinnati, Chicago, Omaha, and Kansas City. Farm interests, particularly those concerned about the Beef Trust in Chicago and the Cottonseed Oil Trust, played a role in passing the Sherman Antitrust Act of 1890. In broadest terms, the Sherman Act prohibited two things: (1) anticompetitive combinations or coordination between actual or potential competitors; and (2) anticompetitive practices as well as exclusionary conduct by firms that have monopoly power in a particular market. Among its early applications was a 1903 injunction against the members of the Beef Trust, which was substantially upheld by the US Supreme Court (Weiser 2009). A 1911 antitrust suit divided the American Tobacco Company into four firms: American Tobacco, R. J. Reynolds, Liggett & Myers, and P. Lorillard.

Although the Sherman Act established lasting principles of antitrust regulation, such regulation continued to evolve into the twentieth century (Winerman 2003). The Clayton Act and the Federal Trade Commission Act were passed in 1914. The Clayton Act attempted to clarify basic policy with respect to the organization and control of industry. It identified conditions under which price discrimination, exclusive dealing arrangements and tying, mergers and acquisitions, and shared directors are anticompetitive. Price discrimination was further defined in the Robinson-Patman Act of 1936.

1900–1920: Food Safety Programs Are Launched

The federal government's concern with food safety can be traced to 1848, when a chemist was hired by the Patent Office to analyze food products (United States Food and Drug Administration 2010). This function moved to the newly formed Department of Agriculture (USDA) in 1862, where it resided in the Division of Chemistry—later the Bureau of Chemistry. Beginning in 1883, chief chemist Harvey Washington Wiley expanded research on food adulteration and mislabeling. This work was to lead to increased public concern about the safety of the food supply. In 1884, federal regulation of meat safety began with the establishment of the Bureau of Animal Industry (BAI) within the USDA. Its role was to prevent diseased animals from entering the food supply. Upton Sinclair's 1905 book, *The Jungle*, describing conditions in Chicago's meatpacking houses, heightened public concern, which led to passing both of the Meat Inspection Act and the Pure Food and Drug Act in 1906. Both Acts were administered within USDA by BAI and the Bureau of Chemistry, respectively. The Meat Inspection Act made the inspection of meats entering interstate or foreign channels mandatory at certain points in the meat marketing channel. With minor exceptions, the Act remained the major legislation governing red meat inspection for over 60 years (Sporleder et al. 1983).

The Pure Food and Drug Act of 1906 prohibited interstate commerce in adulterated or misbranded food and drugs and marked the beginning of modern food safety regulation. It prohibited the addition of any ingredient that would substitute for the food, conceal damage, pose a health hazard, or constitute a filthy or decomposed substance. Food labels could not be false or misleading and amounts of specified dangerous ingredients had to be listed. The Bureau of Chemistry administered the Act from 1906 to 1937. The Gould Amendment passed in 1913 required food packages to show weight, measure, or numerical count. Enforcement of the regulations led to many battles within the Administration and in the courts. After multiple transformations, food safety regulation became administered by the Department of Health and Human Services while meat inspection remained in USDA.

1910–1920: USDA Market News and Grading Services Begin

Information is power in the marketplace. Traders with better information have an advantage. Early in the twentieth century, concerns that farm product buyers had better information than farmers led to demands for government price reporting. The first Office of Markets was established in USDA in 1913. It became the Bureau of Markets, which was incorporated into the Bureau of Agricultural Economics in 1922 (Breimyer 1963). USDA Market News reporting began in 1915 with strawberries in Hammond, Louisiana. Price reporting for meat began in 1917. By 1918, price reporting had begun for most crops and livestock. Market news for cotton began in 1919. However, tobacco market news reporting did not begin until 1931.

Demand for uniform grading standards for livestock and meat arose in the livestock industry early in the twentieth century (Harris et al. 1996). The 1916 Congressional mandate for livestock market news reporting required some type of grading system to make the reports meaningful. Moreover, consumers had begun to ask that meat be identified by grade. The first tentative standards for dressed beef were formulated by USDA in 1916. The standards were improved over several years and first published in 1923. USDA began developing grade standards for market hogs, slaughter lambs, and sheep in 1917.

Prior to the establishment of federal grades, grain transactions were facilitated by a variety of grades and standards established by individuals, boards of trade, and state agencies. The use of federal grades was mandated by the Grain Standards Act of 1916 for grains sold by grade in interstate commerce (Nichols et al. 1983). The Cotton Futures Act of 1916 (which replaced the 1914 Act with the same name that had been declared unconstitutional) authorized USDA to develop standards for color, staple length and strength, and other characteristics to facilitate cotton trading. The Standard Fruits and Vegetables Baskets and Containers Act also was passed in 1916. It sets the cubic contents for dry half-pint, pint, and quart containers.

1920s and 1930s: New Marketing Programs Established to Protect and Empower Farmers

Export demand for US farm products declined after World War I initiating some two decades of low farm prices and incomes. The antitrust and market information programs that had been established earlier did little to restore farm prosperity and address farmers' concerns about abusive practices of farm product buyers. During the 1920s and 1930s several new marketing programs were initiated to protect farmers in the marketplace and increase their marketing power.

Control of meat packing by five companies in the early 1900s led to additional antitrust actions. A 1920 antitrust suit forced the meatpackers to relinquish their ownership and control of stockyards and prevented them from participating in other food processing activities. A Federal Trade Commission (FTC) investigation report in 1919 led to the passage of the Packers and Stockyards Act in 1921, which placed further limits and controls on the ways that livestock markets can operate. It prohibited anticompetitive behavior and unfair trading practices in the marketing and procurement of livestock and poultry and provided for financial protection of livestock sellers. USDA administered the Act while the Department of Justice and FTC retained primary responsibility for enforcing the statutes that directly address anticompetitive behavior, including the Sherman Act and the Clayton Act. Concentration in meat packing declined after the 1920s, prior to increasing again toward the end of the twentieth century. Public markets (auctions and terminals) have declined in volume while direct purchasing has increased.

The farm cooperative movement arose and grew during the last decades of the nineteenth century with support from the Grange (Frederick 2002). Some fruit and vegetable cooperatives on the West Coast and milk cooperatives on the East Coast began bargaining with the buyers of their products. Questions about whether such bargaining behavior constituted anticompetitive behavior arose. The Capper-Volstead Act passed in 1922 gave farm cooperatives a limited exemption from antitrust law. Under this Act, associations of producers could agree on prices and other terms of sale, select the extent of their joint marketing activity, agree on common marketing practices with other cooperatives, and achieve substantial market share and influence. The Act has remained in effect without major amendment for over 80 years. The Cooperative Marketing Act of 1926 established the Cooperative Marketing Division within the Bureau of Agricultural Economics to gather statistics, conduct studies, and provide advice on all aspects of farm cooperatives. It was transferred to the independent Farm Board in 1930 and to the Farm Credit Administration (FCA) in 1933. FCA became part of USDA in 1939. The Robinson-Patman Act of 1936 established that cooperative patronage refunds are not discriminatory.

The marketing of fresh fruits and vegetables requires many informal agreements and much trust because of the perishability of such products and distances shipped. Buyers are sometimes tempted to reject shipments or deny payment without good reason. The Perishable Agricultural Commodities Act of 1930 was designed to protect the interests of producers when marketing firms are slow to pay, go into bankruptcy owing money to farmers, or disputes arise over product quality. The Act is administered by the USDA. It prohibits unfair trading practices and enforces prompt payment. Both sellers (not farmers) and buyers of produce must purchase licenses that may be withdrawn by USDA for infractions.

Trading in standardized forward contracts for grains commenced in the USA about 1865 at the Chicago Board of Trade (Santos 2010). Cotton forward trading followed soon thereafter at New York and New Orleans. The modern clearinghouse, which facilitates final settlement of contracts, did not evolve until the 1880s. Futures trading—trading standardized forward contracts on an organized exchange—enables merchants and producers to reduce their income uncertainty by pricing their products or inputs before delivery. Forward pricing involves either selling or buying futures or entering into a cash forward contract with another party who in turn may buy or sell offsetting futures contracts. Forward pricing in futures (hedging) is effective only if maturing futures prices converge to corresponding spot market prices. To assure such convergence futures contracts either provide for actual delivery or allow final settlement based on an average cash price. Futures trading may fail due to poor contract design that results in thin trading and/or excess price volatility, brokers' taking unfair advantage of their customers, and price manipulation. Futures price manipulation involves either cornering (controlling) the deliverable supply for a contract or distorting the cash prices used to calculate the futures settlement price. Alleged corners or price manipulation on futures occurred on numerous occasions during the late 1800s. This led to movements to regulate or ban futures and options trading, which did not succeed until the decline in farm prices after World War I. The Grain Futures Act of 1922 established the Grain Futures Administration within USDA and required futures markets to be registered, limited market manipulation, and publicized trading information. However, the Act was ineffective because its sole remedy was to ban an exchange, which was too harsh for most infractions.

The Commodity Exchange Act of 1936 established the Commodity Exchange Authority (CEA) within the USDA and enabled the government to deal directly with traders rather than the exchanges. This Act also provided that speculators' positions could be limited, regulated futures merchants, and banned options trading in agricultural commodities. It allowed futures to be traded in cotton, rice, butter, eggs, and Irish potatoes as well as grains. Over ensuing decades, more commodities were added and CEA was given additional regulatory tools. Among the regulatory tools used by CEA to prevent price manipulation were original and variation margin requirements, speculative position limits, price limits, and position reporting requirements for large traders.

Federal marketing orders for milk and fruits and vegetables were authorized by the Agricultural Marketing Agreement Act (AMAA) of 1937. Attempts during the 1920s by some of the larger fruit and vegetable cooperatives to organize and regulate quantity and quality had failed because not enough producers and handlers could be persuaded to cooperate. Those who did not participate received the same benefits as participants. This is called the "free-rider" problem. The purpose of the AMAA was to eliminate "free-riders." Marketing orders are especially attractive to fruit producers as a way to establish and maintain a reputation for quality.

Fruit size and quality are vulnerable to weather conditions and orders provide a way to set and enforce quality standards. Without such quality standards, substandard products sold by one or a few producers may turn consumers away from a product.

In the 1920s, milk marketing cooperatives tried to introduce “classified pricing,” which involves setting a higher price for milk going into fluid uses than for manufactured uses and “pooling” the resulting payments among producers (Cropp 2001). This effort had limited success because buyers, who were mainly sellers of fluid milk, could acquire milk cheaper by staying outside of the arrangement. The Agricultural Adjustment Act of 1933 established a license program requiring all milk processors within a given area to implement classified pricing and pooling. The Agricultural Adjustment Act Amendment of 1935 set more specific terms and provisions and called the programs “marketing orders” instead of licenses. The above-mentioned 1937 AMAA refined the marketing order provisions and remains in effect. The stated purposes of the orders are to provide for orderly marketing, assure reasonable prices for farmers and consumers, and assure an adequate supply. Each marketing order must be approved by the producers involved. Milk handlers were required to pay at least minimum class prices into a pool. Class I applied to beverage milk products, Class II was milk used for soft products, and Class III was milk used for butter, cheese, and dried milk. All producers in each order received the same “blend” or average price. Dairy cooperatives that manufactured dairy products or sold farmers’ milk to different handlers could reblend the prices in making payments to their members.

Federal grades and standards continued to evolve during the 1920s and 1930s. Congress passed the United States Agricultural Inspection and Grading Act in 1924, which authorized federal grading of livestock and meat. The carcass beef grades became official in 1926. Grading was provided free for 1 year and made available on a fee basis thereafter. Official slaughter cattle and veal and calf standards followed in 1928. Public hearings on pork grades were held in 1927 and lamb grades in 1928–1929. Grades for lamb and mutton carcasses became official in 1931. The Standard Container Act of 1928 authorized packaging standards for fruits and vegetables. The United States Cotton Standards Act of 1923 and the Cotton Classification Act of 1937 provided authority for developing the standards used today for classifying cotton. In 1939, USDA’s grading services were moved from the Bureau of Agricultural Economics to the newly formed Agricultural Marketing Service.

1930–1970: Food Safety Regulations Are Expanded

The Food and Drug Administration (FDA) took its present name in 1930 but remained in the USDA. It was transferred to the Federal Security Agency in 1940, to the Department of Health, Education, and Welfare in 1953 and to the newly created Department of Health and Human Services in 1980. The Food, Drug, and Cosmetic Act of 1938 prohibited the addition of poisonous substances to foods and mandated legally enforceable food standards. Tolerances for poisonous substances were addressed and factory inspections were authorized. The first food standards under the1938 Act were for canned tomatoes. Standards were extended to about half of the food supply by the 1960s. Lists of ingredients that could lawfully be included in specified foods were developed. Foods that vary from the standards must be labeled imitations.

During the 1950s and 1960s, mislabeling and adulteration from chemical additives became major food safety concerns. Most of the new concerns arose from new types of products, complex processing methods, and increased volume. Many focused on pesticides, residues of drugs given to meat animals, and preservatives. Following hearings under Representative James Delaney in the 1950s, a series of new laws gave the FDA tighter control over the growing list of chemicals entering the food supply. In 1954 the Miller Pesticide Amendment spelled out procedures for setting limits for pesticide residues in agricultural products. The 1958 Food Additives Amendment requires manufacturers of new food additives to establish safety. The Delaney Provision prohibited carcinogens. In 1959 the Cranberry crop was recalled to check for carcinogens. Standards were extended to about half of the food supply by the 1960s. Lists of ingredients that could lawfully be included in specified foods were developed.

The Fair Packaging and Labeling Act of 1967 required that consumer products be labeled with net contents, identity of contents, and the name and place of business of manufacturer, packer, or distributor. It is enforced by the Federal Trade Commission. The Wholesome Meat Act of 1967 required states to raise their meat standards to at least the federal level. The Animal and Plant Health Inspection Service was established in 1972 to administer this Act and related legislation. Since 1977 meat inspection has been the responsibility of the Food Safety and Inspection Service (FSIS) of USDA. The setting of pesticide residue tolerances was taken over by the newly established Environmental Protection Agency in 1970.

1940–Mid-1970s: Agricultural Marketing Programs Evolve Further

Administration of agricultural marketing programs moved from the Agricultural Marketing Service (AMS) to the Agricultural Marketing Administration in 1942, where it remained throughout World War II. During the war, farm prices were more favorable for farmers than in the 1930s. After the war, attention focused on revising and updating existing marketing programs instead of developing new programs. AMS was reestablished in 1953.

The USDA grading program received a boost when meat grading became mandatory under World War II price control programs and again during the Korean War. These experiences showed that consumers were well satisfied with federal grading and regional packers could compete with national brands by selling graded products. Regional packers temporarily increased their share of the market as a result (Harris et al. 1996).

After the war, efficient marketing gained attention as a way to increase farmers' incomes. The Hope-Flannagan Agricultural Marketing Act of 1946 reinvigorated agricultural marketing research. It declared efficient marketing to be "essential to a prosperous agriculture" and "indispensible to the maintenance of full employment and the welfare, prosperity, and health of the nation" (Breimyer 1963). The added financial support led to a substantial expansion in agricultural marketing research and extension in subsequent years.

The Agricultural Marketing Act of 1946 increased USDA's power to develop and administer standards. Grade standards changed frequently in the decades after the war. In 1950, beef carcass standards were lowered by one grade (Harris et al. 1996). Standards for slaughter lambs and sheep as well as hog barrows and gilts finally became official in 1951 and 1952, respectively. Cutability grades were added to create a dual grading system for beef in 1965 and lamb in 1969. The need to set higher standards for exported grains led Congress to establish The Federal Grain Inspection Service in 1976 to manage the national grain inspection system.

Poultry and livestock inspection were merged within USDA's Agricultural Research Service in 1968.

The work supporting cooperatives moved to the Farm Cooperative Service (FCS) in USDA in 1953, when the Farm Credit Administration again became an independent agency. The cooperative work was performed within the Economics, Statistics, and Cooperatives Service from 1977 to 1980, at which time it was separated as the Agricultural Cooperatives Service.

Uniform milk class pricing formulas were established nationwide in 1960. The Minnesota–Wisconsin (M–W) Grade B manufacturing price paid for farmers' milk price was established as the base price (Class III price) for all federal marketing orders. The Class II price was determined by adding a fixed differential to the M–W price and the Class I price for each order was determined by adding a differential based on distance from Eau Claire, Wisconsin to the M–W price.

Bargaining cooperatives operated in many fruit, nut, and vegetable markets and have played a significant role in the milk and sugar beet industries (Hueth and Marcoul 2002). The Agricultural Fair Practices Act of 1967 protected farmers from retaliation by handlers because farmers belong to any association of producers engaged in marketing, bargaining, shipping, or processing of agricultural products. However, this statute has fallen into disuse. Several states have similar legislation. During the 1970s several bills to facilitate agricultural bargaining failed to pass Congress.

New stand-alone promotion and research programs commenced for wool and lamb in 1954, cotton in 1966, potatoes in 1971, eggs in 1974, and wheat in 1977. Efforts to start a beef promotion program failed on two occasions. Most of the programs allowed for refunds to producers who did not want to participate and refund requests increased over time. Most of the fruit and vegetable marketing orders and some of the milk marketing orders also provided for promotion.

The Farmer-to-Consumer Direct Marketing Act of 1976 provided grants to improve and expand farmers' markets, roadside stands, community agricultural development programs, agritourism activities, and other farmer-to-consumer direct marketing activities. The Federal State Marketing Improvement Program provides matching funds to state agencies for exploring new marketing opportunities for food and agricultural products.

Alleged anticompetitive behavior in the food industries continued to receive attention. More than 200 cases were filed between 1950 and 1965 charging violation of the Robinson-Patman Act by food marketing firms. The growth of large-scale retailing brought efforts to protect small retailers from being undersold. The 1952 McGuire Act restored legality to retail price maintenance by manufacturers. However, with few exceptions, food manufacturers no longer set retail prices for their products.

The growth of futures trading, particularly in nonagricultural contracts, led to the passage of the Commodity Futures Trading Commission Act of 1974, which moved the regulation of futures trading from USDA to the independent Commodity Futures Trading Commission (CFTC). The CFTC was given broad regulatory authority over all US futures trading and exchange activities, including the power to approve new contracts in any commodity and changes in existing contracts. The Commission consists of five Presidential appointees. One of CFTC's early actions was to approve futures trading in financial contracts. The volume of financial futures trading soon exceeded the volume of agricultural futures trading.

1970s and 1980s: Some Regulations Are Eased While Others Are Modified

By the 1970s, there was growing evidence that regulation was stifling competition in some industries, particularly the railroads and airlines. The interstate highway system had enabled truckers to compete vigorously with railroads, who were enmeshed in binding rate regulations. The railroads were losing traffic and many were going bankrupt. The Staggers Rail Act of 1980 gave railroads more flexibility in competing for traffic. The Act resulted in substantial declines in rail rates along with the abandonment of many branch lines serving agricultural communities.

The Futures Trading Act of 1982 lifted prohibitions against options trading in agricultural commodities that had been in place since 1936. It also clarified the jurisdictions of CFTC and the US Securities and Exchange Commission, particularly in the financial markets. Commodity options provide farmers and merchants more flexibility for shifting their price risks than do futures alone. Pilot programs to subsidize farmers' use of options as a possible alternative to price supports were implemented in the 1980s and 1990s for crops and in 1999 for milk (Buschena and McNew 2008).

Concern about excess regulation led to questions about the marketing order program (United States Department of Agriculture 1981). A series of government studies during the late 1970s and 1980s examined the effects of the orders on marketing efficiency (Jesse 1987). The hops and tart cherry marketing orders were terminated in 1986, although a new tart cherry order was promulgated in 1996. New marketing orders for Texas-New Mexico potatoes and Vidalia onions were approved in 1989. By the end of the 1990s, there were 45 Federal marketing orders for horticultural crops.

Use of the Minnesota-Wisconsin price as the base price for milk came into question in the 1980s because Grade B production was declining in Minnesota and Wisconsin and other regions were manufacturing significant amounts of milk. By 1995 the Upper Midwest was questioning the increased differentials based on distance from Eau Claire for Class I milk. The method for determining the base price was changed in 1995 and the new base price was called the Basic Formula Price. The 1996 Farm Bill directed USDA to consolidate the existing 33 milk marketing orders to 10–14 by April 1999 and authorized the Secretary to revisit the federal order pricing provisions.

Changes in meat grading continued. In 1980, grading of wholesale cuts was eliminated leaving only whole carcass grading. Lamb and mutton as well as pork carcass standards were modified. The grade name “Good” was changed to “Select” to better fit consumer perceptions. User fees were required for USDA Grading Services by 1981 amendments to the Agricultural Marketing Act.

After several transformations, inspection services were lodged in the Food Safety and Inspection Service in 1981. The Perishable Agricultural Commodities Act was amended in 1984 to provide additional protection to produce sellers. A 1995 amendment eliminated license fees for retailers and full-line grocery wholesalers and raised license fees for other buyers of produce.

1990–2010: New Challenges Arise for Food and Agricultural Marketing Programs

Increased food imports and changes in food processing and distribution technology during recent decades have posed new problems in assuring food safety, while reduced numbers of agricultural product handlers and processors seem to have increased potential for pricing abuses. The marketing services expected from government also have changed to require increased use of technology and increased coordination with foreign governments. Several major outbreaks of foodborne disease in recent decades have raised concerns about food safety. Concentration remains high in many segments of the food processing and distribution industries. The roles of cooperatives and marketing orders continue to be questioned and price behavior on futures markets has on occasions raised questions about their performance.

The public has begun to realize that foods can be harmful if they contribute excessively to chronic disease, such as diabetes or circulatory problems, as well as acute disease. In particular, excess consumption of sugars and fats is unhealthy, while modest quantities can be part of a healthy diet. Consequently, outright prohibition of such components has not been deemed the solution. Rather, it is hoped that consumers will make better nutritional choices if provided with better information. The Nutrition Labeling and Education Act of 1990 required nutrition labeling on most prepared foods. Required label content continues to evolve. One of the new initiatives is to provide food labeling on the front of food packages.

A 1993 outbreak of *E. coli* killed four and sickened 400 showing that inspection services were not keeping up with evolving food processing and handling methods. By 1997, the Food Safety and Inspection Service began implementation of the Pathogen Reduction/Hazard Analysis and Critical Control Point rule (HACCP) to reduce microbial infections of raw products. HACCP provides flexibility for industry to develop and implement innovative measures to protect food safety while imposing unequivocal food safety responsibilities on the industries involved. It links eligibility to bear the marks of inspection with the plant's ability to control processes and sanitation. Costs of implementing the rule are relatively high and controversial (Ollinger and Moore 2009).

Several events over more recent years have renewed concerns about the safety of livestock products (US Recall News 2008). These include the 2003 Mad Cow Disease scare, the 2005 bird flu alarm, the 2006 North American *E. coli* outbreak, the 2007 withdrawal of approval for Tyson Foods to claim that their poultry was raised without antibiotics, and the 2008 Hallmark Meat recall. The largest food recall of the decade occurred in 2010 when 500 million eggs from two Iowa farms were pulled off store shelves. More than 1,800 people were made ill by salmonella poisoning, but there were no deaths. In December 2010 the Center for Disease Control estimated that there are about 48 million cases of foodborne illness in the USA each year (1 in 6 Americans). These illnesses result in about 128,000 hospitalizations and 3,000 deaths. Four-fifths of the illnesses are from "unidentified agents," including cases with little data and cases caused by organisms or chemicals not yet identified as harmful. About 90% of illnesses, hospitalizations, and deaths from known agents were due to seven pathogens: *Salmonella*, norovirus, *Campylobactor*, *Toxoplasma*, *E. coli O157*, *Listeria*, and *Clostridium perfingens* (Center for Disease Control 2010).

Growing concerns about health and the environment have resulted in movements to return to foods produced with few or no chemicals and foods produced locally. Organic produce, meat, and dairy now constitute about 3% of national consumption and their share is growing. The Organic Foods Production Act of 1990 provided for establishing national standards for organic products. The National Organic Standards Board makes recommendations about what substances should be allowed or prohibited in foods labeled organic and assists in the development of standards. AMS reports limited data on wholesale prices and shipments of organic produce. Debate about whether the nutritional and health benefits of organic foods exceed their extra costs continues. In a related development, country of origin labeling took effect for designated meats and fish, fresh and frozen fruits and vegetables, nuts, and ginseng in March 2009. The desirability of such labeling remains in question.

Concerns about concentration in meat packing have reemerged in the last 20 years. A wave of mergers and acquisitions occurred in the US beef packing industry from the late 1970s to the early 1990s. Four-firm concentration ratios for steer and heifer slaughter increased from 36% in 1980 to 80% in 2004.

Corresponding concentration ratios for hog slaughter increased from 34% to 64% over the same interval (United States Department of Agriculture 2005).

The captive supply (animals procured by packers through forward contracts, agreements, and packer feeding arrangements at least 14 days before slaughter) ratio for packers increased from 20.5% in 1988 to 44.4% in 2002. High concentration is not a violation of the Sherman Act but indicates that monitoring for anticompetitive behavior is warranted.

Concentration also is high in pork and broiler contracting. Drawing from a mix of USDA and industry sources, Hendrickson and Hefferman reported four-firm pork production and broiler concentration ratios of 46% and 50%, respectively, in 2001 (Hendrickson and Hefferman 2007). The Antitrust Division of the Department of Justice (DOJ) declined to challenge Smithfield's acquisition of Premium Standard in 2007, concluding that it would not undermine competition in the market for pork. In October, 2008, the Division filed a complaint about the proposed merger of JBS and National Beef Packing that led to abandonment of that merger (United States Department of Agriculture 2005).

Concentration in grain exporting remains high. Three firms exported 81% of the corn and 65% of the soybeans in 2000 (Hendrickson and Hefferman 2007). DOJ approved the Cargil-Continental Grain merger in 2000, but required divestiture of ten elevators in seven states (Heycoop 2003, P CRS-5). The four-firm concentration ratio for grain handling facilities was 60% in 2002.

In recent years farmers have increased their use of patented biotechnologies, such as seeds resistant to herbicides and insects. DOJ required a spinoff of gene technology when Monsanto acquired Dekalb (both seed companies). Recently, DOJ required Monsanto and Delta Land and Cotton to divest themselves of significant assets before they were allowed to merge.

Responsibilities for regulating competition have changed and been adjusted in the last 20 years. Traditionally, DOJ and the Federal Trade Commission (FTC) divided the antitrust work according to their respective areas of expertise. In a 2002 Memorandum of Agreement, DOJ took responsibility for agriculture and biotechnology, while FTC took responsibility for grocery manufacturers and grocery stores (Heycoop 2003, P CRS-4). The Surface Transportation Board (STB) was created in 1995 as the successor agency to the Interstate Commerce Commission and is part of the Department of Transportation. It is decisionally independent, affiliated with the US Department of Transportation only for administrative purposes. The STB is charged with resolving railroad rate and service disputes and reviewing proposed railroad mergers, serving as both an adjudicatory and a regulatory body. Rail mergers are handled differently at the STB than mergers in other industries (Heycoop 2003, P CRS-6). DOJ and FTC are allowed to testify, but the STB has final authority. In contrast to other industries, where mergers can proceed unless blocked by DOJ or FTC, railroads must have STB permission to merge. Also STB maintains oversight over mergers and can apply additional conditions after the merger occurs. The STB allowed the 1996 merger of the Union Pacific and Southern Pacific even though the DOJ opposed the merger. Recently there is concern that the Staggers Act may have given the railroads too much pricing power over farmers, grain merchants, and other shippers.

The Grain Inspection and Packers and Stockyards Administration (GIPSA) was established within USDA in 1994 by joining the two previously separate agencies. The 2002 Farm Security and Rural Investment Act extended GIPSA's authority to regulate swine contracts as well as broiler contracts. Reporting of livestock prices to AMS Market News became mandatory in 1999 because the transactions not reported under the voluntary system had risen to about 35–40% for cattle, 75% for hogs, and 40% for lambs. Mandatory reporting lapsed in 2005, but continued on a voluntary basis for nearly all covered products. The legislative authority for mandatory price reporting was renewed in 2006 and again in 2010 with pork and dairy products added.

In 1990, federal marketing orders were in force for nearly all fresh citrus, about 60% of the milk and tree nuts produced in the USA, and many other fruits, vegetables, and specialty crops. The number of federal fruit and vegetable marketing orders declined from 45 in 1990 to 32 in 2010. Most farmers who produce commodities under marketing orders support them, but some growers dislike them and many consumers never heard of them. They invite continued scrutiny in an age of deregulation. Other than some administrative expenses, direct outlays are paid by the industries affected and do not show up in the Federal budget, so marketing orders have been called "farm programs that you do not see" (Zepp and Powers 1990).

Bargaining cooperatives continued to operate in many fruit, nut, and vegetable markets in the USA, particularly in California where there were 10 in 2001 (Siebert 2001). They have also played a role in the milk and sugar beet industries (Hueth and Marcoul 2002).

Milk marketing orders have decreased in number and increased in areas covered over recent decades. The 11 federal milk marketing orders that existed in 2000 covered 72% of all milk compared to 39 orders covering 25% of all milk in 1950. During this interval Grade A milk increased from 41% to 74% of the market and the number of handlers declined from 1,101 to 240 (Cropp 2001).

There were ten federal milk marketing orders accounting for about 60% of US milk production in February 2006. The California state order, which operates much like federal orders, accounted for another 20%. Some of the rest is covered by other state orders.

The classified pricing used in milk marketing orders is a form of price discrimination. It is well established that price discrimination—charging different buyers different prices for the same good—can raise sellers' returns at buyers' expense. Whether the public's gain from the coordination and stabilization provided by milk marketing orders outweighs the losses from the price discrimination involved remains an issue. Recently, Chouinard et al. concluded that nearly all groups of consumers, except the wealthiest, would gain by eliminating the price discrimination enforced by milk marketing orders. Poorer families and those with young children would gain the most (Chouinard et al. 2010).

The powers of cooperatives under the Capper-Volstead Act remained under contention at the end of 2010. Plaintiffs in several lawsuits were claiming that certain cooperatives had violated antitrust laws by, among other things, conspiring to restrict the production of agricultural commodities (Varney 2010). During the year, the Department of Justice and USDA hosted a series of meetings across the country to explore competitive issues in agriculture.

The volume of agricultural futures and options trading has increased rapidly in recent years. Commodities have grown as an asset class for investors. New investment vehicles such as managed futures funds, hedge funds, exchange traded funds, and swaps have evolved and their use has expanded. This raises concerns about whether investor (speculator) trading is distorting price (Sanders et al. 2010). In March 2009, the Commodity Futures Trading Commission set up a subcommittee to identify the causes of poor cash-future conversion on certain agricultural futures markets. The Commission initiated new position reports to increase transparency. New variation margin requirements and new price limits also were introduced. Electronic trading of cotton futures began in 2007 leading to a failure of open outcry trading in 2008.

The Future of Food and Agricultural Marketing Programs

We turn now to what history tells us about the future. Trends in the general economy and in agriculture and the food industries are identified and their implications for different types of food and agricultural marketing programs are examined. Such programs will be strongly affected by events arising outside of agriculture. These include the US trade imbalance and heavy debt burden, increasing costs of energy, continuing expansion of world trade, changing communication technology, and global warming. Changes arising within the food and agriculture sector include new production and marketing technologies, continuing consolidation in the handling and processing of agricultural products, growing world food demand, and increasing understanding of the nutritional and health effects of foods and food components.

Although the changes in food and agricultural marketing have been and will be large, many of the problems that originally led to government involvement remain. High among these are assuring food safety and enhancing competition in food processing and distribution. While the food industries have become more like other sectors of the economy, important differences continue to exist. An uninterrupted supply of healthful food remains critical to the nation's welfare. Crop production remains widely dispersed over space and subject to weather uncertainty. Many farm and food products are perishable. Farms have become much larger and fewer, but producers still far outnumber processors and other first handlers in most cases. Such conditions imply that special programs to assure food safety, enhance competition, and help farmers manage and coordinate their marketing activities will continue to be needed. These programs will require continuing modification to deal with changing conditions in the food industry.

The gains from globalization and recent technological advances have not been equitably distributed. Income dispersion has widened. Faulty decisions by government and business in dealing with the effects of globalization have left the USA with serious trade and budget deficits and persistent unemployment (Rajan 2010). Restoration of growth and prosperity calls for increasing exports and restoring fiscal discipline. US abundance of good land with favorable climate makes agriculture one of our prime areas of comparative advantage. The marketing sector needs to do its part to increase exports. This calls for continuing efforts to contain costs and to adjust our standards for food safety, quality, and packaging to better meet the needs and desires of foreign buyers. Our large existing federal debt and entitlements combined with desires for lower taxes imply years of tight federal budgets that will constrain government programs of all types. Considering federal and state budget constraints, expect a need for more marketing programs to be self-financing or be discontinued. Programs with the characteristics of public goods—where the benefits accrue to additional individuals at near zero cost and are nearly impossible to deny to others—are likely to be most constrained because they cannot be effectively financed with user fees. Such programs include basic research, market news, and the regulation of monopolistic practices.

Fuel costs likely will increase as demand for energy continues to grow in the developing world and costs for developing new sources of oil and gas increase. Renewable energy sources will only partly fill the gap and at higher costs. Among the likely food industry effects are increased use of rail transport relative to truck transport and increased consumption of foods grown locally. Food processors and marketers will be motivated to reduce their assembly and distribution costs by relocating plants and warehouses and rearranging their routes. Competition may become more local, which means less competition in some markets.

Improvements in communication technology are changing markets. The internet has become a valuable source of market information for farmers and consumers. Government agencies providing marketing services, such as market news and grading and inspection, will be expected to use the latest available technology. Futures and options trading is already highly computerized and online selling and buying is growing in importance for many nonfood and some food products. How far computerized trading will extend into food and farm product markets remains unclear, however, because of consumers' desire to see, touch, and/or smell many food products and because of expanded farmer-processor contracting that reduces the numbers of transactions while increasing their complexity.

Food production, processing, and distribution technologies will continue to evolve requiring corresponding adjustments in food marketing programs. During the twentieth century, technological developments contributed to increased long distance movement of foods and increased consumption of processed foods. In contrast, growing health and environmental concerns have recently increased interest in organic and locally produced foods. The USA is a nation of varied food preferences. Examples include not only preferences for organic and local foods but also preferences for ethnic foods for crop and livestock products with special characteristics, such as high protein or low fat, and for different kinds and varieties of fruits and vegetables. Higher costs of production will continue to restrain demand for natural and organically produced foods. Demand for such foods will depend on what scientists discover about their health benefits or lack of benefits.

Preventing both chronic and acute food-borne disease will become more challenging as food production and processing technology presses the limits, world trade in food increases, and the climate warms. The long-term health effects of genetic modifications and many chemical and biological food additives remain to be quantified. Changing trade patterns and global warming may introduce unfamiliar human disease-causing organisms and increase the presence of known organisms in the food supply. Among other things, this calls for better international coordination of food safety programs. Broad public concerns about health and the likelihood of new food-borne disease outbreaks suggest that food safety programs will retain support, albeit with tight budgets. Research to identify the sources of food-borne illnesses and find appropriate and effective preventative measures deserves high priority. Additional food safety measures likely will be needed as more is learned. These may include additional inspections and tests for safety and new measures for tracing sources of disease or contamination. For example, concern about the possible recurrence of Mad Cow disease suggests developing a system to identify individual animals. Canada has such a system while the USA and Mexico do not (Knutson 2010). Congress has recently passed legislation to strengthen FDA's ability to order food recalls, require new produce safety standards, and apply stricter standards on imported foods. The burdens imposed on small producers and processors for complying with higher food safety requirements and the risks of exempting them are issues. As more is learned about the effects of foods on chronic health problems, further changes in food labeling likely will become desirable.

Concentration in food marketing and distribution is likely to increase further as expanded markets and improved communication technology increase the advantages of size. Farmer-first handler contracting will also increase as processors seek more control over the flow and quality characteristics of their inputs. Meanwhile, support for antitrust and other regulatory activities seems to have waned because the need has not been very obvious and industry has exerted strong pressures to deregulate. Whether reduced numbers of handlers, processors, and distributors lowers farmers' returns and/or raises food costs to consumers remains unclear in many cases. More research is needed into the conduct of firms in concentrated markets and the performance of such markets. The research should include evaluations of the risks to the food supply from the possible collapse of one or a few dominant firms in each major food sector.

The effects of the aforementioned changes on the marketing programs that serve farmers and/or farmers' organizations directly are mixed. Programs such as market news, support for cooperatives, and research will come under increased budgetary pressure. The roles of these programs are changing as farmers become more specialized and farmer-first handler contracting increases. Growing incomes combined with this diversity of needs and preferences likely will call for more detailed and precise product categorization, quality measurement, and grading. New measures may be needed to promote competition and protect farmers' interests. For example, higher transportation costs and environmental concerns may call for more support for direct marketing by farmers. Programs financed directly by producers through user fees and checkoffs—such as grading, commodity promotion, and marketing orders—are less vulnerable to budgetary constraints. The number of commodity promotion programs seems likely to increase further as more commodity organizations see benefits from advertising. The inconsistencies between some promotion programs and the government's nutrition policies remain to be sorted out.

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Part II
Market Structure, the Supply Chain, and Marketing Orders

This part focuses on programs that affect the structure of the food value chain. Reducing the presence on monopoly structure through the Sherman Antitrust Act and Clayton Act antimerger provisions under the jurisdiction of the U.S. Department of Justice has ebbed and flowed in the level of enforcement activity. In addition, USDA was given responsibility for preventing anticompetitive practices in livestock marketing. The Capper Volstead Act was designed to foster competitive market outcomes by allowing farmers to develop countervailing market forces that might otherwise be a violation of the Sherman conspiracy provisions. Federal milk marketing orders provided additional support for cooperatives by setting minimum prices for milk based on use and blending the proceeds. Federal fruit and vegetable orders, which initially regulated the quantity of products marketed more heavily, evolved over time to emphasize expanding demand through assuring uniformity of product quality, improving market information, advertising and promoting commodities, and conducting market-related research. Generic advertising and promotion have also been utilized to expand demand for other commodities. Globalization of markets resulted in the evolution of demand expansion programs from primarily foreign commodity aid to assisting firms in identifying and capitalizing on commercial export market opportunities.

In Chap. 4, Armbruster addresses market structure and trading practices having potential antitrust, anticompetitive, and consumer implications. He identifies their implications for competition and then examines the economic consequences of current federal policies and programs intended to address the challenges from evolving marketing structures designed to capture marketing efficiencies.

In Chap. 5, Knutson and Cropp focus on various methods of coordination for producers that are supported or regulated by federal and state governments. They address where producers/growers fit in the developing supply chains and potential conflicts with the retailers or processors controlling those chains. The economic implications of current policies/programs for producers, processors, retailers, and consumers of the efficiencies gained are analyzed.

In Chap. 6, Paggi and Nicholson analyze the impacts of marketing orders for dairy and for fruit, vegetable, and specialty crops separately, due to their differing approaches to the markets they regulate. They conclude that fundamental market parameters, nonmarket impacts on nutrition or health, and the dynamic implications of marketing order elimination or modification for price discovery, risk management, and organizational arrangements all deserve further scrutiny.

In Chap. 7, Crespi and Sexton address federal and state initiatives to expand demand for unbranded products and commodities in domestic and foreign markets through producer checkoff programs, which often also provide research funding. They explore the legal battles that have shaped the programs and the modern challenges of promoting commodities in a differentiated marketplace with concentration in food manufacturing, where brands predominate and consumer preferences are dynamic.

In Chap. 8, Henneberry delineates the purposes of export market development programs, how they have been implemented, and the challenges they face. Entering new export markets and maintaining existing markets require market development investments and promotion. Research has shown export promotion programs to be effective in increasing U.S. market shares and export revenues.

Chapter 4
Market Structure, Trade Practice Regulation, and Competition Policy

Walter J. Armbruster

Abstract The dynamic food and agricultural markets continue to evolve, generally leading to larger farms and marketing firms with potentially more market power throughout the supply chain. As the structure of the industry has changed, the ways of doing business have moved further from the perfectively competitive norm to a much more interlinked production and marketing system integrated vertically and horizontally. The US food and agricultural sector has long been regulated or guided by policies and programs which proscribe or limit trade practices or market firm conduct. This chapter addresses to what extent the current US programs adequately regulate market activities or set a framework within which market participants operate in today's global marketing system. It examines existing federal policies and programs to provide countervailing power to producers facing much larger marketing entities in their transactions beyond the farm gate. It also reviews trade practice regulations designed to provide a more fair system of exchange, and to proscribe certain conduct to enhance market performance. Some options for improving the effectiveness of these programs are identified and evaluated for their impacts on market efficiency. Finally, potential for greater public–private sector collaboration and needed additional research and education to foster improved market performance are briefly explored.

The dynamic food and agricultural markets continue to evolve, generally leading to larger farms and marketing firms with potentially more market power throughout the supply chain. As the structure of the industry has changed, so have the ways of doing business, moving further from the perfectly competitive norm of the ideal market to a much more interlinked production and marketing system integrated vertically and horizontally. Today's marketing system is comprised of increasingly larger firms, with

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a few often dominating a market segment. Even in supply chains where producers are involved beyond the farm gate but before delivery of the final product to the consumer, there is generally size disparity and hence market power discrepancy between the producers and the processors and marketing firms of various types.

Globalization over the past few decades has increased the scope of markets in the face of trade agreements and greater demand for diet variety. International firms operating in numerous countries have increased their competitiveness by taking advantage of increasing technology facilitating lower cost production, processing, transportation, and marketing of food and agricultural products. They may face different marketing regulatory schemes in each country aimed at keeping some balance of power between producers and the processing, logistics, and marketing firms.

The US food and agricultural sector has long been regulated or guided by a number of policies and the implementing programs which regulate or limit the trade practices or structure in the markets at various stages in the supply chain. Briemyer (1983) posited that “In large measure, trade practice regulation exists in order to improve integrity, equity, and competition among firms of uneven size and power” (p. 10). The initial laws governing the industry are more than 100 years old, but have evolved with the changing nature of the markets. The forces driving policies have shifted over time from being almost totally focused on marketing-oriented programs at the producer-first point of sale interface to more expansively considering marketing structures or practices that may have impact throughout the supply chain from producer to consumer.

While ever larger firms tend to dominate most segments of the market, there remains a viable and fragmented set of firms also involved with meeting market demands. Some of these smaller firms, especially new entrants, may well be the source of innovation and emergence of market segments as in the local, organic, and sustainable segments of the markets receiving much attention currently (Chap. 16). As newer market segments grow, efficiencies in providing various marketing services lead to consolidation among the smaller firms into ever larger firms. And once a niche market starts to command a profitable portion of the total market, larger firms which may not have been involved in earlier stages are likely to enter the niche or market segment.

This chapter addresses to what extent the current US programs adequately regulate market activities or set a framework within which market participants operate in today’s global marketing system. Have the programs evolved sufficiently that they are still relevant to and needed for efficient market functioning? Are the USDA and other federal agencies charged with administering these programs able to do so without conflicting with potentially competing roles they must play in representing producer and consumer interests in the food and agricultural sector? The analysis will first describe and assess the impacts of the changing market structure, the increasing role of vertical and horizontal integration, and the accompanying role of contracting as a force in establishing prices and terms of trade between producers and participants downstream in the supply chain system predominant in today’s markets. Then, it will examine existing federal policies and programs to provide countervailing power to producers facing much larger marketing entities in their transactions beyond the farm gate. It will next look at trade practice regulations designed to provide a more fair system of exchange, and to proscribe certain features of market structure or conduct to enhance market performance. Some options for improving the effectiveness of these programs will be identified and evaluated. Finally, potential for greater public–private sector collaboration and needed additional research and education to foster improved market performance will be briefly explored.

Market Structure, Integration, and Contracting

Knutson et al. (1983) provided an overview of changes in the marketing institutions over the previous 50 years which carried significant implications for the way transactions take place and the difficult position in which most producers find themselves in negotiating sales of their products. The trends they described have only gained momentum and the implications for producers have been exacerbated in the intervening 30 years.

Markets for agricultural and food products have evolved from traditional spot markets with numerous buyers and sellers to a market structure dominated by ever larger farms and firms. Many transactions are now based on negotiated agreements between producers and marketing firms, or involve increased vertical contract and ownership integration or joint ventures by marketing firms into the production stage of the supply chain. This means that market transactions are:

- Often less transparent.
- Increasingly determined by prearranged agreements specified in contracts based on attributes of the product delivered.
- Frequently tied to a small base price determined by a declining number of transactions in spot markets.
- Represent payments for production services utilizing integrator owned inputs, including animals or plant seeds.

MacDonald and Korb (2011) succinctly summarize potential beneficial effects of contracts, which can help farmers manage price and production risks. Contracts are used to elicit production with specific product quality attributes, by tying prices to those attributes. They also facilitate smooth flows of commodities to processing plants, thus encouraging more efficient use of farm and processing capacities. But contracts can also have less benign effects, introducing new and unexpected risks for farmers. They increase income risk, in the event of a production shortfall, by necessitating spot market purchase by the producer to fulfill delivery commitments. Default risk comes from ties to a single contractor, leaving the producer subject to contractor failure. Finally, farmers face long-term hold up risk at contract renewal, if the initial contract does not cover the entire life of the capital investment which may be required to secure the contract (also see Key and MacDonald 2008).

While agricultural markets were originally one of the most competitive market segments and were often cited by economists as being purely competitive, change has been underway since the late 1800s. However, "Competition fails when one or a few dominant firms in an industry are able to distort prices to their advantage without competitors entering the market. Agricultural product markets are vulnerable to such failures because the products of many producers typically funnel through one or a few buyers" (Heifner, Chap. 2). This surely describes the nature of a number of agricultural markets today. It raises concerns about whether transparency in markets and information flows are sufficient to provide protections to market participants normally ascribed to competitive markets. Alternatively, does the competition between the large marketing firms provide better outcomes for sellers than would result with more firms operating at a less technically efficient scale? Otherwise, the imperfect competition characteristic of markets today may harm individual participants in ways that require government intervention to deal with market structure, conduct, and performance to various degrees.

Antitrust Laws Impacting Agricultural and Food Markets

Legal constraints have long existed to prohibit anticompetitive practices—such as purposely creating barriers to entry, colluding to fix prices and share markets, and dumping products below cost of production. Dumping concerns have been a source of contention in some sectors of the economy in recent years in the face of rapidly increasing imports into the United States, though for agriculture it is generally the other anticompetitive practices which are of most concern. The extent and vigor with which antitrust laws are enforced tends to be rather cyclical in the agricultural and food sector, perhaps driven by contemporaneous levels of consolidation activity and by political philosophy.

Federal antitrust laws, in addition to state laws, prohibit business practices which interfere with competition in order to create higher prices for products and services. The three major Federal antitrust laws are the Sherman Antitrust Act of 1890, the Clayton Act of 1914, and the Federal Trade Commission Act of 1914 (United States Department of Justice 2012).

The Sherman Antitrust Act outlaws contracts, combinations, and conspiracies that unreasonably restrain interstate and foreign trade. Agreements among competitors to fix prices, rig bids, and allocate customers are punishable as criminal felonies. The Act also prohibits monopolizing interstate commerce though anticompetitive conduct.

The Clayton Act is a civil statute—no criminal penalties involved—that prohibits mergers or acquisitions that are likely to lessen competition. It allows the US government to challenge mergers that are likely to increase consumer prices, and it requires persons considering a merger or acquisition above a certain size to notify both the DOJ Antitrust Division and the Federal Trade Commission.

The Federal Trade Commission Act prohibits unfair competition in interstate commerce, again without criminal penalties. It also created the Federal Trade Commission to police violations of the Act.

Certain segments of the agricultural and food industries have been at the heart of concerns about the balance of power favoring marketing firms over producers or impacting them because of downstream concentration. In 2010, the US Departments of Justice and Agriculture convened a first-ever jointly sponsored series of five workshops held around the country "to discuss competition and regulatory issues in the agriculture industry. The goals … were to promote dialogue among interested parties and foster learning with respect to the appropriate legal and economic analyses of these issues as well as to listen to and learn from parties with real-world experience in the agricultural sector" (Department of Justice 2010). They explored implications of consolidation in the farm input and processing sectors, as well as in food retailing. Increased coordination along the vertical supply chain was also of concern. The hearing specifically addressed seed markets, livestock markets, dairy markets, and food retailing (Balagtas 2010). The rest of this section elaborates on issues in these particular industry segments.

Seed Markets

A relatively recent phenomenon has been the emergence of the concentrated biotechnology seed industry, now dominated by a few large US and foreign firms. The industry has transformed under protection of the earlier 1970 Plant Variety Protection Act (PVPA), discussed later in this chapter, and the 1980 Supreme Court ruling in the Diamond vs. Chakrabarty case which authorized plant utility patents, providing much stronger intellectual property rights protection and allowed companies to profit from creating seeds carrying genetically modified traits. Phillips (Chap. 17) addresses issues involved in the applications of biotechnology to agriculture, including the seed industry.

Subsequent to the Chakrabarty ruling, private sector investment responded to the incentive and accelerated dramatically starting in the late 1980s (Fuglie et al. 2011, esp. Tables 1.5 and 2.3). There are two policy issues deserving attention in this vein. First does the right balance exist between current antitrust law and intellectual property (IP) law so that the benefits from added innovation outweigh the welfare losses from monopoly/monopsony pricing? The second is the antitrust issue of whether firms with current IP protection and market power are able to use it to deter entry and R&D spending by others to thereby extend their market power past the period of IP protection, or into other markets. If they can, this would reduce the benefits from IP protection and worsen the losses (MacDonald 2012).

Moschini (2010), drawing on his own and related published research, notes that the limited monopoly positions granted through patenting of seeds are critical to the willingness of the private sector to bring forth innovations such as have been witnessed in the seed industry in recent years. At the same time, it creates inherent conflicts with antitrust concerns about the resulting concentrated industry. Actions designed to acquire or exercise market power which reduces market efficiency are banned by antitrust law, while the IP protection is designed to encourage efficiency increasing innovation. Moschini concludes that the societal trade-offs are generally positive in this case—supporting Phillips position as stated below—but determining the line between exercise of IP-related exclusivity and antitrust-prohibited exclusionary actions is difficult.

The emergence of innovations in biotechnology in the early 1980s led to a number of buyouts and mergers in the seed industry. Research and development expenditures to create innovative, patentable genetic traits embodied in biotechnology seeds are an important cost component of seed production. Rapid commercial adoption of seeds containing biotechnology derived traits increased productivity especially in corn, soybeans, and cotton. Farmers are willing to pay more for these seeds which incorporate such traits as herbicide resistance allowing post-emergent spraying of the crop to kill weeds, and insect resistance to maintain yields without resorting to spraying. The cost savings and yield enhancing qualities of these patented seeds provide value to producers. These traits were initially only available individually in seeds, but subsequently have been "stacked," bundling two or more traits in a single seed.

The efficiencies these traits accord to producers and the licensing of the intellectual property incorporated into the seed provide opportunities for monopolistic price enhancement on the part of the companies producing the seeds. Determining whether concentration and consolidation in the seed industry have reached a point where anticompetitive behavior becomes a concern requires accurate data on market share of individual firms and the total market value of the industry (Phillips, Chap. 17). As the technology began to evolve, it triggered a number of high-profile acquisitions of seed firms to obtain control of embodied germplasm important to the development of varieties containing patentable seed traits. The high cost of research and development to create seeds with profitable traits further drove the consolidation. Horizontal and vertical mergers led to a concentrated and complex industry (Fernandez-Cornejo 2004). The current structure of the industry, in which many of the traditional seed industry firms disappeared as competitors, has implications not only for farmers but also for consumers.

In the case of biotechnology, restraining trade through licensing practices and conditions pertaining to intellectual property rights may impede technology transfer and dissemination (Phillips, Chap. 17). However, Phillips argues that oligopolistic or quasi-monopolistic firms may be able to achieve scale economies in production or marketing that would be difficult or impossible for smaller firms to accomplish. This could thus be desirable from the perspective of maintaining a market outcome similar to that of a competitive economy. Others have examined the seed industry for evidence of how the market structure may negatively impact market outcomes.

Given the oligopolistic structure of the biotechnology seed industry, several strategies can be employed by firms to lower their costs, extract economic benefits from farmers and seed dealers, and increase adoption of GM seeds (Stiegert et al. 2010). They summarized research findings from a number of studies conducted on the pricing, trait bundling, efficiency, and the potential effects of market power in the US biotechnology seed industry. The industry's extensive rights granted under US utility patent protection since the 1980s have largely prevented antitrust oversight, even in the face of high concentration. Biotechnology firms have simultaneously vertically integrated downstream into the seed industry while licensing patented traits to other seed companies which then sell GM seeds, thus competing against their licensees. Determining whether and how these licensing arrangements impact competition is an emerging issue (Stiegert et al. 2010).

Moschini provides evidence using USDA statistics that clearly show significant price increases for both biotechnology seeds and nonbiotechnology seeds between 1996, when GM seeds were first commercialized, and 2008. Higher commodity prices in 2008 made it profitable for the farmer to pay more for the biotechnology seed because the reduced weed or insect-related yield losses had much higher value. But Moschini found evidence that differences in the markup of biotech vs. nonbiotech seeds have increased substantially over time. This may, in part, be due to added traits contained in the seeds through stacking in corn, but for soybeans it pertains to seeds containing the same technology trait over the entire period. While farmers have continued to pay the higher prices, presumably due to increased returns from using the seeds, the licensing arrangements between patent holders and other companies utilizing those traits to market branded products have been the source of numerous lawsuits alleging anticompetitive practices. It is very difficult to sort out the economic effects involved (Moschini 2010).

Livestock Markets

The livestock industry, including poultry, has become much more highly concentrated in recent years. The consolidation has included some international companies taking ownership of, or forming joint ventures with, US companies. These acquisitions or joint ventures, domestic or foreign, have frequently involved competing entities and thus increased the 4-firm concentration ratio (CR4), the widely acknowledged indicator of potential anticompetitive market power. First poultry, and more recently hog production, have gone from small production units scattered over much of the United States to large scale, contract production. Contracts covered 90% of poultry production in 2008, and 68% of hog production (MacDonald and Korb 2011). Growers are basically providing labor and capital to raise the animals provided by the integrator, under contracts which specify various elements of performance for the growers and a mechanism for determining the final price paid to the grower. The capital investment commitment exposes growers to "holdup risks" from nonrenewal of contracts to fill expensive chicken production houses in rapid throughput cycles. This creates the potential for integrators to drive down payments to growers with the threat of being dropped from their producer stable.

The potential for chicken producers to go bankrupt because they are dropped, or even black-balled within the industry, due to conflict with the integrator is a significant fear. This can leave the grower unable to generate income to pay off the loans against the chicken houses they had to build to obtain the contract.

The threat of bankruptcy is less for pork producers who market under production contracts because they tend to have that enterprise as one part of a portfolio of agricultural business lines. On the other hand, poultry producers are likely to be relatively small operations, without much, if any, agricultural activity beyond poultry production (MacDonald and Korb 2011).

Beef Markets

Ward (2010) noted the long history of antitrust concerns in the livestock industry, leading to the passage of the Packers and Stockyards Act in 1921. It created the Packers and Stockyards Administration in the USDA, which is now part of the Grain Inspection Packers and Stockyards Administration (GIPSA). The industry has gone through a series of different dominant firms in periodic dynamic market structural changes, driven in part by evolving technologies. The major upheaval in the late 1960s transformed the industry away from its power base in Chicago and other Midwest cities where transportation access was the initial impetus for location.

The boxed beef revolution led by upstart Iowa Beef Processors (IBP), and now Tyson Foods, reduced the importance of transportation costs for finished product to major markets. This made it feasible to locate plants near the production points, shipping the greatly reduced bulk in the form of final products to destination markets rather than transporting live animals to centralized processing facilities near those markets. The resulting economies quickly created an entirely new set of actors which then came to dominate the market for livestock and beef. Boxed beef also ushered in a new system of pricing, going from pricing a carcass to a carcass "unit" consisting of seven boxes representing a carcass.

MacDonald and Ollinger (2005) pointed to reduced packer costs from scale economies of larger plants and technology as drivers of consolidation. But they also noted accompanying or parallel changes which supported this consolidation. These included significant reduction in wages as firms struggled to reduce costs because of intense pricing competition for beef products in the face of decreasing consumer demand, and increases in size of feeding operations in Colorado, Kansas, Nebraska, and Texas, enabling them to better supply large-scale plants built in those same four states. MacDonald and Ollinger reported that by 1992, three-fourths of all fed cattle—up from one-half in 1974—were produced in these states and the largest feedlots—over 16,000 head capacity—went from producing one-fourth of all fed cattle in 1974 to 57% in 2002. The industry has been highly concentrated since the 1980s, to an extent that anticompetitive behavior and adverse economic performance are a concern (Ward 2010). Sexton (2000) pointed out the rapid escalation in the CR4 which had occurred in key food industries, including beef packing where it had climbed from 30% in 1978 to 86% in 1994.

Ward (2010) reviewed numerous studies which have identified the need to lower operating costs through economies of processing plant size because there are thin margins in both purchasing costs of cattle and sales price of finished products. These plants must operate at high rates of capacity utilization to achieve the full advantage of those economies, leading to shifts in purchasing more cattle through alternative pricing systems rather than spot markets. Forward price contracts tied to futures market prices, negotiated cash prices, and formula-based prices tied to cash markets or to plant average costs are among the alternative marketing arrangements employed by the industry.

Hog and Pork Markets

Turning to the hog and pork industry, Lawrence (2010) reports that 5% of hogs are now sold on the spot market compared to 25% being owned and processed by packers and 70% traded through marketing contracts. The latter are tied to the thin spot markets, or to thin wholesale product markets, to set the price paid under the marketing contract. In 2009, 57% of all hogs were owned by the 130 largest producers having at least 50,000 head inventory, and the remaining 43% were produced by 63,000 farms (Lawrence 2010). Hogs are bought mostly on the basis of quality characteristics. Since the early 1990s, the use of production contracts has expanded for growers producing for an owner who absorbs the feed and hog market price risks, similar to the poultry industry. As in the case of beef production, technology has helped to lower production costs and allowed larger producers to capture economies of scale in hog production. Other factors, including transportation cost savings, dedicated feed mills, and marketing skills have enabled firms to obtain scale economies. Producers turn to production contracts to obtain higher prices and reduced price risk.

RTI International (2007) conducted a major analysis for GIPSA regarding the impacts of alternative marketing arrangements for hogs, including packer ownership and marketing contracts. They found that packers use a combination of marketing arrangements to pay lower market prices. However, they did not find support for market power being increased by use of alternative marketing arrangements; hence restrictions on their use may not reduce market power. Rather, RTI concluded, restrictions on these arrangements would likely harm both producers and consumers.

Wohlgenant's (2010) rigorous empirical study of the implications of banning alternative marketing arrangements reinforces the RTI findings. Significant losses would result for independent hog producers, packers, and consumers from banning packer-owned hogs. Contract producers and independent producers selling on the spot market would be made worse off under a policy to ban packer ownership. While pork processors do exhibit market power affecting spot market prices for live hogs, it cannot be attributed to the amount of animals controlled through alternative marketing arrangements (Zheng and Vukina 2009).

Poultry Markets

The poultry industry—primarily broilers, turkeys, and laying hens—is the poster child of contract production and structural change in agriculture. There is a high degree of vertical integration in the broiler industry with ownership by the contractor of the slaughter and processing plants, which ship branded consumer products. The contractor generally also owns hatcheries and feed mills, providing hatchery chicks to contract growers. The integrators also provide the feed and veterinary services to growers. The growers provide equipment, housing, and utilities, along with their own or hired labor to raise the integrator owned broilers (MacDonald 2008; MacDonald and Korb 2011).

The poultry sector is highly concentrated and the source of numerous anticompetitive concerns. Some of the principal issues involve the pricing system for contracts are interrelated:

- The tournament system of pitting producers against one another on a variable basis.
- Often the availability of only one processor within practical distance for trucking poultry.
- Holdup risk to growers because of contractor threats to withhold bird placement from their facility unless the grower accepts the contractor offer.
- The short terms of contracts—most frequently only one flock is covered—but the expensive housing required to meet contractor specifications when built or required by the contractor to be updated to receive additional flock placements.

Tournament pricing means that a grower's base payment is adjusted with premiums or deductions, compared to the average performance of other growers whose birds are delivered to the processor during the same week. Because of the design of tournament pricing contracts, the processors bear the production risks that are common to all growers—such as from weather or disease. The growers bear idiosyncratic risks—such as fire, or disease on their farm only—and have incentives to look after the birds more closely than a salaried employee would. Despite earlier interest in banning tournament pricing because it is controversial with some producers, neither federal nor state legislation to do so has made it beyond the strong industry opposition.

Vukina and Leegomonchai (2006a) looked at whether the existence of hold up concerns is justified. The substantial variation in facility requirements among contractors creates what is known as asset fixity because the facilities are much less valuable to the producer for use with another contractor having their own detailed facility requirements. Using data from a multistate survey, they found some evidence of a systematic relationship between the number of processors in a given area and the size of grower investment as measured by the number of chicken houses under contract. They also found that growers tend to invest less in terms of achieving maximum technical efficiency of production in situations where asset specificity requirements tend to be high, but only in markets where the number of integrators offering contracts is small. Their results suggest that a fall in grower compensation rates may occur, but only in monopsonistic environments. In addition to negative impacts on productive efficiency, nonmarket outcomes for rural communities in which those growers operate would be reduced. There was no evidence of such behavior under competitive or oligopsonistic market structures.

Separately, Vukina and Leegomonchai (2006b) examined two potential market failure situations—asymmetric bargaining power between integrators and contract growers, and imperfect information—that may justify regulation. They found only weak empirical evidence in available research that sufficient allocative inefficiencies result and thus may merit regulation. They conclude that the political acumen of the few contractors relative to the large and diverse set of growers is what leads to lack of regulatory response.

Dairy Markets

The dairy industry is another point of concern. A few very large bottlers and processors control significant market shares. In addition, large milk marketing cooperatives have evolved as countervailing strategy to market products on a more equal footing with purchasers of milk from the dairy farm. Meanwhile, the size of individual dairy herds has grown dramatically in recent years. Transportation efficiency has allowed dairy production on extremely large scale because feed can be transported cheaply to feed-deficit areas. At the same time, technology development has made possible transportation of fresh milk over long distances within 24 hours of production. This has allowed dairy production to expand into new geographic areas of the country, and the largest herd sizes are now located outside traditional dairy strongholds. Still, these large dairy operations are small relative to the large processors and handlers of milk to whom they must sell their production.

The number of dairy farms has contracted significantly, while total US milk production has increased as the average dairy herd size has increased along with annual production per cow (Gould 2010). Table 4.1 shows the magnitude of changes in various dairy farm characteristics.

Consolidation of dairy cooperatives—the major outlet for most dairy farm production—led the growth of large dairy farms (Knutson 1974). Cooperatives accounted for 80% of milk marketed in 1980, but close to 100% in some regions of the United States (Gould 2010). This gives them potential market power to be used on the part of the producer members.

The dairy processing industry which purchases the milk from cooperatives is also becoming increasingly concentrated. By 2008, the top 20 processors accounted for

Table 4.1 Structural change in US dairy farms

Characteristics	1987	2007	% Change
Number of dairy farms (thousand)	202	70	−65.3
Cows per dairy farm	50	131	162.0
Total milk production (billion lb)	142	186	31.0
Total cows (trillion)	10.3	9.16	−11.1
Production per cow (lb)	13,800	20,267	46.9

Sources: Gould (2010); National Agricultural Statistics Service, USDA two-thirds of the milk purchases from producers and the CR4 is well above 70% in a number of major markets (Gould 2010). These large processor buyers may offset any apparent market power of the large cooperatives in a number of instances.

The pricing of milk at the farm level is regulated by federal milk marketing orders (FMMO) which brings some transparency and addresses the balance between players in the industry. The extent to which this process achieves technical and allocative efficiency is an important question. The wholesale prices established in the Chicago Mercantile Exchange (CME) futures market for large cheddar cheese blocks influence prices received by farmers. This occurs through formula-based pricing and a complex classified pricing system reflecting price relationships between milk used for different manufactured and fluid products.

The dairy sector structure is totally intertwined with cooperatives and FMMO. For further discussion of dairy cooperatives, see Knutson and Cropp (Chap. 5); milk marketing orders are discussed in detail by Paggi and Nicholson (Chap. 6). The results of this marketing system in terms of prices to producers and consumers is what counts in evaluating whether the concentrated industry structure beyond the large dairy producers and plethora of smaller ones, all marketing primarily through cooperatives, is beneficial or in need of change. A number of economists have studied the industry for years and continue to do so. The results of their research provide a wide range of possible answers to these questions, based on findings in recent evaluations of cooperative market power and of the impacts of FMMO.

Chouinard et al. (2010b) argue that since FMMO raise the average price to consumers, they are as detrimental as a monopoly or oligopoly. By increasing the retail prices of fluid milk products and lowering the prices of some manufactured dairy products, they increase the average price of all dairy products and cost the average household $152.88 per year. This totals approximately $15.3 billion for the roughly 100 million US households that buy dairy products, and is an allocative efficiency loss from FMMO. Families with lower incomes or larger numbers of children consume more fluid milk than high-income households or childless couples, who tend to consume more of the higher-valued processed dairy products for which the prices are reduced under the FMMO, which are highly regressive (Chouinard et al. 2010a).

Cakir and Balagtas (2012) found that cooperatives are able to raise the price of milk purchased by fluid milk plants nearly 9% above the minimum price required to be paid under FMMO. They recognize that the market structure for milk is a sequence of oligopolistic markets, but pricing power is influenced by the combination of limited exemption from antitrust law granted cooperatives under the Capper-Volstead Act and by FMMO regulations which keep fluid milk processors from exercising market power in purchasing milk. Because derived demand for milk facing cooperatives is very inelastic, cooperatives can use their market power to obtain the markups of approximately 9% and transfer approximately $636 million from milk buyers to dairy farmers. Since retail demand for fluid milk is also quite inelastic, the resulting retail markup is less than 1%, and transfers approximately $73 million from final milk consumers to processor-retailers.

There has been some discussion of replacing the current formula pricing system for milk with a pricing system based on surveys of prices paid by manufacturing milk plants instead of tying pricing to thinly traded wholesale commodity prices (Gould 2010). However, there is currently mandatory reporting of dairy product prices by manufacturing milk plants, so there is some basis available for replacing the wholesale prices in formula pricing of milk. Further, in some local areas across the United States, a single dairy cooperative markets a very large percentage of milk under supply agreements negotiated with fluid milk bottlers that provide most milk to local retail food establishments. In short, pricing milk at the farm level is very complex, as discussed in depth by Paggi and Nicholson (Chap. 6).

Food Retailing

On the retailer end, growth in power of grocers relative to even large milk processors and other food processors/suppliers completes the imperfectly competitive, oligopsonistic/oligopolistic market structure in the food supply chain. It is widely recognized that retailers have become the dominant decision-maker in the global food supply chain in recent years. Kinsey (Chap. 2) briefly reviews the different eras of dominance of the food supply chain:

- Producers up though the 1930s.
- Food processors starting in the 1950s, creating national and international brands and employing production contracts to obtain the product characteristics they needed.
- Wholesalers evolved into the dominant force in the 1960s, as interstate highways allowed nationwide markets to emerge.
- Large regional supermarkets grew simultaneously with the wholesalers during the 1960s, and developed their own distribution centers to bypass the wholesalers.
- Supermarkets started to generate consumer data in the mid-1990s, and they have subsequently used it to develop a supply management system which gives them control over decisions affecting suppliers as far upstream as the farm level.

The driving force for the concentration which has taken place has been product differentiation to satisfy consumer demand for a broad range of food attributes. These attributes embody various elements of quality—including taste, convenience, brand, and product safety—as well as farm production practices, environmental impacts of production, and other nonmarket outcomes related to production and marketing of food (Caswell, Chap. 10; Sexton 2010). While the focus here is on the retail grocery side of the food market, the same types of factors have driven the emergence of powerful food service companies where close to one-half of consumers' food expenditures now occur (Kinsey, Chap. 2).

The extent to which this current food retailer structure impacts producers and consumers has been studied extensively. However, the analyses have generally ignored the food service side, which now comprises nearly half of food expenditures. This means that retailer concentration measures are partial, and perhaps misleading, because of that omission. Most researchers in earlier years focused on the impacts of market power from large food manufacturers and retailers, including the long running NC-117 regional research project (Marion 1986). In recent years, more attention has been focused on concentration throughout the supply chain between the producer and the consumer. The concern is about how concentration impacts producer prices received and the conditions determining pricing outcomes beginning at the farm, through the downstream firms and ultimately consumer retail prices.

Clearly, overall market performance must be judged relatively favorably in providing consumers with a wide variety of choices in foods which are safe and at the lowest cost of any country (Kinsey, Chap. 2). This includes access to an increasing array of imported products, convenience, and alternative nonmarket values incorporated into the foods purchased, such as production practice characteristics—organic, sustainable, fair trade, etc. The food retail sector is dynamic and provides significant nonmarket benefits to rural communities and safe and healthy food options to consumers. The questions relate more to whether there are areas where the outcomes could be improved in terms of market efficiency and nonmarket beneficial outcomes.

Generally, the studies have found various degrees of market power but resulting efficiency losses have been judged to be relatively small compared to the efficiency gains from coordinating market activities to provide the downstream characteristics so important to satisfying consumer expectations in the final products (Marion 1986; Sexton 2010; Saitone and Sexton 2012). Though supermarkets strive to differentiate themselves rather than to be perfectly competitive in their marketing, they charge prices somewhat below what they could if they were to fully exploit their market power in a given market (Richards and Pofahl 2010). While concentration as reflected in the CR4 ratio has increased steadily throughout the food supply chain for years, it has not been sufficiently tied to significant enough negative industry conduct or performance to warrant antitrust action. This is consistent with the apparent reasoning by the Department of Justice in other industries where concentration at very high levels has generally been accepted based on expected vigorous competition among the remaining larger sized firms to provide consumers with competitive prices and product choices. Some individual market divestitures have been required on occasion where overlapping businesses of the merging entities would reduce the competition too much in that local market. However, this has not often been the case for mergers or acquisitions within agricultural industries in recent years.

On the other hand, Sexton (2000, 2010) argues that the apparent modest market power within the supply chain can have significant redistributive impacts between producers and food manufacturers, and between the marketing firms and consumers. Any price decreases to farmers from the more powerful food manufacturers decrease the farm level output, and oligopolistic market power at the food manufacturing or retail levels raises consumer prices relative to a perfectly competitive outcome. These welfare losses outweigh the marketing efficiency gains and leave producers and consumers worse off overall. Further, any retail prices that do not fully adjust to changes in farm level prices also harm farmers' welfare by reducing average farm income and increasing its variability (Sexton 2010).

Table 4.2 Efficiency impacts of market structure and antitrust policy options, selected sectors

Market structure and antitrust policy options	Technical/ productive efficiency	Allocative efficiency	Dynamic efficiency	Nonmarket outcomes
Seed sector structure	+	+	+	−
Clarify IPR-antitrust boundaries	+	+	+	N
Beef sector structure	+	−	+	−
Hog/pork sector structure	+/−	+/−	+	−
Poultry sector structure	+/−	−/N	+	−
Strengthen P&S Act enforcement	+	+	N	+
Dairy sector structure	+/−	−	−	−
Report milk pay price	+	+	N	N
DOJ monitor dominant cooperative	+	+	N	N
Clarify DOJ/USDA roles	+	+	N	N
Retail sector structure	+/−	−	+/−	−
Enforce prohibitions in local markets	+	+	+	+

Impacts: + positive; – negative; N neutral or not applicable

Market Power and Market Efficiency

Table 4.2 summarizes the market efficiency and nonmarket impacts of the market structures discussed above, and of the antitrust policy options discussed later in this chapter, for selected sectors in the agricultural and food markets. The impact indicators reflect positive, negative, or neutral effects relative to perfectly competitive markets and current policies, respectively.

Based on research results, it is difficult to identify potential antitrust remedies to the rather weak market power most firms are able to exercise at the national level. Of course, the extent of market power appears to be much greater at the local or regional market level, especially in the livestock, dairy, and retailing sectors. The concerns at the national level include fear that potential remedies may cause greater loss of market efficiency and reduce incentives for innovation compared to tolerating the modest impacts of market power able to be successfully exercised by intermediary marketing firms.

In the seed industry, there is some level of technical or productive efficiency gained by producers from the increased returns per unit of seed input, but it is likely offset to a significant extent by the concentration levels which allow the seed companies to capture a larger share of the economic surplus than would otherwise be the case. There is an increase in allocative efficiency in this market, and the industry exhibits significant dynamic efficiency. Nonmarket benefits have decreased over the span of the biotechnology era, as rapid consolidation of the industry reduced the rural community impacts of local companies and their employees.

The beef industry consolidation has brought technical efficiency gains from lower costs of processing beef. It has caused decreases in allocative efficiency due to monopolistic competition in the concentrated markets, and possibly from environmental externalities from the larger confined animal feeding operations (CAFOs). However, the externalities may not be greater than for many smaller operations scattered more broadly across the landscape. Evidence shows that smaller operators in animal production may contribute to water quality problems, and lack financial and other resources to make environmental improvements (Abdalla 2006). This is largely a case-by-case empirical question with very difficult challenges to develop relevant comparisons. Dynamic efficiency has improved somewhat as the industry has adjusted more rapidly though supply chain modifications to deliver products more attuned to changing consumer preferences, though beef industry responses have been slower than in the pork and poultry sectors. Nonmarket beneficial outcomes have decreased as consolidation removed jobs from many communities, imposed significant public service demands on others where larger facilities located, and generally lowered industry wages to remain competitive with international producers.

For the hog and pork sector, most of the top firms in the beef industry also produce pork, though their relationships with growers are generally much more tightly vertically integrated which allows them to capture some additional production efficiencies from scale economies in transportation, feed manufacturing and marketing advantages because of more controllable live animal quality characteristics. As discussed earlier, producers have been able to partially offset the impacts of the monopolistic market structure at the packer level through production contracts to obtain somewhat higher prices and reduced price risk. These lower technical and allocative efficiencies faced by producers due to monopolistic pricing are at least partially offset by the dynamic efficiencies in the market, especially from the viewpoint of consumers who have enjoyed an abundant supply of convenient and low cost pork products. Nonmarket benefits are negative in terms of income levels and wage rates in rural communities, as in the beef case.

The existence of single buyer options for a number of poultry producers implies that growers receive lower compensation for their services than would otherwise be the case. This may lead to some growers investing less to achieve maximum technical efficiency of production in situations where the number of integrators offering contracts is small. Allocative inefficiencies exist because of the weak political effectiveness of the large and diverse set of growers versus the few contractors. However, only weak empirical evidence has been found by researchers that allocative inefficiencies are sufficient to justify stronger regulation, which is consistent with the general lack of significant regulatory response. Dynamic efficiency is evidenced by the expansion of the poultry market share vs. other meat products and the increasing variety of product offerings. Nonmarket impacts on rural communities have been negative, as in the beef and pork cases. In particular, there is ongoing concern about the environmental externalities from concentration of poultry producers near processing facilities and the corresponding amounts of manure which often exceed nearby land fertilization needs.

FMMO increase the average costs to households, and redistribute benefits among consumers of various types of dairy products—as they are designed to do. The combination of FMMO and dairy cooperatives operating together results in prices received by dairy farmers from first handler milk buyers which are higher than a competitive market would deliver. Inelastic demand at the retail level, even with a low retail markup margin, results in higher prices to consumers from processors/retailers than would occur in the absence of those entities. Thus, allocative efficiency losses occur in the dairy sector. However, there are technical efficiencies gained by producers and processors which will be partially shared with consumers though the market, depending on the price elasticity for various milk products. Dynamic efficiency has been reduced by the joint operation of the FMMO and dairy cooperatives resulting in less incentive to innovate to maintain profitability in the supply chain. Continued dairy herd consolidation has had negative nonmarket impacts on rural communities.

Retailers exercise various degrees of market power generating relatively small efficiency losses compared to the efficiency gains from coordinating market activities to satisfy consumer expectations. While supermarkets differentiate themselves in their marketing, they apparently do not fully exploit their market power in what are frequently highly concentrated regional markets. Perhaps it is to fend off potential competitors, or to avoid triggering antitrust regulatory intervention. The high CR4 ratios regionally and nationally have not fostered significant enough negative industry conduct or performance to warrant antitrust action. As in other industries where concentration at very high levels has generally been accepted by DOJ in recent years, vigorous competition among the remaining larger sized firms is expected to provide consumers with competitive prices and product choices.

However, even modest market power within the supply chain can have significant redistributive impacts between producers and food manufacturers, and between the marketing firms and consumers (Sexton 2000, 2010). Lower farm prices decrease farm level output, and food manufacturing and retail level oligopolistic market power increase consumer prices. These welfare losses overpower marketing efficiency gains to leave producers and consumers worse off overall. Technical efficiency is increased in the manufacturing and retail sectors but reduced at the farm level due to lower investment in productivity enhancing technology in the face of lower prices received. Allocative efficiency losses more than offset the overall technical efficiency gains. While dynamic efficiency is increased in the downstream portions of the supply chain, it is likely decreased at the farm level. Nonmarket outcomes are negative because lower incomes for farmers have impacts on the rural communities in which they reside.

Policies to Provide Countervailing Power and Regulate Trade Practices

A number of policies and programs facilitate farmers' ability to countervail marketing power of downstream marketing firms or provide a framework within which the agricultural supply chain operates. The extent to which the established programs are currently well suited to the marketing system which now exists deserves scrutiny. The programs have changed over time, but are seldom as dynamic as the industry itself. Regulations are normally the result of market failure to provide the level of outcome which society expects. As markets evolve, it takes some time to determine whether they are having a positive effect or are creating problems which need attention to have the marketing system satisfy the goals of market efficiency, allocating resources to the right kinds of activity to produce an outcome that approaches that of a perfectively competitive market.

At the first point of entry into the market beyond the farm gate, many producers are likely to face an oligopsonistic market structure wherein there are only two or a few potential buyers within a convenient distance. This is true even in many segments of the market in which contract sales are not the norm. USDA Economic Research Service estimates that approximately 40% of sales are now under contract, excluding production otherwise under a vertically integrated arrangement (MacDonald and Korb 2011). The weak position of producers relative to the contracting marketing firm in setting the terms of production and marketing contracts has been an ongoing source of friction within the marketing system for years. However, the size discrepancy between producer and supply chain firm is generally significant, even in the absence of contracting and vertical integration. This discrepancy is frequently the source of concerns and complaints from producers and/or the public.

A number of federal policies are in place to regulate the industry structure, proscribe its conduct or actions, and/or affect its performance or outcomes. The policies regulate trade practices; provide countervailing power for producers to offset some of the size implications and resulting oligopsonistic or oligopolistic marketing firms; or regulate industry structure, conduct, and performance. This chapter focuses primarily on programs at the level in the supply chain where local or regional production enters the processing and marketing system. Of necessity in today's marketing system, this must also consider how the retail end of the supply chain reaches back through the supply chain to impact producers' options for marketing their commodities or value-added products. This requires attention to market structure and trading practices having anticompetitive and consumer implications. The following sections address these policies and programs intended to provide countervailing power to producers and to regulate trade practices between first handlers and producers.

Countervailing Power

The Capper-Volstead Act and the Agricultural Fair Practices Act (AFPA) are intended to allow producers to work together to mitigate their relative size disadvantages in dealing with much larger marketing firms.

Capper-Volstead Act

The Capper-Volstead Act (C-V) thrust is to provide limited antitrust immunity to growers who band together in agricultural supply or marketing cooperatives under strict guidelines to jointly purchase inputs or to process and/or market their products.

This provides alternative sources or outlets in concentrated market segments where firms may exercise discriminatory or harmful behavior against individual producers. The existence of some strong agricultural cooperatives, while fewer in number than earlier, indicate the continuing need for cooperatives. However, Sexton (2000) believes that this C-V tool provided to farmers—as well as marketing orders under the Agricultural Marketing Agreement Act, discussed in detail by Paggi and Nicholson (Chap. 6)—to take collective action on their own behalf has not been used very effectively in recent years. Reasons might include processor's aversion to dealing with cooperatives, processor's ability to influence producer decisions, and rivalry among a sector's larger producers rather than interest in cooperating. Knutson and Cropp (Chap. 5) discuss in detail the role of cooperatives and the C-V policy, and evaluate their effectiveness in the context of the dairy industry. In dairy, the major issues are whether greater clarification of the roles of DOJ and USDA is needed, and whether Federal Milk Marketing Orders are needed any longer. However, the same conclusions about effectiveness of cooperatives generally apply to the fruit and vegetable, as well as to the livestock, sectors.

Agricultural Fair Practices Act

The AFPA of 1967 affects integrator–grower relations. Under this law, the right of producers to decide whether or not to join together in cooperative associations is protected from interference by processing or other marketing companies. The AFPA forbids discrimination against producers who band together to bargain over terms included in marketing contracts between individual growers and marketing firms and related unfair trade practices. Coercion, discrimination, and intimidation of any kind related to persuading a grower to not join an association are forbidden. However, the AFPA does not require that a company deal with growers who are members of an association, as long as this decision is not based on membership in the association. This legislated loophole makes it virtually impossible to sustain a claimed violation of the AFPA, since a company can relatively easily claim some other lawful reason for not dealing with an individual grower (Vukina and Leegomonchai 2006b). Knutson and Cropp (Chap. 5) also discuss the AFPA and evaluate its effectiveness.

Trade Practice Regulation

Table 4.3 summarizes the efficiency impacts of trade practice regulations described and evaluated in this section, and of the policy options for addressing issues identified with current policies and programs, discussed later in the chapter.

Federal programs which regulate the trading practices between buyers and sellers include the Commodity Futures Trading Commission Act (CFTC), FTC Bureau of Consumer Protection, Country of Origin Labeling (COOL), Federal Seed Act (FSA), Livestock Mandatory Reporting Act (LMRA), Packers and Stockyards

Table 4.3 Efficiency and nonmarket impacts of trade practice regulations and policy options

Trade practice regulations and policy options	Technical/ production efficiency	Allocative efficiency	Dynamic efficiency	Nonmarket outcomes
Commodity Futures Trading Commission	N	+	N	N
Improve futures-cash convergence	N	+	N	N
FTC Bureau of Consumer Protection	N	+	N	+
Obesity information/excise tax	N	+/–	N	+/–
Packers and Stockyards Act	–	–	N	–
Strengthen P&S Act enforcement	+	+	N	+
Perishable Agricultural Commodities Act	+	+	+	+
United States Warehouse Act	+	+	+	+
Federal Seed Act	+	+	+	+
Country of Origin Labeling	–	–	–	+/–
Reduce trade impacts	+	+	+	–
Egg Products Inspection Act	+	+	N	+
Better interagency cooperation	+	+	N	+
Livestock Mandatory Reporting Act	+	+	N	+
More data for research	N	+	N	N
Electronic trading live animals	N	+	N	N
General trade practice regulation	+	+	+	+
Streamline/eliminate overlap	+	+	+	N
Industry-government collaboration	+	+	+	N

Impacts: + positive; – negative; N neutral or not applicable

(P&S) Act, Perishable Agricultural Commodities Act (PACA), Plant Variety Protection Act (PVPA), Shell Egg Surveillance (SES), and United States Warehouse Act (USWA). These programs may have one or more regulatory provisions to address antitrust concerns, unfair trade practices, prompt and full pay from buyers to sellers, truth in labeling, and/or discriminatory practices. They are addressed here in alphabetical order.

Commodity Futures Trading Commission

The CFTC Act of 1974 established the CFTC as an independent agency to regulate commodity futures and option markets in the United States. It was quite clear that Congress wanted the agency to be price neutral, with no role in the price level of commodities (Knutson et al. 1983). Most futures trading in 1974 was of agricultural commodities, but now financial instruments comprise the dominant dollar volume of futures contracts traded, with worldwide implications. The CFTC mandate has been renewed and expanded over the years, most recently by the Dodd-Frank Wall Street Reform and Consumer Protection Act.

The CFTC assures the economic utility of the futures markets by encouraging their competitiveness and efficiency, protecting market participants against fraud, manipulation, and abusive trading practices, and by ensuring the financial integrity of the clearing process. CFTC oversight enables the futures markets to serve the important function of providing a means for price discovery and for offsetting price risk (Commodity Futures Trading Commission Act 2012).

To the extent that CFTC accomplishes its goals, it contributes to improved allocative efficiency in markets by assuring that traders are able to draw upon the best available information in establishing the prices generated on the futures exchanges. However, there have been some concerns about the impacts of futures markets in increased agricultural commodity price volatility observed in recent years, as well as in lack of convergence between the cash price and futures price at contract maturity.

During the economic downturn starting in 2007, commodity speculators found agricultural products to be relatively more attractive than during the preceding several years of booming demand for a variety of commodities used by the booming construction and manufacturing industries in the United States and worldwide. As more speculators started investing in agricultural commodity futures due in part to demand for the products driven by the growth of a large middle class in populous emerging markets, commodity indexes started incorporating agricultural commodities into their portfolios. There was concern that commodity index traders were a principle cause of increasing prices in some commodities contributing to price spikes in 2006–2008 and again in late 2010. However, academic studies have found no evidence of such impacts (Roberts, Chap. 15).

The lack of convergence between the cash price and futures price at contract maturity means that there is no guarantee that futures prices reflect cash market prices. This creates concern about the value of the futures market for price discovery and risk transfer. During the 2007–2008 rapid run up of commodity prices generally, the Chicago Board of Trade (CBOT) gap between the cash price and the higher futures contract price at maturity widened, at least temporarily. Calls for action to correct the problem, and numerous CFTC hearings on the matter led to some changes in requirements to address the problem. Roberts (Chap. 15) draws on academic research findings as he discusses the issue, policy options to remedy it, and the implications of those approaches. To the extent proposed remedies would improve futures and cash price convergence, they would increase allocative efficiency in the futures markets.

FTC Bureau of Consumer Protection

The FTC Bureau of Consumer Protection is charged with protection of consumers against unfair, deceptive, or fraudulent practices in the marketplace. The Bureau may conduct investigations, sue companies and people who violate the law, develop rules to protect consumers, and educate consumers and businesses about their rights and responsibilities. The Division of Advertising Practices protects consumers by enforcing the nation's truth-in-advertising laws, including claims for food, among other products and responsibilities. The Division of Enforcement litigates civil contempt and civil penalty actions to enforce all FTC federal court injunctions and administrative orders that address consumer protection issues, including food advertising claims (Federal Trade Commission 2012).

In the past several years, FTC has come under pressure by various consumer interest groups to take action related to food advertising and childhood obesity. The agency is most involved on the processed food side and advertising claims made about those foods. Some would like to see a complete ban on advertising nutritionally unhealthy foods, at least to children. The Division of Advertising Practices focuses on protecting consumers from unfair or deceptive advertising and marketing practices that raise health and safety concerns, as well as those that cause economic injury. One of its current priorities is monitoring and reporting on the advertising of food to children, including the impact of practices by food companies and the media on childhood obesity.

At the center of the interest in reducing marketing of "unhealthy products" are carbonated soft drinks or sugar-sweetened beverages. Frequently suggested approaches to reducing their consumption are to reduce advertising—especially that targeted to children—and/or implement excise taxes to raise prices and thereby discourage consumption. A number of academics have researched the potential impacts of excise taxes on consumption and ultimately obesity; and whether these taxes would be equitable or regressive. Runge (2010) summarizes findings from his own and others' work on the efficacy of taxing sugar-sweetened beverages. Large excise taxes are needed to have significant impact on reducing consumption, and the impacts are likely to be partially mitigated by consumers substituting noncaloric beverages—which raise other concerns—or perceived healthier products which are quite high in calories, but may have other consumer health benefits. Further, the complexity of the relationship between food consumption and obesity makes simplistic remedies—as in imposing a tax on a single part of the consumer diet—difficult to reconcile with the desired end result of reduced obesity. The importance of educating consumers at all levels about the importance and characteristics of a healthy diet and its contribution to maintaining a healthy weight would at least need to be a complementary part of an overall policy dealing with obesity. Duffy et al. (2012) cite evidence to support this same conclusion about taxes as an ineffective solution and the importance of education about the need of a healthy diet to deal with obesity.

While the academic study findings differ for a variety of reasons (Smith et al. 2010), the overall results suggest that excise taxes—only when passed on to consumers—would lower consumption of caloric sweetened beverages, but they would likely be regressive (Berning 2010). The important role of advertising in increasing consumption of caloric sweetened beverages raises the possibility of an FTC role in closely monitoring for problems of any increases in advertising to offset the impacts of excise taxes on such beverages or other foods, and or other strategies to reduce caloric intake. This role is obviously on their radar screen currently. It suggests that the FTC Bureau of Consumer Protection contributes to market allocative efficiency by increasing information available to consumers and provides nonmarket beneficial outcomes to consumers. However, the involvement of FTC, HHS, and USDA may create duplication of effort, which is unlikely to enhance allocative efficiency.

Packers and Stockyards Act

The P&S Act contains multiple regulatory provisions including banning antitrust and discriminatory trading practices most importantly, but also requiring prompt and full pay, rate regulation, and truth in lending. Title II of the P&S Act addresses antitrust issues, regulates unlawful practices in the meat packing, hog contracting, and live poultry dealers (including contractors); Title III regulates stockyards and livestock dealers and stockyards, which must register with GIPSA, are required to post rate schedules for services provided, and are prohibited from unreasonable and discriminatory behavior; Title IV provides that FTC powers of enforcement are available to the USDA Secretary for purposes of enforcing the Act (Packers and Stockyards Act 2012).

It is under the P&S Act that contracts in animal agriculture are regulated—broiler contracts were clearly included starting in 1987 (Vukina and Leegomonchai 2006b). Over the years, poultry growers have expressed numerous concerns about contract provisions, but processors have always rebutted claims about unfair or discriminatory behavior. Vukina and Leegomonchai reported that very few concrete regulatory actions had been taken, attributing the result to both relatively weak evidence of market failure that harms market efficiency and to integrator companies being relatively more efficient in exerting political influence than contract growers. The small number of contractors means that they can gain substantially from opposing regulation. But the large number of contract growers having various objectives makes their costs of overcoming the free-rider problem very high, since no one grower stands to obtain a substantial share of any increases in prices or profitability relative to all other growers who do not incur the costs or efforts to successfully seek regulation to cure problems. Therefore, regulation or its absence will continue to favor poultry integrator companies at the expense of contract growers.

The Food, Conservation, and Energy Act of 2008 mandated that the Secretary of Agriculture establish criteria to be used in determining whether unfair or discriminatory practices were undertaken by contractors, dealing with the most frequently heard complaints about poultry and swine contractors. In June 2010, GIPSA proposed regulations in accordance with this mandate and received numerous comments both in favor of and opposed to them. Industry commentary in various outlets publicly aired concerns and opposition, as well as the supportive arguments. Subsequently, in the 2012 Agricultural Appropriations Bill, Congress removed the proposed regulations by specifying that GIPSA could use funding only to implement provisions specifically authorized in the 2008 Farm Bill (Saitone and Sexton 2012). The USDA published the final GIPSA rule, on December 9, 2011 (GIPSA 2011), dropping many of the features favored by growers, while keeping some that were opposed by processors. It leaves in place the ongoing potential for conflict in the contractor–producer relationships, and will likely lead to future proposed legislation, most likely in the Farm Bill.

Relatively weak actions have been taken under the P&S Act over the years to address unfair or discriminatory actions by firms which focus on technical efficiency. This allows the firms to capture a greater share of the gains derived from new technology. Allocative efficiency is reduced due to imperfect knowledge about market conditions relative to the highly concentrated firms who are able to exercise more market power than if threatened with more vigorous pursuit of unfair and discriminatory actions. Dynamic efficiency exists in the industries to which P&S Act applies and is not hampered nor helped by the vigor of P&S Act enforcement. Nonmarket outcomes are likely decreased in terms of impacts on rural communities from lower incomes for producers residing in the communities, increases in social issues as more workers are attracted to communities where processors are located, and lower wages offered in the industry relative to earlier periods.

Perishable Agricultural Commodities Act

The PACA promotes fair trade in the fresh and frozen fruit and vegetable industry by establishing and enforcing a code of fair business practices and by helping companies resolve business disputes (Perishable Agricultural Commodities Act 1930). PACA makes it unlawful for firms engaged in interstate or foreign commerce to use discriminatory or deceptive practices; reject or fail to deliver product; discard or destroy product; make false statements about transactions; misrepresent product; distort information about state or federal grades; and substitute products after grading or quality certification. It importantly addresses the need for producers to be paid promptly and fully for the perishable products delivered to marketing firms. This is a critical concern due to the huge investment producers have in the crop before delivery and concern that in bad markets, buyers—often located at significant distances from producers—could arbitrarily reject or dispute shipments or go bankrupt, leaving the producer in a weak position to obtain the agreed upon payment for the crop already delivered.

Under PACA, USDA's Agricultural Marketing Service (AMS) works in partnership with the fruit and vegetable industry to facilitate fair trade practices through education, mediation, arbitration, licensing, and enforcement. The AMS PACA Branch provides many services to the industry in response to companies requesting assistance in, for example, interpretation of inspection certificates, advice on contract disputes, and obtaining bankruptcy payments (Perishable Agricultural Commodities Act 1930). There is a well-understood system of dealing with problems that arise and wherein operating licenses are put at risk and an enhanced standing created in bankruptcy filings to maximize financial recoveries by producers. The original legislation resulted from industry requests and has been amended through the periodic Farm Bills to take account of changing industry operations. The volume of AMS activity in helping to resolve industry problems indicates continuing need for and relevance of the program. Apparently, the mechanisms in place to enforce the various requirements under PACA are sufficient to handle the vast majority of issues which arise in the areas under its charge. It is interesting to note that the NAFTA Dispute Resolution Corp. was created to deal somewhat similarly with commercial produce disputes across US/Canada/Mexico borders. Further, industry in Canada is working hard to get something much more akin to PACA established in Canada. PACA increases technical, allocative, and dynamic efficiency. It also enhances nonmarket beneficial outcomes by assuring viability of local businesses and incomes of the producer residents of rural communities.

The United States Warehouse Act

The USWA, 2001, amended numerous times to accommodate evolving agricultural product marketing practices following its initial establishment in 1916, authorizes the Secretary of Agriculture to license warehouse operators who store agricultural products. Warehouse operators that apply for this voluntary program must meet the standards established by USDA within the USWA and its regulations, and observe the rules for licensing and pay associated user fees. The person applying for the license must file a bond with the Secretary, or provide such other financial assurance as the Secretary determines appropriate, to secure the person's performance of the activities so licensed or approved (USWA 2012).

The USWA prescribes measures which the licensed warehouse must abide by to protect the interests of anyone storing the commodity and to issue a receipt testifying to the amount and characteristics of the stored commodity. Bonding requirements assure that there will be money available to pay the value due the individual or entity storing the commodity, including when a warehouse firm goes bankrupt, in which case secured creditors would have a claim on the value of inventories of the bankrupt warehouse, potentially leaving the producer with the prospect of receiving pennies on the dollar value of their stored commodity. Any person injured by the breach of any obligation arising under this Act may sue with respect to the bond or other financial assurance in a district court of the United States to recover the damages sustained as a result of the breach.

By facilitating the functioning of the market through providing security for market storage, the USWA improves the technical or productive efficiency of the food and agricultural marketing system. By updating this nearly 100-year-old program periodically, it has evolved to effectively serve today's marketing system needs at little cost to the public. User fees are paid by the warehouse firms that value its accreditation of their soundness to do business, when producers face potential devastating losses in the event of failure to fulfill promised services. The USWA facilitates allocative and dynamic efficiency in the market by adjusting to evolving marketing system needs. It provides nonmarket beneficial outcomes to rural communities by assuring the soundness of the warehouse businesses and protecting producer incomes.

Federal Seed Act

The FSA regulates the interstate shipment of agricultural and vegetable seeds. It requires seed shipped in interstate commerce to be labeled truthfully to allow seed buyers to make informed choices. The FSA helps promote uniformity among state laws and fair competition within the seed trade (Federal Seed Act 2012). It protects producers from being sold inferior quality seeds for premium prices which could result in lower yields, lesser output quality, lack of disease resistance or other properties, and lead to higher costs of production (Knutson et al. 1983). In this way, the FSA enhances technical efficiency in the seed markets.

The FSA program operates on appropriated funds in a 50/50 partnership with states. Fines imposed for violations of FSA regulations are generally sufficient deterrent and tend to involve relatively small shipments, but there are a few habitual offenders. The main issue involves trueness to variety. Other ancillary services to help the seed industry operate more efficiently are also available, increasingly on a user fee basis. Certification of seed for export shipment is carried out on a user fee basis, as is process verification for biotechnology seed mixes containing refuge seed to assure that the required amount of non-biotech seed is included. Providing this information to help the seed market function more smoothly enhances allocative efficiency in the seed industry and increases technical efficiency by assuring that the farmer is receiving the appropriate technology which is unobservable to the producer at the time of transaction.

Keeping up with the technology for identifying biotechnology traits in seeds for verification purposes is one of the biggest challenges for the program currently. A significant issue for the future is the possibility that states will cut back programs on which they collaborate with USDA. The seed certification program relies heavily on that cooperation.

AMS also administers three programs for the purpose of providing accreditation to field inspectors, seed samplers, and seed testing laboratories. These are process verification programs to assure that the individual or organization is accredited to provide uniformity of procedures and methodology in testing seed, thereby enhancing commerce in seed markets both domestically and globally. This increases the technical efficiency of the seed markets.

Country of Origin Labeling

A number of producers believe they are being unfairly harmed by imports of agricultural products into the United States. They further believe that a significant portion of the US consumers will choose to purchase US food products if provided information on the product source.

Producers successfully lobbied for legislation requiring labeling. The COOL program was initially authorized in the 2002 Farm Bill, which amended the Agricultural Marketing Act of 1946 to add COOL provisions. Mandatory labeling was implemented for fish and shell fish in 2005, but controversy within the other segments of agriculture affected led to delays in the proposed implementation of COOL and changes were made to it in several steps. Though there was considerable uncertainty about costs to the supply chain to implement mandatory COOL, consumer interest in using the information to be provided, and the impact on and reactions by trading partners (McFadden 2008), it was finalized in the 2008 Farm Bill. COOL requires that certain retailers inform their customers of the origin of specified products being purchased. It covers muscle cuts of livestock and poultry, but not processed products thereof; fresh and frozen fruits, vegetables, and nuts; farm-raised and wild-caught fish and shellfish; and peanuts (Preston and Kin 2008).

Within the beef industry there was contention among producers about the need for, merits of, and costs associated with COOL (Peel 2008). It appears that COOL will benefit the broiler and turkey industries while imposing higher costs on pork and beef. Meyer (2008) discusses the differences in costs expected for the beef and pork industries in implementing COOL and explains why the poultry industry asked to be included in the legislation which originally did not include them—the primarily domestic market focus and integrated supply chains in the poultry industry means they face virtually no costs of implementation but receive any benefits if consumers do turn out to embrace COOL. The fresh fruit and vegetable industry faces some unique features of COOL, due to the prevalence of imports which do not directly compete with domestic supplies during some seasons (VanSickel 2008). The final legislation in the 2008 Farm Bill kept potential costs within reason for the fruit and vegetable industry. Supply chain intermediaries who handle products from several origins and ship mixed products to retailers likely face the greatest burden.

Economic studies have provided a range of findings supporting and questioning the hypothesis that consumers prefer and are willing to pay more for US produced foods than the costs of implementing mandatory COOL. Lusk (Chap. 13) looks at COOL from the perspective of consumers and whether producer benefits outweigh their costs for the program. He concludes the COOL is ineffective on economic efficiency grounds. McFadden (Chap. 16) briefly notes that COOL might be seen as complementary to local foods programs. Krissoff et al. (2004) concluded that the infrequency of voluntarily labeling food as US produced indicates suppliers believe there is little consumer interest. If that is correct, COOL is not likely to be of great benefit to consumers or producers, creating a burden on both and resulting in higher prices to consumers and lower returns to producers (VanSickel 2008). Another pre-implementation study found that COOL would result in decreases in production, consumption, and trade, based on AMS projected costs of implementation for the affected industries and assuming no consumer demand premium for labeled products (Jones et al. 2009). They also did the only possible ex post analysis for COOL as actually implemented—on the fish and shellfish industry implemented in 2005, finding that there had been no structural changes in imports and exports.

However, other research has found that some consumers prefer, and are willing to pay more for, domestic rather than imported products because they believe the domestic products to be of higher quality, provide better food safety, or help the US industry (e.g., Onazaka and McFadden 2011). Saak (2011) found that even without accounting for the direct costs of implementing mandatory COOL, the regulations may decrease social welfare if most consumers view products from different countries as close substitutes while wholesale prices in different countries are volatile and uncorrelated. Further, the exporting countries' history of food safety problems, production methods, and growing seasons also can impact social welfare. Lusk and Briggeman (2009) found that origin ranked last in average importance to consumers, in contrast to some previous studies related to beef which found origin of production to be very important to consumers. They allowed consumers to choose freely among a set of food traits, while in other studies the measured preferences for origin may have been confounded by beliefs about differences in food safety, tradition, and fairness.

While these studies found that COOL could either help or harm producers and may or may not benefit consumers, the impact on other countries may be less ambiguous—which many believe is the main purpose of COOL. Canada lodged a World Trade Organization (WTO) complaint following implementation of COOL, because of adverse impacts on their producer's ability to market livestock in the United States. Canada claimed a $400 million annual loss to their cattle industry due to lower prices for Canadian cattle, increased cost of transporting them greater distances, and processing on fewer days to accommodate labeling requirement in US packing plants (McFadden 2008). On November 18, 2011, the WTO ruled "in support of complaints by Canada and Mexico that US COOL violates global trade rules and unjustly harms agricultural commerce" (Ag Web 2011). The US Trade Representative subsequently announced intent to challenge the ruling (Delta Farm Press 2012).

COOL has reduced market technical, allocative, and dynamic efficiency to the degree it has raised costs, while providing a limited degree of nonmarket beneficial outcomes to selected producers and consumers with particular interests. While the unit costs involved may be quite small, the cumulative industry amounts may be substantial. It is too early to provide empirical analyses of the impacts of the mandatory COOL, as implemented. The future of this program will likely continue to be controversial.

Egg Products Inspection Act

Most eggs are bought and sold as shell eggs—still in the shell. Shell eggs that are undesirable for human consumption are called restricted eggs. The US Standards for shell eggs limit the number of restricted eggs that are permitted in consumer channels, and there are mandatory procedures for the disposition of restricted eggs. The Egg Products Inspection Act (EPIA), passed by Congress in 1970, sets forth requirements to ensure that eggs and egg products are wholesome, otherwise not adulterated, and properly labeled and packaged to protect the health and welfare of consumers of these products (AMS 2012a). The EPIA provides for inspections of shell egg handlers to control the disposition of certain types of loss and under-grade eggs. It also mandates that shell eggs sold to consumers contain no more restricted eggs than permitted in US Consumer Grade B and that restricted eggs be disposed of properly.

USDA AMS is responsible for shell egg surveillance inspections mandated by the EPIA. The SES Program conducts inspections to enhance fair competition and facilitate marketing of consumer-grade eggs by assuring the proper disposition of "restricted eggs"—checked (cracked) and dirty eggs, leaking eggs, incubator rejects, and loss and inedible eggs. This program increases productive and allocative efficiency by assuring proper handling of consumer-grade reject eggs, essentially providing information to the marketing system that only quality eggs are offered for sale—information not otherwise available. And it enhances nonmarket outcomes related to food safety and consumer health.

Shell egg handlers include firms with over 3,000 layers that grade and pack their own eggs, firms that grade and pack eggs from production sources other than their own (grading station), and firms that are hatcheries. They are required to register with USDA. At least four times each year, a state or Federal shell egg surveillance inspector visits each registered packing plant to verify that shell eggs packed for consumer use are in compliance, that restricted eggs are being disposed of properly, and that adequate records are being maintained. Hatcheries are visited at least once annually for the same purposes.

Cracked and dirty eggs may be shipped to an official egg products plant for processing and pasteurization. Otherwise, restricted eggs must be either destroyed or diverted for use as other than human food.

The EPIA also requires that eggs imported into the United States be inspected at the point of entry to determine that they meet the same restricted egg tolerances established for domestic producers. There is no charge to the importer for this inspection. USDA Food Safety and Inspection Service (FSIS) is responsible for the safety of imported eggs for further processing, and for assuring that imported shell eggs destined for the retail market are transported under refrigerated conditions. It also verifies that shell eggs packed for the consumer are labeled "Keep Refrigerated," as well as stored and transported under refrigeration at no greater than 45 °F. FSIS also leads the USDA effort to educate consumers about the safe handling of eggs (USDA Food Safety and Inspection Service 2012).

USDA FSIS and the FDA share authority for egg safety and are working together toward solving the problem of *Salmonella* Enteritidis (SE) in eggs. The FDA Egg Safety Rule, effective since July 2010, applies to egg producers with 50,000 or more laying hens. The egg producers must register with FDA and are required to implement safety standards to control risks associated with pests, rodents, and other hazards; to purchase chicks and hens from suppliers who control for *Salmonella* in their flocks; and to satisfy testing, cleaning, and refrigeration provisions to prevent. They are required to maintain written plans summarizing their safety practices (USDA Food Safety and Inspection Service 2012). This program is intended to head off potential government failure as appears to have occurred in the egg market when two Iowa farms of a major national egg producer were responsible for 1,900 people falling ill during an SE outbreak that started in July 2010 and was later linked to contaminated eggs which led to voluntarily recall of 550 million eggs nationwide. Inspectors found samples of *Salmonella* at both Iowa farms along with dead chickens, insects, rodents, towers of manure, and other filthy conditions (US Food and Drug Administration 2011; AP Newsbreak 2011). The incident raises a question of whether USDA inspectors should have reported unsanitary conditions to FDA, a possible government failure. In this case, better government interagency collaboration could have increased market technical and allocative efficiency.

These programs together provide nonmarket beneficial outcomes by assuring food safety in the consumer-grade egg market.

Livestock Mandatory Reporting Act

In 2001, USDA's Agricultural Marketing Service (AMS) implemented the LMRA of 1999. The purpose of the 1999 Act was to establish an information program on marketing of cattle, swine, lambs, and livestock products to provide information readily understood by producers, improve the precision of USDA price and quantity reporting, and encourage market competition. The assumption of those pushing for the legislation was that greater information transparency would help producers/feeders obtain better prices from highly concentrated packing firms.

When the statutory authority for the program lapsed on September 30, 2005, AMS sought continued voluntary reporting by all packers required to report under the 1999 Act. Sufficient voluntary cooperation was obtained to allow USDA to continue most reports. In October 2006, Congress enacted legislation to reauthorize the 1999 Act through September 30, 2010, and to amend the swine reporting requirements of the 1999 Act. It separated the reporting requirements for sows and boars from barrows and gilts, among other changes. In 2008, the USDA reestablished and revised the LMRA program, incorporating the swine reporting changes, as well as others to enhance the program's overall effectiveness and efficiency based on AMS's experience in administering it. This mandatory information reporting program is intended to facilitate open, transparent price discovery and provide all market participants, both large and small, with comparable levels of market information for cattle, swine, sheep, beef, and lamb meat (AMS 2012b). It thus should increase allocative efficiency in the livestock markets, as they become increasingly thin in terms of total volume sold on them relative to total livestock slaughtered.

But there are questions about how effective the LMRA is in helping livestock producers/feeders to obtain better prices from packing highly concentrated packing firms. Data aggregated nationally does not provide useful information about alternative outlets with different prices for producers so that they may obtain higher prices by switching buyers (Wachenheim and DeVuyst 2001). But making data available at less aggregated levels could inadvertently violate firm confidentiality, or at least allow packers to use the information in oligopsonistic coordination to the detriment of producers (Azzam 2003). Azzam argues that LMRA forces packers to pool information at negligible marginal cost of reporting average prices and quantities, thus reduces their marginal cost of uncertainty for all packers and thereby spurs more competition in livestock procurement. The result is increased demand for livestock, keeping more producers viable and slowing the pace of exit from the industry. The LMRA enhances both technical and allocative efficiency by providing better market information to producers and enhancing competition among packing plants. It also enhances nonmarket benefits to rural communities through higher incomes of its producer citizens.

Mandatory price reporting means that no transaction goes unreported, except for a few exclusions of information that would distort general market conditions or price levels *Salmonella* Enteritidis. The public appears to view price and sales information reported from mandatory collection of data to be unbiased and representative

(Parcell and Tonsor, Chap. 14). Koontz and Ward (2011) found that research supports the view that mandatory price reporting has increased transparency and information at the national level, and across cash and noncash market choices. But they also found that it has reduced price information in regional markets. The Koontz and Ward findings, supported by the Parcell and Tonsor observations, imply that increased transparency from mandatory reporting should offset some of the concerns about thin markets driving prices for the large volume of transactions tied to certain market data. This would be the case at least at the national or some regional levels, depending on mandatory reporting coverage, and hence the LMRA improves allocative efficiency in those markets.

Policy Options to Improve Market Performance

There are several options which might improve market performance and enhance nonmarket beneficial outcomes in agricultural and food markets where negative structural impacts exist currently.

Policy Options to Increase Industry Competition

There are some options for policy changes to mitigate the potential impacts of the market power imbalances existing in today's market structures. Table 4.2 summarizes the marketing efficiency impacts and nonmarket beneficial outcomes of antitrust policy options, as discussed in this section, to address problem areas.

Seed Industry

One policy option could be to clarify the boundaries between conflicting US policies to protect IPR-related exclusivity and antitrust-prohibited exclusionary actions in the seed industry. Biotechnology firms vertically integrate downstream into the seed industry, while simultaneously licensing patented traits to other seed companies which in turn sell GM seeds. There is concern that these biotechnology firms through their seed sales are unfairly competing against their licensees. For example, if a biotechnology firm license prevents the trait acquiring company from buying traits elsewhere, this could deter entry and innovation by others developing competing traits. Other possible restrictions in the licensing agreement could have similar impacts. The question then is whether there are offsetting efficiency benefits (MacDonald 2012) in this emerging issue as identified by Stiegert et al. (2010). If Congressional or DOJ/USDA initiative successfully clarified the boundaries involved and monitored the outcomes of these kinds of arrangements, it would likely improve productive, allocative, and dynamic market efficiencies.

Livestock Industry

It would be possible to increase the vigor of enforcement of existing policies to rebalance the influence of processors and growers in poultry contracting to spur growers to be willing to invest more to achieve maximum technical efficiency of farm level production. This may involve identifying and regulating those elements of poultry contracts that extend processor monopsony power without creating efficiency gains. This is especially relevant in situations where the number of integrators offering contracts is very small or is a local monopsonistic firm. Limited allocative inefficiencies exist because of the superior political effectiveness of the few poultry contractors relative to the large and diverse set of growers, as reflected in the general lack of significant regulatory response. Any improvements in the regulatory requirements to redress this imbalance would improve both productive and allocative efficiencies.

Dairy Industry

An option is to replace the current formula pricing system for milk with a pricing system based on the mandatorily reported prices paid by manufacturing milk plants instead of based on thinly traded wholesale commodity prices. There is currently mandatory reporting of dairy product prices, from which pay prices for milk are derived. Direct reporting of pay prices could increase productive efficiency—as farmers received more accurate price signals—and allocative efficiency in a more competitive market environment.

Another option could be for the DOJ to monitor dominant cooperatives for anticompetitive practices that foreclose markets for raw milk to independent producers and smaller cooperatives dealing with concentrated processors/retailers. Preventive actions to head off potential anticompetitive outcomes would increase productive and allocative efficiencies in the market, reducing the impacts of market power.

An additional policy option involves clarifying the role of the DOJ vs. USDA in enforcing antitrust provisions related to the limited exemption of cooperatives under the Capper-Volstead Act. Knutson and Cropp (Chap. 5) note that DOJ has occasionally found anticompetitive behavior on the part of marketing cooperatives. The implication is that DOJ may be restrained by its lack of clear jurisdiction regarding cooperative anticompetitive activities. USDA has never found undue price enhancement (Chap. 5). In the case of milk, the cooperatives' combined utilization of the minimum pricing provisions of FMMOs—which prevent fluid milk plants from exercising market power against the suppliers—and their dominant position in influencing FMMOs and other dairy policies lead to substantial markups for the cooperatives (Cakir and Balagtas 2012). This option would have the same impacts as the DOJ more closely monitoring dominant cooperatives for anticompetitive behavior.

A related policy option could be dropping FMMO completely. However, given the close relationship between large dairy cooperatives and the FMMO, this appears to be an unlikely scenario in the near term. See Paggi and Nicholson for further discussion of options for addressing issues in marketing orders (Chap. 6).

Food Retailing

An option would be to evaluate the potential benefits of enforcing antitrust prohibitions at the local/smaller regional market levels in the food retailing sector, rather than primarily at the national/large regional levels. National CR4 ratios, reflecting the percent of market controlled by the top four firms, understate the potential for discriminatory and anticompetitive behavior in the generally more concentrated local/regional markets. Whether economists have paid enough attention to potential subnational policy options is unclear, but work in this area may offer opportunities for contributions to better inform antitrust scrutiny of market impacts. This could lead to greater technical and allocative efficiencies in the retail markets and back through the food supply chains.

Policy Options to Improve Trade Practices

Most trade practice regulations appear to be able to adjust reasonably well to market evolution and remain relevant to today's marketing system. Table 4.3 summarizes impacts of options for addressing a few potential policy changes as discussed below.

Packers and Stockyards Act

One policy option would be to strengthen P&S Act enforcement ability to address unfair or discriminatory actions by buyers and provide better access to information about market conditions in contracting situations. Congressional action would be required. It would improve technical efficiency by increasing prices received by producers, thereby providing an incentive for more investment in new technologies. It would improve allocative efficiency to the extent better knowledge about market conditions is available to growers in dealing with the more powerful contractors. Dynamic efficiency exists in the industries to which the P&S Act applies and would not be significantly impacted by the vigor of P&S Act enforcement. Nonmarket outcomes could improve to the extent that better information resulted in higher incomes for producers residing in rural communities.

Country of Origin Labeling

A policy option would be to reevaluate the content of the COOL regulations and how they impact trading partners, as well as domestic demand for US grown products relative to imported. The recent WTO ruling against the US COOL program, in response to complaints from NAFTA partners, makes this an urgent matter to determine the future of COOL. It is perhaps too soon to assess impacts based on the limited time since implementation of COOL in early 2009. However, it is important for researchers to provide policymakers with information about COOL benefits to US producers and consumers relative to the costs of providing the information and monitoring compliance. Reducing COOL's impact on trading partners would increase market technical, allocative, and dynamic efficiency to the degree it reduces costs to trading partners and consumers, but reduce nonmarket benefits to selected producers and consumers with particular interests.

Livestock Mandatory Reporting Act

Given the confidentiality constraints that exist, the regional or national level data currently released publicly provide little directly actionable information useful to growers. Perhaps researchers working in collaboration with USDA personnel would be able to find workable alternatives to better accomplish this goal of providing producers with more disaggregated and actionable information which would exist in more competitive market structures. See Parcell and Tonsor (Chap. 14) for further discussion of this confidentiality issue and a different perspective on how certain steps to make more data available to allow better analysis could lead to policy changes which would benefit the market. If accomplished, it would improve allocative efficiency, relative to what the current system has already accomplished.

A more likely policy option could be to facilitate and promote electronic trading in live animals. This could provide smaller ranchers with a workable alternative. If successfully implemented, it would have the same allocative efficiency implications as the disaggregated data provision option.

Concluding Comments

Clearly the United States enjoys one of the most economically efficient and dynamic food and agricultural production and marketing systems in the world. It has changed dramatically in structure at the producer, marketing intermediary, and retail levels over the past half century. It provides the food, feed, fuel, and fiber needs for the United States, as well as contributing a significant share of exports in a number of commodities. Generally, the supply chain food system works relatively smoothly within an economic and regulatory framework which operates at high levels of technical, allocative, and dynamic market efficiency. It also produces substantial levels of nonmarket benefits for lower income consumers, rural communities, and those with particular preferences which are not directly met through traditional market channels.

There are several reasons that government intervention is needed to maintain a well-functioning marketing system. One is to assure that the large entities which dominate many segments of the supply chain today do not exercise market power through unfair and discriminatory practices to the detriment of producers and consumers. Another is to facilitate countervailing power to allow producers to work together to mitigate their relative size disadvantages in dealing with much larger marketing firms. A third is to provide a framework within which the agricultural supply chain operates more efficiently.

The earlier sections of this chapter briefly reviewed the roles of market structure, integration, and contracting in the food and agricultural sector, then looked in more detail at the four industry segments—seed, livestock, dairy, and retail—where there are the greatest concerns about the balance of power favoring marketing firms over producers or impacting them because of downstream firm concentration. The implications of market power for supply chain efficiency in those segments were explored. The subsequent section reviewed existing US policies to provide countervailing power and regulate trade practices, and their impacts on market efficiency and in providing nonmarket benefits to rural communities and producers or consumers with particular interests.

In today's economic situation, the temptation is to eliminate regulations in an effort to disencumber market participants and reduce government expenditures. There are a number of policies and programs identified in this and other chapters which are apparently overlapping or duplicative. Certainly, to the extent that policies and programs are overlapping or duplicative, they should be reviewed and either streamlined or eliminated to the extent which they serve a minimal positive purpose relative to their costs. However, those policies and regulations which play a facilitative role critical to efficient functioning of the marketplace are essential to maintain.

It will take the food and agricultural industry and government working together to provide US producers opportunities to continue to be efficient, competitive suppliers of food, feed, fuel, and fiber to the domestic and export markets. Producers, consumers, marketing firms, rural communities, and the US and world economies can all benefit from these collaborative efforts.

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Chapter 5
Managing the Supply Chain Through Cooperatives and Contract Integration

Ronald D. Knutson and Robert A. Cropp

Abstract Since the enactment of the Capper–Volstead Act in 1914, marketing cooperatives have been policy dependent. As contract agriculture has become more prevalent, cooperatives have been forced to adopt a supply chain management mode in order to be competitive. Increased demands for equity capital have forced cooperatives to seek means of attracting investor capital. State governments have responded by creating the legal basis for the formation of new generation cooperatives. These new institutional structures are controversial in the eyes of those who believe cooperatives should adhere to their traditional cooperatives principals. During this period of adjustment in the structure of agriculture, USDA and the federal government have failed in supporting bargaining cooperatives, despite increased contract integration. States have stepped in to provide more research and technical assistance support to cooperatives in the face of declining USDA and federal support. Policies supporting cooperatives are based on the ability of cooperatives to enhance allocative and dynamic efficiency, while providing nonmarket social justice benefits to farmers and consumers.

Introduction

Dating back to the nineteenth century, U.S. governments, state and federal, have had laws, policies, and programs that have supported or regulated farmer cooperatives. Harris et al. (1983) provide excellent background reading for a detailed

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chronicle and analysis of the developments that led to several of the key cooperative policies. Even though agricultural production, markets, technologies, and consumer demands have changed monumentally, several of these laws have not been significantly altered since they were enacted. That does not mean that these laws, policies, and programs are obsolete because, at a minimum, the courts interpret their application to an ever-changing agriculture as court challenges arise. Nevertheless, it does justify an assessment of their contemporaneous performance. This chapter presents an assessment on agricultural bargaining and marketing cooperatives. Agricultural supply cooperatives are included only to the extent they have significant marketing activities such as marketing grain.

The federal laws on which cooperatives are based include (1) the Capper–Volstead Act (1922) giving farmers limited exemption from the antitrust laws when organizing bargaining associations and marketing cooperatives; (2) the Revenue Act of 1962 that created subchapter T of the Internal Revenue Code granting single taxation on net income from patronage business allocated to or paid in cash to members based on patronage; (3) the Farm Credit Act of 1933 creating 13 Banks for Cooperatives (subsequently in 1989, 11 of the banks were consolidated into CoBank, and in 1999 CoBank merged with the St. Paul Bank for Cooperatives, making it the single national leader in cooperative lending) and giving defined cooperatives access to the lending authority of the Farm Credit Administration; (4) the Agricultural Marketing Agreement Act of 1937 giving cooperatives bloc voting privileges in the creation of marketing agreements and orders; and (5) the Agricultural Fair Practices Act of 1967 making it unlawful for handlers of and contractors for agricultural products to coerce, intimidate, or discriminate against farmers who join together in bargaining associations.

In addition, the USDA has had a long history of providing statistics, technical assistance, and research in support of cooperatives. The Cooperative Marketing Act of 1926 created a cooperative service division within USDA with a separate line item budget. But since 1985, cooperative services have been rolled into and administered by USDA Rural Development. The result has been reduced funding and staffing by USDA for supporting research and educational services for agricultural cooperatives. However, in recent years, USDA Rural Development has provided significant funds to support the value-added activities of farmers and agricultural businesses, many of which are organized as cooperatives.

Cooperatives are incorporated under state laws. In addition, states such as California have operated a system with their own state marketing orders and agreements in support of bargaining and marketing cooperatives. As is frequently the case, states have been more responsive than the federal government to needed policy adjustments. As a result, several states have amended their cooperative laws and/or passed new laws that support cooperative activities, allowing more flexible structural and financial arrangements than permitted under federal statutes.

The markets in which farmers and cooperatives operate have shifted from predominately spot markets to supply chain, coordinated markets. Contract agriculture, whether through cooperatives or by individual farmers, has become increasingly important and spot markets have declined. Supply chains in the agricultural sector have become increasingly more demanding and more complex. The markets in which

Table 5.1 Efficiency scoreboard for cooperative policy options

Policy options	Technical/ productive efficiency	Allocative efficiency	Dynamic efficiency	Nonmarket considerations
Capper–Volstead	+	+	+	+
Clarify antitrust responsibilities	N	+	N	N
Cooperative tax provisions	+/−/N	+/−/N	N	N
Eliminate 521 tax status	N	N	N	+
Cooperative finance	+	+	+	N
Expand CoBank authority	+	+	+	+
Marketing orders and agreements	+	+/−	−	−
Ban bloc voting	−	−/+	+	+
New generation cooperatives	+	+	+	+
Integrate into federal programs	+	+	+	+
Integrate into state coop laws	+	+	+	+
Agriculture Fair Trade Practices	N	N	N	N
Producer protection act	N	+	+	+
USDA technical and research support	−	−	−	+
Restore cooperative agency	+	+	+	+
State cooperative support	−	−	−	−
Expand state coop support	+	+	+	+
Private sector coop support	+	+	+	+
Expand private sector coop support	+	+	+	+

farmers and cooperatives operate have become global in scope. The requirements for investment capital have grown to the point where farmer ownership has become a limiting constraint on growth and competitiveness of many cooperatives. While the federal laws remain largely unchanged, several states have seen a need to pass new cooperative laws that better enable cooperatives to attract equity capital from non-member investors. For example, Wyoming, Minnesota, Wisconsin, and Iowa added an alternative incorporation statute to accommodate the involvement of outside investors in a cooperative. These statutes create a patronage pool and an investor pool. They also allow investor representation with voting rights on the board of directors.

This chapter assesses the need to modernize public sector cooperative laws, policies, programs, and institutions that were designed to balance the market power of farmers versus larger entities in the supply chain within which they must operate. This will be accomplished in three steps. (1) The market position and performance of cooperatives will first be evaluated in the context of the markets that have existed and supply chains that are developing throughout the entire food system. Conclusions will be drawn using a scorecard regarding the contemporary status of agricultural cooperative marketing and bargaining organizations. (2) Existing laws, public policies, programs, and institutions directly impacting marketing and bargaining cooperatives will be described, analyzed, and evaluated in terms of their impacts on the market position of farmers and their cooperatives. This evaluation will utilize the economic performance criteria prescribed for this project. (3) A set of policy options will be described and evaluated utilizing the same prescribed economic performance criteria. The results of the evaluations of both the current policies and the options are summarized in Table 5.1.

A Cooperative Business Scorecard

Cooperatives are business enterprises intended to allow their farmer-members to compete in an economic and regulatory environment that is constantly changing. Cooperatives have traditionally operated voluntary membership organizations according to a set of basic principles including (1) the user-owner principle, which means that farmers as members and as patrons own and have an obligation to help finance the cooperative; (2) the user-control principle, which means that members control the cooperative under a democratic process, usually one member one vote; and (3) the user-benefit principle, which means that cooperatives' benefits are distributed to members on the basis of use or patronage (Dunn 1986). The application of these principles varies among the state and federal government laws and policies that form the legal basis to regulate and support cooperative businesses (Kelley 2001; Baarda 2006; Pittman 2008).

Current information on cooperative market shares is scarce. Cook (1995) observes that cooperatives account for about 30% of total farm marketing receipts and of total dollars spent on input supplies. Cook observes that, in marketing, cooperatives tend to operate in low value-added first stages of the food supply chain. He adds that cooperative experiences in entering and maintaining market shares in high value-added market positions have had "waves" of success, followed by declines in market shares. These waves are analogous to product cycles where new or modified products must be consistently introduced to maintain a firm's growth pattern. This clearly has been the case in pork where, for example, Farmland Industries established itself as a significant integrated competitive force and then declined precipitously. The same type of scenario holds for Goldkist in chicken and for international grain marketing more generally. Neither Farmland nor Goldkist now exists as a cooperative. Farmland Industries was dissolved in bankruptcy. Portions of Farmland were spun off and purchased by other C-corporations. For example, Farmland's grain division was sold to Archer Daniels Midland (ADM); the Farmland Foods pork division was sold to Smithfield; its beef division was sold to US Premium Beef; its fertilizer division was sold to Koch Industries; and its refinery was sold to a venture capital group. Members of Goldkist agreed to sell their ownership in the cooperative to Pilgrim's Pride, the largest international chicken processing and marketing C-corporation.

There are some prominent exceptions to this cooperative wave theory where cooperatives have maintained and grown their share of high valued-added markets. Examples include Ocean Spray in cranberries and cranberry juices and Sunkist Growers in oranges and juice. Cooperatives have also formed marketing agencies-in-common, in conjunction with noncooperative firms, to successfully establish and market nationally recognized brands such as Sun-Maid Raisins, Citrus World for oranges, Welch Foods for grapes, and Norbest for turkeys. In 2007, dairy cooperatives held an 82.6% share of the raw milk produced by farmers, of which 63% was marketed as raw milk and 37% was processed into value-added products (Ling 2007). Dairy cooperatives dominate the manufacture of nonfat dry milk/skim milk powders and butter, holding market shares of 96 and 71%, respectively from 2002 to 2010. However, cooperatives' market share of natural cheese declined from 34% in 2002 to

26% in 2007. Land O'Lakes, Inc. is a major producer of branded butter, spreads, and deli cheeses. Dairy Farmers of America (DFA), in addition to being the largest U.S. dairy cooperative, is the major supplier of bulk commodity cheese sold to other food firms for cutting, wrapping, and further processing for wholesale and retail sales.

Arguably, exceptions to the wave theory also exist in a range of so-called new generation cooperatives producing and marketing a range of consumer products and ethanol, although sufficient time may not have passed to demonstrate economic sustainability. Some of the early new generation cooperatives were unable to maintain the cooperative business structure. For example, high corn prices and energy prices resulted in Minnesota Corn Processors facing severe liquidity problems which resulted in members voting to sell their ownership in 2002 to ADM (Losure 2002; Katz 1998; Boland et al. 1998). Dakota Growers Pasta Co., organized in 1991, was highly successful in growing the business nationally, but local wheat farmers maxed out in the ability to grow the amount of wheat to support continued market growth, needed more equity capital, and needed to balance ownership and control issues. As a result, in 2001, the members voted to convert from a new generation cooperative to a publicly traded company at an appreciated value (Boland and McKee 2009).

Cooperatives that have consistently pursued competitive growth strategies in value-added activities, in an era that requires higher levels of producer commitment, appear to have demonstrated greater success. Cooperatives have developed in response to a series of overlapping eras, the sequence of which varies from commodity to commodity. The remainder of this section identifies each of these eras and the cooperative response.

Spot Market Era

The era of the spot market has existed historically and for some commodities remains important, albeit declining. In the spot market, production decisions are made independently by farmers, and marketing decisions are made following production. Cooperatives' role in the spot market is as a buyer and seller of commodities as, for example, has most often been the case in grain marketing. This may include providing varying mixes of storage, logistics, processing, and marketing services. Cooperatives operate as competitive pacemakers on margins for the functions they perform and allocate net earnings to the cooperative as a whole or to individual members in proportion to patronage (Helmberger and Hoos 1962; Helmberger 1964). A portion of net earnings at the end of the year may be paid to members as a cash patronage refund in the year earned, usually a minimum of 20%, and the remainder retained as allocated equity, often for substantial time periods before being revolved out to members (Knutson 1966). Spot markets have remained very important in grain and to a lesser extent in cattle, although various forms of forward pricing and contracting have become increasingly prevalent. The key roles for government in spot markets are to establish grades and standards on which commodities are traded, collect and report price information, and maintain a market environment that is free of monopoly. The marketing policy book by Armbruster et al. (1983) contains a number of authoritative articles that provide background on these issues. The policies and programs that underlie these roles are described and evaluated in separate chapters in this book.

Vertical Integration Era

The era of vertical integration began in the 1950s, concurrent with the development of the agribusiness sector (Davis and Goldberg 1958). This period was characterized by closer ties between farmers and value-added processors building national brands and subsequently private supermarket label brands. These closer ties were frequently accomplished by contracts between farmers and processors serving the specification-buying practices of developing supermarket chains and were designed to satisfy consumer demands for product quality and uniformity. These contract markets often relied on spot markets as a reference price for farmer–processor contracts. As vertical integration increased, spot market sales declined, and markets became increasingly thin. Henderson, Schrader, and Rhodes (1983) provide an excellent authoritative review and analysis of the impacts of vertical integration on the development of thin markets, availability of market information, and the role of government and the private sector in price reporting. In an effort to be competitive, cooperatives had a difficult choice between becoming more involved in vertically integrated, value-added processing and potentially being foreclosed from dwindling spot market sales. This was not an easy decision for farmers who valued their liberty and the freedom offered by spot markets. Vertical integration required dramatically increased cooperative investments and higher levels of farmer membership agreement commitments to deliver specified quality products to cooperatives. For poultry, processed fruits and vegetables, pork, and milk, it soon became obvious that there was no choice. Except for milk, many of these cooperatives no longer exist. And the number of dairy cooperatives has been reduced substantially through mergers and consolidations as they effectively adjusted to changing market conditions, but they have been able to increase their market share of raw milk marketed. The number of dairy cooperatives declined from 213 in 2000 to 154 in 2009 (Penn et al. 2010).

Globalization Era

The era of globalization began in the 1970s with the adoption of lower government price supports, freer market farm policies, and reduced multilateral trade restraints. While local cooperatives had control of substantial quantities of grain, regional cooperatives were generally unable to build the international systems that could compete with a handful of multinational grain companies (Knutson et al. 1978). Concurrent with freer market farm program changes, was the reduction of marketing order provisions designed to control quantities marketed and reduce related barriers to trade.

The composition of U.S. exports has shifted since the late 1990s. Up until this time, bulk commodities dominated the exports. Now higher valued, often processed, products dominate. By 2002 only 30% of U.S. exports were bulk commodities, and 60% were higher valued products (Kennedy 2006). Since the major share of cooperative exports has been commodities like wheat, corn, and soybeans, bulk commodities make up about 60% of cooperative exports and cooperatives' share of U.S. exports has declined. In 2002, cooperatives share of U.S. total exports was: bulk commodities 12.6%; higher value products 6.2%; and total exports 8.6%.

Nonfat dry milk/skim milk powder is the leading dairy export product on a volume basis of which 91% is manufactured by dairy cooperatives. Dairy cooperatives organized a marketing agency-in-common, "Dairy America," to market nonfat dry milk/skim milk powder. Lacking international marketing experience, Dairy American contracted to perform its international marketing with Fonterra, the large dairy cooperative in New Zealand that dominates international dairy product markets. Subsequently, both Dairy Farmers of America and Land O'Lakes, Inc. discontinued membership in Fonterra and performed their exporting operations independently.

Supply Chain Management Era

The contemporaneous supply chain management era began in the 1990s as an extension of the vertical integration era. This era spawned a number of new generation cooperatives. Kelley (2001) describes and analyzes two key characteristics that distinguish new generation cooperatives (1) substantial up-front producer investment as a condition for membership and (2) specification of firm and legally binding product delivery rights and quantitative product delivery obligations. These characteristics allow the cooperative to obtain necessary equity capital at startup and to coordinate the volume of commodity marketed by its members to match the market-developed needs of the cooperative. These principles, which are a substantial departure from those of traditional cooperatives, served as the legal basis for the incorporation of many Upper Midwest value-added, food-processing, and ethanol-refining cooperatives. Some of these so-called new generation cooperatives are not recognized as being cooperatives but rather are organized as a Limited Liability Company (LLC). The reason is the LLC's ability to attract investor capital, whereas traditional cooperatives cannot attract outside investor capital because under traditional cooperative law, outside investors have no voting rights and the return on capital is limited. For this reason, states like Wisconsin created a new cooperative law that gives investors some of the same advantages LLCs enjoy. These nuances will be discussed further subsequently. Kelley (2001) and, particularly Baarda(2006), provide extensive analysis of the issues raised by the development of new generation cooperatives, the consequences of which have not yet been fully played out and realized (Fulton and Hueth 2009).

Issues raised by these new generation cooperatives include the ability of local members to increase the production of commodities to meet the cooperatives' growing market and/or the ability of local members to provide additional equity investment required to expand the cooperatives processing capacity to meet the expanded market. Another issue is the temptation of the initial member investors to vote to sell their capital investment in the cooperative at an appreciated value, if the cooperative has been very successful and converts to a C-type corporation as was the case of Dakota Pasta Growers noted previously (Boland and McKee 2009). The appreciated value of market rights may also become a barrier to new growers becoming a member of the cooperative.

Biofuel Era

The biofuel era that began at the turn of the twenty-first century dramatically changed agriculture. For grain cooperatives, mostly headquartered in the Midwest, biofuel offered profitable, albeit higher risk, opportunities. Farmers also invested in new biofuel business startups organized as cooperatives and many as limited liability companies (LLCs). Farmers and their cooperatives entering the biofuel business had to be willing to make the high equity investments and commitments required to operate large capital-intensive plants at capacity. Conflicts have arisen between grain farmers on the one hand and livestock, poultry, and dairy farmers on the other hand as biofuels have helped to increase grain prices and thereby increased the cost of feed for livestock, swine and poultry farmers.

Contemporary Demands Facing Cooperatives

The supply chains in the agricultural sector, including for biofuels, have become increasingly demanding, complex, and capital intensive. Food retailers and consumers demand a consistent and dependable flow of high quality and safe food products at the lowest possible prices. Competition among food retailers puts pressure on their suppliers to provide consistent volume and flow of high quality and safe products at the lowest possible price. Suppliers, whether cooperative or proprietary, compete by cutting costs out of their production, handling, processing, marketing, and distribution system and expanding their customer base. To prevent lapses in and insure safety, consumers and thus food retailers demand traceability systems to identify farm-to-table product sources. Likewise, consumers and retailers increasingly demand process-driven credence attributes such as natural, organic, and animal welfare. As a result of more products and increased product differentiation, inventory management and logistics have become more complicated, with increased stocking units and more just-in-time delivery demands by retailers. Meeting these demands requires a level of farmer-member commitment, director astuteness, management skill, and capital investments not previously experienced by many cooperatives.

To be effective in this new business climate, cooperatives must (1) manage supply chains whereby farmer-members become an integral part of the supply chain. This requires developing business plans that include effectively transferring to farmer-members, the prospective and current information regarding how their farm operations fit the cooperative's supply chains. (2) Operate in a manner that is at least equally efficient and equally effective as competitors in production, marketing, and facilitating adjustment to changing market conditions throughout the supply chain. (3) Develop the systems and institutions that allow cooperatives and their farmer-members to generate the capital required to effectively perform tasks 1 and 2 above. This does not mean that cooperatives need to create, serve, and manage the entire supply chain. They may manage and be linked to varying portions of the supply chain as, for example, is the case for dairy cooperatives. Neither does it mean that bargaining cooperatives are not useful and important institutions. They may play an important role representing farmers in situations where C-corporations manage and control the supply chain.

It should be noted that cooperatives have a potential advantage. A consumer survey documented a positive impression of cooperatives, their farmer-members, and of food grown and marketed by cooperatives over that of investor-owned C-corporations (NCBA 2003). Many consumers would give preference to food products from cooperatives. Also, there is an increasing trend of consumers giving preference to locally grown foods and showing willingness to pay a premium price. Several farmers organizing as a cooperative, as well as individual farmers, are growing and marketing vegetables, meat, and dairy products to local markets including smaller retailers, restaurants, and farmer markets (Chap. 16). More recently, large retailers such as Wal-Mart are beginning to carry locally produced foods in some of their stores.

Cooperative Policies

This section explains the status of cooperative policy in 2010, evaluates this set of policies according to the performance criteria, and then suggests and evaluates potential policy changes. It is important to note that cooperatives, like C-corporations, vary in their effectiveness in achieving the efficiency implied in each of the performance criteria. These differences may be due, for example, to the variation in cooperative goals, management, and operating policies. Therefore, this evaluation is in terms of the potential effects of each policy on market performance. The performance criteria utilized are defined in Chap. 1 for evaluating the current policies and their alternatives in each of the chapters in this book. Table 5.1 summarizes the results of the evaluation of the current cooperative laws/policies. It also summarizes the performance consequences/implications for each of the specified policy alternatives in term of changes compared with the current policy. The section ends with discussion of some cross-cutting policy issues.

Capper–Volstead Act

The foundation of federal cooperative policy is the Capper–Volstead Act because cooperatives' very existence depends on the limited antitrust exemption that it provides. The Sherman Antitrust Act of 1890 declares combination in restraint of trade, monopolization, and related anticompetitive practices to be illegal. Prior to the enactment of the Capper–Volstead Act in 1922, cooperative status under the antitrust laws was unclear (Harris et al. 1983). Groups of farmers attempting to organize and sell on a collective basis were found to have been in violation of the Sherman Act.

The Clayton Act of 1914 only partially dealt with the cooperative antitrust issue by stating that the "operation" of "nonstock organizations" carrying out "legitimate objects" and operating as nonprofit organizations was not forbidden by the antitrust laws. In addition to the nonstock limitation, the meaning of Clayton Act statutory terms such as "organization," "operation," and "legitimate objects" was unclear. The Capper–Volstead Act clarified the exemption by expanding the coverage to stock and nonstock cooperatives, by permitting them to create marketing agencies in common, and by permitting them to make contracts and agreements needed to carry out collective processing, preparing for market, handling, bargaining, and marketing their products. The Capper–Volstead Act does not specifically state that cooperatives may form marketing agencies in common. However, it has been interpreted to allow cooperatives to form marketing agents in common, in part, because the members of the marketing agency in common could have been reorganized as a single larger cooperative. The Department of Justice has questioned whether the Capper–Volstead Act provides protection for dairy marketing agencies in common.

The antitrust exemption is limited. The organization had to be operated for the mutual benefit of members as farmers and did not extend to combinations with noncooperatives (Knutson 1969). However, cooperatives may enter into joint ventures with noncooperatives, and many have done so, as long as the joint venture entity is kept separate from the cooperative and only farmer-members have voting rights on the cooperative board. Further, cooperatives cannot engage in predatory practices, collude with third parties in a manner that substantially lessens competition, or unduly enhance prices (Volkin 1985).

The cooperatives that are covered by the Capper–Volstead exemption must be organized *either* on the basis of one vote for each member *or* limit dividends paid on stock or membership capital to be no more than 8% per annum. In addition, the association shall not deal in the products of nonmembers to an amount greater in value than such as handled by its members. Jurisdiction for enforcing the undue price enhancement provisions lies with the Secretary of Agriculture, while the Department of Justice shares jurisdiction regarding issues involving predatory practices and combinations and conspiracies in restraint of trade. Marketing cooperatives have been found in violation of both the Sherman Act and the Clayton Act, but no cooperative has been found unduly enhancing price under the Capper–Volstead Act.

Since the Capper–Volstead Act enables the existence of marketing and bargaining cooperatives, this evaluation of the Act is made relative to if cooperatives were not allowed to exist.

- Technical or productive efficiency may be enhanced by facilitating the formation of vertical supply chains linking farmers to their cooperative markets and value chains. To achieve these efficiencies, farmer-members need to be committed to supply the volume of product that meets the market developed by the cooperative. Further, the cooperative's plant capacity needs to correspond to the size of the market developed. This assurance not only allows the cooperative to spread its fixed costs but also to make marketing commitments further up the value chain. This requires the ability to access both equity and debt capital markets to fully achieve available economies of size in competition with C-type corporate competitors. Access to equity capital from members has proven to be a particular constraining factor. The cooperative also needs programs that facilitate farmer-members being efficient in producing the quality of products required to satisfy market needs. This may be a problem in situations where there is substantial farmer diversity in size of operations and in the presence of rapid technological change and substantial economies of scale. To achieve technical efficiency, cooperatives must have the ability to discriminate, differentiate, differentially price, and even reject products. Such systems are easier to implement in a C-corporation than in a cooperative. Therefore, to achieve technical efficiency the cooperative strategy must be one of equitable or cost-justified treatment across producers as opposed to equal treatment.
- Allocative efficiency exists when competitive markets send the price signals needed to allocate inputs and outputs in a way that minimizes costs and maximizes the welfare of consumers. Cooperatives contribute to allocative efficiency in the marketplace by setting prices that reflect their technically efficient costs. This is the competitive pacemaker/yardstick concept that has historically been used to justify cooperative policies (Harris et al. 1983; Helmberger and Hoos 1962; Helmberger 1964). Cooperative policies also enhance allocative efficiency when profit margins earned from their operations are returned to members in the form of cash on a timely basis. On the other hand, if profit margins are retained within the business as the main source of equity capital for long periods, their net present value for the member falls to zero (Knutson 1966). In this case, the full burden of improving allocative efficiency falls on cooperatives' pricing policies. Due to the competitive nature of the business and large customers demanding that their suppliers cut cost out of their system, many cooperatives struggle with paying farmer-members competitive prices and at the same time retain adequate net margins to meet both capital requirements of the cooperative and timely redeem past retained allocated equity. As noted previously, allocative efficiency is also enhanced by the allocation of margins on the basis of patronage as required under the income tax law. In order for cooperatives to qualify for single federal income taxation, they are required to allocate and to distribute net income from

patronage business on the basis of patronage, and most cooperatives adhere to one member one vote. Some state cooperative laws allow for additional votes based on business volume with the cooperative and/or invested capital, but few cooperatives do so. However, management must have the flexibility to practice equitable treatment of members to reflect in prices paid any differences in the cost of doing business based on volume of marketings, the cost of services performed, quality of product, and the nature of the producer's marketing commitment. Cooperatives can also reduce the incidents of market failure due to imperfect or asymmetric information by providing a clear and accurate conduit for market information. Achieving allocative efficiency requires that cooperative conduct in the marketplace is as competitors rather than as a monopolist. Providing this assurance is the point of the limited nature of the antitrust exemption for cooperatives. Its realization requires astute enforcement policies by USDA and the Department of Justice.

- Dynamic efficiency may be enhanced by cooperatives if they maintain an aggressive competitive behavior with consistent adjustment to changing market conditions. Achieving dynamic efficiency may require that the cooperative maintains and supports aggressive programs designed to assure that particular member segments are not competitively disadvantaged. As for technical efficiency, this may be interpreted as a requirement for the cooperative operating for the mutual benefit of members. However, operating in a dynamic context for the mutual benefit of members also requires that the cooperative recognizes the need to exit as well as enter/expand its operations. Discontinuing a plant operation, activity, or market area is more difficult for cooperatives because of the attendant adverse member consequences.
- Nonmarket benefits are enhanced by cooperatives through the location of their operations in rural communities and through the enhancement of the incomes of farmers located in those communities. Most cooperatives have local operating branches or tentacles that extend to rural areas, even though their headquarters may be in larger cities. As a result, the cooperative and its farmer membership reflects an interest and identity with the community that is generally not typical of other businesses located in rural areas. In the Capper–Volstead Act, nonmarket benefits are embodied in the requirement that cooperatives operate for the mutual benefit of their members. Since cooperatives are locally owned and net income is distributed back to farmer-members on the basis of patronage, local communities may benefit economically more from a cooperative business than from a noncooperative business in the same activity. Cooperatives may have more staying power as well. That is, a cooperative may continue to operate and serve farmer-members at a lower net operating margin than would a C-corporation that must generate favorable returns to its investors. But, as noted previously, there also may come a time where exit strategies must be employed, which may distract from rural community prosperity.

The options suggested for the Capper–Volstead Act are designed to clarify the responsibility for the Act's enforcement. Rather than opening up the Act to amendment, which has attendant risks, these changes could be established by the Secretary of Agriculture as a sense of policy by USDA and the Department of Justice. This option would clarify, as a sense of policy, the division of responsibility for enforcement of the limited antitrust exemption provisions between the Department of Justice and the Secretary of Agriculture. For example, it could be made clear that while the Secretary of Agriculture will handle the issue of undue price enhancement, the Department of Justice would be responsible for addressing restraint of trade and monopolizing conduct issues. This clarification would provide increased assurance that allocative efficiency is realized while being neutral regarding the other performance criteria. One can assert that this is how it works now. However, market conduct related to pricing involves more than the issue of undue enhancement (Knutson et al. 1972).

Tax Policy

Frequently, cooperatives are said to have special treatment under the federal income tax laws because of the single tax principle under which they are allowed to operate. The most understandable treatment of the cooperative tax issue is contained in Baarda (2006). Cooperatives may retain a portion of net margins as unallocated equity. Unallocated equity distributions are held by the cooperative membership as a whole, and the cooperative pays a corporate income tax on this allocation.

While some cooperatives are moving in the direction of more unqualified distributions, most cooperatives allocate the vast majority of net margins generated from member business as qualified allocations to members based on patronage. For farmer patrons, this patronage refund distribution is taxable income in the year earned and the cooperative does not pay taxes on it, provided the patron has given consent. Consent is usually provided in a membership agreement or stated in the bylaws. Further, to qualify for this tax treatment, a minimum of 20% of the allocation must be paid out to the patron in cash in the year earned and the remainder retained as equity financing. However, the patron includes as taxable income the entire amount of the allocation in the year earned.

Therefore, the patronage refund is treated for tax purposes as a price adjustment to the farmer-patron on products sold to the cooperative or as a right to any income earned by the cooperative based on the principles on which it is organized and operates. This treatment contrasts with a traditional C-corporation where both the corporation pays income tax on its profits, and stockholder dividends are taxed as personal income. If a cooperative chooses to pay a portion of net income as dividends on capital or membership stock, double taxation applies the same as C-corporations. Few cooperatives pay such dividends. It is important to note that single tax treatment is not limited to cooperatives. Single tax treatment also applies to sole proprietorship businesses, partnerships, and S-corporations and limited liability companies (LLCs).

Only a few marketing cooperatives are organized as a tax code section 521 cooperative, often referred to as “exempt cooperatives,” which also provides them single tax treatment under specific circumstances and meeting specific requirements, one of which is to treat members and nonmembers alike. The major difference in the single tax treatment of 521 cooperatives is that they can deduct as taxable income, nonpatronage income such as rent on facilities, and dividends paid on capital stock (Internal Revenue Service 2010). However, the main benefit attributed to organizing as a section 521 cooperative appears to be that it avoids the legal expenses in whether the stock issued by the cooperative is a security and is subject to securities registration and related regulations (Kelley 2001). However, there remain few marketing cooperatives that meet section 521 requirements.

This evaluation of the market performance implications of the tax treatment of cooperatives is made relative to the absence of the single tax treatment of cooperatives. Keep in mind, however, that single tax treatment is not limited to cooperatives and that the IRS has allowed this treatment since 1913. Only in 1962, were cooperative tax principles codified as subchapter T of the tax code.

- Technical/productive efficiency for the cooperative is increased by application of the single tax principle to cooperatives because their net margins are not taxed. Also, productive efficiency may be increased if more of the cooperatives' allocated earnings are retained in the business, and reliance on debt capital is reduced. However, this is debatable. The opportunity cost of equity capital may be more expensive than debt capital, meaning that the patrons' return on capital is higher than that of the cooperative (Knutson 1966). The cooperative very likely can obtain debt capital at a lower cost than can farmer-members in farm operating loans. Plus, farmer-members expect a favorable return on their invested capital as measured by their share of net earnings paid out in cash above the minimum required 20% and/or timely redemption of retained allocations. Therefore, from the perspective of the combination of the cooperative and the patron, the effect on productive efficiency could be neutral or even negative.
- Allocative efficiency is increased when higher production efficiencies are passed on to producers in the form of higher prices as the cooperative competitive pacemaker concept is allowed to operate and market power is neutralized.
- Dynamic efficiency and nonmarket benefits are neutral.

A single option for cooperative tax policy would involve elimination of the section 521 status for cooperatives. This would simplify the tax code treatment for cooperatives and have little or no effect on technical, allocative, distributive, and dynamic efficiency. However, nonmarket benefits would be improved by the elimination of an obsolete law.

Cooperative Credit Banks

Establishing and operating a business requires a combination of equity and debt capital. The patronage-based nature of cooperatives leads to different financing issues and concerns than for C-corporations. The stock of a C-corporation is its equity capital base along with earnings retained within the business. Those who invest in C-corporate stock do so for some combination of its potential capital appreciation and its dividends. For each share of common stock owned, there is a right to vote. The major stockholders, therefore, control the C-corporation and may sit on its board of directors. While corporate policy differs regarding dividends and the amount of stock that is issued, profits retained within the business are an important source of equity capital. There is no individual ownership interest tied to retained earnings, meaning that it is owned jointly by all stockholders.

Traditional cooperatives are different in that the member-patron of a cooperative typically owns only one share of common voting stock, and there is no opportunity for appreciation in its value. As noted previously, the cooperative's net margin is allocated to the members on the basis of patronage. Some portion, generally a minimum of 20%, is paid to members in cash in the year earned and a majority of the balance is allocated to the members on the basis of patronage and retained within the business. After a period of time, this equity capital typically is revolved out to the members. In a time of rapidly increasing capital requirements, some cooperatives have found net income does not allow adequate retained earnings to provide sufficient quantity and stability of equity capital. An alternative involves using a per unit product retain that involves retaining within the business an equity capital deduction per unit of product from the value of products marketed through the cooperative. Per unit retains are a challenge to a cooperative in demonstrating to its members that they are paying a competitive price. Contrariwise, there may be less pressure on the board of directors and management to operate as efficiently as would be the situation with retained earnings, since per unit retains are applied regardless of net income.

In either case, retains are an important source of investment and operating capital. From a theoretical and practical perspective, assuming the cooperative is a financially sound business, utilizing member capital as a basis for cooperative finance is optimal in instances where the cooperative's return on capital is greater than either the farmers' return from using that capital or the cost of debt capital. Returns on that capital are measured by the sum of returns at the cooperative level—patronage refunds generated, and at the member level—higher price received for commodities marketed or lower input or service costs.

An increasing number of agricultural cooperatives are switching from qualified allocation of patronage refunds to unqualified allocations. Under qualified allocations, if members give consent, they pay the federal income tax on both the portion received in cash and the portion retained in the year earned. With unqualified allocation, cooperatives normally pay out a higher percentage than the required minimum of 20% in cash in the year earned, usually near 40%, and retain a smaller portion. The member pays federal income tax only on the cash received, and the cooperative pays a corporate income tax on the retained portion. If the cooperative at a later date pays out the retained portion to the members, it receives a tax credit, and the member then pays income tax on the amount. This approach has been favorably received by members because the 40% of the patronage refund in cash today is better than the minimum of 20% in cash today and paying income tax on the entire patronage refund but not receiving the retained portion in cash until several years later.

Other cooperatives are retaining a larger portion of net income in an unallocated reserve. The cooperative pays the corporate income tax. This allows the cooperative to build more permanent equity capital since it is held by the cooperative as a whole and would only be paid out if the cooperative fails. However, if too much net earnings are placed in an unallocated reserve, it may reduce the value of the cooperative in the eyes of its membership.

The Capper–Volstead Act limited the dividends paid by cooperatives to 8% per annum. Selling preferred stock to raise equity capital has not been widely practiced by cooperatives. However, CHS, Inc., the largest agricultural regional supply and marketing cooperative, has successfully done so. It has a record of strong earnings, and the public appears to have confidence in this farmer-owned and operated company.

It may be argued that cooperatives have an advantage over C-corporations in acquiring equity capital by simply retaining a portion of net income and pushing the income tax burden onto its members. However, the stock of profitable C-corporations is publicly traded at a value that fulfills their equity capital needs. Cooperatives, under the traditional method of retaining a portion of net income as allocated patronage refunds, are constantly obligated to pay out the retained earnings at a later date and replace them with retains from current net income.

As in the case of financing a farm business, special policies have been established for providing debt capital financing to cooperatives as part of the Farm Credit System (FCS). The FCS is organized as a cooperative owned by those who borrow from it. With predecessor organizations that extend back to 1916, FCS was established in 1933 by the Farm Credit Act as a post-depression policy. Included in this Act was the establishment of 12 District Banks for Cooperatives and a Central Bank for Cooperatives, which were later consolidated into CoBank, as previously explained (Farm Credit Administration 2010). FSC issues bonds as its source of lending capital. Since FCS has a history of being backed by the federal government, it is a major source of cooperative debt capital lent on generally favorable terms.

This evaluation of the market performance implications of cooperative finance is made relative to their competitors, most of which would be organized as C-corporations.

- Technical/productive efficiency may be increased by application of the financial options available to cooperatives. While preferred stock has long been utilized as a source of access to equity capital, the new generation approach has provided an additional option for cooperatives that may be otherwise starved for equity capital in order to achieve technically efficient scales of operations. The FCS is a highly competitive source of cooperative debt capital, as it is for the short-, intermediate-, and long-term credit needs of farmers. Also, productive efficiency may be increased as the cooperative's cost of capital is reduced.
- Allocative efficiency would be increased when higher production efficiencies are passed on to the producers in the form of higher prices and patronage refunds, and when cooperatives have sufficient market shares and influence to offset the power positions of generally larger C-corporations.

- Dynamic efficiency may be increased as a result of greater ability to grow their market share, keep operations modernized, and pursue new business ventures.
- Nonmarket benefits would be neutral.

As a policy option, consideration of the need to update the eligibility requirements for borrowing from CoBank is warranted. Kelley (2001) concludes that newly formed new generation cooperatives with farmer-members who are just investors could affect the cooperative's ability to obtain a loan from CoBank. Many of the new generation businesses, ethanol operations in particular, are organized as LLCs rather than as cooperatives. Potential farmer-members lack the ability to provide adequate equity capital, and the LLCs are more adept in attracting equity capital from outside investors. In LLCs, outside investors share the control of the business. With traditional cooperatives, only members may hold voting positions on the board. In order to retain the basic business principles of cooperatives, states like Wisconsin, Minnesota, Iowa, and Wyoming passed an additional incorporation statute for cooperatives. While retaining a minimum of 51% control by member-patrons, investors can sit on and have voting rights on the board. In addition, net income is allocated to a patronage pool and an investor pool, the proportions determined by the statute and bylaws. Nevertheless, since passage of these alternative incorporation laws, few cooperatives have organized as such. Most organize under the traditional cooperative laws. Those that struggle with obtaining sufficient equity capital from potential farmer-members have chosen to organize as an LLC to attract outside investors. CoBank requires that to be eligible to borrow all voting rights on the cooperative's board must be held by member-patrons. Therefore, CoBank cannot lend to new generation cooperatives as borrowers or to LLC cooperatives. Without this change, both new generation cooperatives and LLC cooperatives will be subject to debt capital rationing.

Compared with CoBank's current lending authority, clarifying and adding to CoBank's ability to lend to cooperatives organized under either new generation or as LLC cooperatives would enhance technical, allocative, and dynamic efficiency. It would do this by allowing CoBank to provide debt capital support for a broader range of farmer-owned cooperative activities. Nonmarket benefits would be enhanced by increased cooperative activities in rural areas.

Marketing Orders and Agreements

Marketing orders and agreements are designed to stabilize markets for a specific set of perishable farm products. The common statutory verbiage, contained in the Agricultural Marketing Agreement Act of 1937 for federal fruit and vegetable orders and for milk orders, involves the establishment and maintenance of orderly marketing conditions. Nicholson and Paggi, in Chap. 6 on Federal and State Marketing Orders, analyze the role that orders and agreements play in contemporary markets for perishable products. For fruits and vegetables, this role has been constantly changing in response to market conditions, societal expectations, and political forces. For example, marketing quota provisions, designed to control quantities put on the market, have not been used much in recent years by fruit and vegetable orders, while increased emphasis has been placed on provisions designed to improve product quality and safety (Armbruster and Jesse 1983; Nicholson and Paggi). While milk marketing orders have also adjusted, for example, by dramatically reducing the number of orders, their more intrusive minimum pricing provisions remain (Babb et al. 1983; Nicholson and Paggi).

Though marketing orders were not designed as a cooperative policy tool per se, cooperatives have played a key role in supporting the development of many marketing orders by: being represented on fruit and vegetable marketing order administrative committees, advocating certain order provisions deemed to be of benefit to their members, voting to get orders adopted, and effectuating the purposes of marketing orders and agreements. It has been suggested that some cooperatives would be substantially less effective and even may not exist were it not for marketing orders (Cropp 2003a, b). This cooperative dependence assertion is more frequently made regarding federal orders than for state orders.

While not delving into the details of orders, which is left to the Nicholson and Paggi in Chap. 6, the sole issue addressed here is the degree to which marketing orders and agreements support and sustain marketing cooperatives. This issue appears to be little discussed in the literature, with prominent researchers often failing to even address the topic (Novakovic 1995; Jacobson and Cropp 1995). Cropp (2003a, b) addresses the issue directly in the tenth annual Workshop for Dairy Economists and Policy Analysis. He (p. 104) concludes that without federal milk marketing orders:

No doubt some dairy cooperatives will fail as viable businesses and others will make major changes, whether they be mergers or strategic alliances with other cooperatives or major investor owned dairy firms. Pure bargaining cooperatives will be most vulnerable since their only option is to sell milk at whatever price they can negotiate… To minimize the free rider problem, these cooperatives may become more of a closed membership rather than an open membership cooperative.

Cropp's conclusion is based on the "privileges" cooperatives are granted by federal orders including:

- Petitions for federal order hearings by a dominant cooperative are more likely to get a positive response than those from other petitioners.
- Dairy cooperatives are allowed to vote as a bloc for their members on most order provisions and, thereby, are able to influence the terms of a federal order and, for that matter, its existence. This degree of influence and the outcome may not correlate with the interests of the minority of farmers who are not cooperative members or of farmers who are members of smaller cooperatives. This policy is analogous to contemporary proposals that would allow labor unions to vote as a bloc on behalf of their members in employee-unionization decisions. On controversial federal order proposals, the situation could readily be seen where the outcome of a vote on whether to adopt a proposed order or to terminate would

be different if cooperative members voted as individuals compared with the dominant cooperative voting on behalf of its members as a bloc. Nevertheless, farmers become members of a cooperative and demand that the directors and management operate in the best interest of the members as a whole and to protect members' investment in the cooperative. Federal and state order issues are often highly complex. The board of directors and management may be in a better position than individual members to analyze any controversial proposal's impact on members and the cooperative and thereby bloc voting is more likely to insure improved results.
- Dairy cooperatives under federal milk marketing orders are allowed to blend and potentially pay members less than the minimum blend price required by the order and this has actually occurred in some cooperatives during the past decade (Stephenson 2008). C-corporate processors are required to pay no less than the minimum price.
- Cooperatives may collect proceeds for their members from the sale of milk to other handlers. As noted previously, dairy cooperatives market about 67% of members' milk as raw milk to other milk processors.
- Members of dairy cooperatives performing marketing services are exempt from paying for market services charged nonmembers.
- Dairy cooperatives may pool members' milk in two or more federal milk marketing orders and blend all returns and handling costs in paying their farmer-members.

The Cornell University Dairy Markets and Policy group of dairy economists has from time to time discussed this issue in the context of the impacts of eliminating federal milk marketing orders. In these discussions, there were experts who were even less optimistic than Cropp, observing that cooperatives as they existed at the time (early 2000s) would likely disappear. In other words, they observed that milk cooperatives were absolutely dependent on federal orders. The conclusion by Cropp is limited to his study of milk marketing orders and dairy cooperatives. Milk orders are considerably more prescriptive in terms of pricing provisions. The less prescriptive nature of fruit and vegetable orders, at least in terms of the lack of pricing provisions, may make fruit and vegetable cooperatives less dependent on order provisions.

This evaluation indicates the impacts of the current policy allowing bloc voting by dairy cooperatives on each of the performance criterion. The evaluation assumes that in the absence of bloc voting, dairy cooperatives would have less market influence.

- Technical or productive efficiency could be enhanced because bloc voting can support the maintenance of larger cooperatives performing marketing functions that benefit all farmers and require large fixed-cost investments such as perishable product assembly. To achieve these efficiencies, there must be a level of assurance that the cooperative can utilize its facilities at a level that approaches capacity and can effectively manage the supply chain.

- Allocative efficiency may be enhanced if, by bloc voting on marketing order issues, cooperatives are able to pay patrons higher and more competitive prices for products. Competitive in this case means prices that reflect the benefits of the cooperative in terms of technically efficient production and marketing. Allocative efficiency also may be adversely affected by cooperatives bloc voting only in the predominant interest of their members and contrary to the interests of either members who do not support the cooperatives' order position or the interests of nonmembers. Data from producer milk checks collected from 2000 to 2009 show that cooperatives pay substantially different prices to members in ways that do not seem clearly related to the costs of service or the value/quality of the milk (Stephenson 2008). The current policy depends on the Secretary of Agriculture to protect the interests of nonmembers and the general public.
- Dynamic efficiency may be negatively affected if the order preserves obsolete institutional, marketing, and pricing arrangements. Obsolete arrangements can happen with federal milk marketing orders because the ten orders cannot be changed simultaneously unless a costly and time-consuming national hearing is completed, or unless the Congress mandates a simultaneous change in all orders.
- Nonmarket benefits embody the concept of social justice. For social justice to be achieved, all farmers, as individuals, need to be represented in the order formulation and voting process. Therefore, nonmarket benefits may be negatively affected. Also, negative effects may exist on rural development due to order consolidation, which may have helped to foster the decline in the number of dairy cooperatives.

An option for voting on dairy marketing orders and agreements is to give each farmer one vote and to ban bloc voting. Alternatively, the cooperative could be required to notify each member as to how they are voting. Then any member who disagrees could request their name be removed from the bloc vote and then vote as an individual. The likely impacts of this option would be the opposite of the current policy including:

- Technical/productive efficiency could be reduced.
- Allocative efficiency may increase as marketing order decisions reflect the will of more producers. The argument to the contrary is that cooperatives' members elect their boards of directors from among their peers. The board of directors is to represent the interest of members in making decisions and in directing management of the cooperative to achieve the purpose of the cooperative as stated in the articles of incorporation and bylaws as approved by members. Federal order issues are often very complex, and impacts on members are not easily assessed. The board of directors, in consultation with management, may be better able to assess the implications of these issues and vote on the behalf of the members rather than having individual members vote directly. However, it may also signal a need for improved member communication.
- Dynamic efficiency could increase.
- Nonmarket benefits could increase.

New Generation Cooperative Policies and State Laws

Being competitive in the current and evolving agribusiness environment often requires substantial upfront equity capital to pursue new value-added business ventures. For example, construction of an efficient scale, corn-based ethanol refinery is estimated to require a capital investment that approaches $100 million (Hodur and Leistrictz 2009). To be profitable, such a plant must be operated at or near capacity throughout the year. Such capital requirements have caused a significant segment of farmers, cooperatives, and their providers of debt capital to conclude that the traditional cooperative principles are not consistent with the needs for being competitive as new business ventures in contemporary, supply chain managed markets.

The leadership of this progressive segment of business interests concluded that the type of cooperative required to raise the needed amount of equity capital is one that has several of the following characteristics (1) substantial upfront farmer-member stock investment, sold as shares or marketing rights. Each share corresponds to a specific quantity of product, for example 1,000 bushels of corn; (2) legally binding commitments by farmers to deliver a volume of commodity specified in the shares, even if it had to be purchased in the open market by the farmer/member/stockholder; (3) closed membership; (4) access to significant outside equity capital investment by individuals who may not be farmers; and (5) stock that can be traded and appreciate in value but under the control of the board of directors. (Kelley 2001). Cooperatives having these characteristic are referred to as "new generation" cooperatives.

It will readily be noted that these new generation principles have many of the same characteristics as the vertically integrated and supply chain managed C-corporation systems that increasingly dominate agriculture and the food system. That is, from the 1950s beginnings of vertical integration in poultry, a key feature of these systems has been to gain increased control over the quantity and quality of product to be produced. These specifications have consistently grown over time to include process-oriented production practices and input supply specifications. Some cooperatives not having key new generation characteristics, such as outside investors, have had member agreements that legally bind patrons to market through cooperatives. This is particularly the case for milk and fruit and vegetable cooperatives. Yet, it is also clear that the development of supply chain managed systems does not ensure cooperative success. Fulton and Hueth (2009) served as editors for an excellent series of case studies of business successes and failures involving cooperatives that have restructured their operations into new generation, LLC, and supply chain managed systems.

To facilitate the formation of new generation cooperatives, several states (including, for example, Wyoming, Minnesota, Iowa, and Wisconsin) have enacted a second cooperative incorporation statute that may better accommodate formation of new generation cooperatives. The Wyoming law was a leading initial state law that has become a model for development of new generation statutes in other states. The common features of these laws as summarized by Baarda (2006), who provides a detailed description of new generation provisions related to finance, governance, and profit allocation, include:

- Investor-members may include nonmembers, nonfarmers, and nonpatrons.
- All investor-members have a right to the profit margins.
- All investor-members may have voting rights.
- Patron-members are assured of having at least 50% representation on the board of directors.
- Patron-members vote as a bloc, while nonpatron-members vote individually.
- The new generation cooperative may be treated as a limited liability company.

As stated previously, many ethanol plants organized as LLCs because the state incorporation statutes do not allow investor control. LLCs are very flexible in how voting rights and allocation of net margins can be handled. With new generation cooperatives, member–patrons are assured of at least 50% voting power and 50% of the net margin unless member-patrons vote to reduce the latter, but in no case can investor-members receive more than 85% of the net margins.

For those who believe strongly in the traditional cooperative principles and ideology, the development of new generation cooperatives is not considered to be positive (Torgerson 2003). Obviously, the new generation cooperative requirements are not consistent with the patron ownership, control, and margin allocation principles for traditional cooperatives (Baarda 2006; Dunn 1986; Kelley 2001; Torgerson 2003). The most detailed analysis of these differences and their potential implications is contained in Baarda (2006) and Kelley (2001).

Surprisingly, few new cooperatives have been organized under these new generation cooperative laws, but many have organized as LLCs. The LLCs may operate according to some of the cooperative principles. Reynolds indicates that a real issue with successful new generation cooperatives is that the value of shares, or marketing rights, appreciates to a level such that beginning farmers cannot afford them. Therefore, one reason some new generation coops have become LLCs is that the organization as an LLC broadens the possible investors beyond farmer-members. One of the conclusions drawn by Reynolds (2011) is that the LLC may become the cooperative of the future. Then there is an issue of the principles that a LLC cooperative would be expected to adhere to in order to maintain a semblance of farmer-member ownership and control.

The following evaluation indicates the market performance impacts of the new generation cooperative option compared with maintaining a traditional cooperative structure. Baarda (2006) provides an analysis of the impacts of new generation cooperatives on market performance, which was very useful for this analysis.

- Technical or productive efficiency may be increased by the new generation structure because it gives cooperatives access to outside-investor capital that would not be available to traditional cooperatives. In addition, compared with cooperatives that operate in open markets, the higher level of new generation supply chain managed systems would allow these cooperatives to more effectively utilize their capacity and management expertise to maintain efficiency. However,

traditional cooperatives utilizing legally binding marketing agreements with their members may garner the same benefits.
- Allocative efficiency could be increased due to increased new generation cooperative price competitiveness in the markets in which they operate and due to increased potential for offsetting the supply chain managed market power of C-corporations. In addition, new generation cooperatives offer farmers and other investors increased benefits from value-added activities.
- Dynamic efficiency would be enhanced by this new competitive force that utilizes a different set of progressive management strategies in markets for agricultural products.
- Nonmarket benefits would be enhanced because much of the new generation cooperative activities would be in rural areas.

Numerous policy options have been suggested for dealing with the policy issues that arise from new generation cooperatives. One possible option, abandoning the new generation cooperative concept, is considered to be highly unrealistic considering the number of major cooperative states that have adopted new generation cooperative laws. Two other options are the focal point of analysis in this chapter. Each will be briefly evaluated, in terms of the performance criteria, against the reference point of keeping "pure" traditional cooperatives.

- The first option would integrate new generation cooperative legal concepts into the existing federal policies that undergird cooperatives. This option arises because of inconsistencies between federal law as embodied in the Capper–Volstead Act, the Internal Revenue Code tax status, marketing orders and agreements, and FCS cooperative credit lending policies, and the new generation cooperative laws. As noted previously, each of these federal laws has its own cooperative definition. This option would create a single unified cooperative definition that applies to all cooperatives, including new generation cooperatives. This uniform definition might be framed sufficiently broad that LLCs operating according to specified cooperative principles might also fall under the uniform definition umbrella. To the authors' knowledge, there has been no study of the extent to which new generation type cooperatives that decided to operate as LLCs employ cooperative principles. Modifying any one of these laws would be politically difficult and could have potentially dangerous consequences for the legal status and privileges that undergird traditional cooperatives. For example, the Capper–Volstead antitrust exemption is violated if noncooperative interests are embodied within the cooperative (Knutson 1969; Kelley 2001; Baarda 2006). Therefore, the antitrust exemption of dominant milk cooperatives could be jeopardized if an attempt were made to encompass noncooperative voting interests within the Capper–Volstead Act. The overriding issue then becomes one of whether the integration of a uniform set of cooperative principles into existing federal laws could be accomplished without significantly, adversely affecting the existing privileges enjoyed by traditional cooperatives. If this could be accomplished, the market performance effects of this option would be positive for each of the performance criteria.

- The second option arises from differences in new cooperative state laws and the need to standardize and integrate these laws into those enabling the incorporation of traditional cooperatives. To minimize differences in state laws and encompass both traditional laws and new generation laws into a single law, a uniform model cooperative statute is in developmental stages by the National Conference on Uniform State Laws (Baarda 2006, 127–37). This option, like integrating new generation principles into existing federal policies, is highly controversial as seen in the following letter from six major national cooperative organizations as quoted by Baarda (2006, p. 1).

> Many in the cooperative business community are uncertain about the benefit of new statutes allowing nonpatron investors to claim governance and financial rights in a cooperative. The cooperative business model is intended to provide goods or services at an affordable rate and maintain the core principle of democratic control. We are concerned that undue manipulation of the cooperative business structure will jeopardize the interests of the members that a cooperative is intended to serve.

Despite these negative perceptions, if integration of state traditional and new cooperative laws including both new generation and LLC cooperative business structures could be accomplished, the market performance effects of integrating state laws would be positive for each of the performance criteria and neutral for nonmarket performance.

Contracts and Bargaining

Bargaining cooperatives were among the first organized in the United States as farmers tried to negotiate commodity prices in spot markets with a small number of C-corporate buyers; at times approaching a single-buyer, regional-monopsony situation (Cropp and Graf 2001; Cropp 2003a, b). A bargaining association's role is to alter market relationships between farmers and buyers by negotiating the terms of trade, most often contained in contracts (Harris et al. 1983). Hueth and Marcoul (2002) provide the most recent overview of the status of cooperative bargaining in U.S. agricultural markets. They conclude that while the development of bargaining associations created a hope and expectation of significantly higher returns to growers, actual experience has indicated otherwise. Analysts who have studied these developments and potential solutions to inequity issues have concluded that "concerns about contract production and vertical coordination in agriculture will abound in the future" (Boehlje et al. 2001).

In integrated supply chain managed C-corporation systems, production and marketing contracts are a prime means of accomplishing market coordination. Alternative means are for the C-corporation to produce the product or to joint venture with a producing firm. Such integrated systems often exercise process control over the inputs utilized in production; the timing, method, quantity, and quality of production; the marketing; the price received; and future production opportunities. Under these circumstances, contract terms may be loaded against the contract farmer, and few remedies may exist if a dispute develops. Torgerson (1970) describes situations where contracting Arkansas poultry farmers were dropped by poultry processors because they joined a bargaining association. In addition to being arbitrarily discontinued by integrators, a prime concern of contracting poultry farmers has been so-called tournament contract provisions providing that a grower's deviation from the average cost of raising birds on like growers farms is used as a deduction or addition to the base rate of pay in calculating the payment a grower receives for raising a flock of chickens. These are the types of conditions that existed prior to the enactment of the Agricultural Fair Trade Practice Act of 1967 (AFPA) and the conditions are still festering among contract growers.

The purpose of AFPA was to give producers the right to band together and to establish standards of fair practices by handlers in dealing with farmers. The following practices by processors/integrators are declared to be unlawful: (1) coercing a producer to join or refrain from joining an association of producers; (2) refusing to deal with a producer because the producer joins an association; (3) discriminating against a producer with respect to price, quantity, quality, or other terms of purchasing and handling agricultural products because the producer joins an association; (4) coercing a producer into signing, or breaching, a contract with an association or another handler; (5) paying or loaning money to induce a producer not to join, or to cease belonging to, an association; (6) making false statements about the finances, management, or activities of a producer or handler; or (7) conspiring with others to do any of these actions. While all of these prohibitions were well intended, Section 5 of the AFPA then states:

Nothing in this Act … shall prevent handlers and producers from selecting their customers and suppliers for any reason other than a producer's membership in or contract with an association of producers, nor require a handler to deal with an association of producers.

Assessments of AFPA indicate that it has failed at accomplishing its objectives (Torgerson 1970; Harris et al. 1983; Frederick 1990). Frederick, for example, points out that the language of AFPA Section 5 provides integrators and processors (1) a pretext other than association membership to deal with a producer and (2) legal grounds for refusing to bargain. As a result, Frederick concludes that Section 5 greatly limits the ability of a producer to pursue enforcement of the specified unlawful practices.

These evaluations indicate that AFPC has failed to accomplish its objectives. They may lead to a conclusion that repeal of the law be considered as a policy option. However, AFPA sent a signal to market participants that certain integrator practices are unacceptable. If the law were repealed, it might send the opposite message and encourage one or more of the specified unlawful practices. Therefore, while AFPA may not have significantly improved the performance of any of the evaluation criteria, its repeal may make the situation worse.

Since the AFPA enactment in 1967, there have been many attempts to strike Section 5 and otherwise modify its provisions as suggested subsequently. Most of the proposals that have been made are embodied in the Producer Protection Act, various forms of which have been adopted by several states (Peck 2006). In addition, bills of the same type have been introduced for consideration by the U.S. Congress as an amendment to AFPA but have not been enacted. Boehlje et al. (2001) characterize this legislation as containing the following key provisions (1) require contracts to be in plain language and contain disclosure of material risks; (2) provide producers a 3-day cancellation period to review production contracts and discuss them with advisors; (3) provide producers with a first-priority lien for payments under a contract in the event the contractor goes out of business; (4) protect producers from having contracts terminated capriciously or as a form of retribution; and (5) prohibit tournament contracts.

The proposed Producer Protection Act is evaluated relative to the current largely ineffective AFPA. This evaluation draws on the works of (1) Boehlje et al. (2001), which calls for careful evaluation of potential unintended consequences from the tournament contract prohibition; (2) Harl et al. (2001),which sees the intended consequences of the requirements contained in the proposed law to be greater than any unintended consequences pointed out by Boehlje et al. (2001); and (3) Wu (2003), who cautions against regulation that constrains the ability of the private sector to conduct efficient transactions versus those that facilitate private exchanges by reducing transaction costs. The diversity of these economic perspectives presents a challenge in terms of assessing the performance implications. With this caveat, the implications of the Producer Protection Act option include:

- Technical or productive efficiency would be expected to be neutral because the likely scale of operations and efficiency related practice would not change.
- Allocative efficiency would be increased as the contract terms and related information became more transparent. With risk sharing being more transparent and potentially being more evenly distributed, there would be greater balance in market power and reduced potential for producer exploitation. Boehlje et al. note the key importance played by contract terms clearly stating the short- and long-term distribution of risks between the grower and the integrator. However, as noted by Boehlje et al. and Wu, the prohibition of tournament provisions could present circumstances where pricing efficiency is reduced. Harl does not dispute this concern but concludes that the other positive effects outweigh any unintended consequences.
- Dynamic efficiency would be neutral.
- Nonmarket benefits, which embody the concept of social justice, would be enhanced as the market position of contract producers is improved and as the distribution of risks becomes more transparent.

USDA's Changing Cooperative Support Role

Throughout much of its history, USDA supported cooperative marketing activities through research, education, information, and technical assistance activities specifically oriented toward encouraging the expansion of cooperatives (Harris et al. 1983). While these activities consistently met the objectivity standards for USDA research, education, and market information, the broader role also was clearly one of advocacy on behalf of cooperatives.

According to Harris et al. (1983), this activity began as early as 1912 and was formalized with the establishment of the Division of Agricultural Cooperation in the Bureau of Agricultural Economics in 1922, the year in which the Capper–Volstead Act was enacted. The Cooperative Marketing Act of 1926 codified these activities and made it clear that farmers and their associations could share market information that might otherwise be considered a violation of the Sherman Act. In response, the USDA created the Division of Cooperative Marketing to carry out these codified responsibilities. Further legislation in support of the formation of national cooperatives is contained in the Agricultural Marketing Act of 1929, which created the Federal Farm Board. Overburdened with surpluses and low farm prices, the Farm Board was subsequently abandoned as the centerpiece for farm policies as agriculture entered the Great Depression. From 1929 through 1952, cooperative support activities were centered in the Farm Board and then in the Farm Credit Administration, until it was separated from USDA. Subsequently, in 1953, the Farmer Cooperative Service was created and given USDA agency status. In 1977, USDA's cooperative program was downgraded from agency status to become part of the Economic Research, Statistics, and Cooperatives Service (ESCS). Then in 1980, the cooperative program was once again upgraded to USDA agency status as the Agriculture Cooperative Service, which continued through 1994. During this period, a substantial university research program was undertaken through project funding. Arguably, the periods 1953–1976 and 1980–1994, when USDA's cooperative program enjoyed agency status, were the zenith for USDA support of cooperative activities, although even during this period the level of support was variable (Torgerson 1993). In 1994, USDA's activities in support of cooperatives were further downgraded to become the Business and Cooperative Program reporting to the USDA Under Secretary for Rural Development, with a stated "goal of helping rural residents form new cooperative businesses and improve the operations of existing cooperatives" (USDA, Rural Development, Business and Cooperative Progam 2010).

While USDA's technical, research, and educational support directed at traditional agricultural cooperatives has diminished, its financial support of the cooperative model for rural development has increased. For example, in 2010, value-added producer grants totaled \$22.7 million to 196 recipients of which 15 were cooperatives. Rural development grants exclusively for cooperative development totaled \$8 million. And \$3.6 million was awarded under the Small, Socially Disadvantaged Producer Grant Program to minority-owned and minority-controlled cooperatives or associations of cooperatives (USDA, Rural Development, Business and Cooperative Program 2010).

The following evaluation indicates the impacts of the current policy, which lacks a single-agency focal point for cooperatives in USDA, and of reduced federal research, education, statistics, information, and technical support for cooperative activity.

- Technical or productive efficiency is reduced relative to earlier periods, particularly due to decreased support for cooperative research and technical assistance on cooperative efficiency issues related to needed scale of operation and to potential consolidation with accompanying increased coordination of cooperative supply chains.

- Allocative efficiency is reduced, particularly due to decreased support for analyzing cooperative competitiveness issues and providing technical assistance to deal with them. Allocative efficiency, likewise, is reduced by the decreased ability of cooperatives to accurately assess their market situation and to challenge ever-increasing control exercised by integrated supply chains.
- Dynamic efficiency is decreased, particularly due to the lack of information and education on the rapid changes that are occurring in agricultural markets and cooperative options for dealing with these challenges that are available to producer leaders.
- Nonmarket benefits from the perspective of rural development would improve.

The federal cooperative program option involves restoring agency status for USDA support of cooperative activity. At each stage when cooperative programs have been downgraded to a division of a larger program having a different mission and culture, federal cooperative support has decreased for cooperative research and technical assistance. The impacts of this option would be the opposite of the current policy including:

- Technical or productive efficiency would be increased as cooperative research and technical assistance are accelerated and focused on cooperative efficiency issues related to needed scale of operation and to potential consolidation with accompanying increased coordination of cooperative supply chains.
- Allocative efficiency would be improved with increased support for research and technical assistance on cooperative competitiveness issues and technical assistance to deal with them. Likewise, allocative efficiency would be increased by enhanced ability of cooperatives to accurately assess their market situation and to challenge ever-increasing control exercised by integrated supply chains. Also, moderate-sized farmers, as a primary cooperative constituency, would likely be more fully represented in supply chain managed markets for farm products.
- Dynamic efficiency would be increased by more effective programs providing information and education to producer–leaders on the changes occurring in agricultural markets and cooperative options for dealing with these challenges.
- Nonmarket benefits would be neutral as cooperative development in rural areas continues to be fostered.

State–Federal Support for Cooperatives

States had enacted cooperative laws to assist farmers to organize as cooperatives well before federal laws existed. The first cooperative marketing statute was enacted in 1865 in Michigan (Bakken and Schaars 1937). Other states followed suit. By 1920, numerous states had enacted special cooperative laws. States have amended these laws from time to time to clarify appropriate cooperative business practices and to broaden types of businesses that could be incorporated as cooperatives. These state laws are consistent with the Capper–Volstead Act.

As previously mentioned, the states of Wyoming, Minnesota, Wisconsin, and Iowa have passed new generation cooperative laws under which businesses may incorporate. These laws were in response to new generation type or value-added businesses struggling to obtain adequate equity capital under the traditional cooperative model, and as a result, being organizing as limited liability companies.

Several states have councils or institutes that support cooperatives. In 2010, there were 11 active state cooperative councils or institutes. These councils and institutes are mostly funded by dues paid by cooperatives located within the state. Activities include political representation on the behalf of cooperatives and their members regarding legislation and regulations that may impact them. Councils and institutes also provide information and educational programs regarding the cooperative business model, to youth, members of cooperatives, boards of directors, political representatives, and the general public.

State activities in support of cooperatives have had positive effects for each of the market performance attributes. In certain respects, state support has had the effect of offsetting reduced federal support, but not fully. Universities and colleges have a long tradition of offering courses and conducting research and extension activities pertaining to cooperatives. At some universities, special cooperative centers have been established with financial support from university budgets, program fees, federal and state grants and support from cooperatives. Currently, four of these centers are active: Arthur Capper Cooperative Center at Kansas State, Cooperative Enterprise Program at Cornell University, Quentin Burdick Center for Cooperatives at North Dakota State University, and the Center for Cooperatives at University of Wisconsin. These centers are active in cooperative education, providing cooperative board and management training and, to a limited degree, conducting cooperative research. Much of the activity is coordinated with the state councils and institutes. A few universities have a designated cooperative chair or a single faculty position devoted to cooperatives. Texas A&M University, Iowa State University, Oklahoma State University, and the University of Minnesota are examples (Kenkel and Park 2011).

However, teaching, research, and extension activities directed at cooperatives by universities and colleges have greatly diminished from where they were 30 years ago. Many universities or colleges that once had faculty devoted to cooperatives no longer do. While in 1977, 39 states had an agricultural economist with an extension program in cooperative education and technical assistance; in 2011, there were only six, and five were funded by endowments (Boland 2011). As alluded to previously, research funds devoted to cooperatives from USDA, once a significant source of research support for university faculty, have almost disappeared. The net result is many undergraduates at universities and colleges receive limited or no exposure to the cooperative model, and limited research is directed at cooperative issues. The vast majority of university and college graduates do not have the level of understanding of cooperatives that cooperatives would benefit from when hiring new employees.

Through the efforts of the National Cooperative Business Association, a $500 million grant was obtained in 2008 from the federal government through special appropriations to study the economic impact of all cooperatives, agricultural and nonagricultural. The project was coordinated and implemented by the University of Wisconsin Center for Cooperatives. This study found that nearly 30,000 U.S. cooperatives operate at 73,000 places of business throughout the USA; generate nearly $654B in revenue; add over 2 million jobs that paid $75 billion in wages and benefits; and provide $133.5 billion in value-added income (Deller et al. 2009).

Reduced state university support for cooperative research and education has caused a further deterioration in national support for cooperatives. This has adversely affected each of the market performance dimensions.

One federal–state option involves restoring the number of university and college faculty devoted to cooperatives and restoring the level of funding for research, teaching, and extension. Implementing this option requires a restoration of a state–federal cooperative policy to earlier status. These public sector actions would improve each of the market performance dimensions. However, given budget pressures and competing demands at both the federal and state levels, such actions currently seem unlikely.

The only bright spot for increased cooperative support is from the private sector. As noted previously, the only remaining extension education cooperative positions are endowed by cooperatives. In 2004, over $19 million in endowments were funded by cooperatives, which are the largest contributors to U.S. agricultural economics departments (Boland 2011). These private sector actions improve each of the market performance dimensions. More private sector investments of this type would further improve each of the market performance dimensions.

Conclusions

The most important federal policy undergirding cooperatives and bargaining is the Capper–Volstead Act because cooperatives and bargaining associations, as we know them, could not exist without this landmark legislation. Beyond giving cooperatives the right to organize and exist, the limited antitrust exemption gives them the right to combine by forming marketing agencies in common that can reach the scale of operation required to compete with similarly large C-corporations. The effects of Capper–Volstead on market performance are generally positive. The distribution of responsibility for antitrust enforcement regarding Capper–Volstead is unclear. While statutory clarification runs substantial risks, joint USDA–Department of Justice administrative initiative could be utilized to effectively deal with this policy issue. The effect would be to further enhance allocative efficiency.

Some cooperatives, such as milk cooperatives, may be dependent on marketing orders for their position as strong market forces.

The formation of new generation cooperatives is consistent with integration and supply chain developments in agriculture and the food industry. However, new generation cooperatives present significant statutory challenges for both federal and state policymakers and risks for cooperatives. The main challenge is one of integrating new cooperative laws into traditional cooperative law. While this is an important need, its risks and the resulting resistance from traditional cooperative institutions are substantial.

The AFPA has provided little or no support for effective bargaining since its enactment in 1967. Yet, contract integration plays an ever-increasing role in managing supply chains. This explains the need for and role of new generation cooperatives. While the proposed Producer Protection Act could positively facilitate improved market performance, economic assessments indicate that care would need to be taken to avoid unintended consequences.

USDA could exercise substantial positive leadership in assisting cooperatives and the U.S. Congress in adjusting cooperative and bargaining policies to the twenty-first century supply chain managed food system. Unfortunately, it has taken significant steps backward in its level of and in the nature of cooperative and bargaining support. Fortunately, cooperative private sector support has offset a portion of the decreases in public sector support.

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Chapter 6
Federal and State Marketing Orders

Mechel Paggi and Charles F. Nicholson

Abstract Marketing orders (MO) have been a fundamental component of US agricultural policy since the 1937 Agricultural Marketing Agreement Act. They were established to modify the conduct and performance of participants in selected agricultural commodity markets to achieve "orderly marketing." As of 2011, MO existed for milk and approximately 22 types of fruits, vegetables, nuts, and specialty crops. Commodities regulated by MO share certain economic characteristics, including greater perishability (less storability), price variation and related distributional inequalities and multiple market outlets providing opportunities for price discrimination. MO for fruits, vegetables, nuts, and specialty crops have provisions that focus on grades and standards (including food safety) and volume restrictions (often linked to opportunities for price discrimination). MO for milk focus on minimum price regulation, with emphasis on milk used for fluid purposes. The economic impacts of MO have been examined in numerous studies, often without a strong consensus about how they affect the various forms of economic efficiency, either in general or for specific commodities. Policy options for MO include (a) maintaining current MO, (b) replacing MO with other government marketing programs, (c) modifying MO to keep pace with changes in industry and market characteristics, and (d) elimination of MO with or without a phase-out period. Additional research on MO should focus on the fundamental market parameters (such as relevant elasticities), nonmarket effects of MO (such as impacts on nutrition or health), and the dynamic implications of MO elimination or modification on price discovery, risk management options and use, and organizational arrangements.

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Overview of Agricultural Marketing Orders

Marketing orders (MO) were originally developed in the 1930s and remain under the authority of the Agricultural Marketing Agreement Act of 1937 (AMAA), as amended. They represent a set of policies chosen to achieve preferred objectives with respect to industry conduct and performance. Originally those objectives were associated with orderly marketing and the establishment of parity prices for farmers. Although the notion of parity prices has long since been abandoned, additional commodities have been added and some new issues have been addressed, but the fundamental statutory provisions have remained the same. In a number of cases, the main order provisions have remained in place for over 75 years (Neff and Plato 1995).

Marketing orders exist for milk and approximately 22 types of fruits, vegetables, nuts, and specialty crops, although this number has fluctuated over the last several decades and is subject to change in the future. The AMAA also authorizes a marketing agreement for peanuts, which is not discussed in this chapter. In the case of fruits and vegetables, marketing orders allow industry participants to exercise collective action to achieve a variety of objectives designed to stabilize both product price and market supply. Unlike the provisions for fruits and vegetables, the addition of provisions 8(c) and 18 to the AMAA in 1937 were designed to enable milk marketing orders to establish effective minimum prices. Because many of the milk marketing orders provisions are different from those applicable to fruits, vegetables, nuts, and specialty crops, their provisions and economic impacts will be discussed separately. However, there are several economic similarities between these two groups of commodities that can lead to market failures and have resulted in the use of marketing orders to mitigate the impact of these failures. These similarities are seldom highlighted and can be overlooked in marketing order evaluations of this type. Such similarities include:

(a) Marketing order commodities have various levels of perishability. Many marketing orders regulate products marketed as fresh commodities that are highly perishable, although others have various levels of storability.
(b) Perishability frequently results in substantial price volatility and the potential for distributional, opportunistic, and free-rider inequities in the prices received by farmers/growers. As a result, orders frequently contain provisions for pooling or blending of marketing receipts.
(c) Differences in perishability and storability often lead to multiple market outlets and opportunities for price discrimination as a means of increasing producer returns. For example, fresh markets often create the potential for commanding substantially higher prices than storable processed or dried commodities.

The procedures for establishing a fruit, vegetable, nut, or dairy marketing order are basically the same. Marketing orders apply to specific commodities produced within a defined geographic area. A marketing order is usually proposed by a producer group, subject to public hearings for review, and analyzed by the United States Department of Agriculture (USDA) to determine if it is necessary to promote orderly marketing of the product. If so, the order is proposed for adoption. The Secretary of Agriculture is responsible for reviewing any objections to the adoption of a proposed order, and upon a favorable review grants an approval for a referendum for adoption.

A marketing order will be implemented if two-thirds of the eligible producers voting in the referendum approve or if producers who are accountable for two-thirds of the production of the commodity vote in favor of adoption. Once a marketing order is issued, it is binding on all handlers of that commodity within the specified geographic area. Marketing orders differ in this respect from marketing agreements (also authorized under the AMAA) that are binding only upon the signatories of the agreement. A marketing order may be terminated at any time by the Secretary of Agriculture and (or) if a majority of the producers of the commodity as described above vote to do so. Milk marketing orders are administered by a Market Administrator. Orders for fruits, vegetables, nuts, and specialty crops are administered locally by committees made up of growers and (or) handlers and often include a representative of the public at large. The language available on the Agricultural Market Service website indicates “often a member of the public,” which suggests that public representation is not mandatory.

Fruit, Vegetable, Nut, and Specialty Crop Marketing Orders

Marketing orders and agreements are legal instruments issued by the Secretary of Agriculture that are designed to stabilize market conditions for certain agricultural commodities by regulating the handling of those commodities in interstate or foreign commerce. Under the applicable regulations, marketing orders for any commodity or its products, other than milk, must be designed to accomplish at least one of the following goals:

(a) Limit and (or) allot the amount of any commodity, or any grade, size, or quality of that commodity that is marketed.
(b) Provide for control and disposition of surplus commodities and establish reserve pools.
(c) Require inspection of the commodity covered by the marketing order.
(d) Provide “a method for fixing the size, capacity, weight, dimensions, or pack of the container, or containers, which may be used in the packaging, transportation, sale, shipment, or handling of any fresh or dried fruits, vegetables, or tree nuts.”
(e) Establish research and development projects to “assist, improve, or promote the marketing, distribution, and consumption or efficient production” of commodities covered by a particular marketing order (U.S.C., 608c(6), C.F.R., title 7; subtitle b; Chapter 9).

In addition, certain marketing orders provide for regulation of the imports of like commodities to insure that they meet the same comparable grade, size, quality, maturity, or other standards applicable under the order applicable for domestically produced products. Imports of commodities regulated by Section 8(e) are only subject to these constraints during the period of time the domestic commodity is subject to regulation under an existing marketing order. Currently, those commodities subject to Section 8(e) provisions include: avocados, dates, hazelnuts, grapefruit, table grapes, kiwifruit, olives, onions, Irish potatoes, raisins, tomatoes, and walnuts. In addition, for those fruits and vegetables regulated only in their fresh form under a marketing order, imports of like fruits and vegetables are exempt from regulation if imported for processing. The provisions of Section 8(e) are subject to, and compliant with, provisions of the World Trade Organization (WTO) that ensure imports face no higher standards than those being applied to domestic commodities.

USDA's Fruit and Vegetable Program's Marketing Order Administration Branch (MOAB) is responsible for the overall administration of the fruit, vegetable, and nut marketing orders. In practice, five marketing field offices carry out the oversight functions that include: attend administrative committee meetings, review compliance plans, preparation of committee member selections, committee project approvals, marketing policy reviews, informal rulemaking, formal rulemaking preparations and referenda, new services support, and processing alleged violations.

In 1982, there were 47 federal marketing orders in operation covering 34 states. Currently, there are 32 federal marketing orders in effect for about 20 commodities (USDA 2010). The California nectarine and peach marketing orders were suspended in March 2011. The estimated farm value of commodities marketed under these orders was $8.2 billion in 2007–2009, representing 5% of total farm receipts from crop sales. This number is derived by averaging annual data for the 3-year period 2007–2009. During that period, $11.8 million was the total U.S. farm value of crops regulated under fruit, vegetable, nut, and specialty crop marketing orders. Of that value, $8.2 million, or 70%, was the actual value of the crops regulated, since some marketing orders regulate only a portion of the total U.S. crop. In addition, State marketing orders also exist, primarily in California where 24 non-dairy commodities are covered by some marketing order provision. However, the function of the state orders is to provide for funding of commodity specific research and promotion activities unlike the grades, standards, and quantitative marketing components contained in federal orders.

Evolution of Marketing Orders for Fruits, Vegetables, and Tree Nuts

Since their enactment, marketing orders for fruit, vegetables, and tree nuts have evolved both in terms of the statutory provisions of the orders for all commodities in the group and for the terms of individual orders for specific commodities. In 1948 and 1954, amendments were adopted to allow for the use of minimum quality and maturity standards and continuation of the rate-of-flow regulations. In 1961, amendments to allow actions taken at any point in the marketing season to continue throughout the season were adopted, and in 1965, provisions were added to establish and enforce container and package requirements. Provisions were approved to assess handlers for production research, marketing research, and development projects in 1970 (Armbruster and Jesse 1983).

In the early 1970s, the oil embargo and the Russian grain deal made the public more aware of the impact of commodity shortages on prices and led to increasing concerns about marketing orders. The various concerns about marketing orders included the results of economic analyses that concluded marketing orders lead to chronic overproduction, benefit less efficient firms, restrict new growers, raise prices above what would occur in a free market environment, and are administered with too little consumer input (US GAO 1985). The result of these concerns led to a number of government reviews of the marketing order programs over the period 1974–1981. In each case, the results of the reviews reported both benefits and shortcomings of the programs and suggested some changes to their operations (Jesse and Johnson 1981). These changes were incorporated into broad guidelines issued by USDA in 1982 to marketing order committees on such issues as the establishment of market performance criteria to evaluate marketing order tools (USDA 1982).

The evolution of marketing orders also has included changes to individual marketing orders to reflect concerns over issues related to food safety. Marketing orders have incorporated food safety-related requirements for many years. Most federal marketing order programs include minimum grade requirements with most U.S. grade standards having criteria related to food safety (e.g., lack of mold, insects, foreign material, etc.). For example, the marketing order for California prunes has had inspection and fumigation requirements relative to live insect infestations since 1961. California raisins have had standards related to insects as well as the presence of dirt or mold in place since 1977. Also since 2005, the pistachio marketing order has required handlers to test all nuts destined for human consumption for *aflatoxin*, which, if present, would lower the quality and market value of pistachios. Beginning with the 2007–2008 crop, almond handlers are required to treat almonds prior to shipment to reduce the chance of *Salmonella* contamination, a health hazard that can lower the quality and value of almonds shipped to market (Day 2007).

The evolution of marketing orders and agreements can be expected to continue in the future. In particular, it is expected that closer cooperation between federal agencies will produce increased food quality standards and perhaps new orders and agreements designed to enhance the safety of fruit, vegetables, and tree nuts. For example, the leadership of the U.S. Food and Drug Administration (FDA) believes that closer coordination with AMS will be part of ongoing efforts to enhance food safety. It is anticipated that FDA will work closely with AMS to incorporate produce safety standards in product specific marketing orders to increase compliance with FDA's standards (Taylor 2009).

Economic Impacts of Marketing Orders for Fruits, Vegetables, and Tree Nuts

The numerous provisions of marketing orders for fruits, vegetables, and tree nuts result in diverse economic impacts. This section discusses impacts of minimum quality standards, import quality standards, price discrimination, reserve pools, market flow provisions, and standardization of packing and containers.

Impacts of Minimum Quality Standards

The most pervasive provision in federal marketing orders is the authorization to establish minimum standards for grade, size, and maturity. Shipment of products that do not meet the minimum standards is prohibited. Minimum quality standards (MQS) facilitate marketing by product description, improve marketing efficiency, lower transactions costs, and allow for product differentiation (Farris 1960). In recent years, quality standards for federal orders have been established or modified to include tolerance for the presence of certain microbial contaminants to address increasing concerns over food safety. For example, the marketing order for California pistachios that became effective in 2005 established a maximum tolerance level for aflatoxin and mandates testing and certification for it. In reaction to two salmonella incidents in 2001 and 2004, the California almond industry initiated action to establish a mandatory pasteurization plan in the almond federal marketing order (it had been in effect since 1950) in September 2007. Accordingly all almonds are now pasteurized before being sold to customers in North America.

The use of minimum quality standards for fruits, vegetables, and tree nuts may increase the demand for these products because of the increased buyer certainty of standard attributes. Removal of inferior products from the market decreases consumer dissatisfaction, which would otherwise reduce subsequent sales of higher quality product over the course of a given marketing season. Cost reductions may also result if uniform product deliveries result in less rejected shipments, associated spoilage, and waste.

Impacts of Import Quality Standards

As discussed previously, the imports of some commodities are regulated by Section 8(e) of the AMAA and are subject to the comparable grade, size, quality, maturity, or other standards under the order applicable for domestically produced products. These constraints are only applicable during the period of time the domestic commodity is also being subject to the regulations of the existing marketing order, with exemption for processing use if such use is not covered for domestic production under the marketing order. The provisions of Section 8(e) are subject to, and compliant with, provisions of the World Trade Organization (WTO) that ensures imports face no higher standards than those being applied to domestic commodities. To date, little empirical analysis of the effects of MQS on imports has been reported. However, Chambers and Pick (1994) demonstrated that it is possible for MQS to act as nontariff trade barriers in a theoretical context. This may also be more than a theoretical threat, because Mexican growers have complained that 8(e) provisions are designed to penalize varieties grown in Mexico.

Impacts of Price Discrimination

Some marketing orders such as for raisins authorize handlers to allocate shipments among primary and secondary markets (Keeling and Andersen 2004). These quantity controls are considered to be one of the stronger forms of regulation permitted under marketing orders, assuming the direct control of the supply of a commodity in a given market has the greatest potential for affecting prices. In the case of raisins, there is price discrimination between raisins sold as free tonnage to domestic consumers at higher prices than reserve tonnage raisins destined for sale to export markets and/or government programs sold at lower prices. With price discrimination, the industry demand curve for raisins is the average revenue curve derived from the free tonnage price, the export market price, and the residual market price along with the share of supply sold in each of those markets.

The impacts of the program depend on the elasticity of pooled demand. If pooled demand is inelastic, producers benefit through higher total revenues. If it is highly elastic, the price discrimination program may be ineffective in raising industry income or profits. In the most recent study of the elasticity of demand for California raisins, the own price elasticity was estimated to be −0.67, relatively inelastic, which implies that price discrimination provisions in the raisin marketing order would be beneficial to producers (Green 1999). Although some export markets for raisins may have more elastic demand [e.g., Kaiser (2005) estimated the raisin demand in Japan as −1.1], the overall demand for raisins is believed to be inelastic (Vassilos and McCalla 2009). Under these market conditions, this marketing order provision will result in producer price and revenue enhancement. A similar analysis would be required for each of the commodities covered by price discrimination provisions to discover how their producers may be affected (Alston et al. 1993).

Impacts of Reserve Pools

A reserve pool establishes a procedure for withholding some of the supply of a commodity from the market if the supply is large relative to some estimated demand at a given desirable price level. Over the period of the marketing year, a determination may be made to release some of the quantity held "in reserve" if market conditions improve. Alternative uses for the reserve include sales to secondary markets, sales for nonfood use, or carryover stocks. Some commodities have provisions for reserve pools as part of their marketing orders including California walnuts, Far West spearmint oil (FWSO), tart cherries, California raisins, California prunes, California dates, California almonds, and Florida citrus. But reserve pools are not currently being used by the almond, date, walnut, prune, and citrus industries. The California raisin industry has made frequent use of volume control measures, although recent crop conditions resulted in declaration of 100% free tonnage for the 2010 crop. Most recently, the Raisin Administrative Committee decided in October 2010 to discontinue the two-price system that was utilized to enhance export sales through the volume control provision. The tart cherry industry has used volume control and has placed product in the reserve pool in recent years; it is currently in the process of revising the use of the reserve pool. During the 2010–2011 marketing year, FWSO growers had allotments of 28 and 43% for Scotch and Native production, respectively, with the balance of production destined for the reserve pool (Federal Registry 2010).

The impacts of reserve pools depend in large measure on how, and how frequently, they are used. If reserves are used to smooth supply, reducing marketable supplies in years of large crops and releasing supplies in small crop years, prices could be stabilized compared to the situation without storage availability. In the absence of reserve pools, there may be greater potential for abandonment of crops during times of low prices, which may lead to increased price and production instability. If large quantities are diverted to secondary markets or nonfood uses, the effects would be similar to those of price discrimination.

Impacts of Market Flow Provisions

The provisions for regulating the flow of product, to smooth shipment volumes in the marketplace during a specific time period, are no longer in use. The "prorate provision" was intended to smooth market supply but not affect the total quantity marketed during the entire season. These provisions were last utilized within the California–Arizona citrus marketing orders that were subsequently terminated (Neff and Plato 1995; Thompson and Lyon 1989; Powers 1991). "Shipping holidays" are a provision to prohibit shipment of selected commodities (the Florida citrus marketing order is an example) during a specific time period, usually during the Thanksgiving and (or) Christmas holiday seasons. The motivation is to prevent products from accumulating at terminal markets at times when product movements are usually slow. It is considered the weakest form of quantity control mechanisms among the federal marketing order provisions.

The empirical evidence about the impacts of market flow provisions is limited. In the case of celery, pricing under shipping holidays did not represent a statistically significant departure from that which would be characterized by a perfectly competitive market (Taylor and Kilmer 1988). These results are consistent with those found by Shonkwiler and Pagoulatos (1980) using a simultaneous equation model based on weekly data.

Impacts of Pack and Container Standardization

Some orders specify pack and container regulations, which assure buyers of shipment consistency and may reduce marketing costs. Standardized package sizes make products easily recognized throughout the market. Historically, the existence of standardization of packaging and containers also has allowed for the development of equipment and procedures to increase the efficiency of product handling. In addition, standardized packaging and unit size can facilitate reporting of pricing and other marketing information (Padberg and Hall 1995). More recently, packaging standardization provides additional information to assist in trace-back capabilities in the event of a foodborne illness outbreak.

Overview of Economic Efficiency Under Fruit, Vegetable, and Tree Nut Marketing Orders

In some cases, the evaluation of economic efficiency may be considered redundant. In the neoclassical economic paradigm, all markets are fully competitive and operate under conditions of full information with the absences of externalities and the resulting market equilibrium conditions are, by definition, efficient. Analysis of a market, with regard to economic efficiency, is only relevant in the presence of market imperfections (Rausser et al. 1985). It is within this context that marketing orders may be viewed as government intervention to correct perceived imperfections in the market for selected fruits, vegetables, and tree nuts.

Marketing orders enable producers to alter the operational rules for their industry and, hence, affect the conduct of the firms subject to the regulations associated with a given order and the performance of their industry (Townshend-Zellner 1961). Marketing orders are an alteration of the market conduct intended to lead to more orderly marketing and increased price stability, if not price enhancement. This desired result between government control and market conduct is the basis for the marketing order system authorized by Congress. Accordingly, an analysis of the effect of marketing orders on economic efficiency must imply some ex post analysis of industry performance with regard to price levels, production levels, and other observable measures.

There have been attempts to measure the value of marketing orders in terms of their economic efficiency, as measured by gains and losses in consumer and producer surplus or consumer utility, but with little empirical evidence. The conclusions from these studies are not definitive and results depend on effects of control programs, substitution in consumption, degree of risk aversion, etc. (French 1988). Previous studies also have examined effects on efficiency and other goals by examining major provisions of marketing order separately, such as price discrimination, producer allotments,[1] reserve pools, minimum quality standards, import quality standards, pack and container standards, and research and advertising provisions (USDA 1981). In this way, an assessment can be made of the various market controls with regard to their effects with the view that such controls should be avoided unless (1) efficiency gains from mitigation of market failures and externalities are greater than any losses in efficiency or (2) controls obtain some social goals that are valued more highly than the goal of efficiency.

[1] Producer allotments are authorized and were used in the case of cranberries in the 2000 and 2001 crop years, but for Florida celery the allotment was nonbinding and the order was suspended in 1995. The marketing order for hops authorized allotments but was terminated in 1987. Currently, only Far West spearmint oil has a functional allotment program. Information on the performance of the FWSO may be found in Balagtas et al. (2006).

The evolution of the marketing system over the last several decades may imply the need for additional criteria to be used in judging market performance. Today's fruit, vegetable, and tree nut markets, often dominated by global supply or value chains, may require respecification of the applications of the concepts of economic efficiency to these marketing structures, firm conduct or behavior, and the expectations of consumers for quality, safety, and diversity of choice. Given these market developments, evaluation of the performance of markets operating under the rules and regulations of the federal marketing orders described in this chapter need to also include a review of how well they perform relative to other criteria such as technical or productive efficiency, allocative efficiency, dynamic efficiency, and nonmarket benefits. Within this context, there is little history of studies to examine the performance of federal marketing orders for fruits, vegetables, and tree nuts.

Technical Efficiency Under Fruit, Vegetable, and Tree Nut Marketing Orders

Technical (or productive) efficiency is often measured using an approach in which "inefficiency" is measured as the distance between a farm's actual production value and an estimated "best" (frontier) value for a given technology (Aigner et al. 1977). Although there are many studies of the technical efficiency of farm-level production, especially for developing countries, studies of the efficiency of the marketing system are much less common (Iraizoz et al. 2003). Studies of the technical efficiency of marketing orders for fruits, vegetables, and tree nuts are at best inconclusive.

The existence of marketing orders may increase the development of and (or) adoption of technology that reduces the transactions costs associated with conforming to the mandates of the order. For example, grades and quality standards may lead to the adoption of innovative techniques for monitoring and controlling quality (Filson et al. 2001). To the extent that the entire industry benefits from providing high-quality products, there would be incentive for this type of technology to be adopted by others and shared more freely by its developers. However, others suggest that the opposite might be true: when marketing controls exist it is suggested there is little incentive for growers or handlers to make use of technological innovations. The limited use of "shrink wrap" for lemons is cited as an example (Gattuso 1985). More recently, research on the dried plum industry suggests that easy-to-implement improvements in grading mechanisms were not adopted because these undervalued large prunes relative to small ones, reducing the incentive to produce them. This was cited as "a classic third-degree price discrimination scheme" (Chalfant and Sexton 2002).

Allocative Efficiency Under Fruit, Vegetable, and Tree Nut Marketing Orders

Allocative efficiency exists when competitive markets send the price signals needed to allocate inputs and outputs in a way that minimizes costs and maximizes the welfare of consumers. Market failure due to imperfect or asymmetric information, externalities, and inequality of bargaining or market power among firms, producers, and consumers interferes with the marketing system's ability to achieve allocative efficiency (Hailu et al. 2005). Although an initial emphasis of fruit, vegetable, and tree nut marketing orders was on improving market information, the challenges are greater today because of increased concern about environmental and other externalities. In this context, allocative efficiency now implies that prices paid throughout the supply chain should be equal to (social) marginal costs, so that there is no deadweight loss.

No comprehensive study exists of the allocative efficiency of fruit, vegetable, and tree nut marketing orders. As a result, one must consider a limited number of studies of individual orders as illustrative rather than definitive. One example is a study by Gray et al. (2005) on the marketing order for pistachios. This study also explicitly considers food import safety. The authors analyze the potential effects of marketing orders on consumer and producer surplus measures, providing evidence that marketing orders can have positive impacts on allocative efficiency. The analysis indicated that a benefit–cost measure was always favorable to the marketing order policy across a range of scenarios. The measured benefits to producers, the nation, and the world always well exceeded the measure of costs, generally by many times.

The results of the study of the pistachio marketing order clearly demonstrate the positive potential of such programs. When an order helps correct a genuine market failure, such as eliminating immature but attractive-looking fruit from the market, everyone gains. Similarly, everyone probably benefits if a regulation reduces extreme volume and price swings from week to week, thereby reducing marketing costs (Zepp and Powers 1990). Some of the savings probably are passed on to both growers and consumers. Allocative efficiency gains also may be obtained under marketing orders with the use of minimum quality standards, if the demand for a product is influenced by the standard attributes, as mentioned above. Other efficiency gains may result from a reduction in marketing costs, if uniform product deliveries result in less rejected shipments and associated spoilage and waste.

However, concerns remain that not all marketing orders produce the same outcome. As suggested in the Zepp and Powers article in the *National Food Review,* there is not always a clear-cut answer. The existence of quality standards can negatively affect allocative efficiency through impacts on both the supply and demand for a commodity. On the supply side, the presence of minimum quality standards related to size, grade, and/or maturity will reduce the amount available for sale in the short run, acting as a de facto quantity control and resulting in price enhancement. In the longer run, increased prices may attract excess investment of resources into production. If "below standard" product is diverted to other uses such as processing, the minimum quality standards may also lead to effects similar to those of price discrimination. Growers may gain from regulations that enforce quality standards for cosmetic attributes such as size or shape.

Price discrimination or reserve pool programs can reduce price variation and enhance producer revenues, but these may or may not outweigh the cost of resource misallocation due to price discrimination. If producers expand production in response to higher returns, too many resources may be put into producing the controlled commodity relative to the case where no controls exist. In addition, the short-term effects of marketing orders may be different from the long-term effects. Controls such as market allocations, which, for example, divert output from the fresh domestic market to processing or export, may raise average farm prices in the short term and cause consumers to pay higher prices. However, elevated prices likely will cause farmers to expand capacity in the longer term, which may benefit consumers by providing insurance against shortages and extremely high prices during years with relatively small crops.

Quality standards and other provisions of fruit, vegetable, and tree nut marketing orders may result in net welfare gains or losses depending on how they are used. Little empirical evidence is available to determine the magnitude of those effects. However, existing analyses suggest the effects are small. In the case of supply restrictions, only small amounts of product, 6% or less were kept off the market and those standards were not altered from year to year based on crop size (US GAO 1985). The GAO concluded that quality controls that ensure uniform quality regardless of crop size and prohibit shipments only of clearly unsatisfactory products contribute to an economically efficient marketplace. More recently, these results have been challenged by theoretical work that concludes minimum quality standards can never enhance social welfare because they create two sources of deadweight loss (1) wastage of low-quality product that cannot be sold and (2) excessive product quality enhancement (Saitone and Sexton 2010). Accordingly, Saitone and Sexton suggest that minimum quality standards may represent a second-best policy tool to transfer market surplus from consumers to producers.

Allocative efficiency may also be affected by changing the distribution of costs and benefits (welfare) among consumers, handlers, and producers. Studies that focus on simulation of market performance with and without marketing orders typically conclude that if marketing orders succeed in raising the net returns to growers, they reduce consumer surplus by an amount greater than the benefit to producers. Price discrimination and the use of reserve pools with large sales to secondary markets, or to nonfood uses, should result in a short-run decrease in the consumer welfare in the primary market due to higher prices, a reduction that may be greater than the corresponding increase in producer welfare. French and Matthews (1971) concluded that the cling peach marketing order was an expensive means of providing improved returns and greater market stability. Regulations that prohibit the sale of smaller or misshapen products penalize those buyers willing to purchase such items at a lower price. In addition, diversion of otherwise edible fruit may deny access to the range of dietary choices available to the poorer consumers.

In contrast, some studies have demonstrated that changing the assumptions of the analysis and allowing for the presence of a risk response results in a net change in social welfare (USDA, AMS 1981). Studies of the lemon market suggest trade-offs in the long run, whereby higher returns to growers may lead to increased supplies that would, eventually, benefit lemon consumers (Carman and Pick 1988). French and Nuckton (1991) report a similar effect for the raisin industry. They conclude that reduced variability of prices and grower returns due to market controls resulted in both higher production and lower prices to consumers in the long run. As a result, the authors suggest that the public interest may have been well served by the raisin volume control program, or at worst, there was no significant welfare loss.

Federal and State Milk Marketing Orders

Historical Context for Milk Marketing Orders

Milk marketing orders often are regarded as the most complex of the suite of U.S. dairy policies, and probably have been the most researched. The stated objectives of orders are to bring about more "orderly" marketing, price stability, price adequacy for producers, price equity among both producers and processors—at least within a given region—and adequate supplies of beverage milk for consumers. Largely in contrast to the mechanisms used by fruit, vegetable, and tree nut marketing orders, milk marketing orders are designed to accomplish these objectives by regulating and supervising the terms of exchange between dairy farmers, including the cooperatives that often represent farmers, and the buyers of milk.

The historical context is important to understanding why milk marketing orders were implemented. Although milk orders often are described as Depression-era programs, the problems milk orders were designed to address were recognized and some measures to address them were implemented long before the 1933 Federal legislation initiating orders and later codified. Even the most vehement critics of milk marketing orders recognize that, prior to their implementation, regional U.S. milk markets suffered from severe disruptions including milk strikes, violence, and dramatic fluctuations in both prices and fluid milk availability (Ippolito and Masson 1978). Efforts to promote producer cooperatives as a means to address these problems had seen limited success during the 1920s, and many observers noted that both producers and processors suffered from what was termed "destructive competition" and inefficiencies in marketing, including excessive milk collection and processing capacity (Forest 1975; Novakovic and Boynton 1984). Although some economists have debated the most appropriate definition of a "disorderly" market (AAEA 1986), it is clear that conditions in milk markets during the three decades prior to the implementation of orders in the 1930s frequently fell within that definition, and that the onset of the Great Depression and the Roosevelt administration "precipitated the final decision to regulate the marketing of milk" (Novakovic and Boynton 1984). Thus, milk orders were initially implemented to provide stability to a decidedly unstable market that voluntary actions could not address. Although much has changed in milk marketing since that time, so have the structure and function of milk orders.

Milk Marketing Order Provisions

The principal elements of milk marketing orders, whether federal or state, are (a) classification by use, (b) pricing by class, (c) coordination of class prices across markets, (d) pooling of returns across producers, (e) auditing of milk use to enforce the terms of the order, and (f) administrative procedures to implement, amend, or terminate the order. Under *classification*, milk is assigned to a "class" based on the product for which the milk (more specifically, the components in milk—fat, protein, other solids, or skim milk) is used. Although the number of classes for milk has varied over time and for individual orders, the current Federal Milk Marketing Order (FMMO) system has four classes (I–IV) for fluid milk products, "soft" products (e.g., yogurt and ice cream), cheese, and other manufactured products (of which butter and milk powders are the most important), respectively. California maintains a similar system with five products classes (1 through 4a and 4b). Prices that differ by end use predate the advent of FMMOs. Dairy cooperatives charged, or attempted to charge, different prices for fluid and manufacturing milk as early as the 1890s, recognizing the differences in perishability, demand characteristics, and transportation costs (Erba and Novakovic 1995).

Milk orders set *minimum* regulated prices that first handlers (processors) must pay for the milk components (butterfat, protein, other solids, nonfat solids, or skim milk) they use. To do so, *component prices* are calculated monthly using product prices reported by the National Agricultural Statistics Service (NASS) for American cheese, butter, nonfat dry milk (NDM), and dried whey powder, along with a "make allowance" that accounts for the processing costs involved in transforming the raw milk into products. The make allowance exists to allow a dairy product price to be transformed into an appropriate raw milk price, but is often interpreted by producer groups as a guaranteed margin (profit) for processors, which, ironically, include cooperative processors. Under the formulas, a higher make allowance results in a lower class price, so producers resist adjustments to the make allowance even when processing costs increase due to changes in labor and energy costs. The rationale for these product-pricing formulas is that the component prices should be related directly to the price of the products for which that milk is used, although the specific formula to accomplish this have been subject to evaluation and criticism by both economists (Jesse 2004) and dairy scientists. Under FMMOs, the component prices calculated for butterfat, protein, other solids, and nonfat solids used in Classes II, III, and IV are the same for all regulated areas. For the six milk orders that use "multiple component pricing," the financial obligations of first handlers are derived based on their use of components in Classes II, III, and IV and use of skim milk and butterfat in Class I, rather than for a volume of milk per se. The components used for the calculation differ by class. For convenience, the component prices are used to calculate an announced class price for milk of a standard composition, but this is not per se the price handlers are obligated to pay. Class II and Class IV use butterfat and nonfat solids; Class III uses butterfat, protein, and other solids. For the four milk orders that use skim-butterfat pricing, financial obligations are based on their use of skim milk and butterfat for Classes I–IV.

The formulas used to calculate financial obligations of handlers for milk components used in Classes I and II involve three additional elements including the use of (1) the higher of, (2) differentials, and (3) advanced pricing. The "higher of" refers to setting the minimum regulated value of skim milk used in Class I using the larger of two values calculated for Class III or Class IV skim milk prices. For Class I, the higher of skim milk price serves as a base to which is added an additional amount, the "differential" specific to the county in which the milk was received by a fluid plant. The equivalent differential is added to the butterfat price also. The differential was intended to provide an incentive to ship milk to fluid plants, consistent with the objective of ensuring an adequate supply of fluid milk to consumers, although there is no current consensus about whether this incentive is sufficient to achieve this objective. At present, these location-specific Class I differentials vary from \$1.60 to \$6.00/cwt and are coordinated among the different FMMO markets. To provide sufficient incentives for the movement of milk to fluid (Class I) plants, the largest values of the differentials exist where the imbalance between raw milk production and fluid milk demand is greatest. Therefore, differentials have the largest values in the southeastern USA. The weighted average U.S. Class I differential in 2009 was \$2.70/cwt (Nicholson and Stephenson 2010a), which is roughly equivalent to \$0.23 per gallon of fluid milk. "Advanced pricing" refers to a timing difference that exists among the class prices. Class I skim milk, Class I butterfat, and Class II skim milk prices are priced in advance of the month for which the milk will be purchased, that is, prices for these components are known to fluid milk and soft product processors in advance. Prices for Classes III and IV become known to cheese, butter, and NDM manufacturers shortly after the month in which the milk was purchased.

Class prices assure processors that their competitors cannot legally pay less for milk components, and thus provide information about the input cost structure of their competitors. In addition, as long as the highest price is charged for components used in the aggregated product category with the most inelastic demand (fluid), classified pricing increases revenue to dairy producers through price discrimination. Recent studies offer conflicting evidence about demand elasticities for dairy products. Davis et al. (2010) find that the retail demand (not derived demand for farm milk) for individual fluid milk products is elastic, with values from −1.26 to −1.70 based on analysis of household scanner data from 2007. Chouinard et al. (2010) reported that many of these same products were inelastic, with values from –0.62 to –0.79 based on scanner data from 1997 to 1999. Hosken et al. (2002) note that product, temporal, and spatial aggregation influence elasticity estimates, and elasticities using scanner data for individual fluid milk products will typically be more elastic than those estimated using aggregated fluid milk sales data. Maynard (2000) has conjectured that higher elasticities based on scanner data may reflect adjustments to unexpected short-term price movements. The use of the "higher of" Class III or IV skim milk prices to determine the Class I skim milk price has been criticized as economically inefficient (Jesse and Cropp 2004b).

It is important to note that class prices are *minimum* regulated prices. It is typical for buyers of milk to pay more than the minimum price, sometimes substantially more, based on additional services provided by milk sellers, milk quality, milk volume, market conditions, and cooperative bargaining (market) power. The services performed by a milk seller, most often cooperatives, can include weekly and seasonal "balancing" in which the seller agrees to assist the buyer with the management of milk supplies. An example is that many fluid milk plants process milk only 5 days/week, whereas milk is produced all 7 days. Cooperatives offer to find alternative uses for the 2 days in which the fluid plants do not want to process, which may imply additional costs for the cooperatives but needs to be balanced against the profits from processing and the size of the price charges for these services.

The difference between the actual price paid and the regulated minimum price is called an "over-order premium." The average value of the U.S. over-order premium in 2009 was \$0.63/cwt, or about 5% higher than the U.S. average blend price (Nicholson and Stephenson 2010a).

The value of class prices multiplied by the amount of milk components (butterfat and skim) used in each FMMO marketing area determines the total value of milk across all uses. This is a "pooled" monetary value that is distributed to dairy producers. The regulations specify three important limitations for participating in this pool. (1) Only Grade A (fluid grade, based on higher sanitary standards than Grade B milk) milk is eligible to be pooled. (2) Some of the milk pooled must be used for product sales within the marketing area. That is, the regulated area is defined by where the final product is sold, not where farms are located or milk is processed. Fluid processors are permitted to and often do sell products in multiple marketing areas. The marketing order under which they are regulated is determined by the marketing area in which they have the largest percentage of their sales of Class I products. (3) There are performance requirements that specify the minimum amount of milk that must be supplied for fluid uses from farms or cooperatives in order to participate.

The value of the pool divided by the total volume of milk participating in the pool (with additional minor adjustments) is the *blend price*, which indicates the mean price to be paid to all producers who pooled milk on the order. In most orders, the price received by individual producers depends on the composition of their milk (that is, the amount of fat, protein, and other solids), but the variation in prices received by producers is reduced markedly with pooling, consistent with one of the objectives of orders. Note that only fluid milk processors are *required* to participate in the pool. Processors of other manufactured dairy products often find it advantageous to participate, because this allows them to offer the producers from whom they buy milk a share of the pooled value, which usually results in a producer price higher than the price for "manufacturing" milk the producers would otherwise receive. Given the timing of the class price calculation and depending on relative price movements, it is sometimes advantageous for nonfluid processors not to participate in the pool, which is called "de-pooling." The requirements for pooling and de-pooling, whereby processors not required to be regulated temporarily choose not to participate in the pool, have been ongoing issues (Jesse and Cropp 2004a).

FMMOs also contain provisions that allow them to audit the reported use of milk by handlers to enforce the provisions of the orders. The specific administrative provisions for the orders vary, but the implementation, modification, or elimination of a federal milk marketing order requires a two-thirds vote of all producers that would be affected by the order. The order provides a process to amend the order that involves an administrative hearing at which all interested parties, including producers, processors, cooperative, government, and consumers, can present testimony. On the basis of the testimony, the Order Formulation Branch of Dairy Programs in USDA's Agricultural Marketing Service (AMS) issues a recommended decision for comment. Subsequently, it issues a final decision that must be approved by two-thirds of affected producers. Cooperatives can vote as a bloc vote on behalf of their members.

The administrative costs of FMMOs are paid for by an assessment on handlers that is typically less than \$0.10/cwt (or 0.5% of the total milk value).

State marketing orders have generally similar provisions to the FMMOs, but there are some important differences (CDFA 2007). The largest state order is California, which is divided into two marketing areas. California's pricing formulas are specified in such a way that the milk price received for a given class is slightly lower than the equivalent FMMO class price. In part, this reflects the importance of out-of-state (and export) sales to the California industry and sales by the industry to other states. In addition, the slightly lower regulated minimum milk input costs give California dairy product manufacturers a competitive advantage that offsets, to a certain extent, the disadvantage of higher transportation costs to highly populated eastern U.S. markets for manufactured products. California also has a "quota" system that, despite its name, does not directly limit production, but which provides holders of a tradable quota the right to a larger share of the value (a fixed payment from the pool of \$1.70/cwt) of the pooled milk. Finally, California's order requires consideration of both the costs of processing and the costs of milk production in determination of the class prices. Thus, the California Department of Food and Agriculture (CDFA) devotes considerable resources to data collection for manufacturing and production costs. Some dairy producer groups outside of California have advocated for the use of cost of production in class price determination because they want milk orders to serve more of a price support function. However, USDA has successfully argued in court and elsewhere that consideration of supply and demand factors implicitly accounts for costs of milk production and processing.

Evolution of Milk Marketing Orders

The scope and impact of milk marketing orders have changed markedly over time. In the early years, the number of markets, proportion of total milk, and geographic coverage of orders were small. With improvements in the transportation of milk and dairy products, the number of marketing areas increased and orders became larger and more integrated. The number of FMMOs increased through 1960 (at which time there were 80) and then decreased through the consolidation of orders as the geographic area that could reasonably be considered a marketing area expanded. The 1996 Farm Bill mandated further review and consolidation of federal orders, providing that there must be at least 10 but not more than 14 (with one order maintained in California). Following the implementation of order reform in 2000, the number of orders was reduced to 11. Dairy producers subsequently voted out the Western milk marketing order in 2004, leaving the current number at 10. Other orders were terminated for limited time periods in the 1960s (AAEA 1986). The proportion of all milk priced under federal and state orders increased from about 25% in 1950 to roughly 92% in 2000.

Although the geographic coverage and proportion of milk covered by federal and state milk marketing orders have increased, other developments have offset their impact to a certain extent. One development is growth over time in the proportion of milk in classes used for manufacturing, with a commensurate reduction in the proportion of Class I milk. Because Class I milk has the highest minimum regulated price, as the proportion of Class I milk decreases, the contribution of Class I differentials to the overall blend price decreases. In addition, the magnitude of the Class I differential relative to the manufacturing milk price (Class III or IV prices) has decreased over time. These two developments imply that the contribution of classified pricing and pooling on producer revenues has been reduced over time by the evolution of dairy product demand and the levels of the Class I differential established by USDA/AMS (Novakovic 2004).

The Economic Impacts of Milk Marketing Orders

The economic impacts of milk marketing orders have been examined in a plethora of studies dating back to the 1930s. Despite this extensive investment in economic research, a relatively limited consensus exists about market effects, for three principal reasons (1) the outcomes under marketing orders often have been compared to those under a perfectly competitive market, but the underlying markets may or may not be competitive in the absence of orders; (2) the impacts of orders depend on market conditions and interactions with other U.S. dairy policies like the dairy product price support program, direct payment subsidies and, in some cases, additional state-level farm and retail pricing regulations; and (3) most analyses have relied on estimated values of supply and demand elasticities, which vary based on data sources, time period analyzed, and regional aggregation. Combined, these factors led the AAEA Task Force (1986) to conclude that "what 'we' know has proven difficult…to determine," and a similar statement could be made today. Moreover, most analyses have used a comparative statics framework based on an aggregated U.S. market; few studies have examined milk marketing order impacts with regional dynamic models that are likely to be more appropriate to evaluate their impacts (Schiek 1994).

However, there is a consensus based on the existing work that, relative to a perfectly competitive market, milk marketing orders:

- Have increased average U.S. prices paid to dairy producers.
- Have increased total U.S. milk production and changed the regional distribution of production.
- Have increased overall revenues earned by U.S. dairy farmers but have decreased revenues for regions with large manufacturing milk usage.
- Have increased prices paid for fluid milk and retail prices of fluid milk, which has decreased fluid milk sales.
- Have decreased prices paid for manufacturing milk and wholesale prices of dairy products other than fluid milk, which has increased their sales.
- Have reduced social welfare as measured by typical economic surplus measurements.

Thus, milk marketing orders often are described as causing transfers from consumers to dairy farmers that reduce overall social welfare. However, the use of the sum of producer and consumer welfare as the indicator of social welfare implies a very specific form for what welfare economists call the social welfare function and assumes that that marginal utility of money is the same for all market participants. Economists disagree whether these assumptions are appropriate (Rausser et al. 1987). Nearly all of the other (potential) impacts of orders on markets are more conditional and/or controversial. As an example, federal order impacts on manufactured dairy product prices depend, in part, on whether those prices are well above or near the purchase prices specified under the Dairy Product Price Support Program (DPPSP). If product prices are near purchase prices, then market conditions may imply that the elimination of milk marketing orders would not result in a significant change in product prices. As a practical matter, product prices vary by significant amounts over time, implying that the impacts of orders will differ depending on the time period. A related conditional impact of orders concerns the extent to which they constitute an implicit export subsidy for U.S. dairy products (Sumner 1999). Because orders will lower the prices for dairy products compared to a perfectly competitive market, when prices at which U.S. manufacturers could sell product are near world market prices and/or above purchases prices, orders will increase U.S. dairy product exports. The quantitative importance of this has not yet been examined, however, and will vary over time with relative U.S. and world market prices.

Further consideration of other impacts of orders is provided in the discussion below about their impacts on economic efficiency, but it is important to consider first the underlying assumptions about the nature of markets for milk and dairy products. The impacts above make reference to the perfectly competitive norm endorsed as the appropriate benchmark by many economists. If the underlying markets are perfectly competitive, then milk marketing orders have the types of impacts outlined above and many economists would say that government intervention is unwarranted and harmful to social welfare. If underlying markets are *not* perfectly competitive, especially if milk buyers have market power compared to dairy producers, then both the impacts of orders and their implications are different. Imperfectly competitive markets with buyer market power would imply that milk prices for producers would probably be lower, and possibly less stable than under perfect competition. However, buyer market power would imply a social trade-off between two distorted markets, one of which favors milk buyers without orders and the other that favors dairy farmers with orders.

The question of the true nature of the underlying milk and product markets is essential to understanding and interpreting the impacts of milk marketing orders. Determining this true underlying nature is not easy, particularly after more than 70 years of regulated milk markets. Most analysts have adopted one of three approaches to this dilemma: The first is to assert that milk markets now are undoubtedly perfectly competitive. Sometimes, this is preceded by an assertion, from the more historically inclined, that conditions with respect to transportation costs and market integration have changed substantially since the initiation of milk marketing orders, changing the fundamental nature of milk markets (Ippolito and Masson 1978).

The second approach is to indicate that the impacts of orders are conditional on the assumption of perfect competition, sometimes with a statement regarding how the likely magnitude of reported empirical estimates would change if markets are not competitive (Cox and Chavas 2001). Some authors do better than others at maintaining the analytical neutrality implied by this statement. The third approach makes no explicit assumption about the nature of the markets, but implies indirectly that they are perfectly competitive (Hammond and Brooks 1985).

An alternative viewpoint allows that the underlying markets might not be perfectly competitive, but that dairy cooperatives have evolved over time in terms of membership and market power to provide a countervailing presence to any market power buyers might exercise. Thus, a crucial question is whether cooperatives can exercise market power, particularly in the absence of orders. A number of studies have examined this issue, usually by considering over-order premiums charged by cooperatives. These studies generally find that over-order premiums do not provide evidence of cooperative market power (Babb 1989; Cakir and Balagtas 2010). Another study using aggregated dairy price data (Clark and Reed 2000) could not reject the hypothesis of perfectly competitive price relationships for dairy between the producer and retail levels. Many other dairy industry analysts have indicated that dairy cooperatives "still rely heavily upon the federal milk marketing order system to achieve their objectives" due to the free-rider problem (Cropp 2003). Stephenson (2003) described the experience of Milk Marque, a UK dairy cooperative whose share of total producer milk fell from 80 to 37% following price deregulation, implying by extension that the oligopsonistic structure of U.S. dairy markets "will be difficult to overcome with cooperative influence."

Although many U.S. dairy cooperatives have invested in manufacturing facilities to enhance marketing options, add value and gain market power, some analysts (Novakovic 1995; Stephenson 2003) believe that the success of this strategy could be undermined in the absence of marketing orders. Thus, the currently available empirical evidence is not definitive regarding the hypothesis of cooperative market power and/or its continuation in the absence of milk marketing orders. One final approach is to explore the competitiveness of the underlying dairy markets using experimental economics. Doyon (2001) used experimental markets to simulate the impacts of elimination of milk marketing orders with treatments of oligopoly and regulation. Doyon found that, in the absence of regulation, buyers were successful in reducing the milk price and capturing a larger share of the market surplus than would be the case in a perfectly competitive market. Regulation similar to marketing orders under oligopoly reduced both the market power of buyers and fluctuations in the milk price without creating deviations from the welfare outcomes of perfectly competitive markets. One observation consistent with this is the presence of persistent and sometimes proportionately large over-order premiums in many order markets for milk uses other than butter and NDM, which may suggest the minimum regulated milk prices may not be as distorting as is usually suggested in the literature (Stephenson 2003). However, this does not imply that minimum price regulation is not important during periods of larger milk supplies or that regulation does not play a role in the setting of price expectations and strategic decision making by farmers or dairy companies.

Technical Efficiency Under Milk Marketing Orders

The impacts of milk marketing orders on the technical efficiency of dairy farms, processing firms, and food retailers have been little studied. Most studies of technical efficiency are undertaken at the farm level and indicate both large variation among farms and increasing technical efficiency over time (Tauer and Belbase 1987; Byma and Tauer 2010). This diversity makes it all the more difficult to evaluate farm-level technical efficiency impacts. Moreover, the impacts of orders on technical efficiency are related to impacts on farm and processing firm size, structure, and location. The AAEA Task Force (1986) admitted that "the structural impacts of marketing orders are largely in the realm of informed speculation."

Orders have different regional impacts on the average price received by producers, because both the Class I differential and the utilization of Class I milk vary by region. Numerous studies have concluded that average milk production and transportation costs are higher than they would be without milk marketing orders given that they provide incentives for milk production in locations, such as Florida, with higher milk production costs (Ippolito and Masson 1978; Buxton 1979; Hammond and Brooks 1985; Cox and Chavas 2001). Regions with higher production costs often will be closer to markets where products will be sold, so higher production costs may be offset to some degree by lower transportation and distribution costs. Balagtas and Sumner (2005) have indicated that pooling only Grade A milk has provided incentives for overinvestment—and therefore higher costs—by farms in Grade A milk production. But this may overstate the degree of inefficiency because conversion to Grade A often has been associated with investments that increased herd size and efficiency that increased farm profitability, and this conversion was supported by manufacturers (Buxton 1979).

Two analyses undertaken for this chapter provide additional insights about technical efficiency and federal milk marketing orders. We modified the national-level dynamic simulation model developed by Pagel (2005) and extended by Nicholson and Stephenson (2010a) to examine the impacts of eliminating Class I differentials on farm size, farm numbers, and average production costs. Elimination of Class I differentials in 1975 would have reduced the rate of increase in average farm size, which would have the effect of increasing average production costs for milk. This result is consistent with the logic that structural change in dairy farming is accelerated with higher net farm incomes, but further work on the linkages between structural change, production costs, and milk marketing orders is merited. Moreover, the simulated all-milk price would have been quite similar to that with continued Class I differentials beginning in 1992. These dynamic effects for farms suggest that a similar process may have occurred in manufacturing plants, whereby investment in those plants facilitated reductions in average processing costs. The opposite may be true in fluid milk plants because fluid milk processing volumes would be lower due to higher prices under milk marketing orders. A second analysis used the cost-minimizing transshipment model described in Nicholson and Stephenson (2010b) to compare the marginal value of milk received at fluid plants to the current Class I differentials. The results suggest that there are significant regional differences in the value of milk received at Class I plants under perfectly competitive market conditions and that these differences are highly correlated with, but generally larger than existing Class I differentials, which is consistent with the payment of over-order premiums.

Allocative Efficiency Under Milk Marketing Orders

Allocative efficiency issues often are at the heart of criticisms of milk marketing orders. By one definition, allocative efficiency refers to a "Pareto optimal" outcome in which no market participant can be made better off without another participant being worse off (Rausser et al. 1987). Novakovic (1995) suggested that "there are no Pareto superior choices" with respect to U.S. dairy policies, which implies a limited ability to assess marketing orders using this criterion. Numerous other authors have focused on the likely resource allocation effects, often assuming perfectly competitive markets as a benchmark. The key inefficiencies discussed in the literature include (1) overinvestment in milk production generally and specifically in less cost-efficient locations; (2) overinvestment in Grade A milk production; (3) inefficient spatial movements of milk and products due to both the locational inefficiencies and the need to ship minimum quantities of milk to a marketing area to qualify for pooling; and (4) the restrictions marketing orders have placed on use of reconstituted milk (Buxton 1979). When milk orders were first implemented in the 1930s, they probably increased allocative efficiency by reducing destructive competition (Novakovic and Boynton 1984). Many economists question whether this destructive competition or disorderly marketing would exist today in the absence of orders and, therefore, whether milk orders currently provide any allocative efficiency benefits (AAEA 1986).

Dairy processing firms also argue that the allocation of milk to its highest and best use is impeded by the incentives under milk marketing orders. Their argument is that although Class I prices are higher to attract milk to fluid plants, an individual nonfluid plant has little to gain by giving up milk to fluid plants or any other plants for two reasons (1) because this results in a relatively small increase in the blend price, which is what the individual plant is able to pay its producers and (2) because releasing milk for other users can reduce plant utilization and increase processing costs. The empirical importance of this argument has not been evaluated.

Studies generally conclude that marketing orders generate substantial transfers from consumers to dairy producers, increasing overall milk production and increasing marketing costs. However, the effects on various groups within these categories differ. Among producers, there has likely been more equal treatment among dairy farmers in a given region due to the pooling provisions of milk marketing orders (Novakovic 1995). At a regional level, however, milk marketing orders have redistributed income among dairy farmers. Cox and Jesse (1995) and Cox and Chavas (2001) indicate that regions with low Class I utilization and, therefore, high manufacturing milk use such as the Upper Midwest and California, are made worse off under FMMOs than they would be in the absence of orders under perfect competition.

According to some analysts, cooperatives have probably gained membership and assets as a result of milk marketing orders, which can provide some farmers with benefits. This is a corollary to the argument that cooperatives "still rely heavily on federal milk marketing order system" (Cropp 2003). These benefits can take the form of access to inputs, risk management, and other information. Cooperatives have the ability, however, to reblend, that is, to pay members in a manner different than the blend price would suggest. Analysis of producer milk checks indicates that cooperatives routinely pay different prices to producers with similar production volumes and locations (Mark Stephenson, personal communication).

Dairy processing firms also are affected differently by marketing orders. Milk input costs are lower for dairy product manufacturers and higher for fluid milk processors than they likely would be in the absence of orders. With class prices tied to product prices, the main effects may be to increase sales/revenues for products such as butter, NDM, whey, and cheeses and to reduce sales/revenues for fluid milk products. Recent work by Chouinard et al. (2010) indicates that different consumers are affected differently under assumptions about the relative price impacts of milk marketing orders on various product prices. Families with lower incomes or larger numbers of children and, therefore, higher consumption of fluid milk are more negatively affected than high-income households or childless couples, some of whom are shown to benefit from milk marketing orders given their consumption patterns. Another issue concerns the impacts of milk marketing orders on consumer welfare through price variability. Maynard (2000) examined the hypothesis that consumers would benefit from more stable fluid milk prices, which Doyon (2001) and Buxton (1979) have suggested would be an effect of marketing orders. Maynard indicated that consumers in a more volatile environment are likely to incur higher search costs to understand the local milk price distribution but, also, that volatile prices did not systematically depress fluid milk demand.

Dynamic Efficiency Under Milk Marketing Orders

Impacts on farm structure and costs have been discussed previously. Other issues for which limited information is available include the impacts of marketing order price regulation on price variability; impacts of orders on forward contracting and risk management; the ability of the marketing order system to respond to change over time; and the impacts on technological innovation in milk production and dairy processing.

Most analysts agree that milk marketing orders have reduced the intertemporal and cross-sectional uncertainty (the degree to which future prices can be accurately predicted) and price variability (the degree to which prices vary, based on a variety of measures) for both dairy farmers and processors (Buxton 1979; Novakovic 1995; Doyon 2001). Although the significant price volatility of the past 15 years is sometimes attributed to price regulations under milk marketing orders, Nicholson and Stephenson (2010a) suggest that the largest component of movements in milk prices has an amplitude and periodicity that is not easily explained by reference to classified pricing and pooling. Reductions in uncertainty and variability result from both the additional information reported under orders and because of increased equity among dairy producers and milk buyers. Because this variability is costly, if dairy producers are risk averse, marketing orders may have reduced the average price required to obtain a given quantity of milk.

A marked increase in price variability since the late 1980s has awakened interest in risk management tools, such as forward contracts and hedging. But milk marketing orders probably have mixed effects on the adoption of these tools. Forward contracting could be inhibited under marketing orders because the provisions that require minimum prices to be paid to individual producers would make the contract illegal if it proposed to pay a producer a price lower than the blend price. However, the 2008 Farm Bill allowed the establishment of a Dairy Forward Pricing Program. This program allows producers and cooperatives to voluntarily enter into forward price contracts with milk handlers for milk used for nonfluid purposes. The program exempts handlers regulated under the federal milk order program from paying producers and cooperative associations the minimum federal order price for milk under forward contract (USDA 2008). Cooperatives may offer forward contracts given their ability to reblend returns among their members. Milk marketing orders also may have positive impacts on risk management for dairy producers. Thraen (2003) argued that elimination of FMMOs would place serious limitations on the continued use of futures and options contracts and would increase the degree of basis risk inherent in the use of futures contracts because of the role that orders play in price discovery.

The FMMO system has changed markedly since the inception of orders in the 1930s. This change has been driven by the changing structure and complexity of the dairy industry and is undoubtedly one reason why orders still exist 75 years later. That said, there are frequent criticisms of the inability of order regulations to keep pace with changes in the industry. The most common complaints involve classification of new products, changes in make allowances to account for changes in manufacturing costs, and changes to the values of Class I differentials in specific locations. The process of convening an administrative hearing, considering evidence and issuing preliminary and final rulings under FMMOs can require years, particularly if there are court challenges or Congressional interventions. The California process for amending orders is more streamlined, but the optimal length of time required to assess and address an issue under marketing orders is uncertain.

Finally, critics of milk marketing orders sometimes argue that they discourage innovation for new products and thereby reduce long-run industry revenues. The evidence related to this claim is limited, although certain cases suggest a possible impact. In 2003, dairy companies introduced low carbohydrate fluid milk products that would have been assigned to Class II based on existing federal order definitions. For several milk orders, USDA determined that these new products would be competitive with fluid milk sales and should therefore be treated as Class I products. This resulted in an increased price for milk used in these products and therefore increased costs. It is uncertain to what extent this contributed to the limited commercial success of this product line.

Nonmarket Benefits Under Milk Marketing Orders

Very limited information exists to evaluate the impacts of milk marketing orders on other outcomes of social importance such as nutrition and health, rural development, animal welfare, or social justice. One impact requiring further study is whether marketing orders provide benefits that vary in importance with farm size. It is sometimes argued that smaller, less favorably located, and higher-cost farms may be helped by marketing orders to a larger extent than larger, better located, and lower-cost farms (Novakovic 1995; Stephenson 2003). This could occur if milk orders facilitate cost sharing in cooperatives with open membership policies. Although additional research is required to determine the extent of these impacts, they would imply both a distributional and a social justice impact of milk marketing orders. To the extent that marketing orders modify relative prices for some dairy products, there may be impacts on consumption that result in modifications to health status, but this sort of analysis is difficult because many factors influence nutritional outcomes.

Policy Options and Information Needs for Marketing Orders

Congress enacted the AMAA in 1937 with a vision to establish and maintain orderly marketing conditions and fair prices for agricultural commodities. To achieve this goal, a carefully planned regulatory process was established. Our review of the evidence suggests that the AMAA has, in fact, accomplished many of the outcomes that Congress originally intended, especially that of providing agricultural producers operating under orders a more stable operating environment. Thus, proposals to change existing programs should attempt to balance addressing (perceived) restraints on competition with the unique characteristics and market context for agricultural businesses.

A Common Framework for Analysis of Marketing Order Options

Although marketing orders share some common characteristics across commodities, the mechanisms employed by marketing orders for fruits, vegetables, and tree nuts differ from those used for milk. Even within the broad categories of fruits, vegetables, and tree nuts or milk, individual orders differ in legal language or the emphasis placed on individual provisions. This makes it challenging to develop a common framework that can be applied to assess future policy options for marketing orders. In addition, the economic and political environment prevailing in mid-2011 (culminating in the Budget Control Act of 2011 in August) is likely to make some options infeasible, such as development of alternative government programs or, perhaps, maintaining the current programs. As a result, we discuss the policy options in very broad terms, recognizing that future modifications of marketing orders could differ substantially for individual commodities, and for the sake of completeness include options whose political or economic feasibility is questionable. In essence, the broad policy options are:

(a) Maintain current programs
(b) Replace current marketing orders with other government marketing programs
(c) Modify orders to accommodate changing industry and market conditions
(d) Eliminate marketing orders, either in the near term of over a longer period through mandatory sunset criteria

Maintaining or Eliminating Marketing Orders

The specific elements would determine the impacts of these changes under these options, but a brief discussion of possible changes and likely impacts is merited. The maintenance of existing marketing order programs is the path of least resistance. The description of the effects of the various order provisions for fruits and vegetables, and for dairy, in this chapter adequately discuss the pros and cons of the existing system. Likewise, the elimination of federal marketing orders for fruits and vegetables, either immediately or with a phase-out period, can be evaluated with reference to the impacts of the existing system. Where further analysis would appear to become important is in the options available between these two extremes, although the details of any phased elimination may be important to minimize negative impacts. However, the effects of immediate or phased elimination of FMMOs appear less clear, in part not only because of disagreements about the impacts of the current order system but also because of the uncertainties of future price discovery and institutional arrangements such as contracts and cooperative membership. Further, although the authorizing legislation for marketing orders also allows marketing agreements between handlers and producers, it is more challenging to envision the alternative marketing programs that might replace FMMOs. One such program might be to continued provision of detailed market and pricing information to facilitate price discovery.

Replacing Marketing Orders with Other Government Programs

Replacement of existing marketing orders with other government marketing programs could involve two distinct possible courses of action, although neither is likely to be politically or economically tractable at present. The first would be to incorporate commodities with marketing orders into existing federal programs provided for other commodities. Existing programs often have objectives and outcomes at least somewhat different than those of marketing orders, so replacement often would imply an imperfect substitution. The other path could be to develop entirely new programs designed to address the perceived shortcomings of the existing programs.

For dairy, "replacement of orders" is not entirely accurate, because numerous other federal and state programs affecting dairy markets already exist. These include price supports (the DPPSP), income supports (the Milk Income Loss Contract, MILC), export subsidies (the Dairy Export Incentive Program), and tariff rate quotas (TRQ) for many dairy products. Although each of these programs provides support to dairy farmers—sometimes at considerable taxpayer or consumer expense—these programs do not per se regulate the terms of exchange between farmers (or cooperatives) and first handlers, provide greater equity among producers and processors in a given region, nor have "orderly" marketing as an objective. To the extent that these other programs enhance returns to dairy producers, they could to some extent replicate the effects of price discrimination under classified pricing. Even with these programs in place, elimination of FMMOs would likely imply the effects described in detail above. Another program for dairy producers, Livestock Gross Margin insurance for dairy (LGM-Dairy) or other proposed margin insurance programs (when adequately funded) can play a role in risk management, but risk management per se is not an objective of orders—except to the extent that they were developed to avoid "disorderly marketing" that posed a risk to farmers. Another option would be to establish or expand crop insurance coverage, although such insurance already exists for many fruits and vegetables. Although some additional risk management products may be developed, the current participation rate in specialty crop programs is 75%, which compares favorably with the participation levels for major program crops of 83% (USDA 2010) Typically these risk management tools are more successful in tree crops and perennial vine commodities.

Incorporating fruit, vegetable, and tree nuts in existing price and income support programs would have a number of drawbacks. First among those is the increase in budgetary cost exposure that would result from the addition of new commodities. In the current environment, establishing baseline budget authorization for new expenditures required to finance such an increase in commodity coverage would be extremely difficult. Although there have been a limited number of studies that have examined such an option, those that have suggest an expensive program, although expenditures would be less than spent historically on commodities such as corn. For example, a price support program for orange producers in Florida was estimated to cost $1.5 billion over the 6-year period 2002–2007, compared to estimates for expenditures on corn of $25.1 billion over the same period (Weldon and VanSickle 2002). Additional problems beyond costs can easily be envisioned. For example, if loan forfeitures resulted in government acquisition of perishable commodities, storage and disposal issues would be difficult to resolve. The establishment of applicable program provisions would be difficult as well, given the many different fruits and vegetables involved. The same complications would arise if such commodities were to be added to the direct payment scheme currently in place for cotton and for food and feed grains.

Existing programs to address concerns over market power are already utilized by FMO commodity producers. Certainly the (limited) cooperative exemption from federal antitrust laws is utilized throughout the array of commodities under FMO programs, both dairy and produce, although there have been recent legal challenges to this exemption. The same can be seen in collective bargaining by many of the fruit and vegetable FMO commodities. See Chap. 5 for a discussion of these cooperative and bargaining issues. It appears that within the set of existing programs for other agricultural commodities, few if any new opportunities to substitute for FMOs are available.

With regard to the provision of market information and asymmetry, existing federal and state market news programs appear to already substantially address those issues. However, with current programs reporting is voluntary, so to assure coverage was complete for all FMO commodities some form of mandatory reporting requirement would be necessary. Mandatory reporting requirements would likely be met with resistance in some commodities. In addition, the information currently conveyed through FMO grades and standards would need to be maintained. The elimination of current mandatory grading and labeling would make the option of incorporating FMO products into existing commodity programs less attractive. See Chap. 14 for a discussion of market information and mandatory reporting; Chap. 9 for a discussion of grading issues; and Chap. 13 for a discussion of labeling issues.

Modify Orders to Accommodate Changing Industry and Market Conditions

For fruit, vegetable, and tree nut marketing orders, modifications may not require significant changes to order provisions. Rather, the emphasis and use of specific provisions could be altered over time. For example, the evolution to greater importance of food safety as a function of orders is well underway and will continue. As noted above, closer cooperation between orders and other federal agencies and the addition of new orders is expected. The use of authorized quantity-related provisions has much less importance and this will likely continue.

Modification to FMMOs will require changes to order provisions. Many changes to provisions have been suggested, including replacement of the current product–price formulae with a competitive pay price for farm milk, modifications to the existing spatial structure of Class I differentials (different proponents argue for increases and decreases), changes to the number of classes (usually, consolidation of Classes II, III, and IV into one manufacturing class), and pooling of the Class I differential without minimum Class III or IV prices. In fact, some of these changes were key provisions of the program recently proposed by the National Milk Producers' Federation under its "Foundation for the Future" program, which also has the support of some organizations representing dairy processors. The impacts of these changes have not yet been fully assessed in the current policy and market context.

The rules and regulations related to FMOs have provided for an evolution of the terms of the orders over time. Accordingly, participants in the marketing orders have been engaged in modifications since orders came into existence. In some cases, participants have chosen to do away with the marketing orders themselves, such as the case with California Tokay grapes or the Western milk marketing order in 2004.

More recently, reauthorization of the marketing order for California nectarines and peaches failed to get the required two-thirds majority to favor continuance in 2011. In other cases, marketing orders have been terminated by the Secretary of Agriculture, such as the California–Arizona orders for lemons, Valencia oranges and navel oranges in 1994; and in other cases certain provisions have been little used—such as the walnut reserve pool—or abandoned—such as the recent suspension of the raisin reserve pool. Other examples of self-imposed modifications include change in the almond order to mandate pasteurization to address food safety concerns. Pistachio growers currently are considering a vote on amendments to their order that would place additional regulations on exports.

Future evolution of marketing orders for specialty crops may reflect moves by industry to compel participants to adopt specific production and handling practices in an attempt to decrease the probability of foodborne illness and enhance consumer confidence about product safety. Such changes may continue to manifest in provisions of existing orders such as almonds and pistachio. However, there may emerge a new set of initiatives in the form of national marketing agreements fashioned along the lines of the current Leafy Green Marketing Agreement in place for California and Arizona producers. Although different in degree from existing marketing orders, with compliance limited only to signatories to the agreement, such efforts may become more popular as the specialty crop industry attempts to implement food safety provisions contained in new legislation such as the Food Safety Modernization Act (FSMA). The FSMA, passed in December 2010, aims to ensure the U.S. food supply is safe by shifting the focus of federal regulators from responding to contamination to preventing it. Ultimately, industry participants may find it to their advantage to craft programs that fall within the USDA agency structure with which they are familiar rather than discover how to work with the Food and Drug Administration as they promulgate food safety rules and regulations.

Market forces and the efforts of marketing order participants have modified, and will continue to modify, the MO system to accommodate changing needs and priorities. Given the specific requirements associated with adopting new provisions or changing the way an order administers existing rules, little additional government intervention would seem necessary beyond the current oversight role assigned to the Secretary of Agriculture.

Information and Research Needs

Although marketing orders have been among the most-studied agricultural policy interventions, some basic questions lack a consensus based on the extant literature and other emerging questions have received limited attention. As the AAEA (1986) noted, empirical analysis of the impacts of marketing orders depends on accurate recent estimates of supply and demand elasticities, which vary over time and by location. Thus, evaluating the economic costs and benefits will require ongoing effort to understand these response parameters. The impact of marketing orders on nonmarket beneficial outcomes, particularly on nutrition and health, has received limited attention and is a priority for future research. The continuing debate about whether to eliminate marketing orders raises key questions about the dynamic impacts of elimination, both in the sense of what phase-out provisions would be most appropriate, and the impacts on price discovery, risk management options, and the organizational and institutional structure of the regulated industries. Evaluation of these questions may require application of methods generally little used to assess marketing orders, such as agent-based models. To date, there has been limited evaluation of options for increased collaboration among industry segments as a replacement for marketing orders, or for more collaborative and less regulatory interaction between government and industry. For fruit, vegetable, and tree nut orders, this collaboration would likely focus on continued improvements to food safety. For dairy, such collaboration could take the form of government continuing to collect and disseminate market information to facilitate allocative efficiency. In general, future research on marketing orders can usefully focus on dynamic evolution of regulated markets in preference to the comparative static frameworks often employed in the past.

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Chapter 7
US Generic Advertising and Promotion Programs

John M. Crespi and Richard J. Sexton

Abstract Nine in ten US farmers collectively contribute about $1 billion annually to generic advertising and promotion campaigns. This chapter discusses the rationale and history of these controversial programs; explains the importance of the legal battles that shaped their development; and discusses the modern problems facing these campaigns. An especially difficult challenge is promoting commodities in a marketplace where food manufacturing is increasingly concentrated, brands are more and more prevalent, and consumer preferences are fluid. Areas for future research are cited.

Overview

The terms generic advertising and promotion are used in different ways. Although marketers commonly refer to "generic advertising" as a type of advertising undertaken by a firm to showcase the firm itself, rather than any particular product it produces, in the case of agricultural commodities the term describes a program of collective advertising of a commodity by its producers and, possibly, its handlers. The agricultural marketing program is "generic" because it covers the entire commodity and never promotes any particular firm in the industry. The well-known

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"Got Milk?" commercials are an example of generic advertising and promotion of fluid milk that is paid for by dairy farmers. "Beef, it's what's for dinner." is another well-recognized commercial paid for by assessments on cattle ranchers. Generic advertising and promotion is an attempt to increase the demand for the industry, not just for one producer. Thus, while branded advertising would market the good of a particular firm, generic advertising markets the commodity for an entire market.

A particular agricultural industry can, and many do, have both industry-financed generic marketing and firm-financed branded marketing. Currently throughout the agricultural industries of the USA, about $1 billion dollars are spent annually on producer-funded, generic marketing programs (Alston et al. 2007). This chapter discusses the rationale for these programs, reviews the controversy that has historically surrounded them, provides some insight into their effectiveness, assesses possible policy options to address issues and challenges facing the programs, and identifies needs for future research.

The marketing programs that allow generic advertising and promotion exist under various state and federal statutes, though the goals of the programs are arguably equivalent. Advertising typically refers to commercial activities that occur through television, radio, print, and billboard messages, while promotion includes public relations, sponsorships, coupons, or other price discounting. The programs that include generic advertising and promotion are often referred to as "marketing orders" or more typically "check-offs," although there is a legal distinction between an order and a check-off. Chapter 6 provides more detail about federal and state marketing orders and related marketing agreements. Marketing orders can have generic advertising and promotion as part of their mandate in addition to other marketing order provisions; a check-off includes only promotion and research. Check-off programs are also known as "research and promotion programs." A number of generic advertising and promotion programs are authorized under marketing orders. Others are stand-alone programs authorized by separate legislation or in farm bill legislation and are generally significantly larger in the amount of funding involved than those under marketing orders. Although our focus is programs for generic advertising and promotion, most marketing orders cover a variety of other collectively financed activities such as production research, market development, standardized packaging, minimum quality standards, and, in a few cases, quantity restrictions.

When talking about the advertising and promotion mandates, because so many participants simply refer to both types of promotion programs as "check-offs," we will only make the distinction in this chapter as the need arises. The term "check-off" grew out of the administration of the programs whereby a handler, the initial entity that buys the farm product, deducted or "checked off" an amount from each producer's payment and sent that amount to an industry association to finance the generic program. The per-unit amount of the check-off is called the "assessment rate." A marketing order is a specific type of check-off defined by Congress in the Agricultural Marketing Agreement Act of 1937. Other check-offs arose out of special state or federal legislation for particular industries.

In the Federal Agriculture Improvement and Reform (FAIR) Act of 1996 (P.L. 104-127), also known as the 1996 farm bill, Congress granted to the USDA the ability to create promotion programs for any commodity, if the producers wished to have such programs. Each statute has its own idiosyncrasies as far as how referenda to create a check-off are conducted, voting rights, commodities covered, grading standards, assessment rates, etc. States have similar legislation and, in addition to the 51 commodities currently covered by federal programs, there are hundreds of other industries covered by state programs. The biggest difference between the federal and state programs is that only the federal programs can encompass interstate commerce. A list of federally authorized commodity marketing programs is provided in Appendix A to this chapter.

Understanding how a federal marketing order to establish a promotion program works is illustrative, as the various state orders and the related check-off programs are similarly structured. Programs must be for specific commodities and in as small a region as possible to further the objectives of the order. If two-thirds of the producers in an industry or producers representing two-thirds of the value of production vote to regulate the marketing of their product, they can petition the U.S. Secretary of Agriculture to establish a federal marketing order for their product. Once established, an order is legally binding on all producers in the industry, though a simple majority vote by the producers can abolish the order. In this way, a marketing order is a compelled collectivization of an industry for a marketing purpose. Firms do not make production decisions under this collectivization and there is no restriction on a firm's performing its own branded marketing campaign, nor is there any restriction on firms entering or exiting an industry.

The assessments to fund the program are typically collected from the producers by the "first handlers" of the commodity. For example, when peaches from the farm are delivered to the buyer, the buyer collects the assessment to send to a producer board. These assessments are used by this overseeing board to finance an order's generic marketing activities. The boards themselves exist under various names: boards, commissions, councils, etc., and throughout this chapter we simply refer to them as boards. Overseeing program planning, budgeting, development, and management, board members are appointed to fixed terms by the U.S. Secretary of Agriculture. The USDA Agricultural Marketing Service (AMS), which administers these programs from the government perspective, participates in the board's deliberations and audits the functioning of each program.

Why would a sizable majority of an industry's producers vote to jointly pay for advertisements such as "Real California Cheese," "Got Milk?" or "Pork, the other white meat," when individual producers or handlers could advertise and promote their products on their own? The most important justification for generic commodity programs is that agricultural products are, essentially, homogeneous, and free-rider problems create little incentive for unilateral promotion. Consider a beef steak. It is sold mostly without a brand name, thus consumers cannot tell what producer or packer supplied a particular steak. Suppose a dollar's worth of beef advertising generated two dollars' worth of increased revenue to the beef industry by increasing consumer demand. Suppose, also, there are a hundred beef producers with equally sized herds and one of these producers spent $10,000 advertising beef. Since consumers cannot tell which steak comes from which producer, this advertising increases demand for all steaks. Given our assumed benefit–cost ratio, the advertising generates a $20,000 benefit to the industry, which would be distributed equally among all producers, each of whom receives a $200 benefit. Clearly, although the advertising is beneficial for the industry, the cost to the single promoter is greater than his or her proportionate increase in revenue.

When other producers benefit from the advertising of a single producer, we say they are "free riding" on the advertisement. Free riding by the other producers leaves little incentive for unilateral promotion. But, instead of one producer paying for the advertisement, if each producer was assessed $100 to pay for the $10,000 campaign, each would profit by $100 (i.e., $20,000 in benefits to the industry minus $10,000 in advertising divided equally among the 100 producers). In this simple example, a collective generic program helps all producers by distributing the costs in proportion to the benefits. Historically, generic marketing programs have been justified under this rationale, as there would be too little advertising in an industry in their absence.

Other rationales exist for these programs, too, and these rationales are increasingly important as the homogeneity rationale has come under attack as we shall discuss. Other rationales include the strong evidence that the rate of return on advertising is very high for producers, as a defensive marketing strategy to thwart a declining market share for the commodity, and to help insulate producers from the negative effect of food scares by providing the flexibility to respond to negative news collectively rather than individually (Messer et al. 2011).

Historical Context

The simple benefit–cost rationale can be seen in the history of agricultural policies, especially with respect to industry collective action. In the 3 years from 1929 to 1932, the farm commodities price index fell by 56% and net farm income fell by 70% (Breimeyer 1983; Ezekiel and Bean 1993). To aid their industries, some farm groups and cooperatives attempted industry-wide commodity marketing programs using voluntarily collected producer funds. Not surprisingly, these voluntary marketing programs failed, as many producers chose to remain outside the programs, free riding on the efforts of those producers adhering to the voluntary programs (Forker and Ward 1993, pp. 78–80).

Lawmakers responded to the growing discontent among farmers with a sequence of acts enabling the development of marketing orders designed to restore market stability by *compelling* producers to act collectively in the marketing of their goods. US courts, however, were skeptical of expansions of government powers allowing the regulation of prices and production (Iron 1982, p. 112; Woeste 1998, p. 230). The Agricultural Adjustment Act (AAA) of 1933 gave the Secretary of Agriculture the power to impose production restraints to reduce commodity surpluses in order to increase farmers' purchasing power to the level that farmers had enjoyed in the more prosperous years of 1909–1914, so-called "purchasing power parity." However, the 1933 Act was vaguely worded, granting rather broad legislative and taxing powers to a member of the Executive branch namely the Secretary of Agriculture without clearly delineating the specifics for these powers. Thus, in 1935, when the U.S. Supreme Court ruled that similar portions of other "New Deal" legislation were unconstitutional, Congress amended the AAA.[1] Nonetheless, it had only a short life. In 1936 the Supreme Court in *United States v. Butler* (297 U.S. 1 1936) ruled that the powers granted to the Secretary of Agriculture violated the U.S. Constitution's Tenth Amendment.[2]

In an attempt to satisfy the courts, Congress passed the Agricultural Marketing Agreement Act of 1937 (7 U.S.C. § 601 et seq.), where the vagaries of the previous acts were clarified so that the specific powers of the Secretary with regard to the creation, terms and conditions, administration, enforcement, and termination of marketing orders and agreements were now sufficiently delineated.[3] Likewise, the tax or assessment provisions were narrowed so as to provide for the costs incurred solely for the furtherance of the goals of the act. This was important because the courts had ruled that regulatory projects could be self-financing through assessments and if such self-financing were the extent of the assessment, then the assessment would not be construed as a "tax." Although economists see little difference between an "assessment" and a "tax," the legal distinction is important given that only Congress has taxing authority for the federal government.

The 1937 Act provides for four types of regulatory actions: (a) restrictions on the quantity of a commodity that can be sold, either through marketing allotments or reserve pools, (b) limits on the grade, size, or quality of the commodity, (c) regulation of packaging and container sizes, and (d) generic promotion and advertising allowances (most notably for milk promotion, with broader provisions for generic advertising and promotion coming with later amendments). After the 1937 Act was declared constitutional, other commodity-specific check-off programs for promotion arose in later acts of Congress and in state legislatures.

[1] Iron's (1982) discussion (Chaps. 6–8) shows that both the farmers and the lawyers working on the AAA were hardly unanimous in the type of programs to put into place. See also the discussion of the New Deal agricultural policy reform by Paarlberg (1983), Harl (1999, p. 388), and Gilbert (2000).

[2] The Tenth Amendment states, "The powers not delegated to the United States by the Constitution, nor prohibited to it by the States, are reserved to the States respectively, or to the people."

[3] The Supreme Court upheld the Act and the Order in 1939 in a 5 to 4 decision (*United States v. Rock Royal CO-OP., Inc.* 307 U.S. 533). The ensuing years would still be filled with litigation involving marketing orders, but most of these complaints were along procedural grounds such as the timing or calling of board elections and voting, or the Secretary's handling of various suspensions of program provisions. There would be no serious challenge to the constitutionality of the programs for nearly 50 years.

Do the Programs Work?

We provide a brief discussion of the economics of the generic advertising and promotion programs to facilitate understanding their economic impact and also to explain how economists generally measure these impacts relegating the details of the measurement of economic returns to an appendix. At the time of this writing, there have been nearly 250 research studies including 124 peer-reviewed journal articles and chapters in 14 books examining the effectiveness of commodity promotion programs.[4] The overwhelming majority of these studies have shown that the benefits outweigh the costs. A summary and discussion can be found in Alston et al. (2007).

First what do we mean when we say a program "works"? Marketing analysts look at various impact measures such as market reach, e.g., how many prospective buyers actually saw the advertisement, or advertising recall, e.g., whether consumers recollect the advertisement. These factors are important and occasionally do enter into an economic analysis. However, economists typically answer the question of whether the program "works" as whether the benefits, which differ depending on the study but are usually measured as producer surplus, profits, or revenue accruing to the industry from the generic campaign, outweigh the costs of that campaign.

Consumers have a demand for a product, conceived as a demand curve or demand schedule, that is a function of outputs of the generic marketing program but also a function of factors including the price of the good, the prices of substitutable and complimentary goods, and branded advertising by firms in the industry. Other demand factors might include some measure of income, the time of the year, the average age of consumers in the particular market, the proportion of children in the community, the educational attainment of the typical consumer, etc. Economists cannot control for every factor affecting demand for a product, but they try to control for as many of the most important factors as they can when they evaluate generic program impacts. The rationale for doing this is simple: since many factors affect the demand for a commodity besides generic advertising, economists need to account for other factors that affect demand such as the prices of other goods, competing advertising, changes in income, and consumer demographics. By including these demand factors, economists are able to net out the true effect of generic advertising on demand.

In most studies, the starting point is the collection of data on the quantity of the commodity sold and on the other factors thought to be important determinants of demand, including some quantitative measure of the magnitude of the generic marketing program, e.g., the amount the industry spent on promotion, the number of promotional venues, the amount of advertisements aired on television, etc. In some cases these data might be cross-sectional—gathered, for example, across a sample of cities or states, but more commonly they will be time series—observations of an industry across distinct points in time, such as months, quarters, or years. Some studies merge cross-sectional and time-series data into what is known as

[4] This is based on an Internet search using the academic search engine EconLit on the key words "generic/commodity and advertising/promotion".

a panel data set. From these data, typically a statistical analysis is undertaken to estimate as best possible the impacts of the factors in explaining variations in the quantity of the product sold. What economists are looking for in their analyses is whether, when controlling for the myriad of other important factors influencing demand, the generic marketing program causes consumers to purchase more of the product. This is the first step in understanding whether the advertising works or not. If it cannot be concluded with a high degree of statistical certainty that an increase in the quantity demanded resulted from the generic program, then there is little reason to perform any further analyses; it cannot be concluded that the program worked.

If a positive and statistically significant relationship between the demand and the generic program is found, the next step is to determine the change in industry benefits, such as profits, attributable to the advertising. The researcher must determine whether the benefits from the advertising exceeded the cost to the industry in terms of the check-off funds expended. These additional costs represent a supply-curve shift since they raise the per-unit production cost by the amount of the assessment. Thus, both consumer demand and farm supply shift under a typical check-off program, and the responsiveness of price and quantity to these shifts depends upon the price-responsiveness, or "elasticity" of these functions.

If the researchers' data and methods are sufficient to sort out these effects, the analysis will yield an estimate of the program's benefit to producers. The researchers will typically next subject the analysis to sensitivity checks by varying key parameters of the model to determine whether the results are robust to plausible alternative specifications. Additional details on this process are provided in Appendix B.

Ultimately estimated benefits are typically divided by the costs to the industry from the assessment to obtain a benefit–cost ratio. Just as there are differences in how benefits are measured, there is debate as to whether the costs should be the full costs of the program or just the incidence of the costs borne by the producers. Using either method, in nearly every study that has been conducted the benefit–cost ratio is higher, and sometimes exceptionally higher, than one, meaning that the advertising or promotion program not only worked but worked very well because a dollar spent on it earned the industry greater than a dollar's worth of benefits.[5] Given this conclusion, it might be surprising to learn that there is some strident opposition to the programs.

Recent Constitutional Issues[6]

Despite the evidence of benefits exceeding the costs, there is opposition to these programs from a significant minority of producers because of the compulsory nature of these programs. The 2011 news story regarding "President Obama's Christmas Tree Tax" is just the most recent example of the objections, in this case the opposition of a minority of Christmas tree growers, to the compelled funding of the generic

[5] See, for example, the summary of various studies provided in Alston et al. (2007).

[6] This discussion is adapted from a lengthier article on the litigation by Crespi and McEowen (2006).

programs. Understanding the objections is worth taking some time to discuss since the concerns still exist even though the legal route may now be closed to opponents of generic advertising.

Between 1997 and 2005, the U.S. Supreme Court ruled on three cases concerning the constitutionality of generic advertising in agricultural markets. The markets involved were California peaches and nectarines under marketing orders 916 and 917, mushrooms under the check-off created by the Mushroom Promotion, Research, and Consumer Information Act of 1990, and beef under the check-off created by the Beef Promotion and Research Act of 1985. An issue in all three cases was whether generic advertising violated the First Amendment of the Constitution, as courts have long held that advertising is a form of speech and that freedom of speech includes the freedom not to be compelled to speak.

After an initial victory for generic advertising involving peaches and nectarines in 1997 in *Glickman v. Wileman Brothers & Elliott, Inc.* [521 U.S. 457 (1997)], the U.S. Supreme Court ruled 4 years later in *United States v. United Foods, Inc*. [533 U.S. 405 (2001)] that the federally mandated mushroom advertising program was unconstitutional. Then, in what seemed a dramatic change to the arguments present in these two cases, the Supreme Court in the 2005 beef case seemed to dismiss the previous cases entirely by ruling that check-off-funded generic advertising programs were not private speech but government speech and, therefore, not subject to challenge under the First Amendment.

The main issue in *Glickman* concerned the amount of regulation that already existed in the California tree-fruit industry. Writing for the Court, Justice Stevens repeatedly stressed the statutory context within which the generic promotion program had arisen and that generic campaigns had to be viewed in light of the regulatory scheme that Congress had put forward: “The business entities that are compelled to fund the generic advertising at issue in this litigation do so as a part of a broader collective enterprise in which their freedom to act independently is already constrained by the regulatory scheme” (*Glickman*, at 457).

The Court stressed that the regulatory nature of the marketing orders for the industries in question required that the generic advertising be judged in a different light from that of other commercial speech cases. Congress had made a regulatory decision that certain commodities should be marketed jointly. As such, Justice Stevens stated this was just another “species of economic regulation” that Congress has created and “should enjoy the same strong presumption of validity that we accord to other policy judgments made by Congress.” His next sentence struck to the heart of the case of the independently minded litigants, “The mere fact that one or more producers ‘do not wish to foster’ generic advertising of their product is not a sufficient reason for overriding the judgment of the majority of the market participants, bureaucrats, and legislators who have concluded that such programs are beneficial” (*Glickman*, at 477).

In November 1999, the Sixth Circuit Court of Appeals ruled that the Mushroom Promotion Act of 1990 (7 U.S.C. § 6101 et seq.) was unconstitutional because, unlike the marketing orders in *Glickman*, the Mushroom Act was not in the same spirit as the broader, collective regulation that the Supreme Court used to uphold the tree-fruit order (*United Foods, Inc. v. USDA* 197 F.3d 221 6th Cir. 1999). United Foods, Inc., a Tennessee food processor, had challenged the 1990 Mushroom Act on the grounds that the assessments were compelled commercial speech and that the marketing of mushrooms was distinct from the marketing that existed in the California tree-fruit industry in the *Glickman* case.

United Foods argued that the regulatory environment used to justify collective advertising in the tree-fruit order was almost completely absent in the mushroom industry, which has a stand-alone generic advertising program. The Court of Appeals found this limited-regulation argument persuasive. Writing for the majority, Judge Merritt stated: “The Court’s holding in *Glickman*, we believe, is that non-ideological, compelled, commercial speech is justified in the context of the extensive regulation of an industry but not otherwise” (*United Foods, Inc. v. USDA* 197 F.3d 221 6th Cir. 1999 at 224). In other words, without the extensive regulation present in the tree-fruit marketing orders, there was no justification for any further limits on compelled speech.

On appeal, the U.S. Supreme Court upheld the Sixth Circuit’s ruling in 2001. Writing for the majority, Justice Kennedy pointed out the differences between the 1997 tree-fruit case and the mushroom case: “The program sustained in [*Glickman*] differs from the one under review in a most fundamental respect. In [*Glickman*] the mandated assessments for speech were ancillary to a more comprehensive program restricting marketing autonomy. Here, for all practical purposes, the advertising itself, far from being ancillary, is the principal object of the regulatory scheme” (*US v. United Foods, Inc*. 533 U.S. 405 2001 at 411–412). As long as the generic advertising is part of a broader regulatory scheme like the marketing orders for fruit, the assessments pass constitutional muster. However, if generic advertising is the primary purpose for collecting the assessments, the assessments then violate the First Amendment.

This ruling presented an immediate challenge to many advertising programs because their authorizing legislation made them stand-alone programs that were not part of a broader regulatory scheme. It did not take long for opponents of such programs, including the beef check-off program, to adopt the strategy that was successful in the *United Foods* case. The Beef Promotion and Research Act of 1985 (“Beef Act,” 7 U.S.C. § 2901 et seq.) was passed by Congress as part of the Food Security Act of 1985 (16 U.S.C. §§ 3801–3862). Citing *United Foods*, a trial court ruled in 2001 that the beef check-off program was unconstitutional [*Livestock Marketing Assoc.* (*LMA*) *v. USDA*, 132 F. Supp 2d 817 D. S.D. 2001].[7] What differed in this case was that the government argued that the advertising in the beef check-off was not private speech but government speech. The trial court rejected this argument.

[7] In October 2002, a U.S. district judge in Michigan, Richard Enslen, also citing *United Foods*, ruled that similar legislation for the pork check-off program was not only unconstitutional but “rotten” as well (*Michigan Pork Producers Association v. Campaign for Family Farms*, 229 F. Supp 2d 772 W.D. Mich. 2002), and struck down the entire pork check-off, including the portions for research and education.

On appeal, the U.S. Court of Appeals for the Eighth Circuit affirmed the lower court's ruling [*LMA. v. USDA*, 335 F.3d 711 (8th Cir. 2003)]. The Supreme Court subsequently agreed to hear the case. In a 6-3 ruling, with the majority opinion written by Justice Scalia, the Court upheld the beef check-off on the grounds that the program was *government speech* [*Johanns et al. v. LMA*, 544 U.S. 550 (2005)].

Why the change? In the majority's opinion, the beef check-off case revolved around the question of whether the statutory language of the Beef Act created an advertising program that could be classified as government speech. Thus, as Justice Scalia explains, "We have not heretofore considered the First Amendment consequences of government-compelled subsidy of the government's own speech." Justice Scalia opined that Congress has provided the rationale for a compelling state interest and instructed the Secretary of Agriculture to both impose the order as well as oversee the actions of the Beef Board and the program's Operating Committee. While the opponents of the beef advertising program had argued that the Operating Committee was a nongovernmental entity and, thus, the advertising cannot be considered government speech, the Court rejected this premise finding, "The message of the promotional campaigns is effectively controlled by the Federal Government itself .... Congress and the Secretary have set out the overarching message and ... have left the development of the remaining details to an entity whose members are answerable to the Secretary" (125 S.Ct. 2055 at 2063 2005).

Justice Scalia further argued that the compelled assessments are unaffected by whether the funds are raised through general or targeted assessments: "Citizens may challenge compelled support of private speech, but have no First Amendment right not to fund government speech. And that is no less true when the funding is achieved through targeted assessments devoted exclusively to the program to which the assessed citizens object."

What are the implications of the Supreme Court decisions for commodity check-off programs? It seems that neither *Glickman* nor *United Foods* are relevant anymore in determining the constitutionality of a check-off program. After the *United Foods* ruling, supporters of generic advertising argued that their industries were more like California tree-fruits, while their opponents argued that the industries were more like the mushroom industry. Because of the beef check-off ruling, however, the overall degree of regulation in an industry no longer seems important if the generic advertising can be considered government speech.

So, is the litigation over? The U.S. Supreme Court seems to have placed a very high hurdle before opponents of generic advertising programs: a plaintiff now has to prove not simply personal harm but also that the generic advertising was private speech in order to claim a First Amendment infringement. Based on the majority's opinion, the Secretary of Agriculture effectively approves generic advertisements for beef through his or her oversight of the industry board. But the statutory language supporting other marketing orders and stand-alone check-offs tends to be very similarly worded to what was upheld for beef promotions. The ruling, thus, seems to force opponents of generic advertising to seek other routes to challenge the programs.

Indeed it is rare for the U.S. Supreme Court to take up the same issue as often as three times in a single decade as it did here. Perhaps the Court in its decision on the beef check-off was also signaling that it had tired of this issue and effectively telling opponents of these programs that they needed to target future efforts to the other branches of government, not the courts.

Economic Issues Remain Unresolved

The legal controversy led some economists to go back to the drawing board, so to speak, and consider how to achieve a sustainable voluntary program if the courts ruled the programs unconstitutional. Under a provision point mechanism, a laboratory experiment showed a program could be funded voluntarily if some threshold of voluntary payments were received and if the threshold were not met, all donations would be refunded. Messer et al. (2008) showed that such a mechanism could work among subjects in a laboratory experiment and also showed that if the refund had to be requested rather than being automatic, subjects were less likely to ask for a refund. Similar work had been done by Messer et al. (2005, 2007), which showed that voluntary contributions could be effective even though free riding would never be completely eliminated, and the key would be whether the contributors felt their assessments were helping the industry or not. The drawback of laboratory experiments is how well they match reality and they also can tell the researcher little as to whether the programs can be maintained if voluntary contributors observe free-riding behavior for years at a time. Even with the reprieve from the U.S. Supreme Court, such economic models may still find themselves of use in the near future because the underlying economic issues remain.

Although the U.S. Supreme Court settled a legal question, it answered no economic questions underlying the opposition to the programs. Most programs have the support of a majority of the producers operating under their auspices. However, opponents to these programs collectively have spent many years and millions of dollars fighting battles against generic advertising. Why, if the research shows that the programs work?

What were the opponents actually saying? The following quote is illustrative. From a November 29, 1996 *Los Angeles Times* story on the *Glickman* case, here is producer Dan Gerawan, "'We're doing everything we can to differentiate ourselves,' gripes Gerawin, 34, a third-generation [California] Central Valley farmer. 'Yet we have to pay into a fund that advertises that all peaches and plums are the same. A generic message, we feel, definitely hurts us.'" Plaintiffs in *Glickman*, *United Foods*, as well as in similar cases that never made it to the U.S. Supreme Court argued vehemently that the premise of identical or homogeneous products that provides the fundamental rationale for generic advertising of commodities was false. These producers held that their products were differentiated from those of competitors. Thus, even if total demand increased with generic advertising, which most of the economic studies showed, the effects were not the same for all growers. Specifically, they argued that generic promotion reduced the differentiation among products and therefore harmed some producers who had worked so hard to establish a brand identity.

Advertisements for a specific brand or variety are used to influence consumers' preferences when facing an array of choices. Those choices are ever increasing. Increasing varieties within the check-off commodity itself call into question the homogeneity assumption. For example, while in the 1950s there were only a handful of major California table grape and peach varieties, today there are around 50 major grape varieties and 80 major peach varieties (Crespi and Marette 2002). Likewise, as firms develop their own brands, how does generic advertising fit into that marketing? The raisin cooperative, Sun Maid, is implicitly saying in its marketing that Sun Maid raisins are better than other brands of raisins. But does *generic* advertising, intended to raise demand for all raisins, send a signal to consumers that all brands are equally worthy, e.g., "buy any California raisins since all California raisins are good"? Some producers think so. Cheese producer Mike Gallo, who sued the California Department of Food and Agriculture and the California Milk Advisory Board over the Board's "It's the cheese" generic marketing campaign, claims, "We're trying to differentiate ourselves from other products with quality, and their message is just the opposite. They're saying all cheese is the same, and it's not" (*Stockton Record*, November 26, 1997). The U.S. Supreme Court did not address the validity of these arguments, nor was it asked to.

Very little research has addressed these claims. Crespi and Marette (2002) provided the first theoretical argument that it was possible to both shift the demand curve for a generically advertised product and harm an individual seller at the same time. This would occur if the harmed firm produced a product considered to be high quality, and the generic advertising increased demand for all of the goods in the industry, while also lowering consumers' beliefs that the higher quality good was distinct. The authors found some evidence of this effect in the US dried plum market. In a lab experiment, Chakravarti and Janiszewski (2004) showed that generic advertisements could dampen consumers' responsiveness to branded advertisements, thus making a firm's own advertising less successful than if the generic program did not exist. More research is clearly needed on how impacts of the programs are distributed both across and within markets.

Issues of Market Efficiency and Nonmarket Social Values

Market efficiency with respect to generic advertising programs mostly concerns how a program affects both market structure generally and market participants in a given industry or in a competing industry and most research is with regard to allocative and dynamic efficiency as discussed in the introduction of the book. Most studies examining the effectiveness of generic promotion and advertising focus exclusively on impacts specific to the industry supporting the program. A handful of researchers have examined allocative efficiency in how the programs affect other industries or impact the market structure of a single industry. Alston et al. (2001) examined the effects on producers in one industry from generic promotion by producers in a second industry—what they labeled "beggar-thy-neighbor advertising" after the card game where benefits to one player come at the expense of another player. The essential question is whether getting consumers to drink more milk, for example, causes them to drink less cranberry juice. Further, what is the effect on an industry that has no generic program when it is competing with industries that have programs? Alston, Freebairn, and James looked at three different industries—beef, pork, and poultry, only the first two of which have generic advertising and promotion programs. They showed that benefits from one program do come at the expense of the other, and the poultry program was harmed the most by the generic advertising of its competitors.

There has been ever increasing consolidation and market concentration across all stages of the market chain, including farm production, food manufacturing, and retailing. Market power of retailers and food manufacturers, both as buyers from farmers and sellers to consumers, is a legitimate concern in many markets. Only a few studies have taken these considerations into account when investigating the allocative efficiency of generic marketing programs. Norman et al. (2008) showed that when industry concentration is low, generic programs are welfare improving but when concentration is high, there may not be a good reason to have the generic advertising. Suzuki and Kaiser (1997), Kawaguchi et al. (1997), Chung and Kaiser (2000), and Wohlgenant and Piggott (2003) looked at the effect of generic advertising by size of firm and/or in imperfectly competitive markets and in markets with differing farm supply elasticities, finding various differential effects among producers. Further, while most studies examine what is happening at a particular sector of the marketing chain, typically the production sector, Zhang and Sexton (2002) examined the entirety of the supply chain and showed that at least half of the benefits from an advertising program will not get to the farmers if either the processing or retailing sectors are imperfectly competitive, and will instead be captured by the players holding market power.[8]

The studies above considered the impact of market structure on the generic programs. An alternative question concerning allocative efficiency is whether generic programs themselves alter the market structure? Little research exists here. Crespi and Marette (2009) explored the effects of demand enhancements like advertising by firms in industries where generic marketing programs exist and how firms with market power interact in the presence or absence of these programs. They considered the case where a firm may shift demand for its product through its own private advertising and use that advertising as a way of increasing a rival firm's costs of

[8]Modern agricultural markets also feature increasing use of what economists call "vertical control" implemented through various types of contracts. Traditional "spot" or auction markets wherein prices are "discovered" on a continuous basis are increasingly rare. Mushroom marketers, for example, report that there is a single window of time during the year when they are able to negotiate prices with food retailers, and the price is fixed for the rest of the year. How does generic advertising work in this environment? What if it succeeds in raising consumer demand, but retailers capture that demand shift in the form of higher prices? No more farm product is sold in such a case, and, thus, farmers derive no benefit from a program that "worked" in the sense of raising consumer demand. Little research has been conducted into such possibilities. One exception is the work by Carman et al. (2009), which used retail-level scanner data to examine price and quantity impacts of promotions conducted by the Hass Avocado Board. This study found no evidence that retailers raised prices in response to avocado promotions.

doing business. The authors found that the presence of a check-off program limits the ability of a large firm to raise its rivals' costs in this way. In other words, a check-off program may have the benefit of making the industry more competitive. Schulz and Crespi (2012) found significant evidence for such an effect after examining over 40 food manufacturing industries with and without generic programs at three points in time over 15 years. Their results were that the industry four-firm concentration ratio was on average 27% lower in industries that incorporated generic advertising and promotion programs.

Nonmarket social values may lead to government intervention to deliver attributes of growing concern to consumers or policy makers. This nonmarket intervention may be in the form of wealth redistribution to satisfy a concept of distributive justice, or it may involve issues in the food safety, nutrition, and health area that are best dealt with by prohibition or policy incentives and fall into the "merit good" category. Earlier we examined this issue from the perspective of allocative efficiency and how firms trying to market certain product attributes may be hindered by a generic program. However, there is a question of whether generic advertising could be used to actually further a policy goal or otherwise aid in dynamic efficiency, how well markets innovate. National concerns over obesity, nutrition and health, and food safety have become ever more important to consumers and policy makers and, hence to economic researchers in recent years. Yet little research has been performed on how generic programs fit into these and other important food issues, although the research ideas would seem to be ripe.

Traditionally economists have only measured the benefits to producers from the commodity programs, but theoretically there is also an impact on consumers that can be measured from shifts in a demand curve. For example, an industry-financed commodity program could be beneficial to society in more ways than producer profits if, say, low-fat milk or fruit juice was replacing soft drink consumption or fruit and vegetable consumption supplanted eating junk foods on account of the generic advertising. Only a handful of studies have looked at the effectiveness of these programs on various human health or nutrition issues. Jensen and Kesavan (1993) and Alston et al. (2005b) examined nutrition impacts of the California dairy promotion programs and Park and Capps (2002) studied the nutritional benefits of pork promotion. Richards and Patterson (2005) and Alston et al. (2005a) looked at food safety impacts under the promotion programs of strawberries and pistachios, respectively. Most studies give some indication that the consumer benefits exist. Given the importance of these issues to the American consumer, research into how generic programs might fit within the current health and food safety debates represents an important area for future consideration.

Possible Policy Options

Despite the vast number of studies of commodity promotion completed in recent decades, this discussion has shown that more work is needed. We need to better understand how effectively programs that were designed to meet the needs of farmers 70–80 years ago—even though adjustments have been made over time—work to meet the needs of farmers today. Likewise, there is a need for new research that examines not only producer benefits but consumer and societal impacts of these programs as well. Given that governments sanction and oversee these programs even though producers and marketers directly fund them, examining a broader set of impacts seems appropriate since economic analysis shows that the actual costs are partially borne by consumers according to the elasticity of demand for the products involved.

Are there policy options that need to be considered to make these programs more dynamically efficient and effective in today's marketing environment? Our discussion has revealed several potential limitations of programs presently, including possible: (1) failure to meet the needs of producers who want to differentiate their branded product from the generic message; (2) harm to producers of related commodities—the beggar-thy-neighbor effect; and (3) lack of concern for broader nonmarket or societal impacts.

An option to consider with respect to point (1) is to allow branded advertisers full or partial credit toward a generic obligation for funds expended promoting a branded product. The almond industry is a prime example of use of the credit-back provision. However, such programs tend to be controversial and must be tailored carefully to only allow credit for expenditures that are truly demand expanding. Too often in such contexts sellers' "marketing" expenditures are little more than rebates and discounts to buyers, which do nothing to expand demand and serve only to intensify price competition. We also must keep in mind that the few studies that have been done looking for harm to firms from the generic message have found only small revenue losses.

Other options might be to allocate check-off funds to industry subgroups who have their own committees distributing these funds as they see fit. The Hass Avocado Board (HAB) studied by Carman et al. (2009), for example, collects money from USA, Mexican, and Chilean avocado marketers and then rebates up to 85% of the money collected from each group back to country-specific boards which then tailor their own advertising campaigns. Although a Hass avocado is a rather homogeneous commodity, the producing countries are differentiated as to the time when their production hits the market. The HAB's program enables each country to promote during its market window, while preserving a share of the funds for industry-wide promotion initiatives. Might a similar idea work, e.g., for conventional and organic producers? It should be noted that the U.S. Department of Agriculture has worked to revise check-offs along these lines, for example, exempting some organic producers from the assessments.

Either of the above options should have positive impact on technical, allocation, and dynamic efficiency by facilitating industry decisions about production scale, product offerings, and reallocation of resources as markets evolve. Further, they should be neutral to nonmarket interventions to address distributive justice or credence goods issues.

As to point (2) and issues of allocative efficiency, the scant research conducted has suggested producers in competing programs could be better off if they pooled or shared their promotion in some way to maximize total industry welfare. One might imagine "coordinating boards" that would oversee promotions across related commodities, such as meats or fruits, to insure that programs were not unduly rivalrous. However, it seems unlikely that either legislators or producers would be interested in creating an additional layer of bureaucracy and expense. Notably there is nothing to prevent coordination across industries, in essence a détente, if industry leaders want to do it.

Finally, policy changes may not be needed to address point (3) and the issue of nonmarket societal impacts. Commodity boards have become acutely aware in recent years that healthfulness of food consumption is now a paramount consideration for many consumers. This has led to boards expending funds to support research into the health properties of their products and then to communicate those results to consumers. Of course, boards will naturally accentuate the positive, so an appropriate remedy might be expanded consumer representation on commodity boards, as well as diligent government oversight to insure the veracity of the industry's messages. We must remember that the U.S. Supreme Court has ruled that these programs are government programs, an interpretation the boards themselves have embraced since their survival depends upon it. As such, a board that has the farmers' interests as a primary consideration but also considers the consumers' interests seems only natural and we should not be surprised to see such an evolution of the marketing boards.

Are Generic Promotion Programs Relevant in Today's Agricultural Markets?

As noted, collective marketing programs emerged from the turmoil of the Great Depression. If nothing else, the litigation and controversy that has surrounded these program, especially in recent years, raises the larger questions of whether markets are simply much different today than when the programs began and if collective marketing programs are necessary or even justifiable in modern agricultural markets? In the 1930s, there was much less differentiation among agricultural commodities and little branded advertising of them. Do we still need generic programs when firms can differentiate their products through their own branded programs?

Such questions are at the heart of today's concerns about commodity promotion programs and reflect the concern of how nimble these programs, given consumers' growing interest in the food they are consuming. Dynamic efficiency concerns how quickly and how well the market as a whole can adapt to changing consumer tastes and preferences.[9] Often these adjustments occur outside of the traditional food marketing chain, but bringing the adjustments into that chain is not always easy. Take the organic movement, for example. Until the USDA set up specific standards for

[9] These concerns also tie in with nonmarket social values and government market intervention as discussed in the introductory chapter in that consumers may want certain food attributes.

the definition of organics, consumer preferences for organic foods had to be satisfied mostly from smaller niche producers and retailers. Once the standards were in place, however, the growth of organics among larger producers, traditional food processors and handlers, and retailers happened very quickly.

Relatedly, consumers have shown a willingness to pay higher prices for not only organic foods, but credence goods as craft production, local production, cruelty free, and sustainably produced products, many of which are similar in scale to the niche organic demands prior to the USDA standards. The parallel with generic advertising is whether a new type of promotion program would allow producers to take advantage of the demands from consumers who cannot "hear their message" from the current generic program.

Is there a change that could be made to commodity promotion messages, similar to the change that occurred in the organic market once the USDA set the organic standard, which would open new markets for some producers? For example, does "Beef, it's what's for dinner" help or harm a producer supplying a niche market for grass-fed beef to the Bay Area locavore restaurant market? Should such a producer be required to pay into the beef check-off and, if so, can the check-off program be nimble enough to provide benefits to that producer's very specific, niche market? Or should producers targeting these markets be exempted from the generic programs? Such exemptions are already commonly made for organic producers. Will those exempted be able to promote their products unilaterally or form alliances with similarly situated producers for mutual promotion? Will such promotions be effective if they are not able to raise threshold amounts of money required to target key media outlets? The question needing further exploration is whether the programs designed to improve market efficiency can simultaneously address nonmarket social goals.

How a generic program responds to growing product differentiation and the ability of a firm to differentiate its product is equally important. Even agricultural industries that have little firm-level, branded advertising often feature considerable product differentiation. For example, the California Table Grape Commission, created in 1967 by an act of the California legislature, is responsible for promoting a great variety of fresh grapes that differ with respect to target markets, harvest timing, and marketing window. Can a generic promotion program for grapes do justice to all grape marketers who operate under its jurisdiction? Similarly, the Mushroom Council operates under authority derived from stand-alone federal legislation passed in 1990. The agaricus (white) mushroom is the dominant seller, but "exotic" mushroom varieties have proliferated and gained a market foothold in recent years. Mushroom marketers differ in the product lines they emphasize. Can the Mushroom Council design and implement generic promotion programs that are effective in promoting such a differentiated product with differentiated uses? The challenges faced by either the Table Grape Commission or the Mushroom Council would seem to pale, however, relative to the challenges faced by dairy boards in promoting "cheese".

Controversy is almost inevitable when check-off programs operate in industries containing one or two relatively dominant firms, often cooperatives, with sizable market shares and their own branded programs. Independent handlers and growers are often suspicious in these cases that the generic program is tailored to benefit the dominant cooperative. The foundation of such suspicion is that these cooperatives exercise considerable voting power on the commodity boards. However, some interesting differences have emerged in these cases. For many years, Sun Maid raisins were advertised along with industry-sponsored generic advertisements for California raisins; the "I heard it through the grapevine" commercials featuring the "California Dancing Raisins" of the 1980s were extremely popular with viewers. Sun Maid growers eventually voted for a raisin commission that got rid of the generic advertising program.

On the other hand, Sunsweet, which has the largest share of the retail dried plum market, Blue Diamond, which is the largest seller of almonds, and Ocean Spray Cranberries, the largest cranberry marketer, each operate their own branded advertising programs and participate in an industry-wide generic program. An important difference which exists within these three cases, however, is that the regulations of the Almond Board of California allow branded advertisers to receive a credit back for those expenditures towards their obligations under the generic program.

Conclusion and Looking Forward

Generic advertising and promotion programs are grower funded initiatives designed to raise the demand for a commodity. From the well-known advertisements like "Beef, it's what's for dinner." and "Got Milk?" to the buying guides and promotional material from boards as diverse as the Arkansas Catfish Research and Promotion Board and the U.S. Popcorn Board, nearly one billion dollars is spent annually by thousands of producers in the United States to expand the demand for their commodities. Ninety percent of all US farmers, in fact, pay assessments to support at least one commodity promotion program (Congressional Research Service 2005, p. 52).

This chapter has outlined the historical and economic rationale for these popular but controversial programs. For an indistinguishable food commodity, marketing by the industry is imperative as there is no incentive for any single producer to promote and advertise his or her product if every other producer of that commodity can free ride on those efforts. Generic industry advertising and promotion, on the other hand, helps all producers of that commodity as long as the benefit from the demand response outweighs the cost of the generic program. Indeed, nearly all economic research has found this to be the case for generic programs.

However, as food and agricultural markets change, farm, processing, and retail sectors become more concentrated; tastes become more diverse; and producers that once sold commodities now find that they can differentiate and brand their goods, the benefits and even the function of generic advertising and promotion programs become, perhaps, more nebulous. Generic advertising programs designed for industries with homogeneous products and many competing firms may have different and unintended consequences when implemented in industries involving buyer and seller concentration and differentiated products. Economic research has only begun to examine the issues of generic advertising in modern agricultural markets.

A central tenet surrounding these programs is that all producers benefit from a "successful program," namely one that raises industry revenues more than costs. Discerning whether that tenet is true today and, if not, how and whether these programs need to change with the times is critical to insuring their future viability.

Acknowledgments The authors are grateful to Walt Armbruster, Ron Knutson, and three anonymous reviewers for helpful comments, and they are held blameless for any errors.

Federal Orders and Check-Offs That Include Promotion and Advertising

The 51 industries covered by federal marketing orders and stand-alone research and promotion (check-off) programs that can partake in generic advertising and promotion are listed here. Not all programs are active and some have more activities than others. Other commodity promotion programs have state authorization and operate exclusively within the boundaries of the authorizing state. As of 2011, there are three Federal research and promotion programs under consideration (raspberries, Christmas trees, and softwood lumber).

Marketing orders for fruits, vegetables, and nuts	
1	Marketing Order 981: California Almonds
2	Marketing Order 922: Washington Apricots
3	Marketing Order 915: Florida Avocados
4	Marketing Order 923: Washington Cherries
5	Marketing Order 930: Tart Cherries
6	Marketing Order 905: Florida Citrus
7	Marketing Order 906: Texas Citrus
8	Marketing Order 929: Cranberries
9	Marketing Order 987: California Dates
10	Marketing Order 925: California Desert Grapes
11	Marketing Order 982: Oregon and Washington Hazelnuts
12	Marketing Order 920: California Kiwifruit
13	Marketing Order 916: California Nectarines
14	Marketing Order 932: California Olives
15	Marketing Order 958: Idaho and Oregon Onions
16	Marketing Order 959: South Texas Onions
17	Marketing Order 955: Georgia Vidalia Onions
18	Marketing Order 956: Walla Walla Onions
19	Marketing Order 917: California Peaches
20	Marketing Order 927: Oregon and Washington Pears
21	Marketing Order 983: California Pistachios
22	Marketing Order 993: California Dried Prunes
23	Marketing Order 924: Washington-Oregon Prunes
24	Marketing Order 945: Idaho and Eastern Oregon Potatoes

(continued)

Marketing orders for fruits, vegetables, and nuts	
25	Marketing Order 946: Washington Potatoes
26	Marketing Order 947: Oregon and California Potatoes
27	Marketing Order 948 Colorado Potatoes
28	Marketing Order 953: Virginia and North Carolina Potatoes
29	Marketing Order 989: California Raisins
30	Marketing Order 985: Far West Spearmint Oil
31	Marketing Order 966: Florida Tomatoes
32	Marketing Order 984 California Walnuts
Milk marketing orders	
33	Dairy Federal Milk Marketing Orders (currently there are 11 federal marketing orders)
Current research and promotion check-off programs	
34	Beef Promotion and Research Program
35	Blueberry Promotion, Research and Information Order
36	Cotton Research and Promotion
37	Dairy Producer Check-off Program
38	Egg Research & Promotion
39	Fluid Milk Processor Promotion Program
40	Hass Avocado Research and Promotion Plan
41	Honey Packers and Importers Research, Promotion, and Information Order
42	Lamb Promotion and Research Program
43	Mango Promotion, Research and Information Order
44	Mushroom Research and Promotion Plan
45	Peanut Promotion, Research and Information Order
46	Popcorn Promotion, Research and Consumer Information Order
47	Pork Promotion and Research Program
48	Potato Research and Promotion Plan
49	Sorghum Promotion, Research, and Information Program
50	Soybean Promotion and Research Program
51	Watermelon Research and Promotion Plan

How Economists Measure the Benefits of Generic Promotions

There are a number of methods for measuring the benefits and costs of generic promotion programs. Here we present the method discussed by Alston et al. (2007) because it has been used extensively and because an understanding of this method is useful to understand other methods that have been proffered. The analysis begins with a model of supply and demand, as in Fig. 7.1, where S_0 represents the initial market supply of a commodity and D_0 represents the initial market demand. The market equilibrium price is P_0 and equilibrium quantity is Q_0.

Applying some additional standard assumptions in applied economics, the same supply and demand curves can be used to measure the total variable costs and benefits from consumption. Specifically, these assumptions state that (1) the area

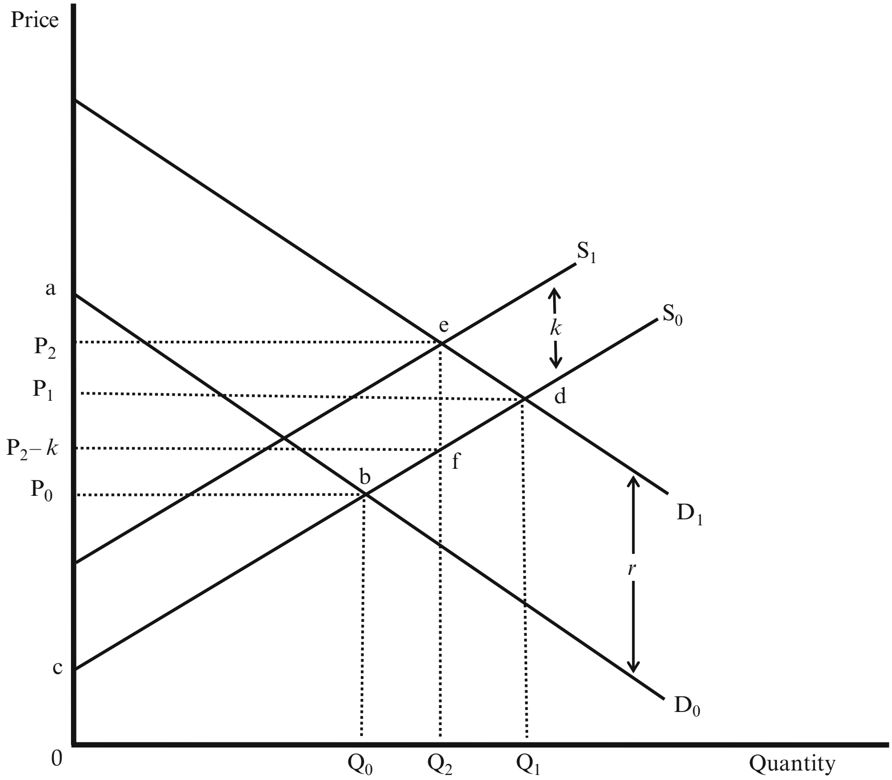

Fig. 7.1 Model of generic advertising

beneath the demand curve represents total consumer benefits from consuming the commodity; (2) the area beneath the supply curve represents total variable costs of production; and (3) we can add up benefits and costs across producers and consumers. Hence, for the initial quantity of Q_0, total benefits from consumption are equal to the trapezoidal area $0abQ_0$ and, given consumer expenditure of P_0Q_0 = area $0P_0bQ_0$, consumer surplus is equal to the area of the triangle, abP_0. Similarly, for the initial quantity of Q_0, total variable costs of production are equal to the trapezoidal area $0cbQ_0$ and, given total revenue of P_0Q_0 = area $0P_0bQ_0$, producer surplus is equal to the area of the triangle, P_0bc. The total net benefit in this market is equal to the sum of producer surplus and consumer surplus, the area *abc*.

Now suppose a check-off of k per unit is collected from producers of the commodity. We can model the check-off as a parallel shift in supply from S_0 to S_1. The check-off generates revenue, R, that is used to finance promotions designed to enhance demand. Suppose the expenditure of R results in a shift in demand from D_0 to D_1, reflecting an increase in consumers' willingness-to-pay for the commodity by r per unit for any quantity. The combined effects of the check-off and promotion shift the industry equilibrium from point b to point e, the market price (inclusive of the

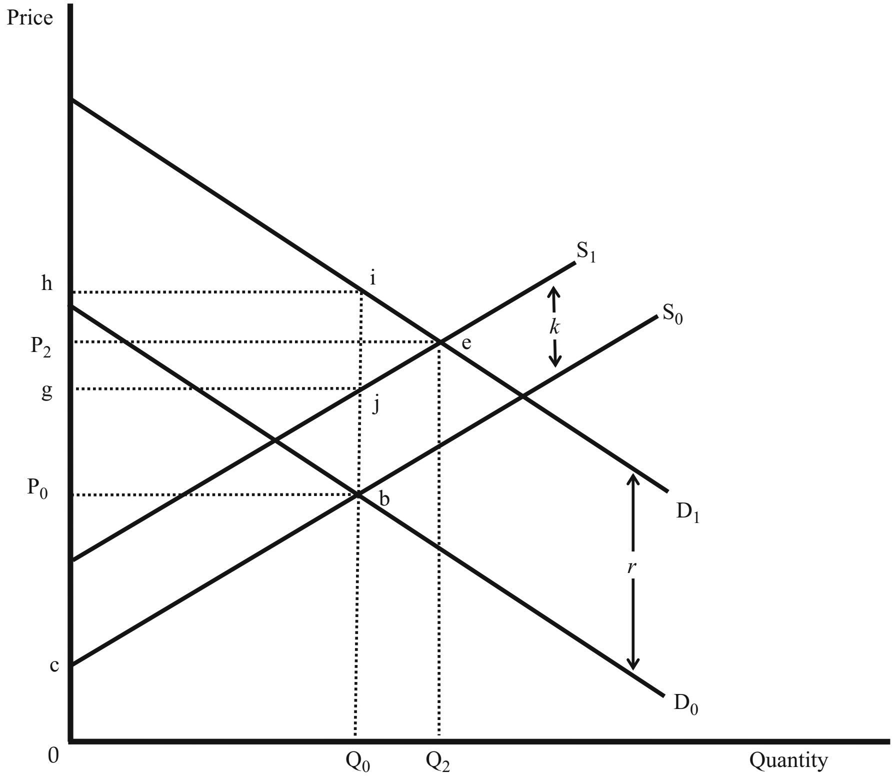

Fig. 7.2 Measuring benefits and costs of generic *r* advertising

check-off) increases to P_2, and the quantity demanded increases to Q_2, which is also the quantity supplied at a producer net price of P_2-k. This represents the final equilibrium, reflecting both the promotion-induced increase in willingness-to-pay of r per unit and collection of the check-off of k per unit that finances the promotion. The total expenditure on promotion equals the amount raised by the check-off: $R=kQ_2$.

Areas in Fig. 7.1 represent the implications for consumer, producer, and national welfare. Only the key elements of Fig. 7.1 that are required for the welfare analysis are replicated in Fig. 7.2. First, we wish to measure the change in producer surplus between the initial equilibrium at point b (P_0, Q_0) and the final equilibrium reflecting the check-off and the induced demand shift, point e (P_2, Q_2). This producer net benefit can be represented as the area of additional producer surplus associated with the increase in production from Q_0 to Q_2 measured along the supply curve that includes the check-off, S_1—in other words, the trapezoidal area P_2ejg. When studies report benefit–cost ratios, generally they refer to the producers' gross gain associated with the promotion (which is best measured as the change in producer surplus, area P_2ejg in Fig. 7.2) divided by either (a) the loss of producer surplus associated with collection of the check-off, which is equal to area $P_1df(P_2-k)$ in Fig. 7.1—the final producer incidence of the check-off, or (b) the total expenditures on promotion, which are equal to $P_2 ef(P_2 - k) = kQ_2$ in Figs. 7.1 and 7.2—the initial incidence of the check-off that does not take the shifting of the tax into account.

How the benefits are reported differs across studies. For many studies a simple comparison of total benefits and total costs yields a measure of an *average* benefit–cost ratio, comparing the costs and benefits from having the program with a hypothetical alternative of no program. Other studies compute a *marginal* benefit–cost ratio by comparing the costs and benefits associated with a small hypothetical change in the size of the program. The average benefit–cost measure indicates whether a program was profitable while the marginal measure indicates whether it would have been profitable to increase the size of the program (marginal ratio >1) or reduce it (marginal ratio <1). Both ratios can be computed using the above methodology. Typically such computations are performed after collecting data and estimating the necessary functions, usually using some type of statistical analysis. Often researchers are forced to approximate key demand and supply variables, such as prices and quantities, with industry averages or aggregate-level data. Issues arise here as to the appropriateness of the chosen data, though more recent uses of retail-level scanner data gathered directly from supermarkets have lessened these concerns. Another issue that has led to debate among researchers is the appropriateness of the functional forms chosen to represent supply and demand.

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Chapter 8
US Export Market Development Programs

Shida Rastegari Henneberry

Abstract The production of US agriculture has been growing faster than the domestic food and fiber demand, at least until the ethanol mandate took hold. Considering that over 95% of the world's customers lie outside the USA, US farmers and agricultural firms have relied heavily on export markets to sustain revenues and prices. However, entering new export markets and maintaining existing markets may require market development investments and promotion costs from both the public and private sectors. To create, expand, and maintain export markets for US agricultural products, the USDA's Foreign Agricultural Service has partnered with nonprofit trade associations representing commodity or regional interests. Despite its projected benefits, the US government's financial involvement in the promotion of agricultural exports has been an issue of growing debate. For example, some of these programs have been highly criticized as promoting corporate welfare. Nevertheless, most of the published studies evaluating export promotion programs have shown that these programs have been effective in increasing market shares and export revenues. Additionally, many small to medium sized agricultural industries find these programs valuable, as they might not have enough knowledge about export markets or enough funds to effectively promote their products. In this chapter, a critical overview of the US export market development programs is provided.

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Introduction

Over the past two and a half decades, US imports have exceeded its exports by a large margin (Figs. 8.1 and 8.2). The US trade deficit peaked in FY 2008, reaching almost one trillion dollars. However, during the early 1990s, the US trade deficit was reduced as the dollar depreciated and the economies in other countries grew which led to increased demand for US exports. In the latter part of 1990s, the US trade deficit grew larger as a result of the US economy growing faster than the economies of America's major trading partners which led to US consumer demand for foreign goods growing at a faster rate than foreign demand for US products. Also, the financial crisis in Asia sent Asian currencies plummeting, making their goods relatively cheaper than American goods which led to an increased US demand for their goods. During the past decade, a combination of factors contributed to the continued US trade deficit. In FY 2010, the total US trade deficit was $756 billion, composed of $1.1 trillion in exports minus $1.8 trillion in imports. America's dependence on foreign oil has been blamed as a major contributor to the US trade deficit.

Despite the overall trade deficit, the US agricultural sector has experienced a trade surplus since 1960. The surplus has helped counter the persistent deficit in nonagricultural US merchandise trade (USDA/ERS/Briefing 2012). The US agricultural trade surplus has fluctuated during the FY 2006–2010 period, growing from $4.6 billion in 2006 to $29.6 billion in 2010 (Fig. 8.1). Despite one of the worst

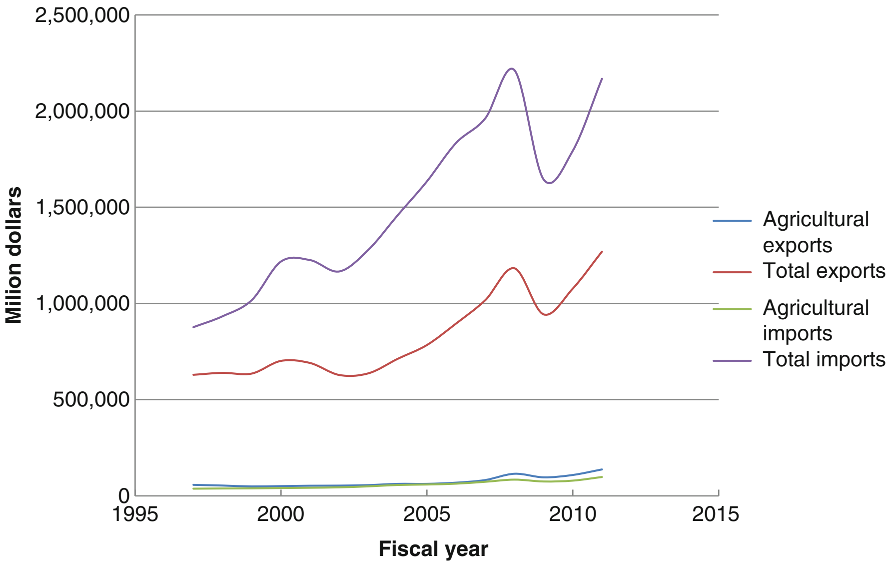

Fig. 8.1 Value of US trade—agricultural and total by fiscal year from 1997 to 2011. *Source*: Based on data from USDA/ERS/FATUS 2012

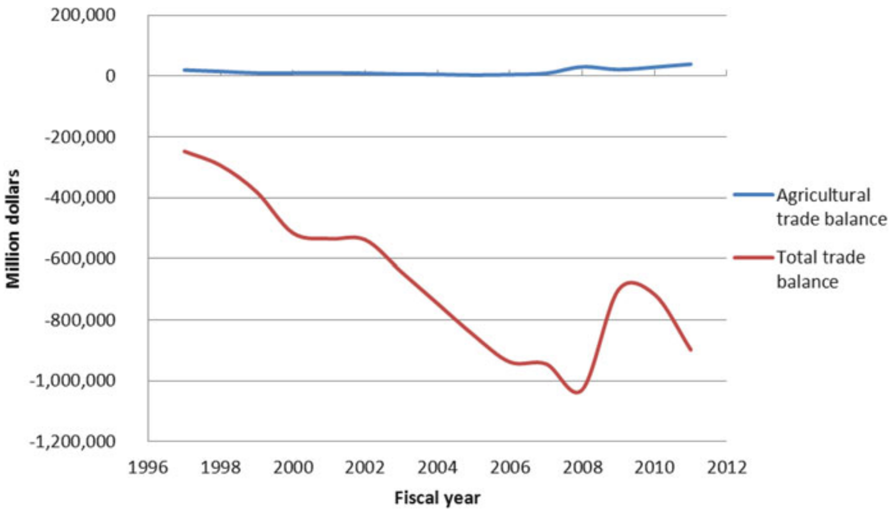

Fig. 8.2 Value of US trade—agricultural and total trade balance by fiscal year from 1997 to 2011. *Source*: Based on data from USDA/ERS/FATUS 2012

global recessions, the top US agricultural export products have increased by 78% in the past 5 years (FY 2005–FY 2010) (USDA/FAS/OTP 2010). It can be argued that the world macroeconomic outlook both supports and depends on increasing US exports in general and US farm exports in particular (USDA/ERS/AES 2010).

The production of US agriculture has been growing faster than the domestic food and fiber demand, at least until the ethanol mandate took hold. Considering that over 95% of the world's customers lie outside the USA, US farmers and agricultural firms have relied heavily on export markets to sustain revenues and prices. Exporting also helps develop jobs and strengthens wages. Exports already support more than a third of the US manufacturing jobs and it has been reported that Americans who work for firms that export earn at least 15% more than similar workers at firms that do not export (NEI 2010). During the last 5 years, exports have accounted for over 10% of US GDP as well as contributing more than one percentage point to GDP growth which is a larger contribution than either consumption or fixed investment. The goal of the US President's National Export Initiative (NEI) plan is to double US exports in 5 years.

However, entering new export markets and maintaining existing markets requires market development investments and promotion costs from both the public and the private sectors. To create, expand, and maintain export markets for US agricultural products, the US government has invested in various programs. In this comprehensive agricultural export promotion system, the US Department of Agriculture (USDA) Foreign Agricultural Service (FAS) has partnered with nonprofit trade associations representing commodity or regional interests. During the period of 2002 through 2010, federal support of US agricultural exports—including the Food for Peace Act (FPA), credit guarantees, and generic and brand commodity promotion programs, averaged $5.5 billion annually (Table 8.1).

Table 8.1 Export program activity, FY 2002–2010, in million US dollars

Program	2002	2003	2004	2005	2006	2007	2008	2009	2010
DEIP	55	32	3	0	0	0	0	100	25
MAP	100	110	125	140	200	200	200	200	200
FMDP	34	34	34	34	34	34	34	34	34
EMP	–	10	10	10	10	4	10	10	10
TASC	2	2	2	2	2	1	4	7	8
QSP	2	2	2	2	2	1	1.4	2	2
GSM-102	2,936	2,545	2,926	2,170	1,363	1,445	3,115	5,357	5,400
Food for Peace (P.L. 480)	1,095	1,960	1,809	2,115	1,829	1,787	2,067	2,321	1,690
Section 416(b)	773	213	19	76	20	0	0	0	0
Food for Progress	126	137	138	122	131	147	220	216	148
McGovern-Dole IFECN	–	100	50	90	96	99	99	100	210
Local and Regional Procurement Pilot	–	–	–	–	–	–	0	5	25
Total	*5,123*	*5,145*	*5,118*	*4,761*	*3,687*	*3,718*	*5,750*	*8,352*	*7,752*

Source: Ho and Hanrahan (2010a, b)

Despite its projected benefits, the US government's financial involvement in the promotion of agricultural exports has been an issue of growing debate in recent years. Although the federal government has played an important role in expanding sales of farm and food products to global markets for nearly six decades, the tightening of the federal budget over the years and the significant amount of public funds invested in export market development programs have raised concerns about the effectiveness of the federal promotion expenditures.

The objective of this chapter is to provide a critical overview of the US export market development programs. An overview of the US agricultural trade is followed by a description of current US government market development programs. Specific objectives of each program, their implementation methods, and the challenges faced in today's market environment are examined. Policy options addressing potential alternatives in dealing with challenges faced by each program are then presented. A summary of the studies and the models that have been used to measure the effectiveness of the export promotion programs is also included.

US Agricultural Trade

The USA is a net exporter of food and one of the major players in world agricultural markets. The US agricultural trade surplus has almost tripled over the past decade, from \$11.90 billion in FY 2000 to \$29.6 billion in FY 2010 (USDA/ERS/FATUS 2012). This agricultural surplus is helping mitigate the huge total negative trade balance which exceeded half a trillion dollars (\$755.8 billion) in FY 2010. The US share of agricultural exports as a proportion of world exports has increased from 7% in 2000 to 10% in 2010. Stronger economic growth in China and other key markets and tighter global supplies of soybeans, corn, wheat, and cotton have stimulated the

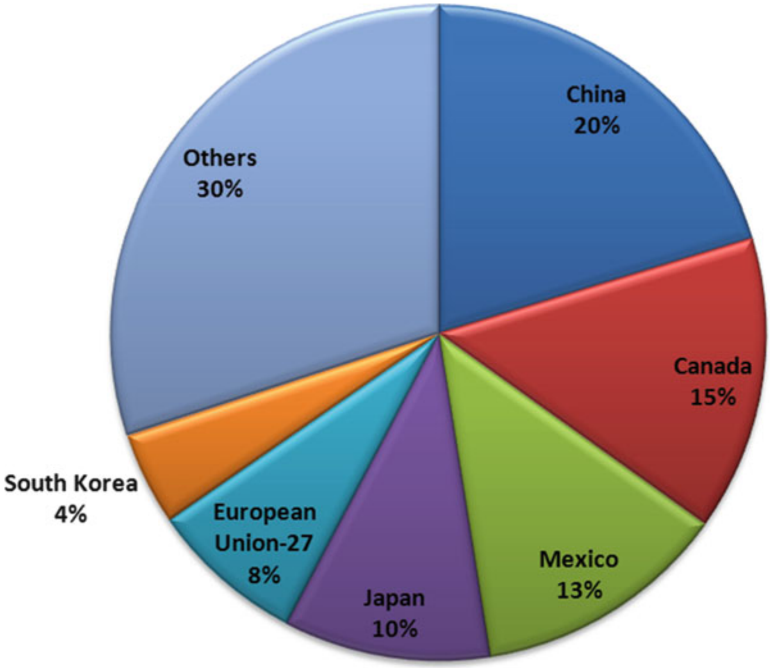

Fig. 8.3 US agricultural export destinations in 2010, weighed by export value US dollars. *Source*: Based on data from USDA/ERS/FATUS 2012

growth in US agricultural exports. Also, higher commodity prices during the recent years have significantly contributed to the export value gain.

The top US agricultural export destinations in CY 2010 were China and Canada, accounting for 20% and 15% respectively of the total US export value; Mexico, 13%; Japan, 10%; EU-27, 8%; and S. Korea, accounting for 4% (USDA/ERS/FATUS 2012) (Fig. 8.3). In CY 2010, bulk products (grains, oilseeds, cotton, and tobacco) accounted for 40% of total US agricultural export value. High-value products (HVPs) accounted for another 60%. Raw products (live animals, fresh fruits and vegetables, nuts, and nursery products) accounted for 21% of US HVP exports, while semi-processed products (fats, hides, feeds, fibers, flour, meals, oils, and sugar) accounted for another 26%. Over half (53%) of US HVP exports are in processed products (meat, milk, grain products, processed fruits and vegetables, juice, wine, beverages, and other processed products). It is interesting to note that HVP accounted for only about 30% of total US agricultural exports in the 1970s.

Grains and livestock products are the US top major export commodities and the United States is an important player in the global trade of several agricultural products. During the period October 2009-November 2010, the United States accounted for an average of 10, 39, and 1.6% of global production of wheat, corn, and rice, respectively; while accounting for a notable portion of global trade in these commodities. The United States accounted for 23, 52, and 11% of world exports of wheat, corn, and rice, respectively (USDA/FAS/PSD 2012). Additionally, global markets are notably important to US agricultural producers. Agricultural exports have been about a third of total US agricultural cash receipts. During the period October 2009-November 2010, 51% of US wheat, 15% of US corn, and over 50% of US rice were destined for global markets. For some other agricultural products, such as almonds and cotton, export sales have far exceeded domestic sales (USDA/FAS/OTP 2010). Some government estimates show that every dollar spent on US exports in 2008, generated another $1.36 of expenditures created in the US economy to support exporting activity and in 2008, 8,000 American workers were engaged in supporting activities for every $1 billion of US agricultural exports (USDA/FAS/OTP 2010).

For livestock products, The USA accounted for over 20% of the world volume of beef and veal and for 10% of the world volume of swine meat production. The USA is also one of the largest meat exporting and importing countries. In 2010, US export volume of beef and pork accounted for 14.3 and 33.5%, respectively, of global trade in red meats, while its imports accounted for 16.4 and 6.8% of global trade in beef and pork, respectively (USDA/FAS/PSD 2011). Moreover, meat exports accounted for a notable portion of meat production in the USA. About 11% of US beef and beef variety meat production volume and about 24% of US pork and pork variety meat production were exported (USDA/FAS/OTP 2010). The leading markets for US beef and pork exports, although varying from year to year, have primarily been Mexico, Canada, Japan, South Korea, Taiwan, and China/Hong Kong (USMEF 2011).

Despite having the lion's share of the global agricultural trade, the US global market share has fluctuated during the past decade. For instance; imports of beef from the USA were banned by Canada, Mexico, South Korea, and Japan following the outbreak of *Bovine Spongiform Encephalopathy* (BSE) in 2003 (Henneberry and Mutondo 2009). Another issue that is important to consider when analyzing the US export market share is the fact that markets in major importing countries are differentiated in terms of buyers' attitudes toward agricultural products from various sources (Henneberry and Hwang 2007). For example, in the Asian markets, grain-fed beef imported from the USA has generally been viewed as having a higher quality than grass-fed (nonfed) beef imported from other sources. Therefore, supply source differentiation is important when analyzing global agricultural markets (Mutondo and Henneberry 2007).

In order to increase sales and market shares of their agricultural products, US exporters and commodity groups have conducted a wide range of promotion activities in their import markets. Source differentiation has been the focus of many of these activities. For example, one of the major goals of the US non-price export promotion programs has been to market US agricultural products as being of a higher quality or better at meeting consumer (buyer) demand than those offered by US competitors.

With the rapid globalization of the commodity markets in countries across the world and given the fluctuating US share in global agricultural markets, understanding the potential impacts of US promotion activities is important in developing effective marketing strategies and the allocation of advertising investment. The US export promotion activities and their intended impacts are examined in the following sections.

US Export Promotion Programs

Over the past several decades, with the goals of increasing agricultural exports and providing food aid, the USA has operated a comprehensive agricultural export promotion system, wherein non-price export promotion has been subsidized by the federal government and matched by industry dollars. The Food, Conservation, and Energy Act of 2008 (the 2008 farm bill) which established US farm policy for 2008 through 2012, contains a trade title (Title III of P.L. 110-246) that authorizes and amends the USDA agricultural export promotion and the US international food aid programs. Current legislative authority for most of these activities will expire with the 2008 farm bill in 2012.

The trade title of the 2008 farm bill authorized and amended four kinds of export and food aid programs: direct export subsidies, export market development programs, export credit guarantees, and foreign food aid (Ho and Hanrahan 2010a) (Fig. 8.4). The USDA's Foreign Agricultural Service administers all these export promotion programs, except for Titles II and III of the Food for Peace Act (P.L. 480), which are administered by the US Agency for International Development (USAID). USDA's international activities are funded by discretionary annual appropriations acts and by using the borrowing authority of the Commodity Credit Corporation (CCC), (Ho and Hanrahan 2010a). More specifically, the foreign food assistance is under the Food for Peace Act (P.L. 480) and programs such as export credit guarantees, non-price market development programs, and export subsidies are funded through the borrowing authority of CCC. The total program value for international programs has decreased from \$5.7 billion in 1998 to \$4.97 billion in FY 2009 (Ho and Hanrahan 2010a).

P.L. 480 is the largest of these programs, with average annual spending of \$2.2 billion on international food aid programs over the past decade. Title II activities have comprised the largest portion of the Food for Peace budget. The 2008 farm bill sets the annual authorization level for Title II of the food aid program at \$2.5 billion (Ho and Hanrahan 2010a). The Export Credit Guarantee Program (GSM-102) is also a significant export market development program and is authorized for export credit guarantees of \$5.5 billion worth of agricultural exports annually. The acronym GSM refers to the General Sales Manager, an official of FAS who administers the credit and other export programs. The most notable of USDA's non-price export market development programs are the Market Access Program (MAP) and the Foreign Market Development Program (FMDP). In 2009, non-price market development activities totaled over \$570 million, consisting of \$234.5 million of USDA market development program allocation for the FMDP, Cooperator Program and MAP, which leveraged an additional private sector investment of over \$335 million (USDA/FAS/OTP 2010).

The US generic commodity promotion programs seek to both inform and change consumer attitudes and perceptions, with the goal of increasing domestic and export sales and market shares for US agricultural commodities. However, in recent years, the continuation of these programs has generated much debate. These arguments have centered on the total costs and benefits and the distribution of costs and benefits

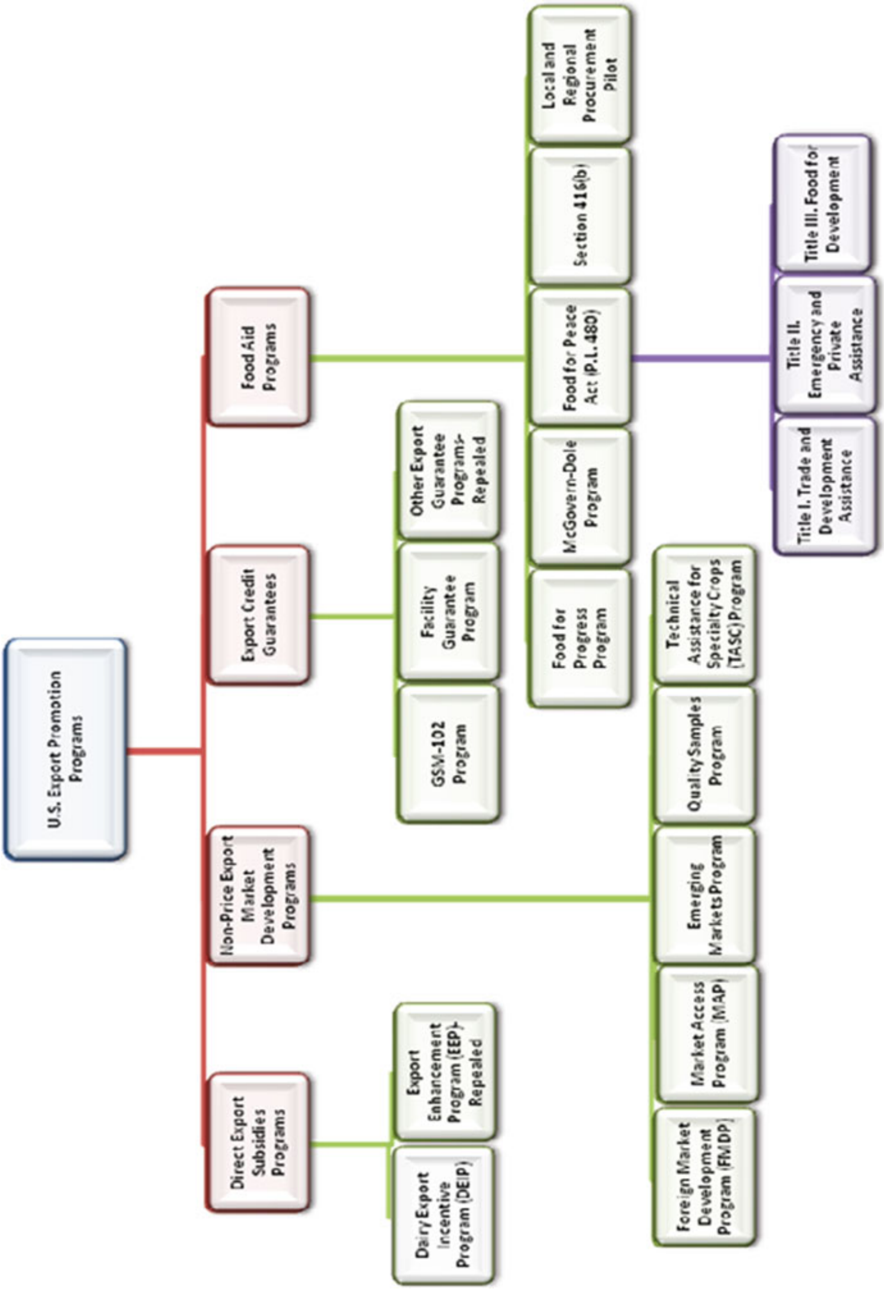

Fig. 8.4 US Export Market Development Programs

among producers and handlers of a given commodity covered by a promotion program. Given the significant amounts of producer and US government funds devoted to the domestic and international promotion of agricultural products and the ongoing debate over the welfare implications of advertising, it is crucial for the continuation of the programs for policy makers to understand the effectiveness as well as the economic impacts of market development expenditures (see Chap. 7 for detailed treatment of domestic advertising and promotion programs). Despite their intended contribution to US agricultural exports, these government funded export market development programs have been highly criticized as promoting "corporate welfare." The following section provides a description of each market development program that is included in Title III of the 2008 farm bill, including challenges faced and their successes.

Export Subsidy Programs

Most of the past programs that provided direct export subsidies to producers/marketers, such as the Export Enhancement Program (EEP), have been phased out to comply with World Trade Organization (WTO) rulings. In the Doha Round, agricultural export subsidies are on the agenda of currently stalled WTO multilateral trade negotiations (Ho and Hanrahan 2010a). As the US and world prices have moved closer together, there has been less need for direct export subsidies which were originally created to close the gap between world and US domestic prices and to encourage US exports during the periods when US support prices are higher than the world prices. In the Doha Round of WTO multilateral trade negotiations, the USA and other trading partners have tentatively agreed to phase out all agricultural subsidies by 2013.

The only remaining direct export subsidy program in the 2008 farm bill, authorized in the commodity program title and not the trade title, is the Dairy Export Incentive Program (DEIP). This program was established under the 1985 farm act to assist exports of US dairy products, with the objective of countering the adverse effects of foreign dairy product subsidies—mainly those of the European Union. The DEIP program has strong support in Congress and dairy producers consider DEIP as an integral part of the US dairy policy and an important addition to domestic support programs. The DEIP operates on a bid bonus system, with cash bonus payments. The subsidies originally were in the form of sales from CCC-owned dairy stocks, later they were generic commodity certificates from CCC inventories, and currently cash payments are used to subsidize the exporters. For FY 2002, bonuses totaling $53.7 million were awarded for 85,251 metric tons of nonfat dry milk, and bonuses of $931,775 were awarded for 1,222 metric tons of cheese (USDA/FAS 2002). The DEIP levels for FY 2003 and 2004 were reduced to $32 and $3 million, respectively; however, no DEIP payments were awarded during FY 2005–2008. Legislative authority for DEIP expires on December 31, 2012, as DEIP is included in the WTO export subsidy commitments which limit the volume and financing of export subsidies.

The Export Enhancement Program (EEP) was another important US export subsidy program. The program was authorized through 2007 under the 2002 farm bill, at the funding level of $478 million per year. The stated purpose of EEP was to help US farmers compete with subsidized farm products from other countries, especially the European Union. More specifically, EEP's main objectives were to expand US agricultural exports, to encourage other agricultural exporting countries to engage in negotiations on agricultural trade problems, and challenge unfair trade practices. Trade-distorting subsidies, trade barriers (such as labeling that restricts new technologies), unjustified sanitary and phytosanitary restrictions, and monopolistic state trading enterprises (including those that implemented noncommercial pricing practices) all fall under the definition of unfair trade practices which are challenged under EEP. Under the EEP, exporters were awarded cash payments that enabled them to sell certain commodities to specified countries at competitive prices. About 80% of EEP was used to subsidize exports of wheat and wheat flour (USDA/FAS 2012a). However, the last year of significant EEP subsidies was 1995 and as a result of the US and world prices moving closer together there were no EEP subsidies granted during 2002–2007. The 2008 farm bill officially revoked legislative authority for EEP. The elimination of agricultural export subsidies has been a longstanding goal of US agricultural trade policy (Ho and Hanrahan 2010a).

Nonprice Export Market Development Programs

The US government has played an important role in developing, maintaining, and expanding markets for US agricultural products by funding export promotion programs. The Agricultural Trade Development and Assistance Act of 1954 authorized the use for foreign currencies generated by the sale of PL-480 surplus commodities to help develop new markets for US agricultural commodities (USAEDC 2011). USDA FAS administers the market development programs, as previously stated. The agency was created March 10, 1953 and began to look for new partners to work with to carry out the commodity promotion activities, as it was recognized that FAS did not have the staff or the necessary expertise for implementing the intended market development programs (USAEDC 2011).

To date, FAS has continued its cost-sharing trade promotion partnership with the US agricultural producers and processors, who are represented by nonprofit commodity or trade associations, called cooperators. This public/private partnership, which has evolved since its inception during the Eisenhower/Benson era in 1953, has played an important role in promoting the growth of the overseas markets for US agricultural products. The FAS export promotion programs were created when it became apparent that the US domestic markets could not absorb the US agricultural production and external markets were needed to absorb the US excess supplies. This partnership originally involved in-country survey teams composed of FAS and cooperator staff that met with foreign government officials and local trade associations, under the auspices of the US Embassy officials and agricultural attaches. In the USA, FAS provided the statistical data and analysis (USAEDC 2011).

Cotton, wheat, and tobacco were the first commodities to be included in the export market promotion programs.

Currently, FAS administers five programs with the goal of promoting US agricultural products in international markets: FMDP, MAP, Emerging Markets Program (EMP), Quality Samples Program (QSP), and Technical Assistance for Specialty Crops (TASC). These programs were created as marketing tools to increase foreign demand for US agricultural products. All these programs are funded through the borrowing authority of the CCC. Legislative authorization of CCC funds for the market development programs expires with the most recent farm bill expiration date in FY 2012.

The non-price export promotion programs encompass four types of activities: trade servicing, technical assistance, market research, and consumer promotion. Consumer promotion includes point-of-sale promotion activities, and both generic and brand advertising. Technical assistance and trade servicing (including trade policy support) have accounted for over half of the USDA's market development program expenditures, while consumer promotions have accounted for a much smaller share (USAEDC 2011).

Under these programs, the USDA and the cooperators pool their financial resources and technical expertise to conduct overseas market development. In this respect, the export market promotion programs differ from domestic non-price promotions funded primarily by nonprofit producer organizations through producer assessments and by other private funding sources. The following section provides a description of each program, including history and allocation requirements.

Foreign Market Development Program

The goals of the Foreign Market Development Program (FMDP), which has been in operation since 1956, are to create, expand, and maintain long-term export markets for US agricultural products. This program, first established under the authority of P.L. 480 and reauthorized by Title VII of the Agricultural Trade Act of 1978, uses funds from the USDA CCC to conduct the promotion programs. FMDP is exempt from Uruguay Round agreement reduction commitments (USDA/FAS/FMDP 2011).

In order to carry out the export market development activities, FAS enters into partnerships with those eligible nonprofit US trade organizations (cooperators) that have the broadest producer representation of the commodity being promoted. As stated on the USDA/FAS website, the FMDP benefits the participants in the US agricultural industry by assisting their organizations through addressing long-term foreign market import constraints and by identifying new markets or new uses for the agricultural commodities or products in the foreign market. In general, the FMDP aims to increase global demand for US agricultural exports by addressing infrastructural impediments, technical and regulatory issues, or cultural factors which limit the consumption of the promoted products. The FMDP approved projects have averaged 6 years in length, reflecting the long-term nature and focus of the program. The focus of FMDP is on generic promotion of US commodities, rather than brand-name advertising, and the promotion activities are targeted toward long-term development

(USDA/FAS/FMDP 2011). These long-term programs are concentrated on technical information and trade servicing activities which target infrastructural impediments in markets that inhibit demand growth. More specifically, the FMDP cooperators mostly represent bulk product (unprocessed commodity) associations, the activities are conducted in less developed markets, and consumer promotions are ineligible.

Preference is given to nonprofit US agricultural and trade groups that represent an entire industry or are nationwide in membership and scope. FMDP applications go through a competitive review process and funds are awarded to applicants that demonstrate effective performance based on a clear long-term strategic plan (USDA/FAS 2012a). Cooperators receive partial reimbursement from CCC funds for conducting approved overseas promotional activities.

The 2008 farm bill reauthorized CCC funding for FMDP for FY 2008–2012 at an annual level of $34.5 million. Total allocation for FY 2010 was $34.2 million; with the largest cooperator recipients being the American Soybean Association ($7.3 million), Cotton Council International ($5.1 million), US Grains Council ($4.3 million), the US Wheat Associates ($4.2 million), the American Hardwood Export Council and other wood and paper related associations ($3.5 million), and the US Meat Export Federation ($1.9 million).

The FMDP was the only export market promotion program in place until the early 1980s, when the decline in US agricultural exports after years of record gains led to growing agricultural surpluses (USAEDC 2011). The imposition of trade barriers by US major markets and aggressive promotion and subsidization by US competitors were among the factors that led to eroding US exports and export market shares. To strengthen US exports, the US Congress included in the Food Security Act of 1985 the Targeted Export Assistance Program (TEAP). It emphasized trade policy goals which attempted to counteract the "unfair" trade practices of competitors.

Initial funding for the TEAP was set at $110 million for the first 3 years and $200 million for the remaining two. Although the level of funding allowed only limited expansion of the relatively costly and labor intensive trade servicing and technical information activities, it did allow an array of consumer promotions. The consumer promotion activities could be contracted through public relations firms and once the original fixed cost of developing the promotion was incurred, it could be reused in the same and other markets with little additional cost (USAEDC 2011). Until the late 1980s, the horticultural and tropical products groups ended up receiving the majority of the TEAP funds.

In the late 1980s, the focus on the type of agricultural exports began to change from bulk to value-added products, requiring a different type of promotion activity, including branded product promotion programs. The value of US agricultural exports grew from $27.9 billion in 1987 to $40.1 billion in 1990 and the US share of global trade in HVPs had doubled from its share in 1985. Still, the United States accounted for only 15% of the global trade in HVPs. In 1990, the EU had 24% of the global market share of agricultural HVP. As a result of the changing international trade environment in the 1990s and more emphasis on trade of HVPs, the Conservation and Trade Act in 1990 eliminated the TEAP program and replaced it with the Market Promotion Program (MPP), funded at $200 million per year.

This level of funding remained in place until 1993 when it was reduced to $147.7 by the Agricultural Appropriations Committee. The 1996 farm bill renamed MPP as the MAP.

Market Access Program

The authorization for MAP funding goes back to the funding for its predecessor programs which were authorized by Section 203 of the Agricultural Trade Act of 1978. The MAP is administered by FAS and its goal is primarily to promote US exports of value-added products. Unlike FMDP, the MAP is intended for consumer-ready food products and has a significant consumer promotion component, including electronic and print advertising, consumer exhibits, point-of-sale promotions, market research, trade team exchanges, and brand promotion. Agricultural cooperatives and small companies can receive assistance under the brand program. Under MAP, at least 50% of the branded product promotion activity funding must be provided by individual companies and promotions to an individual country are limited to 5 years. For generic promotion activities, trade associations and other organizations must contribute a minimum of 10% cost match (FAS/USDA/MAP 2011). A wide variety of US food and fiber products qualify to receive MAP funds.

More than half of MAP funds typically support generic promotion—about 60%—and the remaining 40% support branded product promotion. For branded product promotion, since FY 1998, USDA policy has been to allocate all MAP funds to cooperatives and private US companies for branded product promotions. More specifically, MAP is intended for shorter-term, consumer-oriented promotions of high-value and processed products. Additionally, no foreign for-profit company may receive MAP funds for the promotion of foreign-made products (Ho and Hanrahan 2010a). Multi-market, cross-commodity projects are encouraged under an FAS initiative which was launched in 2003.

The 2008 farm bill, authorized funding for the MAP at $200 million annually through fiscal year 2012. Total allocation for FY 2010 was $197.4 million. The largest recipients were Cotton Council International ($20.7 million), US Meat Export Federation ($16.5 million), Food Export Association of the Midwest ($10.7 million), Western United States Agricultural Trade Association ($9.7 million), Wine Institute ($7.2 million), and Southern United States Trade Association ($6.6 million).

Emerging Markets Program

The general objective of the Emerging Markets Program (EMP) is to provide market access for US food and agricultural products. More specifically, the EMP provides funding for technical assistance activities intended to promote exports of US agricultural commodities and products to emerging markets in all geographic regions, consistent with US foreign policy (USDA/FAS 2012a). An emerging market is defined as any country that is taking steps toward a market-oriented economy through food, agricultural, or rural sectors of the economy and also the country must have the potential to provide a viable and significant market for US agricultural commodities or products (Ho and Hanrahan 2010a). Examples of the technical assistance activities are those that focus on trade capacity building or addressing technical barriers to trade. FAS limits EMP projects to countries that have per capita incomes of less than the World Bank's current ceiling on upper middle income economics and those whose populations are greater than one million.

The funding for EMP is authorized in the 2008 farm bill at $10 million each fiscal year for 2008–2012. The FY 2010 funding recipients included universities, state and federal agencies, trade groups, and nonprofit organizations. Total approved funding allocation for FY 2010 was $8.3 million, with project examples being: Food Consumption in China's Second-Tier Cities, for the University of Florida ($468,600): Exporting US Dairy Genetics to China, for Cooperative Resources International ($277,632); Hotel, Restaurant and Institutional Sector Development for USDA/FAS in Chengdu, China ($212,000); and Cotton USA Technical Assistance Initiative in Bangladesh, for Cotton Council International ($200,000).

Quality Samples Program

The Quality Samples Program (QSP) also applies to emerging countries and its objective is to stimulate interest and demand for US agricultural products by permitting potential customers to discover US quality. More specifically, the QSP is intended to help US agricultural trade organizations provide small samples of their agricultural products to potential importers in emerging markets overseas. This program focuses on industrial and manufacturing users of products and is not intended for end-use consumers. The QSP allows manufacturers overseas to do test runs to assess how US food and fiber products can best meet their production needs (USDA/FAS 2012a).

To carry out the program, under the authority of the CCC Charter Act of 1948, FAS can use up to $2 million of CCC funds. In 2010, USDA provided allocations totaling about $1.9 million to trade associations and state agricultural organizations, with recipient examples including: National Potato Promotion Board ($455,000), American Sheep Industry Association ($365,000), California Agricultural Export Council for China ($300,000), and the Mohair Council of America ($225,000).

Technical Assistance for Specialty Crops

The Technical Assistance for Specialty Crops (TASC) Program provides funding to US organizations for projects that address sanitary, phytosanitary, and technical barriers that prohibit or threaten the export of US specialty crops. The legislation defines specialty crops as all cultivated plants, and the products thereof, produced in the USA, except for wheat, feed grains, oilseeds, cotton, rice, peanuts, sugar, and tobacco (Ho and Hanrahan 2010a). Examples of activities these grants may cover include seminars and workshops, study tours, field surveys, pest and disease research, and pre-clearance programs for imports to the USA. TASC proposals are accepted from any US organization, including, but not limited to, nonprofit trade associations, universities, agricultural cooperatives, private companies, US and state government agencies. Applicant matching contributions are not required, but are strongly encouraged.

The 2008 farm bill reauthorized the TASC Program and provided mandatory CCC resources of $4 million in FY 2008, $7 million in FY 2009, $8 million in FY 2010, and $9 million in FY 2011 and FY 2012. This was a significant increase in TASC funding of $2 million per fiscal year under the 2002 farm bill. In fiscal year 2010, $7.3 million were allocated to TASC Program proposals, with a significant portion of funds allocated to the California Dried Plum Board which received $1.5 million for Low-Emission Methyl Bromide Fumigation for Quarantine and Pre-Shipment Uses, and the California Pistachio Export Council which received $1.2 million for Navel Orange worm control to overcome sanitary and phytosanitary barriers in major export markets.

Challenges Facing Non-price US Export Promotion Programs

In summary, all of the nonprice export promotion programs are intended to increase demand (shift the demand curve to the right) for US food and fiber products and to increase the size of the market, as well as the US market share. The two programs, FMDP and MAP, work together in the global markets for increasing US agricultural exports. Due to the change in incomes, lifestyles, and food demand of the global population and consumers in the US export destinations, the FMD and MAP activities have been refined and changed over the years to be more appropriate for the targeted audience.

For the most efficient use of resources, FMDP should precede MAP activities in the targeted markets. The goal of FMDP is to create and develop markets through research, trade servicing, and technical information activities, thereby laying the ground work and establishing relationships for subsequent MAP market expansion activities.

The nonprice market promotion programs, and MAP in particular, have been criticized by members of Congress who maintain that these programs are a form of corporate welfare. Additionally, these programs have been highly contested on the grounds that they offset expenditures on other programs, they fund activities that private firms would and could fund for themselves, principal beneficiaries are foreign consumers, and they open up markets for competing exporters (free riders). Many argue that these funds could be better spent, for example, on educating US firms on how to export (Ho and Hanrahan 2010a).

Nevertheless, there are many success stories of how these programs have impacted US sales in markets overseas by creating a positive image for US products. The supporters of government funded export promotion programs argue that US's major competitors, especially EU member countries, spend a significant amount of funds on market promotion in the US export destination. Therefore, US market promotion programs are needed to help keep US products competitive in global markets.

Another economic justification for government involvement in export promotion is the inability of many American small- and medium-sized enterprises (SMEs) to successfully export their products into overseas markets and to participate in global marketing. This inability may be viewed as a market failure condition and from an economic standpoint, if there exists a market failure, then the government's role in market development and export promotion is justifiable (Wilkinson and Brouthers 2006). In general, market failure occurs when the allocation of goods and services by a free market is not efficient (does not maximize welfare). According to Armbruster and Knutson (Chap. 1), Pareto optimality is the economic foundation for measuring marketing efficiency. If it is not possible to make one person better off without making another person worse off through a reallocation of resources, then the market is said to have reached Pareto optimality.

State government staff have the training and knowledge to help SMEs in exporting through an array of marketing tools, including trade shows, trade missions, and electronic trade-lead-matching programs. It may be argued that when the government gets involved in conducting the export promotion activities of SMEs, that involvement increases technical efficiency of promotion activities. In a market context, because of economies of scale and know-how, the cost of the promotion activity per unit exported is expected to be lower with government involvement.

Enhanced exports by SMEs as well as larger manufactures are expected to increase employment, expand tax base, and encourage capital formation. Therefore, state and federal policy makers encourage export market development activities that result in increased sales of US products in global markets.

Export Credit Guarantees

The USDA administers export credit guarantee programs for commercial financing of US agricultural exports to buyers in countries where credit is necessary to maintain or increase US sales, but where financing may not be available without CCC guarantees (USDA/FAS 2012a). The objective of these USDA CCC programs is to encourage US exports to foreign market destinations. The export credit guarantee programs were first established in the Agricultural Trade Act of 1978 and reauthorized in the 2008 farm bill, from FY 2008 through FY 2012. Under these programs, private US financial institutions extend financing at interest rates which are at prevailing market levels to countries that want to purchase US agricultural exports and guarantee that the loans will be repaid. The CCC essentially assumes the risk of default for loans on US farm exports for payments by the foreign purchasers (Ho and Hanrahan 2010a).

Two export guarantee programs are authorized under the 2008 farm bill: the GSM-102 short-term guarantee program and the Facility Guarantee Program (FGP).

GSM-102 Program

The Export Credit Guarantee Program (GSM-102) underwrites credit extended by the private branding sector in the USA (or, less commonly, by the US exporter) to approved foreign banks using dollar-denominated, irrevocable letters of credit to pay for food and agricultural products sold to foreign buyers. GSM-102 guarantees repayment of short-term financing for 6 months to 3 years.

The 2008 farm bill authorized export guarantees of $5.5 billion worth of agricultural exports annually from FY 2008 through FY 2012. The actual level of guarantees depends on market conditions and the demand for financing by eligible countries. FAS announced $5.4 billion in credit guarantees for FY 2011. The largest FY 2011 allocations were for Africa and the Middle East ($700 million), Central America ($600 million), the Caribbean Region ($325 million), and Mexico ($300 million).

Facility Guarantee Program

The USDA's Facility Guarantee Program (FGP) is designed to expand sales of US agricultural products to emerging markets where inadequate storage, processing, or handling capacity limit trade potential. The program provides payment guarantees to finance commercial exports of US manufactured goods and services that will be used to improve agriculture-related facilities. Eligible projects must improve the handling, marketing, storage, or distribution of imported US agricultural commodities and products (USDA/FAS 2012a). Emerging markets are the target of this program, as these countries often lack the infrastructure to support increased trade volume. Export sales of US equipment or expertise to improve ports, loading and unloading capacity, refrigerated storage, warehouse and distribution systems, and other related facilities may qualify for facility guarantees, as long as these improvements are expected to increase opportunities for US agricultural exports (USDA/FAS 2012a).

Other Credit Guarantee Programs

Two other export guarantee programs were revoked by the 2008 farm bill. These were the GSM-103 program and the Supplier Credit Guarantee Program (SCGP). The GSM-103 guaranteed long-term (3–10 years) financing, while the SCGP guaranteed very short-term financing of exports.

Challenges Facing Export Credit Guarantees

The US export credit guarantee programs came under scrutiny by WTO during a dispute between the United States and Brazil regarding cotton subsidies. The USA is the world's largest cotton exporter, accounting for a significant portion of global trade. In 2001, US cotton exports accounted for 39% of world trade, while US cotton subsidies averaged $2.8 billion per year. In 2002, one of the US major competitors, Brazil, expressed its growing concerns about US cotton subsidies by initiating a WTO dispute settlement case (DS267) against specific provisions of the US cotton program. A WTO dispute settlement panel ruled against the USA on several key aspects of US cotton programs in September 2004. Although this ruling was appealed by the USA, on March 2005, the WTO Appellate Body (AB) upheld the panel's ruling and provided specific deadlines for removal or modification of the offending US subsidies (Ho and Hanrahan 2010a).

The WTO panel found that all three export guarantee programs existing at the time of the dispute (GSM-102, GSM-103, and SCGP) effectively functioned as export subsidies because the financial benefits returned to the government by these programs failed to cover their long-run operating costs. Because export subsidies in general lead to a gap between the subsidized price and the actual marginal cost, they may be viewed as creating market failure. Allocative inefficiency—which exists when the allocation of scarce resources to production activities do not maximize welfare—will result.

Moreover, the WTO panel found that this export-subsidy aspect of export credit guarantees applies not just to cotton, but also to all recipient commodities that benefit from US commodity support programs. Therefore, so long as the credit guarantees act as an implicit export subsidy, only US program crops that have export subsidies listed in their WTO country schedule are eligible for US export credit guarantees. The WTO, AB recommended that the "prohibited" subsidies be withdrawn by July 1, 2005 (Ho and Hanrahan 2010a).

The American negotiators discussed possible solutions with Brazil and declared that it would be very difficult to get rid of cotton subsidies. The two sides agreed that the US would pay Brazilian cotton farmers $147 million a year. In conclusion, the credit guarantee programs were one of two programs which caused such an issue with Brazil, and the settlement has come at a high cost to all US tax payers. It can be argued that the cost of subsidies and retaliations that have resulted from the subsidies create marketing inefficiencies and are not Pareto optimal for the US tax payers. This is an example where supporting US cotton producers and encouraging their exports have come at a high cost in terms of the welfare of US tax payers. This market failure has led to a gap between marginal social cost (US tax payers) and marginal private cost (cotton producers and marketers). This gap could have been reduced by changes in the export enhancement policies that have led to market failure in general and to technical, allocative, and dynamic inefficiencies in particular.

International Food Aid Programs

The FAS provides US agricultural commodities to millions of people in various countries, through direct donations and concessional programs. The objectives for international food aid programs are providing emergency and humanitarian assistance in response to natural or manmade disasters, and promoting the development of market-oriented agricultural sectors and food security. The USA provides food aid for emergency food relief and to support development projects. The food aid programs in the 2008 farm bill include: the Food for Progress Program, the

McGovern-Dole International Food for Education and Child Nutrition Program, the Food for Peace Act [formerly referred to as Public Law 480 (PL 480), Titles I, II, and III], Section 416(b), and the Local and Regional Procurement Project. The full name for Public Law 480 is the Agricultural Trade Development Assistance Act, which was signed into law in 1954 by President Dwight Eisenhower (USDA/FAS 2012b).

Food for Progress Program

The Food for Progress (FFP) program provides for the donation or credit sale of US commodities to developing countries to strengthen free enterprise development in the agricultural sector. FFP mainly focuses on private sector development of agricultural infrastructure, including improved agricultural production practices, marketing systems, farmer training, agro-processing, and agribusiness development.

A minimum of 400,000 metric tons of commodities are required in 2008 farm bill to be provided through the FFP program. USDA purchases those commodities from the US market, donates them to the implementing organizations and pays for the freight to move the commodities to the recipient country. The freight cost is limited to no more than $40 million annually. Organizations eligible to carry out FFP programs include private voluntary organizations (PVO), cooperatives, and intergovernmental organizations, such as the World Food Program (WFP).

In FY 2009, USDA provided over 280,000 metric tons of US commodities, such as wheat, wheat flour, soybean, and corn, with an estimated value of over $200 million to PVO and foreign governments for implementing agricultural and rural development projects in developing countries.

McGovern-Dole International Food for Education and Child Nutrition Program

The McGovern-Dole program uses commodities and financial and technical assistance to carry out school feeding programs and maternal, infant, and child nutrition programs in foreign countries. Commodities are donated through agreements with PVO, cooperatives, intergovernmental organizations, and foreign governments. Priority countries under the McGovern-Dole program must demonstrate sufficient need for improving domestic nutrition, literacy, and food security.

The funding for McGovern-Dole in the 2008 farm bill is on a flexible basis. The appropriations of FY 2010 provided $209.5 million for the McGovern-Dole Program, more than doubling the program level in FY 2009. In addition, there was $84 million of CCC funding provided to the program in FY 2009 as a one-time authorization in the 2008 farm bill. It also includes an appropriation to the US Secretary of Agriculture of $10 million to conduct pilot projects to develop and field-test new and improved micronutrient-fortified products to improve the nutrition of populations served through the McGovern-Dole program.

Food for Peace Act

The Food for Peace Act (FPA), formerly referred to as Public Law 480, is the primary legislative mechanism that authorizes foreign food assistance. Over the past decade, FPA typically accounted for 50–90% of USDA's total annual international food aid budget. The objectives of FPA food aid is improving global food security and nutrition, promoting sustainable agricultural development, expanding international trade for US commodities, and fostering private sector and market development. There are three primary programs in FPA: Title I, Trade and Development Assistance; Title II, Emergency and Private Assistance; and Title III, Food for Development. Title I is managed by USDA, while Titles II and III are managed by USAID. Titles I and II are no longer funded. Detailed information regarding these programs is available from USDA/FAS (2012a).

A Food Aid Consultative Group (FACG) advises the USAID Administrator on food aid policy and regulations. FACG currently consists of the USAID Administrator, the USDA Under Secretary of Agriculture for Farm and Foreign Agricultural Services, the Inspector General of Agriculture for Farm and Foreign Agricultural Services, the Inspector General for USAID, a representative of each private voluntary organization (PVO) and cooperative participating in FPA programs, representatives from African, Asian, and Latin-American indigenous nongovernmental organizations (NGO) determined appropriate by the Administrator, and representatives from US agricultural producer groups.

Challenges Facing International Food Aid Programs

Food aid has been essential for saving lives around the world, especially during a crisis or natural disaster. But its value in long-term development has been controversial. International food aid was initiated when agricultural support policies of North American and European countries had led to large surpluses of cereals. Food aid provided an outlet for the disposal of surplus and gained support of the farmers because it reduced storage costs and opened access to new overseas markets. Food aid had also become an instrument of foreign policy to gain support. The support of the shipping industry has been indicated as another major interest of US food aid as, according to the 1985 Farm Bill, at least 75% of US food aid has to be shipped by US Vessels (Mousseau 2005).

It is argued that the donor-driven food aid has led to a decline of the agricultural sector of the recipient countries, as a negative correlation between food aid flows and international cereal prices is observed (Mousseau 2005). It is also argued that in-kind food aid, while releasing resources in the recipient country, might not necessarily help the developing countries as the released resources might be used for nondevelopment purposes such as military purchases (Shah 2007). Additionally, the recent surge of interest in biofuel crops and the increased crop values and food prices has not only reduced the amount of the American food aid but also has made it harder for poor country consumers to afford food.

From an efficiency point of view, the theory of comparative advantage emphasizes that in order to maximize welfare, countries should specialize in the production of the commodities for which they have a comparative advantage and export them and import those commodities for which they do not have a comparative advantage. However, when prices are distorted because of cheap food supplies through food aid, the recipient country producers will not receive the correct price signals and therefore, resources will not be allocated to their highest value use. This would lead to technical and allocative inefficiencies.

Improving aid effectiveness and developing "demand-driven" strategies considering the recipient country's needs and strategic plans for food security are challenges faced by international food aid programs. In addition, determining the best form for providing food aid and assistance, whether in the form of cash or commodities and determining the cost-effectiveness of US cargo preferences for delivering US food aid are also big challenges for food aid.

Measuring the Effectiveness of Export Market Development Expenditures

The US generic commodity promotion programs seek to both inform and change consumer perceptions and attitudes, with the objective of increasing domestic and export sales and market shares for US agricultural commodities and products (Henneberry et al. 2009). In an attempt to isolate and measure the effects of promotion on product sales, researchers have used a wide range of models and statistical methods, ranging from basic correlations to conjoint analysis of consumer preferences. These have included consumer behavioral approaches, quantitative models measuring the relationship between advertising and sales and the effects of prices, income, and promotion expenditures on consumer demand. Industry market researchers develop baseline data by tracking consumer attitudes and product sales. A notable portion of current research on promotion effectiveness has involved measuring consumer behavior by conducting primary data analysis. The data are collected through various means, including telephone and e-mail surveys of consumer awareness of products and advertisements, by establishing focus groups and consumer panels, and by conducting consumer tests in retail stores and shopping areas (Henneberry and Ackerman 1991).

Although many researchers have analyzed the effects of advertising and promotion expenditures on domestic consumer demand, the studies dealing with the effects of export promotion expenditures on import demand have been limited. Export market development expenditures, which have been typically used to fund promotional efforts, are intended to shift the importer's demand curve to the right or rotate the demand curve by changing the elasticity of demand schedule. Assuming no change in the supply schedule, promotion expenditures are expected to increase US exports and export value. It is important to note that several studies have used a benefit/cost analysis to measure the return per dollar of promotion expenditure.

In this section, an overview of the studies that have analyzed the impacts of foreign market promotion programs and challenges faced by researchers are discussed. Table 8.2 provides a synopsis of 12 export promotion studies that have been published since 2000, in terms of key assumptions, including regions and time period

Table 8.2 Impact studies on US export promotion programs, selected studies from 2000 to 2011

Study	Author	US export promotion programs	Products	Location	Period covered	Type of model	Results
Measuring the impacts of US export promotion programs	Adhikari et al. (2003)	FMD and MAP	US wheat	Middle East, Pacific Rim, and Mexico	1996–2001	Single export demand function	Export promotion has a positive impact. The per dollar returns to wheat export promotion were \$1.49 in Middle East, \$0.42 in Pacific Rim, and \$2.01 in Mexico.
The Effect of the US FMD program	Boonsaeng and Fletcher (2008)	FMD	US shelled peanuts	European Union	1991–2005	Differential factor allocation model (DFAM)	Positive impact of FMD program on EU demand for US shelled peanuts. The marginal return per EURO dollars of US FMD expenditures is 240 Euros.
The impact of US Non-price export promotion	Boonsaeng and Fletcher (2010)	FMD and MAP	US peanuts	Canada and Mexico	1991–2006	Single equation, export demand	US peanuts exported to Canada and Mexico are own-price elastic. US export promotion return in Mexico is \$35.92 per dollar invested.
Global welfare impacts of US meat promotion activities	Henneberry et al. (2009)	FMD and MAP	US beef and pork	World	2002	Equilibrium displacement model	US producer welfare increases from a 10% increase in promotion expenditures, ranging from –\$1.29 million to \$2.60 million for beef producers and from –\$0.96 million to \$1.67 million for pork producers.
A benefit–cost analysis of US agricultural trade promotion	Kinnucan and Cai (2010)	FMD and MAP	US agricultural commodities	World	2000–2004	partial-equilibrium model	Subsidies for nonprice export promotion can harm domestic consumers by increasing prices and by diverting funds from domestic market promotion. Federal expenditures for export promotion may be too high.
An analysis of cotton research and promotion program	Murray et al. (2001)	Cotton research and promotion programs	US cotton	World	1975–2000	Structural model	The Cotton Program has a strong and positive effect on the demand for US upland cotton. The returns to producers substantially outweigh the costs.

Effectiveness of US dairy export promotion programs	Olukoya (2008)	FMD and MAP	US cheese, whey, and Nonfat dry milk	Mexico, South Korea, Japan and Thailand	1998–2005	AIDS, CBS, NBR, and single equation for import demand	The US promotion activities were not found effective, with the exception of cheese in South Korea.
Export demand for US walnuts	Onunkwo and Epperson (2000)	TEA and MPP	US walnuts	Asia and EU	1986–1996	Single equation, export demand	The marginal return per dollar to promotion expenditures for walnuts is $6.14 in Asia. There is no detectable response to promotion expenditures in the EU.
Export demand for US pecans: impacts of US export promotion	Onunkwo and Epperson (1999)	FMD, MAP, MPP, and SUSTA	US pecans	Asia and EU	1986–1996	Single equation, export demand	The returns per dollar of promotion expenditure for pecans are $6.45 in Asia and $6.75 in EU. The US pecan industry can benefit substantially from increased export promotion in both Asia and the EU
Export demand for US almonds	Onunkwo and Epperson (2001)	FMD, MAP, and MPP	US almonds	Asia and EU	1986–1996	Single equation, export demand	The marginal return per dollar to promotion expenditures for almonds in Asia is $47.74. EU appears to be a mature market for US almond exports with no detectable response to promotion expenditures.
Effectiveness of US rice export promotion programs	Rusmevichientong and Kaiser (2009)	FMD and MAP	US rice	World	1984–2005	Double logarithmic export demand	Export promotion has a positive impact on demand for US rice exports. The US is underinvesting in rice export promotion compared to the optimal amount.
Are there halo effects on US grain export promotion?	Rusmevichientong and Kaiser (2011)	FMD and MAP	US rice, wheat, and sorghum	World	1990–2005	Dynamic LA/AIDS model	US grain export promotion has a positive direct impact on exports, while the indirect effects are not found (anti-halo effect) on competing country exports.
International market promotion effectiveness for soybeans	Williams (2012)	Soybean checkoff program	US soybean	USA, Brazil, Argentina, EU, Japan, and ROW	1980–2006	180-equation simulation model	Soybean checkoff investments in international market promotion have enhanced the international competitiveness of the US soybean industry and increased the global market share of US soybean and product exports.

MAP Market Access Program, *MPP* Market Promotion Program, *TEA* Targeted Export Assistance, *FMD* Foreign Market Development, *ROW* The rest of the world, *SUSTA* Southern United States Trade Association, *EU* European Union covered, locations, type of expenditure, techniques used, and results. The studies are organized by commodities studied. A summary of the export promotion effectiveness studies prior to 2000 is given by Rusmevichientong and Kaiser (2009).

Challenges in Measuring Effectiveness of Expenditures

The US promotion effectiveness results presented in Table 8.2 vary widely across commodities and countries. Generally, the estimated benefit–cost ratio is positive but not always. A diverse set of quantitative models have been used by researchers in estimating the effects of promotion and advertisement on demand. These studies have differed in terms of the choice of variables and source of data on promotion expenditures, which may lead to different outcomes and conclusions about the effect of promotion (Coulibaly and Brorsen 1999). Many researchers have focused on the appropriate model selection in the context of a demand systems approach. Typically, import demand models include price variables (own- and substitute/complement prices), income, exchange rates, population, a measure of international restrictive or expansionary trade policies, and export promotion expenditures (own- and competitors).

Data and Exchange Rate/Deflator Issues

Because data on some of these variables (especially competing country promotion activities/expenditures) might not be readily available, it would not be possible to include all the variables, which would lead to estimation biases resulting from the omitted variables. Given that most of the studies of export promotion effectiveness have utilized time-series data, accounting for inflation on the variables that are measured in monetary terms must be considered. Various techniques have been used to deflate nominal data into real terms. Some have expressed all monetary variables in US currency and have used the real exchange rate as an additional variable to account for the weakening or strengthening the dollar. Another approach has been to enter all the monetary variables into local currency. These varying approaches might lead to different promotion coefficients.

In order to incorporate the effects of seasonal marketing trends and shocks (e.g., drought or flood) or trade barriers and import bans on exports, many researchers have used dummy variables as an intercept, or as a slope shifters. Some have also used dummy variables to take into consideration trade and structural barriers, as well as trade bans—such as those which have occurred in recent years due to animal disease. Dummy variables have also been incorporated to take into account the international trade and domestic policies that restrict imports, such as, taxes, quotas, and subsidies; as well as infrastructural limitations, such as limited access to ports, the lack of availability of refrigerated storage, food regulations regarding genetically modified foods, additives, chemicals, growth hormones, and packaging and labeling requirements. The use of too many dummy variables will create estimation challenges, including limiting degrees of freedom.

Selection of a Model

Economic researchers have analyzed relationships between income, prices, and promotion expenditures on sales or consumption. Earlier published research on the evaluation of nonprice export promotion programs includes a single-equation approach for relating promotion expenses to US exports (Lee 1977; Lee et al. 1979; Priscott 1969; Rosson et al. 1986). A major limitation of the single-equation approach is that the inter-commodity effects of various advertising programs are ignored. The complementary and substitution effects resulting from the promotion expenditures on other commodities or the same commodity originating from other exporting countries may have as significant impact on the effectiveness of the market development programs for the studied commodity as its own (Henneberry and Ackerman 1991).

Types of Promotion Expenditure

As mentioned earlier, nonprice export promotion programs involve various activities, ranging from consumer promotion to trade servicing and technical assistance. In most of the past studies on promotion effectiveness, market development activities have not been separated by the type of activity. Aggregating promotion dollars implicitly assumes that the promotional activities for the same commodity will have the same impact on importer demand, regardless of the type of activity. This might not be an accurate assumption as, for example, trade servicing activities are expected to sustain medium- and long-term demand for US agricultural exports; while in consumer media advertising or in-store promotions, the impact is expected to peak during or immediately after the advertising campaign and then decline. In the case of technical assistance which involves the adoption of a new technology, increased US exports are not expected until several years after the implementation of the activity which make the modeling of the effects more complicated (Henneberry and Ackerman 1991).

Another estimation challenge has involved measuring the impact of promotion activities when both generic and brand advertising are involved. While the goal of generic advertising is to increase the size of the market, the objective of brand advertising is to increase market share through product differentiation. Therefore, these two types of promotion are intended to have different impacts on market development. Therefore, there can be both complementary and competitive aspects of these two types of promotion, which makes measuring their impact on exports more complicated when they are conducted simultaneously.

Measuring the Lagged Effects of Non-price Promotion Expenditures

Many types of export promotion activities are expected to affect export demand beyond the year that the promotion expenditures occurs. Therefore, the type of the lag structure that is used in export demand models is very crucial in having an accurate estimate of promotion effectiveness. Realizing this, many researchers have used elaborate forms of lag structure. These include a distributed lag model to measure the long-run impact of generic advertising expenditures on per capita consumption. In this form, advertising expenditure is usually specified as a weighted sum of current and lagged advertising expenditures. Some have referred to the weighted sum of lagged expenditure variable as the “good-will” variable.

However, a more elaborate formulation of lag structure may lead to degrees of freedom problems. And therefore, given the time-series data limitations in export demand models, some researchers have used a simple linear lag structure.

Measuring Promotion Effectiveness

Depending on the choice of the model, data, variables, and type of promotion activity involved, the measurement of promotion effectiveness can vary, even for the same commodity and during the same time frame. Researchers conducting studies on promotion effectiveness have to be aware of any or all of these challenges. The selection of the functional form or the type of data and variables included can affect the outcome of measuring the impact of promotion.

In assessing the impact of export promotion on US producer welfare, it is important to take into account the effect on domestic market promotion. For example, the FMD funds provide a strong incentive for industry to divert funds from domestic market promotion to export promotion (Kinnucan and Cai 2010). Also, advertising spillovers may be an issue (Kinnucan et al. 1996). More specifically, there might be spillover effects of export promotion activities into industries that are related to the promoted industry through consumer preferences. For example, pork might be substituted for beef due to pork promotion activities. Therefore, looking at the total US producer welfare, the gain to welfare might be over- or underestimated if these spillover effects are not considered.

Researchers planning to analyze the economic effect of US nonprice export promotion programs should be aware of the limitations in available public data. Researchers planning to analyze the economic effects of these programs should be aware of the limitations in available public data. FAS keeps detailed accounts of program budgets and expenditures for every nonprofit organization and private company which directly participates in the programs. The FAS expenditures reflect actual claims filed by the program participants for reimbursement of eligible expenses. Therefore, the complete data might not be available for current promotion years. In addition, data might not be available for each detailed category of promotion and only be available for general descriptions of promotion activities. Finally, FAS promotion expenditures represent the government’s share of promotion costs. In order to determine the total costs of promotion, researchers might also want to include contributions from private organizations and companies (Henneberry et al. 1992).

Another limitation to export promotion studies is the lack of the availability of competing country promotion data. Not including competing country promotion data, may lead to biased estimates of the US promotion effectiveness.

Concluding Remarks

The US agricultural export promotion programs seek to both inform and change global consumer attitudes and perceptions, with the goal of increasing export sales and market shares for US agricultural commodities. However, in recent years, there has been a lot of debate about the continuation of these programs (Henneberry et al. 2009). For example, some of these programs have been highly criticized as promoting corporate welfare and helping promote US competing country products. Given the significant amounts of tax payer, producer, and US government funds devoted to export promotion of agricultural products, it is important to understand these programs and their intended economic impacts. This chapter gives a critical review of US export market development programs and their impacts.

The support of US producers and industries is the foundation for the US export promotion programs. The USA is one of the major players in world agricultural markets. However, US market share for several agricultural commodities has been declining. Effective export promotion programs can help the US maintain or increase its market share. Additionally, many small to medium sized agricultural industries and food processing firms do not have enough funds to be effective and efficient in advertising their products. These export promotion programs can be of a great value to these smaller firms. The impact of promotion of a certain group of agricultural commodities or products on related industries, such as the shipping industry, can also be significant.

The number of published studies on export promotion impacts has been limited. While most of these studies have found positive benefit cost ratios associated with US export promotion activities, the payoffs indicated are widely variable within commodities and among markets. Some studies indicate an increase in market shares (Table 8.2). However, it is important to consider the types of the models and data that have been used to estimate promotion effectiveness and the shortcomings of each study. Also, there are many data limitations that cause biases in estimation results. Therefore, caution should be exercised in interpreting the results of the analyses regarding promotion effectiveness and applying the results to design or revise policy.

Another issue that policy makers might consider in future farm bills is regarding the required match from the industry for some of these export promotion programs. For example, other than imposing a minimum match for certain programs, the nonprice US export promotion programs do not require a 100% match from the industry. For example and as mentioned earlier, for generic promotions under MAP, trade associations and other organizations are required to contribute only a minimum of 10% cost match. Increasing the minimum match level for these programs might be a future policy consideration for increasing the efficiency of the investment in export promotion.

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Part III
Food Quality Standards, Food Safety, Border Inspection, and Invasive Pests

This part begins with a discussion of the shift in consumer expectations from quality standards and grades based primarily on appearance to also incorporating process standards. Consumers wanting to know more about how products are produced led to organic production standards and an increased role for third-party product certification and verification in both domestic and international marketing. The discussion then turns to the expanding demands for the implementation of Hazard Analysis Critical Control Programs (HACCP) and of HACCP-type standards across agricultural production and marketing functions. USDA's Food Safety Inspection Service took the lead in implementing HACCP in meatpacking plants. Now the focal point of attention is shifting to the Food and Drug Administration's implementation of the Food Safety Modernization Act. Subsequent developments can be anticipated in traceability systems for plant and animal products that could extend from the retail to the farm level. Consumers' demands for fruits and vegetables throughout the year have meant increased imports. The quality and safety standards for imported products are the same as for domestically produced products. The program issue is one of enforcement of these standards both at the U.S. border and in the countries where the products originate. Increased globalization has also meant increased movement of invasive species, pests, and pathogens across U.S. borders. This poses the potential for jeopardizing U.S. and global food production and marketing. As a result, the USDA mission of protecting the food supply from plant and animal diseases has become more challenging and critical.

In Chap. 9, Caswell presents a framework for evaluating federal programs based on the quality attributes targeted, their policy rationales, and the mandatory or voluntary policy instruments utilized, including types of labeling. U.S. quality assurance programs target food safety, nutrition, sensory/organoleptic, value/function, and process attributes. The federal government faces several challenges in developing a more effective mix of activities targeted at agricultural and food quality assurance.

In Chap. 10, Souza-Monteiro and Hooker discuss food safety and traceability policies and their impacts in food markets. Mitigating foodborne illness outbreaks requires ability to quickly detect the cause, origin, and spread of an incident, necessitating traceability. Food safety policies increasingly impose science and risk-based standards to assure food safety and traceability challenges in the increasingly global and highly connected food supply chains.

In Chap. 11, Nganje focuses on the impacts of increased international trade on the marketing system; emphasizing inspection and surveillance activities, and policies to mitigate potential market failure risks from unintentional food safety contamination and intentional food defense contamination risks. A framework to evaluate economic efficiency of policies and tools used to ensure imported food quality and safety is discussed.

In Chap. 12, Peck addresses how the ability to efficiently produce and market U.S. agricultural goods is contingent upon keeping them relatively free of harmful weeds, insects, microbes, and diseases. Policies and interventions that prevent or control nonnative pests play a crucial role in safeguarding U.S. agriculture. Some interventions have ambiguous impacts and some improve one outcome at the expense of others.

Chapter 9
Challenges in Choosing the Mix of Public and Private Standards for Food Quality Assurance

Julie A. Caswell

Abstract Several federal agencies have mandates to regulate and/or oversee and support the provision of agricultural and food quality in the USA. Federal policy and regulatory choices determine the resulting mix of public and private responsibility for quality assurance. This chapter presents a framework for analyzing and evaluating federal programs based on the quality attributes they target, their policy rationales, and the policy instruments (mandatory and voluntary) they use, including types of labeling. This framework is applied to survey the quality assurance programs of the U.S. Food and Drug Administration and the U.S. Department of Agriculture in the areas of food safety, nutrition, sensory/organoleptic, value/function, and process attributes. The federal government faces several challenges in adjusting its policies and regulations in order to develop a more effective mix of activities targeted at agricultural and food quality assurance. These challenges include scrutinizing rationales for marketing policies across agricultural and food quality attributes and evaluating the mix of mandatory regulatory versus voluntary market oversight/support approaches used.

The federal government faces several challenges in choosing an effective set of marketing policies targeted at assuring the quality of the tremendous flow of agricultural and food products, sourced domestically and internationally, sold within the USA. The range of quality attributes that are of interest to government agencies, participants in the supply chain, and consumers has been expanding over time resulting in more highly differentiated products. The private sector (first-party sellers and second-party buyers along the supply chain) and third-party (not buyers, sellers, or government) certification bodies have responded with increasingly

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sophisticated systems of standards, certification, and labeling. In choosing and implementing policies, the federal government is continually calibrating a mix between public, private (market), and third-party responsibility for agricultural and food quality assurance.

This chapter presents a framework for characterizing and evaluating federal marketing policies for quality assurance. This framework focuses on:

- The agricultural or food quality attributes targeted by the policies.
- The rationales for federal policies to address agricultural and food quality assurance issues for those attributes.
- The major types of policy instruments used by the federal government:
  - Regulatory policies focused on setting and enforcing mandatory minimum standards and/or labeling requirements.
  - Oversight/support of market policies focused on building markets; supporting fair trade; and setting, overseeing, and/or guiding voluntary standards and labeling.
- Bases for evaluating policy effectiveness.

This framework is used to survey current, federal agricultural and food quality assurance policies with an emphasis on highlighting the resulting mix of public and private responsibility that they create. Marketing policies regarding quality are important to all participants in the supply chain, domestic consumers, nongovernmental organizations, and foreign governments and consumers because they influence the levels of quality that are produced, the information available, competitive advantage, and consumer protection. The political process influences the quality issues focused on and the federal marketing policies chosen.

The chapter concludes with a discussion of options for adjusting federal agricultural and food quality assurance policies and ways in which the framework developed can be a useful decision-making tool in that process. While not the focus here, the framework approach can also provide insights for the analysis of regulation and markets for quality for participants in the supply chain, including input suppliers; food producers, manufacturers, distributors, and retailers; food service operators; third-party certification bodies; nongovernmental organizations; consumers; and others.

Framework for Characterizing and Evaluating Food Quality Assurance Programs

Several federal agencies have mandates to regulate and/or oversee and support the provision of agricultural and food quality in the USA. A framework for characterizing and evaluating these programs helps in understanding policies, given the program diversity. The framework developed here focuses on the quality attributes targeted by the policies, policy rationales, types of policies, and bases for evaluating policy effectiveness.

Quality Attributes Targeted by Policies

The quality assurance policies of the federal government, as well as private and third-party quality assurance programs, can be characterized by the individual product attributes or suites of attributes on which they focus. In specifically considering federal policies, it is useful to think about the entire range of quality attributes that may be their focus and on external indicators and cues that can be used to signal product quality (Caswell et al. 2002). Figure 9.1 separates intrinsic product attributes—those that are characteristic of the product itself—into five categories: food safety, nutrition, sensory/organoleptic, value/function, and process attributes (Caswell 2006). A particular attribute may fall into more than one of these categories. For example, where a product is produced could influence its food safety and taste (sensory/organoleptic attribute), as well as being of importance to buyers who prefer products from that region (process attribute).

Figure 9.1 also presents a set of external indicators and cues—such as certification, labeling, price, and brand name—that may be used to signal the levels of intrinsic quality attributes to buyers. Federal policies for quality assurance can focus on levels of intrinsic quality attributes themselves (e.g., using standards and enforcement to ensure that foodborne pathogen levels are below acceptable limits), on extrinsic indicators and cues (e.g., nutrition labeling), or both (e.g., definition of organic products and related labeling requirements).

Rationales for Federal Policies to Address Quality Assurance Issues

Federal agricultural and food quality assurance policies can also be characterized by the rationales that are used to support them. From an economic perspective, marketing policies may be a response to situations in which the performance of the market is viewed by legislators, or federal agencies under legislative mandates, as not being satisfactory. Following the definitions laid out in Chap. 1, market performance may not be satisfactory because it does not achieve the desired level of technical, allocative, or dynamic efficiency or does not achieve desirable outcomes in terms of nonmarket social values. Policies may also be put in place for rent-seeking purposes that do not further economic definitions of performance.

A central economic rationale for product quality policies is to address allocative inefficiencies that result from inadequate information being available in markets. Companies produce products with different quality levels at different costs to meet demand from buyers for particular combinations of quality attributes and prices. A well-performing market for quality requires that buyers have adequate information to identify and buy products that meet their needs, thereby providing economic rewards to companies whose products meet buyer demand. There is a market failure if information is inadequate.

Intrinsic Quality Attributes

1. **Food Safety Attributes**
   Foodborne Pathogens
   Heavy Metals and Toxins
   Pesticide or Drug Residues
   Soil and Water Contaminants
   Food Additives, Preservatives
   Physical Hazards
   Spoilage and Botulism
   Irradiation and Fumigation
   Other
2. **Nutrition Attributes**
   Calories
   Fat and Cholesterol Content
   Sodium and Minerals
   Carbohydrates and Fiber Content
   Protein
   Vitamins
   Other
3. **Sensory/Organoleptic Attributes**
   Taste and Tenderness
   Color
   Appearance/Blemishes
   Freshness
   Softness
   Smell/Aroma
   Other
4. **Value/Function Attributes**
   Compositional Integrity
   Size
   Style
   Preparation/Convenience
   Package Materials
   Keepability
   Other
5. **Process Attributes**
   Animal Welfare
   Authenticity of Process/Place of Origin
   Legality of Production Practices
   Traceability
   Biotechnology/Biochemistry
   Organic/Environmental Impact
   Worker Safety
   Other

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Extrinsic Quality Indicators and Cues

1. **Test/Measurement Indicators**
   Quality Management Systems
   Certification
   Grades
   Records
   Traceability
   Quality Signaling/Labeling
   Minimum Quality Standards
   Occupational Licensing
   Other
2. **Cues**
   Price
   Brand Name
   Manufacturer Name
   Store Name
   Packaging
   Advertising
   Country of Origin
   Distribution Outlet
   Warranty
   Reputation
   Past Purchase Experience
   Other Information Provided

Fig. 9.1 Attribute space for food products. *Source*: Adapted from Caswell (2006)

The adequacy of information in markets for quality, and how well markets perform, depends on the amount and timing of available information (Akerlof 1970; Nelson 1970, 1974; Darby and Karni 1973; Golan et al. 2001). For example, a consumer may choose between apples based on their color and firmness, two quality attributes that can be evaluated by inspecting the product. In the economics literature, this type of attribute is called search—information is relatively readily available. For other attributes, called experience, the quality of the product—for example, taste or cooking qualities—cannot be known until after the product is purchased and used. A third type of attribute is called credence—the buyer cannot know the quality, for example the level of pesticide residues, even after purchase and use and must rely on extrinsic indicators and cues to evaluate quality.

In general, market failures due to inadequate information are less frequent where search attributes dominate product quality because buyers can evaluate quality and reward companies that provide the desired level with their purchases. Failures are more likely with experience goods because buyers may mistakenly purchase products that do not meet their needs. However, in markets for agricultural and food products, which are bought repeatedly, buyers can through experience correct their purchase choices over time, again rewarding companies that deliver the desired level of quality (Klein and Leffler 1981; Carriquiry and Babcock 2007). Market failures are most likely where quality attributes are credence because the mechanism for buyers to reward sellers who produce desirable quality levels breaks down as the buyer cannot accurately judge quality. However, here as well as with search and experience attributes, extrinsic indicators and cues (e.g., grades, certification and labeling systems, and brand names) can be developed to signal quality to buyers throughout the supply chain. If reliable, these indicators provide a strong incentive to companies to produce the desired levels of quality and communicate it accurately.

A second type of market failure that is an important rationale for some federal agricultural and food quality assurance policies is the existence of monopolistic competition and concentrated market power. The long distance shipping of perishable and/or nonstandardized products, for example, may present opportunities for buyers to exercise market power over suppliers (see, e.g., Nichols et al. 1983). Setting grades and standards, and other quality assurance programs, can level the playing field for different participants in the supply chain.

A further significant rationale for agricultural and food quality assurance policies in some cases is the existence of externalities that cause market failures. For example, public health costs may be higher than optimal if buyers are not sufficiently informed about food safety risks and companies do not have sufficient incentives to produce safe food. Finally, nonmarket social values may provide rationales for quality assurance programs—for example when local food production is promoted in order to support particular farming communities.

Federal policies focus on quality assurance issues where market forces are judged to be inadequate to deliver the desired levels of market performance. For example, food safety may frequently be a credence attribute for which market incentives are not strong enough to induce all companies to supply products with sufficient levels of safety, resulting in market failure due to inadequate information and externalities. The government may step in to set mandatory, regulatory standards. In other cases, the government may choose voluntary, oversight- and support-related policies. Whether the market is performing satisfactorily is a judgment call, however, and different stakeholders may have different views about the existence and seriousness of the market failure and the need for federal marketing policies. There is always the potential, as well, that stakeholders promote a marketing policy not because of a market failure but as a means of gaining competitive advantage.

Types of Federal Marketing Policies

The framework developed here also characterizes federal marketing policies by the types of policy instruments that they use. The federal government has a range of policy options to choose from in addressing performance problems in markets for agricultural and food quality. In thinking about these options, it is important to recognize that quality assurance involves a three-step process:

- Standard setting.
- Standard enforcement or certification.
- Quality signaling—the communication of quality levels to buyers within the supply chain or to final consumers.

Each of these three steps can be done by government agencies (here the focus is on federal agencies) or by private and third parties. Many markets for agricultural and food quality feature a mixture of government, private, and third-party activity in the quality assurance process. Government agencies always have an underlying role in preventing fraud or deception in markets.

Figure 9.2 presents the spectrum of options (or policy instruments) for assigning government and private responsibility for agricultural and food quality assurance (Garcia Martinez et al. 2007). On the end of the spectrum with the least intervention, government can choose to make no interventions, relying entirely on the market to produce, verify, and communicate quality. On the next level, government involvement is still low, but private parties develop various types of self-regulation—for example, quality assurance schemes by farmers' associations or retailers' proprietary quality assurance schemes. A third level of government involvement focuses on providing information and education that may improve the functioning of markets for quality—for example, providing advice to consumers on what to look for in products or providing training to food companies on quality assurance.

Government takes increasingly stronger roles in quality assurance in the next three options for public/private mixes of quality assurance. In coregulation, government and public parties cooperate in setting up systems of quality assurance (Garcia Martinez et al. 2007). For example, the government may set voluntary standards for quality assurance that are graded or certified and labeled by private companies or third parties. In using incentive-based structures, governments encourage quality assurance through mechanisms such as liability rules, subsidies for investments, or enforcement that is responsive to the company's record on quality assurance. Finally, governments may directly regulate quality assurance through banning or sanctioning particular types of products, or prescribing methods of processing and marketing. There is an ongoing interest in shifting government regulatory practice from

Fig. 9.2 Options for assigning public/private responsibility to assure food quality. *Source*: Adapted from Garcia Martinez et al. (2007)

using "command and control" or "process" approaches that mandate specific practices to setting expectations that preventative measures will be taken or setting "performance standards" for final product quality, leaving the means of achieving those levels up to companies (Henson 2008). However, process approaches remain a substantial or even dominant part of many regulatory systems.

The survey of federal policies later in this chapter uses shorthand to characterize policies as one of two types. The first type is regulatory policies focused on setting and enforcing mandatory minimum standards and/or labeling requirements. The second type is oversight/support of markets policies focused on building markets; supporting fair trade; and setting, overseeing, and/or guiding voluntary standards and labeling.

The major challenge for legislators and executive branch members is choosing the mix of government, private, and third-party approaches to agricultural and food quality assurance to rely on to address market performance issues. Federal agencies have different mandates and must identify the areas of quality assurance they should be involved in and through which of the policy instruments shown in Fig. 9.2. The playing field has become very crowded with the rapid development of private and third-party standard setting, certification, and labeling schemes domestically and, even more markedly, internationally (Henson 2008).

Federal policies may use labeling schemes as part of their quality assurance programs. Table 9.1 captures the current diversity in labeling schemes in markets in

Table 9.1 A labeling typology

Type	Owner of labeling standard	Primary means of label certification	Labeling approach	Description
I	Private, first, or second party	First or second party	Voluntary	Product or process attribute claims on labels by individual companies based on self-declared standards, with self-certification by buyer or seller
II	Private, collective third party	First or second party	Voluntary	Product or process attribute claims on labels by companies based on collective self-declared standards, with self-certification by buyer or seller
III	Private, collective third party	Third party	Voluntary	Product or process attribute claims on labels by companies based on collective self-declared standards, with third-party certification
IV	Independent third party	Third party	Voluntary	Product or process attribute claims on labels by companies based on standards set by independent body (e.g., nongovernmental organization and private certification body), with third-party certification
V	Government	Government or third party	Voluntary	Product or process attribute claims on labels by companies based on government standard, with government or third-party certification
VI	Government	Government	Mandatory	Product or process attribute claims on labels by companies based on government standard, with government certification

Note: First party = product seller; second party = product buyer; third party = not the buyer, seller, or government (e.g., private collectives of companies; independent entities such as nongovernmental organizations or private certification bodies); government = local, regional, national, or multi-country government entities
Source: Caswell and Anders (2011)

terms of who sets standards, certifies them, and develops labeling rules (Caswell and Anders 2011). Types I–IV correspond to the no intervention and self-regulation options in Fig. 9.2. In Type I, the first party (the product seller) or the second party (the product buyer) takes responsibility for different parts of the scheme. In Types II and III, a private, collective party (not the buyer, seller, or government) of companies owns the standard, with certification by first, second, or third parties. In Type IV, an independent third party [e.g., nongovernmental organizations (NGOs) or private certification bodies] owns the standard with third-party certification. Type V, which involves government and private or third parties, corresponds to coregulation or incentive-based structures. Type VI where government sets standards, enforcement, and mandatory labeling is an example of direct regulation.

The rapid development of a broad range of quality assurance approaches requires a reappraisal of where federal marketing policy is needed and where it is not timely for legislators, federal agencies, all participants in the food supply chain, and consumers. Figure 9.2 and Table 9.1 are helpful in this process by pinpointing exactly where current or proposed federal marketing policies are located on the spectrum of public/private approaches to quality assurance and labeling.

Bases for Evaluating Effectiveness of Marketing Policies

The final element in a framework for analyzing federal marketing policies is to consider bases for evaluating whether the policies chosen are effective in reaching the desired performance goals. Systematic review of policy impacts after implementation is rarer than it should be. Some important considerations regarding the performance criteria, as outlined in Chap. 1, when applied to quality assurance policies are explained below.

Technical Efficiency

Quality assurance policies are generally not directly focused on the achievement of technical or productive efficiency. However, the effect of these policies on this type of efficiency should always be considered. For example, existing and new safety standards should be evaluated in terms of their effects on production processes and costs, and existing and new labeling requirements should be similarly scrutinized. Regulatory impact assessments do consider these issues to some extent, but post-implementation assessment is relatively rare. An exception is post-adoption analysis of the impacts of Hazard Analysis Critical Control Points (HACCP) requirements in the late 1990s (see, e.g., Ollinger and Mueller 2003; Ollinger et al. 2004). This work indicates that new policies can have short-term as well as long-term effects on the choices of companies, which affect technical efficiency and, over time, dynamic efficiency.

Allocative Efficiency

Federal quality assurance policies frequently do focus on improving allocative efficiency by addressing market failures due to imperfect or asymmetric information, externalities, or inequality in bargaining or market power. For example, food safety policies often seek to protect consumers from risks of which they are not fully aware and where the market may have weak incentives to produce high quality. They may also seek to control externalities such as the burden of foodborne illness on the costs of health care. Labeling policies may have the aim of providing better information to buyers about quality attributes in order to facilitate their choice of products that meet their quality demands, thus improving allocative efficiency. Grades and standards used within the supply chain may serve to equalize bargaining power through the provision of more reliable quality information over space and time.

Dynamic Efficiency

The design of federal quality assurance policies can facilitate or impede dynamic efficiency, particularly because private and third-party quality assurance programs are so quickly evolving across supply chains. For example, as noted above, changes in food safety regulations generate changes in production processes, which in turn frequently affect the design of supply chains. Another example is the strong interest in the USA and the European Union in front-of-package nutrition labeling that can serve as shorthand for consumers to use in making purchasing decisions. The dynamic efficiency question here is whether healthy eating choices will be better facilitated by government mandated front-of-pack labeling or by the development of competing, private, voluntary systems.

Nonmarket Social Values

Federal quality assurance policies may address several types of nonmarket social values. These policies are often called upon to meet distributive justice goals. Policies may be implemented in order to provide more level playing fields for market participants by addressing competitive disadvantages faced by certain types or sizes of firms. They also may be implemented to serve particular consumer interests. For example, a rationale for USDA's voluntary organic standards was to provide a common definition of organic production and products across the market, as well as to set consistent labeling requirements. A second rationale was to improve consumers' information and ability to reliably identify organic products in making purchasing decisions. Federal policies may also be implemented to address particular issues that interest groups bring to the forefront, for example the protection of animal welfare. Where there is a lack of consensus about which nonmarket social values are important, voluntary quality assurance systems may be used to facilitate the market provision of classes of products that meet diverse demands.

Overall Bases for Evaluation

Overall, federal marketing policies for quality assurance tend to focus on issues of allocative and dynamic efficiency, with an increasing emphasis in some market segments on nonmarket social values. However, as a part of benefit–cost analyses, the effects on technical efficiency, particularly as it affects dynamic efficiency, should always be under consideration.

A Survey of Federal Agricultural and Food Quality Assurance Policies

The current mix of use of public and private approaches to agricultural and food quality assurance is a product of the evolution of policy over time. In the USA, it is difficult to characterize this evolution in general terms—for example, that is a becoming consistently more publicly (particularly, federal government) or privately based. On the contrary, the mix of public and private takes many forms, with the public, private, and third-party approaches becoming stronger in some areas and less prominent in others. Federal programs are surveyed using the framework presented above to characterize their major features.

The federal government has quality assurance programs and marketing policies across the entire spectrum of intrinsic attributes and for many of the related extrinsic cues and indicators shown in Fig. 9.1. We explore these policies by major category of intrinsic attribute and identify the different cells they occupy in Fig. 9.2 (level of public policy involvement) and Table 9.1 (if labeling is part of the policy). A major differentiating factor between policies is whether they impose mandatory regulatory requirements or are voluntary oversight/support approaches.

Food Safety

The U.S. GAO found in its 2001 review that 12 different agencies administer as many as 35 laws that make up the federal food safety system (US General Accounting Office 2001). Most federal responsibilities are under the Food Safety and Inspection Service (FSIS) of the United States Department of Agriculture (USDA)—which regulates meat, poultry, and processed eggs—and the Food and Drug Administration (FDA), under the Department of Health and Human Services, which regulates all other foods. The Environmental Protection Agency also plays an important role in pesticide safety (see Chaps. 10 and 11 for additional discussion).

In the USA, food safety policy has relied primarily on direct regulation (the last box in Fig. 9.2) of this intrinsic quality attribute, with relatively little focus on extrinsic indicators and cues such as labeling, with some exceptions such as safe handling labeling for meat and poultry products and allergen labeling (see Chap. 13).

The rationale for mandatory, direct regulation is that there are basic market failures in the area of food safety due to imperfect information. Food safety has significant elements of being a credence attribute; buyers cannot adequately judge food safety before purchase and can only partially, if at all, link foodborne illness to particular food products or companies after purchase and consumption (Caswell and Mojduszka 1996). This can result in market-based incentives that are too weak to induce companies to produce the level of food safety desired by society, as expressed through legislation and regulations.

Within direct regulation of food safety, there is an ongoing reorientation of regulatory programs that tends to focus responsibility for producing and delivering safe food more squarely on companies in the supply chain from farm to fork. Command and control policies focused on setting standards that were then enforced through inspection of facilities and sanctions for noncompliance. These policies (e.g., continuous inspection of meat slaughter facilities by FSIS) have largely remained in place with a new layer of regulation being added. Beginning in the second-half of the 1990s, FSIS implemented the Pathogen Reduction-HACCP (PR-HACCP) approach to ensuring food safety. It placed the responsibility for identifying hazards and taking effective measures to control them on processing firms. It was backed up with performance standards for selected pathogen levels in final products. The emphasis was increasingly on a science- and risk-based approach to food safety. FSIS used information and education programs to provide support to the industry on HACCP adoption. FDA adopted HACCP for seafood in 1997 and for juices in 2002. An evolution of HACCP focused on preventive measures will be extended to all FDA-regulated foods under the FDA Food Safety Modernization Act of 2011. To date, FSIS and FDA have not played a major role in regulating food safety at the farm level. Most retail and restaurant food safety is under the jurisdiction of states and municipalities.

Regulation of food safety works in the context of private and third-party food safety assurance programs (the self-regulation box of Fig. 9.2) that may go beyond the minimum mandatory standards of direct regulation. In the USA, food safety assurance has tended to be focused within the supply chain and not been differentiated through to consumers. Many companies have extensive food safety assurance programs that they push back through their supply chains to assure the desired level of safety in inputs (see Chaps. 10 and 11). Thus, while food safety is directly regulated, private systems also play a primary role in assurance.

The use of private and third-party standards for food safety signaling in the supply chain is currently developing quickly across the world (Henson 2008). For example, EUREPGAP, first developed in the European Union, has evolved into GLOBALG.A.P., reflecting its international role in establishing standards for Good Agricultural Practices in food production. GLOBALG.A.P. is an example of self-regulation (Fig. 9.2). The owner of the standard is a private, collective, third party with membership from large retail chains, food producers, and other interested parties. It is a voluntary organization that uses accredited third-party certification bodies. It does not engage in labeling at the consumer level. Overall, food safety assurance is provided by a web of federal, other public, private, and third-party activities.

Nutrition

FDA and USDA are responsible for the major quality assurance policies related to nutrition in the USA. FDA and USDA policies in the consumer market focus on direct regulation of labeling as an extrinsic quality indicator of nutrition. Their additional programs in the consumer market, particularly those of USDA, focus on information and education (e.g., http://www.ChooseMyPlate.gov) to help consumers make healthy food choices (see Chap. 13 for a more detailed discussion of consumer information and labeling).

Nutrition labeling in the USA is regulated under the Nutrition Labeling and Education Act (NLEA) of 1990. The major rationale for NLEA was that the market was not voluntarily providing an adequate amount of nutrition information to consumers to facilitate healthy eating choices. Inclusion of the nutrition facts panel is Type VI labeling (see Table 9.1)—the standard, enforcement, and labeling approach are mandatory. Nutrient content and health claims are Type V labeling—whether a company chooses to use these types of claims is voluntary, but if they choose to do so the claim must conform to mandatory standards set by the government.

A significant amount of the marketing of food products based on nutritional quality in the USA is Type I (Table 9.1), with private first or second party definition of the product claims. The exception is nutrient content and health claims as discussed above. The advent of interest in front-of-the-pack nutrition labeling (e.g., summary measures or judgments about overall quality) has brought forth some third-party labeling activity (Types II–IV), but it has not broadly taken hold in the USA. FDA maintains regulatory oversight of all label claims though the prohibition of misbranding of food products.

USDA also has a large impact on the nutritional quality of food through its administration of the Women, Infants, and Children (WIC) Nutrition Program; the National School Lunch and Breakfast Program; and the Supplemental Nutrition Assistance Program (also formerly known as food stamps). After comprehensive reviews by the National Academies (2005, 2008, 2010), both the WIC (Federal Register 2007) and School Lunch and Breakfast (Federal Register 2012) Programs have made comprehensive changes to align foods and diets in the programs with U.S. Dietary Guidelines for Americans (http://www.cnpp.usda.gov/dietaryguidelines.htm). These programs influence the nutritional quality attributes of food products offered for sale at retail and served in schools across the country. Nutritional quality is also affected by FDA through its regulation of the fortification of food products.

Sensory/Organoleptic and Value/Function Attributes

USDA and FDA are the major federal agencies that operate quality assurance programs focused on sensory/organoleptic and value/function attributes for agricultural and food products. The major rationale for these programs is to improve the functioning of markets for quality by improving information available to buyers throughout the supply chain—and in some cases through to consumers, to protect against fraud, and in some cases to protect against exercise of market power along the supply chain. These programs are forms of direct regulation or market oversight/support that may use either Type V or VI labeling.

USDA has a rich history of providing grades and standards for agricultural commodities. As defined by Nichols et al. (1983, p. 62), "Grades are used in the classification of commodities and are defined as numerical or descriptive categories, which have specified characteristics in common. Standards are the values, the limits, and measurement procedures, which determine the grade of a product—the criteria by which a product is divided into its various grades." These grades and standards are largely focused on the sensory/organoleptic and value/function attributes of agricultural products. USDA involvement originated out of a recognized need to facilitate the operation of agricultural markets and supply chains that are geographically dispersed with large volumes of commodities from different sources and that have significant variability in quality attributes (Nichols et al. 1983).

The performance problems judged to be important that were addressed by national grades and standards included market failures due to inadequate information on quality and the proliferation of quality standards, as well as market failures related to the manipulation of quality measurements and prices by buyers with market power. Nichols et al. (1983, p. 62) underline the diversity of purposes for these programs in noting:

> There appears to be considerable diversity among product groups as to the purposes of grades and standards. Examples can be found to show that some grades are intended only to facilitate wholesale pricing and marketing. Others have stated that the purpose in grading is to identify value to the user. It is difficult to evaluate whether the programs are meeting their objectives, because objectives and purposes have never been consistently and clearly established.

Nichols et al. also describe how grades and standards evolved over time in the grain and cotton industry, with the broad authority to establish grades and standards being given to USDA under the Agricultural Marketing Act of 1946, with user fees over time becoming the means for supporting these programs.

Within USDA, the Agricultural Marketing Service (AMS) currently has a very wide range of programs focused on the sensory/organoleptic and value/function areas under its grading and standards, certification, and verification programs (United States Department of Agriculture and Agricultural Marketing Service 2011a). For example, AMS provides quality grade marks for fresh fruits and vegetables, processed fruits and vegetables, poultry, eggs, livestock and meat, and dairy products, among other commodities. These grade marks may carry forward to the consumer level (e.g., for beef: US Prime, Choice, or Select) as Type V labeling or be largely used within the supply chain. AMS maintains very detailed quality standards for products in many commodity classes. These activities provide market oversight and support, are voluntary, and are usually paid for on a fee for service basis. In terms of Fig. 9.2, AMS services can be thought of as being on a coregulation continuum, with the programs being voluntary. Their essential character is as a cooperative effort between government and industry to provide oversight and support markets. While not regulating sensory/organoleptic and value/function attributes, and generally not able to be categorized by the attribute type focused on by the program, AMS also enforces the Perishable Agricultural Commodities Act of 1930, which promotes fair trade in the fresh and frozen fruit and vegetable industry (see Chap. 4 for more information about PACA).

FDA enforces standards related to sensory/organoleptic and value/function attributes as well. For example, there are FDA standards of identity, quality, and fill for over 300 food products. These standards are intended to prevent substandard products and fraudulent packaging. These marketing policies are direct regulation of the quality attributes of food products. More generally, FDA is mandated to prevent misbranding of food products, which encompasses any type of false information provided on a food product.

The federal government's involvement in regulating or providing market oversight/support for sensory/organoleptic and value/function attributes comes under periodic scrutiny (see, e.g., Gardner 2003). The question asked is whether in the modern era this type of regulation is needed for market functioning or whether the private sector, through self-regulation and private or third-party certification can effectively provide this oversight of market organization. In the case of AMS, there is a partial market test of value based on the fee for service structure, but it is unclear whether these services are priced by AMS at full cost. FDA's regulatory activities in this area are defended as providing an important level playing field for the food industry.

From a private party perspective, the provision and communication of sensory/organoleptic and value/function attributes for food products is a crucial part of product success. As discussed in regard to multi-attribute approaches below, the assurance and certification of these attributes is increasingly becoming part of systems that focus on suites of, rather than individual, attributes of products.

Process Attributes

The federal government has a wide array of programs that focus on quality assurance for process attributes, aside from the effect that process may have on other categories of attributes, for example, on food safety or nutrition. The rationale for these policies usually includes some level of market failure due to inadequate information. The policies may also seek to promote other nonmarket social values, such as supporting local production, market development, rural development, or views of social justice. Looking across the range of process attribute-oriented policies it is difficult, however, to identify a level of market failure or lack of achievement of nonmarket social values that would consistently propel an issue forward strongly enough for federal marketing policy to be viewed as warranted. Lobbying by interested parties in support of government action may be the strongest factor in establishing these policies.

Direct regulation of process attributes by USDA's Agricultural Marketing Service includes the country of origin labeling program (COOL) that under the 2002 and 2008 Farm Bills requires retailers to notify customers of the origin of most meat and fish, fresh and frozen fruits and vegetables, some nuts, and ginseng (see Chaps. 4, 13, and 16 for additional discussion). COOL is a Type VI (Table 9.1) mandatory labeling program. The rules explicitly state that COOL is not a food safety policy; its intent is to inform consumers who would like to know country of origin for the products they are purchasing. COOL rules are particularly interesting to consider regarding whether there is a market failure related to imperfect information that supports the adoption of federal marketing policies or that supports selective adoption for some foods but not others.

Under the Organic Foods Production Act of 1990, products labeled with the process attribute organic must meet standards established under the National Organic Program administered by AMS (see Chaps. 13 and 16–18 for additional discussion). Certification occurs by Accredited Certifying Agents that are in turn certified by AMS. Organic labeling is Type V labeling (Table 9.1); labeling a product organic is voluntary, but if a company chooses to do so, following the government standard is mandatory. The major rationales for enactment of a national standard were to increase welfare by reducing confusion among consumers about what organic means and to reduce transaction costs for processors and handlers.

AMS also has a large number of audit and accreditation services that focus primarily on process attributes with a purpose of market oversight/support. Examples of these services include: the Export Verification Program for meat and meat products; the Domestic Origin Verification Program for fruit, vegetable, and nut commodities purchased for USDA food assistance outlets; and the Animal Protein Free Certification Program for Poultry. The USDA Process Verified Program operated by AMS provides certification services following the format of the International Organization for Standardization (ISO) 9000 series for documenting quality management systems. Under this program, companies with approved programs can make marketing claims about verified process attributes including, for example, the age, source, and feeding practices of livestock. Companies in the program can market themselves as and use the shield for "USDA Process Verified."

These AMS services can again be thought of as being on a coregulation (Fig. 9.2) continuum; they are voluntary and a cooperative government and industry effort supported by a fee for service structure. If labeling is involved, it is Type V (Table 9.1). Another example of AMS support for a process attribute is its efforts to promote direct Farmers Markets and Local Food Marketing (see Chap. 16). These programs largely fall into the incentive-based structures box in Fig. 9.2.

First-, second-, and third-party certification of process attributes is a quickly developing area, as buyers in the supply chain and consumers place more emphasis on these attributes such as animal welfare, the authenticity of process or place of origin, and worker/farmer conditions. Prominent examples of these developments are the eco-friendly and Fair Trade movements that currently feature a mix of first- and second-party claims, and third parties such as NGOs that are defining and certifying to this process attribute.

Multi-attribute and Mixed Approaches

The landscape for the assurance of agricultural and food quality attributes is very diverse and is constantly evolving (see Henson 2008; Fulponi 2006 for detailed discussions). As the sampling of approaches discussed above indicates, these quality assurance and communication programs cover all types of intrinsic quality attributes and extrinsic indicators and cues (Fig. 9.1). Private and third party, and to some extent federal quality assurance systems, are focusing increasingly on suites of attributes, both because of efficiencies in simultaneous audits and because markets expect consistent quality across attributes.

As the sampling of approaches discussed above also indicates, quality assurance can be undertaken with any of the private and public approaches shown in Fig. 9.2, including many hybrid combinations of these approaches. It can then be communicated to buyers through a wide range of labeling schemes (Table 9.1). On the private side, there has been an evolution from an initial reliance on first- and second-party systems to third-party ones. The development of GLOBALG.A.P. (2011) and SQF (Safe Quality Food) (2011) are prominent examples. Several services provided by USDA-AMS offer a governmental, not first or second party, platform for certification of attribute suites, production processes, or auditors themselves, for example though the Partners in Quality Inspection Program, the Qualified Through Verification program, and the ISO Guide 65 Program.

Federal marketing policies that affect quality assurance and communication through regulation or market oversight/support are taking on additional forms, including what has been termed "coregulation" or joint government/company initiatives. A major challenge for federal policy makers is identifying from among the myriad activities the government could engage in those that are significant and important to do.

When barriers exist to getting things done one way, in the political and collaborative process they may get done another way. For example, after a series of foodborne illness incidents involving leafy green products, especially spinach in 2006, there was a call for improved on-farm oversight of food safety. The FDA declined, however, to go beyond its already issued voluntary guidelines for good agricultural practices and to move into on-farm safety assurance. The vacuum was filled in 2007 by the state level California Leafy Green Products Handler Marketing Agreement and a similar agreement in Arizona (California Leafy Green Product Handler Marketing Agreement 2011). An AMS national marketing agreement regulating leafy green vegetables is currently under consideration (United States Department of Agriculture and Agricultural Marketing Service 2011b). The broader context for this quality assurance activity is the question of which policy approaches are likely to provide enhanced safety most effectively as part of a risk-based system of quality control.

Economic Consequences of Current Federal Quality Assurance Policies

The economic consequences of the current mix of federal (public), private, and third-party approaches to agricultural and food quality assurance can be measured by their relative benefits and costs and, more generally, by performance criteria such as technical, allocative, and dynamic efficiency, and the attainment of nonmarket social values. The chapters of this book discuss these consequences in detail. An overall consideration when thinking about the current mix, particularly the current mix of federal marketing policies, is that the system involves many players, nationally and internationally. Therefore, a grand rationalization of the entire system is probably not attainable, given it is a moving target. A grand rationalization may not even be desirable, if leaving room for innovation allows the entire system to evolve effectively. However, addressing outdated programs where they exist would likely increase the ability of the federal programs to improve market performance.

Options for Adjusting Federal Quality Assurance Programs

The federal government faces several challenges in developing an effective mix of marketing policies targeted at agricultural and food quality assurance. There are different federal agencies involved, with various mandates and a patchwork of responsibilities. The rationales for marketing policies vary across agricultural and food quality attributes, as does the mix of mandatory regulatory versus voluntary market oversight/support approaches. And the system is addressing a tremendous flow of product sourced domestically and internationally.

Over the last three decades in the area of food safety assurance, a focus on developing a risk analysis framework that is science based and the subsequent development of risk-based systems have moved policy thinking, planning, and implementation as well as private actions forward (National Academies 2010). A similarly comprehensive process would be fruitful going forward for thinking about the mix of federal regulatory and market oversight/support polices for agricultural and food quality assurance. Analysis and evaluation could be undertaken from different viewpoints by the legislative or executive branches of the federal government; federal agencies themselves; and companies in the supply chain, third parties, nongovernmental organizations, and consumers.

For the federal government itself, an overall evaluation of programs could develop a road map that would in turn be used to determine what quality assurance issues related to which attributes should be addressed with what mixes of federal policy instruments and private/third-party approaches. This evaluation would be based on the risks—public health, market, trade, consumer perception, and social sensitivity (Ruzante et al. 2010)—the policy would be addressing, the benefits and costs of taking or not taking action, and the impact on performance criteria.

On a general level, Figs. 9.1 and 9.2 and Table 9.1 can be immediately helpful in this process. For example, for a new policy, the policy decision maker could outline the quality attributes or external indicators and cues the policy is intended to address, as well as alternative suites of attributes, cues, and indicators that it might address. Then thinking about where the policy would fall along the continuum of approaches shown in Fig. 9.2 will pinpoint the regulatory philosophy behind the proposed policy and its possible strengths and weaknesses. Finally, if the policy is to have a labeling component, analysis of where it falls in the labeling typology shown in

Table 9.1 will highlight the elements of standard ownership, certification, and labeling that will need to be decided. Perhaps most beneficial to policy decision makers is to compare alternative policies by locating them along the dimensions laid out in the figures and table.

A key constraint facing legislators and federal agencies in choosing policies is limited resources in terms of capacity, funding, and support for marketing policies related to agricultural and food quality assurance. A road map approach could be applied systematically to look at the areas of risk and the market failures that are judged to merit government activity versus those that do not. As an example, this road map might incorporate the judgment that attributes with significant public health impact typically merit direct regulation, while process attributes must have a high level of market or trade impact to merit federal marketing policies. A similar or separate criterion for action could be chosen to evaluate policies related to sensory/organoleptic and value/function policies. Based on a road map, legislators, administrations, and agency personnel could respond systematically to calls for government action in markets for quality attributes and information related to them. Similarly, companies, consumers, and citizens could develop their own maps to evaluate what areas are best suited to private or third-party activities versus federal policy or hybrid systems. More systematic approaches to marketing policies for agricultural and food quality assurance will require comprehensive data on the risks associated with taking or not taking action in terms of public health, market and trade impacts, efficiency, or changes in consumer perceptions and choices.

The first major challenge for the federal government in choosing an efficient set of marketing policies for quality assurance is to evaluate which markets have significant performance problems—in other words where are there market failures or nonmarket social values that make market performance unsatisfactory without marketing policies. The second major challenge is for the federal government to evaluate for those markets where a change in marketing polices appears to be needed, whether it has options that improve market performance. The third challenge is choosing appropriate marketing policy options. The final challenge is to evaluate whether the policy options chosen are effective in improving market performance.

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Chapter 10
Food Safety and Traceability

Diogo M. Souza-Monteiro and Neal H. Hooker

Abstract Foodborne illness cause significant costs to societies. This chapter discusses food safety and traceability policies and their impacts in food markets. Since 1906, the USA has been in the forefront of food safety policies. Food safety is broadly defined as the probability that a food causes no harm to consumers. One of the key factors in mitigating foodborne illness outbreaks is the ability to quickly detect the cause, origin, and spread of the incident. This is where traceability and food safety are linked, as the former is defined as the ability to follow a path of a food through a food chain, from farm gate to the consumer's plate and in the reverse direction. In the United States, both the FDA and the USDA/FSIS have mandates to manage food safety policies. However, several other Federal and State agencies are commissioned to assure a safe food supply. Food safety policies are increasingly imposing science- and risk-based standards, some of which (such as GlobalGAP) have been led by the private sector. Increasingly global and highly connected food chains present new food safety and traceability challenges. The recently enacted Food Safety Modernization Act mandates the FDA to issue science-based food safety standards and introduces a requirement for mandatory traceability. Food safety and traceability policies are costly and choices over alternative options need to take into account their impact on a food market's technical, allocative and dynamic efficiencies, as well as nonmarket impacts.

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Introduction

Over the last 20 years a number of foodborne illness outbreaks spanning a variety of products and societies led to heightened review and updating of food safety regulations. According to the Center for Disease Control and Prevention (CDC) data, while infections caused by the six key food pathogens[1] decreased significantly since 1996, *Salmonella* infections haven't been reduced and there was a surge in the incidence of *Vibrio* infections (CDC 2011). Increasing technological and supply chain management capacity provide opportunities for heightened food safety management. This chapter considers the role of US Federal policies targeting food safety and traceability. Public agencies around the world have been calling for zero tolerance for food contaminates, and have introduced new inspection procedures, risk-based interventions and traceability systems to minimize, prevent or mitigate the impact of food safety failures. Interestingly, the private sector not only adapted to this new regulatory environment but also, in some cases, led changes by developing private food safety standards. For example, European food retailers created and imposed best farming practices on suppliers of fresh produce and private label contract manufacturers to manage food safety risk (Fulponi 2006).

Within this environment several key questions arise: how (and why) do US Federal agencies regulate food safety and traceability? How do these controls impact marketing activities throughout the US food system? What are the implications of an increasingly connected global food system? How can traceability be used to prevent, mitigate, and learn from food safety failures? What is the likely evolution of food safety and traceability regulation in the foreseeable future? How can economic impact of such regulations be evaluated? This chapter addresses these questions.

Food safety activities can be broadly defined as increasing the probability that foods cause no harm to consumers. Food safety concerns span physical, chemical, and microbial risks. It is also important to recognize a particular unsafe food will not necessarily cause a disease, malaise or even be identified as the cause of a foodborne illness. Moreover, the same unsafe food may have different consequences in various people. For instance, it is well known and reported that certain segments of the population (such as children, pregnant women, the elderly, and those with compromised immune systems) are less resistant to unsafe food (DHHS 2011). Contaminated food may be associated with minor and short-term malaises or more acute systemic complications such as rheumatoid arthritis, or in some more serious cases cause death. There are various sources of food contaminants: microbiological organisms, chemical components (an example being naturally occurring mercury in seafood), and physical processes (e.g., the stability of a food in response to dramatic changes in holding temperatures). Food safety incidents may have natural causes, be prompted by negligence or, in bioterrorism cases, caused intentionally.

[1]CDC identified six key pathogens responsible for the majority of foodborne diseases outbreaks. These are *Campylobacter, Escherichia coli O157:H7, Listeria, Salmonella, Shigella, Yersinia,* and *Vibrio*.

One of the common features of the most recent US based food safety outbreaks was the lag between the detection of the incident and the full assessment of its origin, cause(s), and spread.

Public and private agents have struggled to fully identify and contain problems in a short amount of time. This is where food safety and traceability are linked. Traceability can be defined as the ability to follow the path of a pathogen through its various stages of production, processing, and distribution. Applied to food this translates into the ability to follow, at the very least, the path of a food from farm gate-to-plate and plate-to-gate in the case of traceback. Golan et al. (2004) suggest that traceability is a "record-keeping system primarily used to help keep foods with different attributes separate from one another" (p. 27). Another way to think about traceability is as an information system that is constantly updated with data about the location and condition of foods moving through supply chains.

An increasing proportion of food supply is traded internationally and blended, transformed, and assembled by multiple agents along supply chains. Thus, this record keeping system can be quite complex and require coordination from different agents to be of any use. Moreover, in an increasingly connected and global food system, the structure of most value chains is in constant flux, with sources and intermediaries changing throughout the year depending on market conditions. For these reasons it is extremely challenging to design a traceability system that is able to fully characterize all products in the food chain instantaneously.

Golan et al. (2004) proposed that traceability systems should be developed in three dimensions: breadth of information recorded, depth in terms of the layers of the food chain covered, and precision relating to the level of detail of the information. These dimensions may vary with the type of food chain for which a traceability system is designed. Not all traceability systems have a food safety role. However, it seems critically important and timely, in light of recent foodborne illness outbreaks, to add another dimension to the description of traceability systems when considering food safety. That is, traceability systems should also be designed in terms of the speed at which information can be retrieved from the information management system(s). Since time is a key factor for the mitigation of consequences of food safety outbreaks, effective food safety traceability systems should be able to quickly identify the source(s) of the outbreak and then enable a rapid assessment of the total extent of the problem.

The economic impact of food safety and traceability controls largely depends on how public and private initiatives are set. Some of the recent food safety outbreaks suggest that there may be opportunities for improvements in technical efficiencies. However, some studies indicate that more stringent food safety standards have reduced the allocative efficiency of food markets (Hooker et al. 2002; Muth et al. 2007). Another economic impact of alternative food safety and traceability regulations is their dynamic efficiency. Policies that are periodically reviewed or based on performance standards can more easily be updated than process standards, so may better foster innovation and technological improvements. Finally, it is important to assess nonmarket social impacts of food safety and traceability policies. These are likely to include improvements in public health. The challenge for economists and decision makers is to combine these different economic measurements in a comprehensive framework that enables comparisons of alternative options through a common measurement.

It has become increasingly apparent that a traceability system (either voluntary or mandatory in nature) is a necessary building block for any effective food safety strategy. The ability to isolate batches or units of ingredients or products, to describe the unique production or processing environments from which they are sourced, and their related risk creates an incentive for farmers, distributors, food processors, retailers, and food service firms to invest in quality-enhancing activities. When combined with heightened food safety management practices, traceability systems can promote food protection and public health goals for firms and societies.

It is important to recognize that the complexity and multidimensional nature of food safety requires a range of different perspectives and expertise. Thus, tackling food safety and traceability challenges and opportunities requires a holistic and systematic approach, linking causes and possible outcomes that span all aspects of product quality. While we cannot entirely rely on industry alone to assure the optimal provision of food safety, it is also naïve to trust that the government alone can do so. As recent food safety incidents reveal, government failures are just as prevalent as market failures. There are no clear answers or easy solutions about the best food safety governance system. Moreover, as science and societies' preferences evolve, there will be new challenges and opportunities that require responses from both private and public agents.

The next section provides an historical overview of the major US Federal programs and agencies targeting food safety and traceability. Section "Recent Changes in Federal Food Safety and Traceability Systems" reviews and updates regulatory changes occurred since the 1990s and their impact on Federal Agencies. Section "Food Safety and Traceability Impacts of Private Initiatives and Food Chain Globalization" discusses the challenges presented by private food safety initiatives, interconnectivity of food chains, and globalization for Federal agencies managing food safety and traceability. Section "Future Challenges and Economic Impacts of Food Safety and Traceability Management Regulations" suggests potential economic impacts of future regulations, concludes and identifies areas for future research attention.

History and Institutional Structure of US Food Safety and Traceability Policies

Since 1906, with the enactment of the Pure Food and Drugs Act, Federal agencies have played an increasingly important role in food safety and traceability. Over the last 100 years there were important changes in legislation and institutional organization at both Federal and State levels to ensure a safe supply of foods to American domestic and export markets. Historically, food safety oversight has been the responsibility of the United States Department of Agriculture (USDA), through agencies such as the Agricultural Marketing Service (AMS), Food Safety and

Inspection Service (FSIS), Animal and Plant Health Inspection Service (APHIS), and Agricultural Research Service (ARS). Indeed, the Food and Drug Administration (FDA) only separated from USDA in 1940 and was later incorporated into the Department of Health, Education, and Welfare in 1953.[2] An important feature of this organizational architecture is the separation of agencies with public health authority, such as the Centers for Disease Control and Prevention CDC) and regulatory agencies, such as FDA with oversight for 80 % of US food supply (IOM 2010). These agencies implement a range of regulations promoting public health by assuring a safe and transparent food supply. Along with the role of Federal agencies, at the State level, Departments of Health and Departments of Agriculture are also involved in food safety surveillance, prevention and mitigation often working in collaboration with Federal agencies. Besides the USDA agencies mentioned above and the FDA there are other Federal agencies with major responsibilities on the assurance of a safe food supply. These include the Centers for Disease Control and Prevention (CDC), the Department of Homeland Security (DHS), USDA National Institute for Food and Agriculture (NIFA), and the Environmental Protection Agency (EPA). Table 10.1 summarizes the main duties of each of the Federal agencies in food safety and traceability policies.

As Table 10.1 shows there are two main Federal agencies in charge of food safety: FDA and FSIS/USDA. However, there are other agencies with some level of responsibility. For instance AMS is the main agency with oversight for standards which may impact, for example, egg products (see Box 10.1 as a case study of egg safety and traceability), EPA monitors pesticide levels in food products and the National Oceanic and Atmospheric Administration (through the National Marine Fisheries Service, Department of Commerce) runs a voluntary fee-for-service seafood inspection of vessel, processing plants and retail outlets to check conformity with Federal regulations.

A number of studies have identified or raised concerns about the apparent inconsistencies and duplication of effort in the way food safety is treated by the different agencies (Hoffmann and Taylor 2005; IOM 2010). For example, whereas FSIS has inspectors located in every domestic meat and poultry slaughter and processing plant, FDA only conducts inspections on a sample of egg producing plants. Often many years pass before an inspection actually occurs (see Box 10.1), which may lead to food safety incidents such as the recent egg-related foodborne illness outbreak (Kamotani et al. 2010).

It must be noted that many other authorities influence food safety and traceability. A recent study published by the Institute of Medicine (2010) lists 24 agencies that have some impact on food safety regulations and implementation. This report suggests that this dispersion of primary and secondary authority may cause disruptions and ultimately lead to an ineffective and inefficient governance of food safety and traceability at the Federal level. As a GAO (2004) report also pointed out, more than a regulatory problem, there seems to be an organizational issue in the way food safety is governed in the United States.

[2] A good history of US food safety regulation over the past 100 years can be found in Merrill (2005).

Table 10.1 Summary of US Federal agencies responsible for food safety and traceability

Who	What
FDA	• Oversees all domestic and imported foods except for meat and poultry, egg products, catfish, and alcohol beverages with less than 7 % alcohol content. • Inspects food production facilities and warehouses, taking samples for analysis • Checks food additives and animal drugs before marketing • Works with State agencies to develop protocols for inspections of milk and shellfish as well as food retail and catering establishments • Proposes Good Manufacturing Practices (GMPs) and other production standards to be implemented by the food industry. Notably Hazard Analysis and Critical Control Points (HACCP)—based programs • Collaborates with foreign governments to assure safety of imported foods • Conducts research and educates industry and consumers on good food safety handling practices • Enforces the *Public Health Security and Bioterrorism Preparedness and Response Act* • Manages product recalls (mandatory authority extended from infant formula/ baby foods to all FDA regulated foods by FSMA see below)
CDC	• Performs surveillance of foodborne diseases on a national level and through FoodNet—Foodborne Diseases Active Surveillance Network • Researches, develops, advocates, and educates the public on how to prevent foodborne diseases
USDA—AMS	• Responsible for grading and market information for dairy, fruits and vegetables, livestock, seed, poultry, cotton, and tobacco markets • Enforces *Perishable Agricultural Commodities Act* • Oversees country of origin labeling for muscle cut and ground meats: beef, veal, pork, lamb, goat, and chicken; wild and farm-raised fish and shellfish; fresh and frozen fruits and vegetables; peanuts, pecans, and macadamia nuts; and ginseng. • Enforces the *Egg Products Inspection Act* • Responsible for the National Organic Program
USDA—APHIS	• Conducts risk assessments and collects data on pesticide use and imported agricultural products • Inspects and enforces pesticide record-keeping programs • Manages the border quarantine programs detecting and eliminating animal diseases and exotic organisms that may be a threat to US agriculture
USDA—FSIS	• Responsible for the supervision of domestic and imported meat and poultry products, as well as products derived from these commodities. • Enforces all food safety laws governing domestic and imported meat and poultry including the *Federal Meat Inspection Act, Poultry Product Inspection Act,* and *Humane Methods of Livestock Slaughter Act* • Inspects food animals for diseases before and after slaughter • Inspects meat and poultry slaughter and processing plants • With AMS inspects processed egg products • Collects samples of meat and poultry for microbiological and chemical evaluations • Defines production and processing standards for the meat and poultry industries, including use of additives and other ingredients in packaged products • Ensures foreign meat and poultry plants exporting to the USA are producing under equivalent standards • Works with industry to manage voluntary recalls of unsafe meat and poultry products • Advocates and educates the industry and consumers about food safety for meats and poultry
USDA–NIFA	• Supports research and education on a range of agricultural, environmental, and human health topics • Provides funding for Land-grant University research

(continued)

Table 10.1 (continued)

Who	What
DHS	• Through Customs and Border Protection ensures that all goods entering or exiting the US abide with the laws of the land • Customs and Border Protection (CBP) personnel conduct agricultural product border inspections on behalf of USDA/APHIS • The Office of Health Affairs leads veterinary and agro-defense activities • The National Biodefense Analysis and Countermeasures Center (NBACC) uses science-based methods to identify bioterrorism threats to the nation
EPA	• Is in charge of municipal (tap) water and regulates toxic substances and waste to avoid their entry into food chains • Conducts risk assessments and regulates the use of pesticides under the authority of the *Federal Insecticide, Fungicide, and Rodenticide Act*; the *Federal Food, Drug, and Cosmetic Act;* and *Food Quality Protection Act* • Works with FDA and USDA to regulate use of biotechnology in agriculture

Source: Adapted from Institute of Medicine [IOM] 2010

Box 10.1 A Case Study of Egg Safety and Traceability

Egg safety is the shared responsibility of FDA, FSIS, and State agencies. FDA regulates shell eggs, while FSIS regulates the processing of egg products (dried, frozen, or liquid form with or without added ingredients (USDA-AMS 2008)). FDA is responsible for developing standards for egg producers, and then State agencies conduct inspections and enforce those standards (President's Council on Food Safety 1999).

In 1999, the Egg Safety Action Plan was developed to strengthen the safety of US eggs after it was estimated that 1 in 20,000 shell eggs were internally contaminated with *Salmonella* Enteritidis. The plan set forth the goal of eliminating the incidence of foodborne illnesses associated with *Salmonella* Enteritidis eggs by 2010 (President's Council on Food Safety 1999). In-shell egg pasteurization was proposed as one risk reduction strategy for egg processors. FSIS estimated that if all shell eggs were pasteurized for a 5-log reduction of *Salmonella* Enteritidis, the annual incidence of shell egg-related illnesses would decrease from 130,000 to 19,000 cases (USDA-FSIS 2005).

The Egg Safety Action Plan also called for the implementation of consistent science-based standards from production to consumption in the egg industry. In response, FDA published a proposed rule, "Prevention of *Salmonella* Enteritidis in Shell Eggs During Production" which suggested all shell egg producers implement mandatory *Salmonella* Enteritidis preventive measures. These measures were to include (1) Procurement provisions of chicks and pullets, (2) biosecurity program, (3) pest and rodent control program, (4) cleaning and disinfection plans of poultry houses testing positive (environmental or egg), (5) egg testing if environmental testing results in a positive test, and (6) refrigerated storage of eggs held at the farm. An exemption from the measures (except the refrigerated storage) is permitted if producers (with 3,000 or more laying hens) choose to add a pasteurization step (FDA 2004).

The *Egg Product Inspection Act* of 1970 requires the mandatory pasteurization of all liquid egg products.

Recent Changes in Federal Food Safety and Traceability Systems

A close examination of US food safety legislation history reveals that most reforms were prompted by either a food safety incident or through pressure from stakeholders concerned with public health. Thus, it should not be surprising that food safety and traceability reforms over the last two decades were also prompted by major food safety failures. In the mid-1990s the "Jack in a Box" food scare led to the mandatory introduction of Hazard Analysis of Critical Control Points (HACCP) in meat and poultry slaughter and processing plants. Subsequently, the aftermath of the September 11, 2001 events and concerns over the fragility of the food supply to terrorist acts led to the approval by Congress of the *Bioterrorism Act* (107th United States Congress 2002). The novelty of this legislation and relevance for the food industry was the introduction of mandatory one step forward–one step back traceability in US food chains. This Act is summarized in Box 10.2. In January 2011, and following a number of highly publicized food safety outbreaks between 2006 and 2011, President Obama signed the *Food Safety Modernization Act* (FSMA). This regulation further strengthened the role of FDA in food safety enforcement. In this section, these three recent food safety legislative initiatives are briefly described and related to traceability.

One of the key features of the recent changes in food safety legislation, and more so in the recently approved FSMA regulation, is the adoption of HACCP procedures by all operators at all levels of the food chain (Ribera and Knutson 2011). The Pillsbury Company initiated HACCP in the 1960s in an attempt to guarantee a 100% safe supply of food for the US space program (Bauman 1990; Ross-Nazzal 2007). It soon became evident that controls that relied on end-point performance testing of each product were impractical. Further, given the increasing importance and concern over chemical and microbiological food safety attributes, the inability to noninvasively or nondestructively test food, even for such a specialized program, was

Box 10.2 The *Bioterrorism Act*

The *Public Health Security and Bioterrorism Preparedness and Response Act* of 2002 directs FDA to take steps to protect the public from a threatened or actual terrorist attack on the US food supply and other food-related emergencies. The Act established new regulations requiring:

- Food facilities to be registered
- FDA given advance notice for shipments of imported food.

The *Bioterrorism Act* required domestic and foreign facilities that manufacture, process, pack, or hold food for human or animal consumption in the US to register with the FDA by December 12, 2003. Farms, food retailers, and restaurants were exempt from the Act.

Source: FDA (2002) and (2006)

clear. Therefore a holistic system that targeted process characteristics was developed, identifying the most likely stages of production that could give rise to food safety concerns and the specification of related control systems. This process control system was the basis of the HACCP regimes we see today.

Two key HACCP-based regimes were introduced in the 1990s, one by FSIS/USDA and one by FDA. The FSIS HACCP-based regime for meat and poultry slaughter and processing plants (FSIS 1996) works in conjunction with several other regulatory requirements. In addition to general Good Manufacturing Practices (GMPs) already in place that FSIS considers to be a minimum basis for the production of safe meat and poultry, the HACCP rule also required companies to implement: written Standard Operating Procedures for sanitation programs (SOP); microbial testing for generic *Escherichia coli* in slaughter plants to ensure that CCPs are indeed preventing fecal contamination; and, that plants meet the pathogen performance standards for reduction of *Salmonella* for all raw product.

Late in 1995 the FDA released its HACCP-based regulations for processing and importing fish and fishery products (FDA 1995). Once again this regulation is in addition to GMPs applicable to all human food (as contained in 21 CFR Part 110). The seafood HACCP requires a written Standard Operating Procedures (SOP) for sanitation practices. As the US imports a majority of its seafood, the international trade language relating to importer obligations contained in the regulation was vital (see FDA 1995, pp. 65,152–65,160). Briefly the rule allows for two options for importers to be in compliance. First, the seafood must be sourced from a country that has an active Memorandum of Understanding (MOU) or similar agreement with the FDA. Such an agreement would indicate the US equivalence of an exporting country's food control program. Alternatively, a second option allows for importers to maintain written verification that the seafood was processed in accordance with the seafood HACCP requirements and Good Manufacturing Practices (GMPs). Various steps are open to the importer to ensure this compliance: checking the HACCP plan and/or records of the source company, occasional performance testing of the shipments, or visiting and inspecting the foreign plant(s).

The *Bioterrorism Act* marked the first time food safety and traceability were combined in a US legislation. Section 306 of the Act requires records of the immediate source and destination of ingredients and food (one step back, one step forward) to be maintained for 2 years. In other words firms operating in food chains are required to have a management information system, though the nature of such a system (e.g., paper based, electronic, real time access—on-line) is not specified. Although this was a positive development, this type of traceability has its limitations. It does not allow for a systemic view of the entire food chain. To effectively prevent or mitigate the effect of accidental or intentional food safety failures, it is critical to have an accurate representation of the entire chain.

Under the *Bioterrorism Act* key players at each end of food chains were exempt from the traceability requirements of this regulation (farms, retailers, and restaurants). These exemptions imply that an important part of the US food system remains invisible to monitoring and food security activities. Due to political pressure, there seems to a strong reluctance to impose transparency on certain agents participating in the food system. In part this may be related to the privacy rights assigned by the First, Fourth and Fourteenth Amendments of the US Constitution, and also it may be motivated by the strict liability rules that are typically applied by US tort law in product liability cases. The focus on developing information about potential targets of terrorism acts may also compromise the efficacy of this legislation. In common with previous changes to food safety and traceability legislation, the *Bioterrorism Act* assigns clear responsibilities to agencies but seems to offer limited powers to enforce them.

The limitations of US traceability systems and their consequences became critically apparent in the series of food safety failures that spanned both fresh agriculture commodities (such as leafy greens and cantaloupe) and processed foods (like peanut butter) from 2006 to 2011. Common factors in these outbreaks were the considerable amount of time taken to find the source of contamination and the sense of agencies' ineffectiveness that passed through the media to the public. While the agencies were investigating the sources and spread of these outbreaks, consumers were being advised not to consume the products suspected of being unsafe. This caused considerable disruption to the markets and extended economics losses. Along with the burden placed on consumers by incomplete and ineffective crisis communication, the industry incurred significant direct and indirect costs, namely in lost sales and damaged reputation (see for instance Cuite et al. 2009 and Hallman et al. 2009). These failures prompted another food safety and traceability regulatory initiative that led to the approval of the *Food Safety Modernization Act* in January 2011. The Act is briefly described in Box 10.3.

This reform builds on the two previous initiatives described above. One of the key features of this new legislation is that, in sections 103 through 105, it imposes a risk based, more specifically, an HACCP type of approach to manage food safety risks in producing, handling, and processing facilities (Ribera and Knutson 2011). The FSMA has five main elements: (1) mandates the FDA to focus on preventive measures across the food chain; (2) reinforces inspection and compliance, proposing risk-based approaches for all establishments and other innovative monitoring approaches; (3) requires importers to ensure compliance with US food safety standards through third-party certifiers accredited by the FDA; (4) gives the FDA authority to impose mandatory food recalls; and (5) seeks partnerships and collaborations between federal and other domestic and international, private or public stakeholders in the food chain (FDA 2011a).

More specifically, under section 103 of the FSMA all operators in food chains, with the exemption of small or very small qualified facilities, must adopt measures preventing, minimizing, or controlling hazards in their facilities when producing, manufacturing, processing, packaging, or holding food. Importantly this new legislation recognizes the link between traceability and the ability to quickly respond to food safety failures. In section 204 of the FSMA, the FDA, along with the USDA and State agencies, is required to conduct pilot tests of systems and technologies enabling quick and effective ability to identify sources and locations of potentially contaminated foods in the food chain (FDA 2011a). Also, under section 204 of the FSMA, the FDA must publish specific recordkeeping requirements for high risk food products.

The FSMA also gives the Secretary of HHS increased authority to prevent and respond to food safety failures with traceability tools, including the power to

Box 10.3 The *Food Safety Modernization Act*

In a sweeping legislation, the Act advances Federal food safety and traceability controls conducted by FDA in several ways including:

Title I: Improving Capacity to Prevent Food Safety Problems—Amends the *Federal Food, Drug, and Cosmetic Act* (FFD&CA) to permit the inspection of firm records, if the Secretary of the Health and Human Services (HHS) believes that there is a reasonable probability of serious adverse health consequences or death. Requires HACCP-based plans in all facilities, with an exemption for farms. Prepares risk-based guidance documents, action levels, or regulations. Establishes science-based minimum standards for the safe production and harvesting of fruits and vegetables, to include updated good agricultural practices. Requires the Secretary to promulgate regulations to protect against the intentional adulteration of food.

Title II: Improving Capacity to Detect and Respond to Food Safety Problems—To apply risk-based inspection sampling procedures and to increase the frequency of inspection of all facilities. Requires the HHS Secretary to improve tracking and tracing of fruits and vegetables in the event of a foodborne illness outbreak; and establishes standards for the type of information, format, and timeframe for persons to submit records to aid the Secretary in such tracking and tracing. Requires the Secretary to establish 3 pilot projects to explore and evaluate methods for rapidly and effectively tracking and tracing processed food so that the Secretary may quickly identify the source of an outbreak involving such a processed food and the recipients of the contaminated food. Requires the Secretary, acting through the Director of the Centers for Disease Control and Prevention (CDC), to enhance foodborne illness surveillance systems to improve the collection, analysis, reporting, and usefulness of data on foodborne illnesses. Provides authority to the Secretary to conduct mandatory recalls for serious adverse health consequences or death to humans or animals

Title III: Improving the Safety of Imported Food—Requires US importers to perform risk-based foreign supplier verifications that imported food is produced in compliance with applicable requirements related to hazard analysis and standards for produce safety and is not adulterated or misbranded. Requires the Secretary to issue guidance to assist US importers in developing foreign supplier verification programs. Authorizes the Secretary to enter into arrangements and agreements with foreign governments to facilitate the inspection of registered foreign facilities. Requires the Secretary to direct resources to inspections of foreign facilities, supplies, and food types to help ensure the safety and security of the US food supply. Sets forth provisions governing the establishment of a system to recognize bodies that accredit third-party auditors and audit agents to certify that eligible entities meet applicable *FFD&CA* requirements for importation of food into the USA.

(continued)

Box 10.3 (continued)

Title IV: Miscellaneous Provisions—Establishes whistleblower protections for employees of entities involved in the manufacturing, processing, packing, transporting, distribution, reception, holding, or importation of food who provide information relating to any violation of the *FFD&CA*. Requires the Secretary to update the Fish and Fisheries Products Hazards and Control Guidance to take into account advances in technology. Small and very small farms or processing facilities are given a period of 1 or 2 extra years, respectively, to comply with the regulation. An exemption is given to farms marketing directly to consumers, having average annual sales over 3 years lower than half a million dollars or marketing within the state or a 275 miles radius.

Source: FDA (2011); Ribera and Knutson (2011)

re-inspect food producing facilities, conduct food recalls, assess voluntary qualified importer programs, and to re-inspect imports. Along with these new authorities there are also responsibilities. In terms of food safety prevention, the Secretary is required to issue guidelines for risk reduction for critical foodborne contaminants and to set minimum standards for the safe production of fruits and vegetables. Then, in response to food safety incidents, the Secretary is required to allocate resources to inspect food facilities and imported foods based on known safety risks and to establish a system to track and trace both US based and imported products (FDA 2011a). Therefore, this new food safety act clearly establishes a comprehensive risk-based food safety inspection program and mandatory traceability system.

Although the FSMA significantly contributes to the ability of US to assure a safer food supply, it still has some limitations. It is quite clear that the adoption of a prevention strategy and the new mandate to withdraw unsafe products from the market should contribute to the reduction of the public health impact of food safety failures. However, the scale of these impacts critically depends on the identification of the correct location of the products to recall. While section 204 of the act suggests FDA will put in place a system enabling traceability, it does not clearly specify how it will be designed. Until this system is in place, the ability to conduct effective prevention activities and product recalls is still compromised.

To summarize, over the last couple of decades Federal agencies have designed food safety and traceability standards in response to food safety failures. The most recent legislative initiatives have recognized and, perhaps too modestly, recommended the introduction of traceability systems as a tool to mitigate food safety failures and to promote investments in prevention. As described in this section, the two most relevant pieces of Federal legislation have been allocated to different agencies (DHS and FDA), perpetuating the dispersion of food safety and traceability oversight. Moreover, exemptions within these regulations may undermine their effectiveness.

Food Safety and Traceability Impacts of Private Initiatives and Food Chain Globalization

One of the most striking developments in the arena of food safety and traceability over the last decade has been the emergence of private regulatory initiatives supporting contract relations between partners at different levels of food chains. These private standards are designed by commodity producers, processors, or retailers and are typically written in best practice format. They are often drawn from domestic or international standards, but typically impose stricter conditions than the legal rule. Also, they often include both food safety and record keeping/traceability provisions. One example is the California Leafy Green Products Handler Marketing Agreement (LGMA), which was created in the aftermath of the spinach recall of 2006 and was subsequently endorsed by the State of California (CDFA 2008). The California Leafy Greens Marketing Agreement is mandatory for all members and specifies food safety practices at the farm level, includes a traceability system and is monitored by the California Department of Food and Agriculture inspectors (LGMA 2010).[3] Similar to other initiatives the emphasis is on trust and risk-based food safety practices.

Along with producer-led food safety standards there have also been a growing number of retailer initiatives. A key example is GlobalGAP, which is being used by leading food retail chains such as Wal-Mart—imposed on suppliers of its private label products and other food categories, especially produce (see Box 10.4). Similar standards can be benchmarked and recognized as equivalent under the Global Food Safety Initiative (GFSI).

The GlobalGAP standard originated in Europe but now has global reach, being used by over 100,000 farmers, from 100 countries across the globe (GlobalGAP 2010). GFSI currently recognizes 11 standards as equivalent (GFSI 2011c). The advantages of such private standards compared to public initiatives include

- Global reach,
- Periodic review, incorporating new information from advances in science or risk assessment research,
- Formulated by consensus across supply chains, with strict certification procedures, often setting the bar higher than existing public food safety standards.

However, there are also some disadvantages with private approaches to food safety and traceability. A common problem with these private food standards is that they seldom take an integrated and systematic perspective of the food chain. Rather they focus on primary production or manufacturing alone. This is a problem as focusing on hazards on the farm or some other point of the supply chain in isolation may not be sufficient to mitigate the overall food chain safety risk. Only a full supply chain food safety system—from raw materials to plate—assessing the critical

[3]For a deeper treatment and further information of marketing agreements and Federal and State marketing orders see Chap. 6.

Box 10.4 Private Food Safety Standards: GlobalGAP and GFSI

GlobalGAP

Is a compilation of voluntary and private standard defining rules of production for vegetable and animal products at the farm level. It is based on farms best practice recommendations and farmers using this standard must be certified by third party organizations at least once a year. These standards are available for farmers worldwide aiming to supply leading European and US retailers and foodservice operations. GlobalGAP standards are reviewed every 4 years in a forum, which includes participation by both the production and retail sectors, where production rules are updated.

GlobalGAP covers four main areas: (1) farm practices assuring food safety, (2) reduction in the level of chemicals used in production and minimization of the impact of farming on the natural environment, (3) assurances of good working practices and safety conditions for farmer labor, and (4) promotion of animal welfare.

In each of these main areas the standards define a set of major and minor critical control points with which farmers should comply. Farmers need to keep and provide access to a registry of their practices, which in turn are the basis for the traceability system associated with this standard.

Although the main goal of these standards is to assure consumers on how their food is produced, this is a business to business standard. Therefore retailers using GlobalGAP do not pass on information on which foods in their product range comply with the standard.

Global Food Safety Initiative (GFSI)

Is a nonprofit organization associated with the Consumer Goods Forum, a global network of food manufacturers, retailers, foodservice organizations, and industry associations. The main aim of GFSI is to propose guidelines for the design and implementation of food safety management schemes, as well as to create benchmarks to compare existing standards against food safety criteria. This initiative started in 2000, in the aftermath of a series of food safety failures in Europe. GFSI created guidelines against which any food standard can be compared or benchmarked. If the standard meets the comparison criteria then the users of that standard can participate in the supply chains of firms affiliated with the Consumer Goods Forum. GSFI benchmarks primary production and manufacturing schemes. For instance, GlobalGAP is a food standard complying with the food safety criteria established by GFSI. In general, the food safety criteria are in line with those defined by the *Codex Alimentarius* as well as industry best practice codes. As with GlobalGAP and other private standards, GFSI guidelines are regularly updated (roughly every 2 years). Along with detailing the benchmarking procedure, the GSFI guidelines include suggestions on how to develop a food standard complying with the food safety criteria used in benchmarks. A food standard will have better chances of being benchmarked if is based on HACCP, is verified by accredited third party organizations, and conforms with principles of total quality management and continuous improvement.

Source: GlobalGAP (2011) and GFSI (2011a) and (2011b) points can assure optimal control (Hoffmann and Taylor 2005). Further, private interests may focus on traceability of commercially valued food attributes moving through chains but not safety attributes. This complicates the transparency of trace-back processes. The proprietary nature of these information systems may, therefore, prove to be a barrier to effective and prompt crisis communication. Moreover, these standards mainly apply to products sold in supermarket or major restaurant chains that, while representing a large proportion of food supply, do not account for the totality of food consumption.

Another concern with private food standards is their lack of public scrutiny for the following reasons: (1) the development, implementation, and monitoring of these standards often dispense with an official public approval process; (2) the party leading the initiative typically determines the process through which the rules in the standard are set; (3) although there are certain forums discussing the rules and implementation of such standards, these forums do not necessarily represent all interests nor is each participant necessarily able or capable of influencing the final outcome. Specifically, there is clear underrepresentation of consumer groups in most of these initiatives. Fourth, noncompliance typically involves an immediate punishment without recourse to a tribunal, court or similar entity to hear an appeal. For all these reasons Laconto and Busch (2010) argue that private institutions are creating alternative markets and economies, outside the traditional structures of market economies and democratic regimes. In such cases, there may be reasons for concern over ethical and social welfare implications which traditional economic analysis may not fully capture.

Another recent trend is the increasing global interconnectivity of food chains. In the past, food chains for different foods where fairly linear and separated. Then, with the emergence of supermarkets, products from different categories and origins started to aggregate in distribution centers where they are often repackaged and then shipped to a network of stores. More recently, producers are finding alternative uses for their agricultural products and creating new foods or ingredients including preprepared meals and other added value outputs. A remarkable example is soy, which is used to produce seasoning and cooking oil, substitutes for dairy products, animal feed, etc. In turn, these can be incorporated in several different food processing supply chains, such as cookies, chips, or ready-to-eat meals like pizzas. Also, food processors increasingly develop meal solutions and convenience foods combining ingredients from different sources. These ingredients often are substitutes and can be switched in response to availability, consumer preferences, and market conditions. Furthermore, along with the United States, Brazil, other South American, and Asian countries are main producers and exporters of this product. Therefore, different types of soy-based products with different origins can be incorporated in different products and supply chains. Without sound food safety management and traceability systems that identify and enable a visualization of the raw and processed soy supply chains, a food safety incident can arise that has global impacts and seriously disrupt a critical food value chain segment.

While some of these developments create great opportunities and have important economic benefits, these very dynamic and intertwined supply chains are not risk free. A particularly significant example of how this global interconnectivity may complicate the management of food safety failures was the peanut paste *Salmonella* outbreak of 2009 (Hallman et al. 2009; Cuite et al. 2009). The impact of this outbreak dramatically increased in magnitude once it was recognized that along with the contamination of peanut butter, this ingredient was used in more than 3,000 individual products. This event demonstrated why it is important to understand the evolution of supply chains and how previously separate food sectors may become closely intertwined in their food safety controls and traceability systems. In this case, it was relatively simple to find the original source of the contamination due to high levels of market concentration by key ingredient supply firms. However, during the recalls associated with this outbreak, effective and complete crisis communication and contaminated product identification was hindered by use of peanut paste as an input in a variety of food products. Additional recent examples have included human and pet food products impacted by microbial, physical, and chemical contaminants.

This interconnectivity of food chains often has an international dimension. Since the liberalization of agricultural and food trade initiated by the conclusion of the Uruguay Round of General Agreement on Tariffs and Trade (GATT) and the creation of the World Trade Organization (WTO) in 1994, there was a spectacular increase in food trade across many countries. This impacted the configuration of agri-food supply chains, as processors can quickly purchase inputs from foreign suppliers that meet their requirements and offer competitive prices. It is beyond the scope of this chapter to fully discuss the implications of the globalization of food markets (for food safety impacts, see Hooker 1999; for traceability, see Souza Monteiro and Caswell 2010). However, for illustrative purposes, consider the example of tomato paste. Until recently this product had a relatively straightforward supply chain. Given that tomatoes are very perishable, processing plants were located near production areas—in the United States these were mainly California, Ohio, and Florida—and tomato paste was then shipped to wholesalers that would either sell to retailers or ship to second-level processors that would use it as an ingredient, for example, in ketchup. Over the last decade, due to technological developments, consumer demand shifts, and trade liberalization, this configuration changed considerably. Production shifted to countries such as Mexico, Costa Rica, Honduras, and other nations in Central America, Thailand, and China. A range of new products using tomato paste emerged and, what used to be fairly linear supply chains, now became a dense network linking firms on a global scale.[4]

The complexity of the tomato supply chain is by no means an isolated example of challenges now facing authorities in charge of regulating and monitoring food safety and traceability. Until the FSMA, US Federal agencies had limited authority to impose their standards on foreign production and processing facilities even when these contracts are with US firms. Further, while increasing border controls are feasible and to some extent required, the dramatic growth in the volume of imports has increased inspection costs and decreased sampling rates, Finally, in the event of a food safety management failure, an advanced global traceability system becomes

[4]Pritchard and Burch (2003) further develop the globalization of processed tomato supply chains as an example of the impact of globalization on food industries.

critical because it is extremely hard to quickly and effectively communicate the food safety information necessary to facilitate a product recall for food produced and processed on a global scale or to rapidly identify other impacted supply chains.

These challenges mark a new era following the passage of the FSMA. The evolving role of third-party certification and the yet to be defined role of import certifications make for an interesting, dynamic public-private partnership for food safety and traceability.

Future Challenges and Economic Impacts of Food Safety and Traceability Management Regulations

In light of the institutional and regulatory evolution of policies to improve the way public and private agents shape the markets to increase food safety and traceability, it is unlikely that the approval of the FSMA will be the last chapter of this century old story. As one looks to the foreseeable future, it is tempting to reiterate some of the proposals of recent reports produced or sponsored by respected groups of experts such as those involved in the Food Safety Research Consortium[5] and the IOM (2010). Both groups of experts advocate for more risk- and science-based regulatory approaches and, the latter, suggests a single agency to govern food safety. However, alongside this discussion it is important to mention other relevant issues such as challenges posed by the juxtaposition of globalization and localization, or the relationships between politics and policy discussed in the previous section.

True risk-based approaches have been proposed by international organizations for decades, including the Food and Agriculture Organization (FAO 2006), adopted by New Zealand in 2000 (FAO/WHO 2002) and more recently in Canada (Canadian Food Inspection Agency 2010), to guide food safety management. They are inspired by HACCP principles applied to the entire food system. In general, these approaches propose a stepwise method to strategically assess, prioritize, and manage interventions according to food safety risks. This process goes through four to six steps to assess safety risks across food supply chains, evaluating alternative interventions and aiding in decision making.[6]

While risk-based approaches are certainly a step forward and have proven to be reliable in other industries, they are not without fault. One of the problems with this approach is the heavy dependence on reliable information. When this is not available or accurate, it becomes extremely difficult to have a precise estimation of the risks inherent in a system. Certain elements of this data can be retrieved from traceability systems, insofar as they have been designed to record information related to production processes and product attributes—and the systems are deep, broad, and precise enough for regulatory design. However, as described above, many of these

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[5]The reflections of this group were published by Hoffman and Taylor Eds. (2005).

[6]For a detailed description of how a risk-based food safety framework could be implemented at FDA, see Chap. 3 of IOM (2010).

systems are proprietary, so privacy issues emerge when accessing such information.[7] How can Federal agencies gather and manage the information required for risk-based decision processes? Likely there will be both private and public efforts to collect such information. But how transparent and complete will the process be? These are questions that need to be addressed.

It must also be taken into account that, for example, in ready to eat meals, food systems are complex networks, where ingredients originate from multiple sites and converge in hubs where they are processed into consumer goods (Souza Monteiro and Caswell 2010). Risk-based management systems and traceability capabilities should be as holistic as possible, if they are to aid sound food safety decision making. Finally, just as having a zero tolerance for food safety risk is a mirage, so is the idea of having perfect data sets upon which to base risk-based systems.[8]

Another recurrent proposal on how the US food system should be managed in the future is the call for a single agency. Starting in 1998, the Institute of Medicine opined that the dispersion of authority in food safety management was compromising the ability to assure public health. They recommended the creation of a single Federal food safety agency. According to recent reports from both IOM (2010) and the GAO (2004 and 2011) consolidation of all food safety regulation and monitoring services would

- Enhance coordination between international regulatory partners, stakeholders—including state and local agencies, consumers, and industry.
- Allow standardization of procedures and the adoption of consistent risk based, chain wide food safety, and traceability systems.
- Eliminate duplication of government resources.
- Resolve conflicts of interest between stakeholders.

Nevertheless, there is continuing resistance to the creation of such an authority. Schmidt (2001) reported that the National Food Processors Association claimed that the move to a single food safety agency would eliminate checks and balances in the current system. However, the current dispersion of authority means that there is not a single view on what food safety should be and how to promote it. The fact that there are different agencies, each with its own ethos and history, means that a range of perspectives and the specificities of each particular industry are understood and taken into account. Moreover, local and state authorities may worry about the concentration of power at the Federal level and how this move may lose sight of the impacts of regulation in particular communities. Some of these concerns can be resolved by involving representatives from both local and state agencies along with those from different private interest groups in advisory committees and adopting more transparent decision making processes.[9] However, this may increase bureaucracy and slow

[7]This is particularly true in the case of information at the farm level, as the *FD&C Act*, *Bioterrorism Act* and FSMA all exempt farmers from needing to keep records.

[8]According to both FDA's science board (2007) and the GAO (2009), there are actually critical deficiencies in FDA's information systems and the quality and consistency of data collection.

[9]An example of how these could work is to mimic the stakeholder advisory committees and openness policies adopted by the UK Food Standards Agency (2010).

decision making. Thus one of the main arguments for the creation of a single agency is economic, as it could lead to cost reductions in the application of regulations and gain efficiencies by reducing duplication of resources (Ribera and Knutson 2011). While there are advantages and challenges on both sides of these issues, the balance needs to be evaluated. Namely, how and who will produce, analyze, and store the information required to assess and manage risks? How can a single agency retain the checks and balances embedded in the current system, and in particular address the differences in inspection authority and intensity between meat and poultry (FSIS) and all other food processing plants (FDA)?

As already discussed, strengthened traceability systems should be considered a critical option for future food safety policy. The advantage of having information on the location, origin, and key processing dimensions of food is critical for effective and rapid food recalls. Also, such systems can provide critical information to be used in risk assessment, management, and communication studies. Furthermore, traceability systems are critical for the detection and control of animal diseases (Disney et al. 2001; Souza Monteiro and Caswell 2004) and plant protection (Karaca et al. 2007). However, it must be recognized that traceability per se does not improve food safety. A food traceability system is only valuable insofar as the information recorded therein is accurate, up to date, and easily accessible to whoever relies on it to make decisions. Critical issues therefore center on the design and management of these systems, what information should be recorded, who has access to and ownership of the data, and how the information can be accessed?

In retrospect, despite a seemingly sluggish and reactive process, there have been important legislative and regulatory initiatives in response to changes in the food safety environment. Omissions of the past, repeatedly identified by reputable institutions such as the IOM and GAO, are still being made. However, the recently approved FDA *Food Safety Modernization Act* seems to be changing this trend by aligning with the recommendations of academic experts and different stakeholders.

The adoption of a food safety standard, private or public, will typically involve additional costs to a firm (Antle 2001). The question is whether these are compensated by additional benefits, are permanent or temporary, and if the additional costs lead to inefficiencies. Focusing on technical efficiencies, the question is whether or not the costs of food safety are currently at the minimum level and whether these regulations necessarily increase such costs. Note that firms may be operating efficiently in terms of output production, but inefficiently in terms of the delivery of food safety (Antle 2001). That is, the same resources could result in higher levels of safety. For example, an employee may be more effective in cleaning the premises, with no additional time. Moreover, if one considers costs across the industry, there may be economies of scale transferring production to more efficient firms delivering improved levels of food safety. Still the evidence so far, from the implementation of HACCP systems in the meat industry, suggests that certain firms (namely smaller ones) have higher costs when complying with the regulation (see Hooker 2002). However, the magnitude of these costs may be very limited when compared with sales volumes. It is not clear whether regulations will necessarily lead to additional costs, particularly when extended compliance time for smaller firms permits scale-specific adjustment and learning speeds to be taken into account. In fact, these regulations can be a catalyst for efficiency gains as they may force managers to take a closer look at their processes and, perhaps, find practices that not only may lead to safer food but also output production efficiencies, for example, by reducing the amount of spoilage or waste.

Turning to allocative efficiency, which can be defined as the allocation of scarce resources over alternative uses, such as products or activities, that maximizes welfare. It is quite challenging to evaluate the impact of food safety and traceability regulations based in this criterion, as it is not easy to determine the price of safety or its marginal costs. However, economic theory suggests that under asymmetric information or imperfect market structures, allocative inefficiencies more likely will occur. Assuming the information available in traceability systems is accurate, credible and publicly available, it reduces information asymmetries along the food chain and therefore may lead to improved allocative efficiency. This is a topic for future research. In terms of the impact of proposed food safety regulations on market structure, the evidence so far suggests that there may be efficiency losses. In a series of papers, Muth et al. (2002, 2003, and 2007) suggested that implementation of PR/HACCP regulations in the meat industry leads to firm exit. This research further suggests that the negative impact was stronger in small slaughterhouses. A similar pattern is observed in the implementation of private GAPs at the farm level, which seems to force smaller farmers—especially in developing countries—out of premium or international markets (Asfaw et al. 2009; Berdegué et al. 2005; Hernández et al. 2007). Note, however, that this may be associated with gains in technical efficiency across the industry. Also, the analysis of private standards considers exit from supplier pools to retailers, not necessarily from the industry. So there are opportunities for future research on the evaluation of allocative efficiencies of both food safety standards and traceability systems that take into account market structure, supply chain, social welfare, and market access from developing world operators.

Finally, considering impacts on dynamic efficiency, it is important to assess whether the programs discussed in this chapter contribute to innovation and market adjustment over time. This is perhaps the least researched criterion in this particular area. Economic theory suggests that command and control standards are the least innovative, whereas performance standards typically foster innovation and the ability to adjust. Thus, if the risk-based food safety standards are designed as pseudo-performance standards, then they will likely lead to innovation and improved adaptability. This seems to be the case of the FSMA act,[10] and arguably, one of the key features of the HACCP process is the need for constant revision and improvement of the production process to minimize risks. Also, the private standards described above seem to have such dynamic elements, as they are regularly revised based on novel scientific knowledge or better understanding of risk at the farm level. However, whether increased dynamic efficiency actually materializes is an empirical question that requires attention.

One of the concerns over private food safety and traceability standards is whether they exclude access of certain social groups to safer food. If that were confirmed, then

[10] Section 104 of the FMSA describes a performance food safety standard.

this would be a case of negative nonmarket impact of such standards, as they would not lead to an equitable distribution of the benefits of the standard. However, it is important to conduct a rigorous evaluation of such claims, which requires a specification of a metric with which to measure "distributive justice" performance of alternative options. Since the impact of food safety improvements is reflected in public health performance, the evaluation of nonmarket impacts may be based on responses to regulations in terms of reduced cases of deaths, days in hospital or sick days. A potential problem in these evaluations is how to establish causality and the extent that improvements can really be attributed to individual food safety and traceability regulations.

In short, this chapter reviews food safety and traceability programs. After defining and establishing a link between food safety and traceability, it offers a review of previous regulations. Then it proceeds with a description of recent public initiatives regulating food safety and introducing traceability systems. Finally, it suggests future developments and discusses potential economic impacts of public and private interventions suggesting opportunities for future research.

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Chapter 11
Quality Assurance for Imports and Trade: Risk-Based Surveillance

William E. Nganje

Abstract American consumers continually demand more fresh produce and food throughout the year, in particular during nonproductive seasons in the Northern Hemisphere. Consumer demand escalates food imports and requires delivering more tonnage through the current U.S. Ports of Entry (POE). Increased volumes of imported foods with ever-increasing velocity have been associated with significant food safety risks (unintentional food contamination from pathogens, chemical, or physical agents) and food defense risks (intentional food contamination by disgruntled employees or terrorists). While import inspections should help protect against outbreaks of food-borne illnesses, as well as plant or animal pests and diseases, it is neither possible nor optimal to inspect all produce at the POE. This chapter focuses on the impacts of increased international trade on the marketing system, emphasizing the sourcing of products from other countries, inspection and surveillance activities, and policies to mitigate potential market failure from food safety/defense risks. A framework to evaluate economic efficiency of policies and tools used to ensure imported food quality is discussed.

Increasing Food Imports and Trade Expansion

American consumers continually demand more fresh produce and food throughout the year, in particular during nonproductive seasons in the Northern Hemisphere (Table 11.1). Consumer demand escalates food imports and trade and requires delivering more tonnage through the current U.S. Ports of Entry (POE). For example, the

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Table 11.1 Increasing U.S. food imports

Food group	1999 (million $)	2000 (million $)	2001 (million $)	2002 (million $)	2003 (million $)	2004 (million $)	2005 (million $)	2006 (million $)	2007 (million $)	2008 (million $)	2009 (million $)
Total U.S. food imports[a]	41,161.8	43,080.7	43,641.8	46,558.6	52,302.6	58,219.6	64,202.1	70,587.2	76,563.0	84,276.4	76,839.4
Live farm animals	1,245.7	1,468.9	1,833.0	1,787.8	1,290.1	1,115.2	1,675.1	2,175.8	2,597.3	2,297.7	1,653.0
Meats	3,276.7	3,838.2	4,270.9	4,298.4	4,439.6	5,736.6	5,774.7	5,268.9	5,403.3	5,110.1	4,648.5
Fish and shellfish	8,877.6	9,902.5	9,685.8	9,990.8	10,895.0	11,145.2	11,890.1	13,176.2	13,508.7	14,024.0	13,031.9
Dairy	930.3	922.3	995.8	1,008.8	1,110.3	1,292.3	1,388.4	1,405.7	1,500.8	1,595.6	1,353.0
Vegetables	3,589.2	3,727.5	4,124.0	4,345.0	5,030.6	5,689.7	6,006.1	6,576.4	7,209.6	7,748.4	7,449.6
Fruits	4,793.4	4,647.1	4,677.2	5,080.0	5,567.2	5,974.4	6,907.8	7,735.0	9,250.9	9,913.1	9,657.3
Nuts	794.3	809.3	671.3	701.9	780.1	1,082.4	1,124.9	1,105.3	1,194.6	1,363.1	1,285.9
Coffee and tea	3,108.7	2,921.3	1,915.7	1,942.2	2,227.3	2,559.7	3,309.3	3,695.5	4,171.4	4,855.3	4,508.6
Cereals and bakery	2,659.9	2,735.0	2,990.6	3,343.9	3,619.2	4,012.6	4,242.9	4,911.6	5,916.9	7,691.8	6,847.6
Vegetable oils	1,553.6	1,525.0	1,316.7	1,446.3	1,689.9	2,488.0	2,626.1	3,066.7	3,853.4	6,178.9	4,391.4
Sugar and candy	1,593.7	1,560.9	1,606.6	1,860.4	2,137.6	2,114.3	2,500.6	3,055.3	2,606.8	2,990.5	3,100.8
Cocoa and chocolate	1,521.9	1,403.0	1,535.0	1,759.8	2,438.2	2,483.5	2,750.0	2,658.8	2,661.6	3,298.4	3,476.0
Other edible products	2,498.6	2,514.8	2,625.3	2,864.2	4,134.9	5,172.9	5,800.1	6,245.7	6,418.0	7,031.7	6,445.2
Beverages	4,718.1	5,104.9	5,394.0	6,129.3	6,942.7	7,352.9	8,206.1	9,510.4	10,269.8	10,177.8	8,990.6
Liquors	2,381.9	2,725.5	2,847.0	3,091.1	3,438.2	3,709.2	4,089.9	4,511.5	5,047.7	5,040.4	4,788.4
Total animal foods	14,330.3	16,131.9	16,785.4	17,085.7	17,735.0	19,289.2	20,728.3	22,026.5	23,010.1	23,027.4	20,686.4
Total plant foods	22,113.4	21,843.9	21,462.4	23,343.6	27,625.0	31,577.5	35,267.7	39,050.3	43,283.1	51,071.2	47,162.4
Total beverages	7,099.9	7,830.5	8,241.0	9,220.4	10,380.9	11,062.1	12,296.0	14,021.9	15,317.4	15,218.3	13,779.1
Total U.S. agricultural imports	37,672.8	38,366.0	39,366.0	41,915.3	47,393.7	53,989.2	59,291.1	65,325.8	71,913.0	80,487.7	71,698.8
Nonfood ag. imports	5,388.6	5,796.2	5,410.0	5,347.5	5,976.1	6,914.7	6,979.0	7,914.7	8,858.7	10,235.4	7,891.3

Source: USDA, www.fas.usda.gov/gats

[a]Values are obtained by HS-6 codes, by calendar year. Total food imports exclude liquors

demand for Mexico-grown fruits and vegetables in the USA is increasing substantially because off-season demand is not being met by domestic production. Approximately 6.2 billion pounds of fresh fruits and vegetables were imported from Mexico to the USA in 2005, 6.49 billion pounds in 2006, and 7.24 billion pounds in 2007 (USDA FAS 2008). The largest share, approximately $2 billion dollars, of Mexico-grown fresh produce is imported into the USA through the Nogales, Arizona Port of Entry (POE) during the winter months (Shannon 2007). Unnevehr (2004) noted that increasing trade flows also result from globalization, increasing integration of markets for goods, services, and capital throughout the world. In this chapter, a framework is presented to assess the safety and quality assurance for U.S. imports with particular emphasis on risk-based inspection (to reduce Types I and II errors),[1] policies, and tools used at the U.S. POE and other segments along the import supply chain.

Increased volumes of imported foods with ever-increasing velocity have been associated with significant food safety and food defense risks (USDA AMS 2003; Acheson 2007). Food safety can be defined as food system reliability—reducing exposure to natural hazards, errors, and failures. It is the unintentional contamination of food, which may have dangerous and lingering consequences (Acheson 2007). Food defense, on the other hand, is system resiliency—reducing the impact of intentional system attacks either from disgruntled employees or terrorists. The term food protection is an umbrella term used to define global food supply system safety and defense. Historically, firms may have considered supply chain risks and defense in the context of the potential threats and disruptions to their own operations. However, the interconnectedness of firms, products, and transportation infrastructure in high-speed global supply chains multiplies the potential costs of these risks without adequate supply chain safety and defense measures.

One recent example of market disruption is the 2008 *Salmonella enterica* outbreak of fresh jalapeño and Serrano peppers from Mexico, which caused at least 1,329 cases of *salmonellosis* food poisoning in 43 states throughout the USA and in the District of Columbia. Nationwide, about 257 people were hospitalized and two deaths were associated with the outbreak. A second contamination event was the outbreak of *Hepatitis A* that occurred in Tennessee, North Carolina, Georgia, and Pennsylvania in 2003. In Pennsylvania, over 650 people were infected and 4 people died as a direct result of this outbreak (Marler 2005). Public health officials used genetic sequencing techniques to trace the outbreak back directly to green onions grown on farms in Mexico (Infectious Diseases Society of America 2005). These outbreaks cause significant public health and market disruption problems that may result in complete market failure. Other examples include melamine adulteration of pet food, dairy products, and infant formula from China (U.S. FDA 2009).

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[1]A false positive or Type I disruption occurs when an inspection system incorrectly identifies a threat or a diagnostic system incorrectly identifies a food risk cause, so that a safe product is excluded from the supply chain. A false negative or Type II disruption occurs when a defective product is distributed to the consumer and causes harm that is extensive enough to create market failure (inefficient allocation of goods and services) as a result of the failure to detect the problem or correctly diagnose the cause.

Imported foods can also be exposed to intentional adulteration with biological, chemical, physical, or radiological agents by a terrorist, which is called agro-terrorism (World Health Organization 2002; Acheson 2007). Chalk (2003) notes that in the last century, there were 12 documented cases where pathogenic agents were used to infect livestock or contaminate food intentionally. Ecoterrorist factions have used plant toxins in Africa (Carus 1999), anthrax in the UK (Chalk 2003), and potassium cyanide in Sri Lanka (Cameron et al. 2001) to intentionally contaminate food. It should be noted that food safety systems will prevent food defense problems in addition to quality control problems that arise in the normal course of commerce. Many and probably most food contamination cases go unreported because the contamination vectors are very difficult to identify. Even when people do not die from contaminated food, the economic loss and market failure impacts can be substantial. When limited inspection resources are not efficiently distributed, market failure may arise from negative externalities.

Firms that import or produce goods that cause human illness impose negative externalities (similar to a type of pollution, which is a common example of an externality). In the same way, importing goods that cause plant or animal pests and diseases also cause negative externalities. The externalities are imposed on both consumers and also, potentially, on other firms if those other firms are impacted by a product recall which they did not cause or if they are now at risk of having their crops or animals infected by the imported disease. When inspection systems fail to mitigate outbreaks from credence-type food protection, then market failure can be attributed to the public good nature of food protection, arising from a violation of global standards. Unnevehr (2004) discussed how globalization leads to deeper integration of taste, standards, and uniform methods of production, which are examples of global public goods. Some challenges to mitigate market failure and ensure quality for imports and trade are discussed next.

Import Inspection and Complexity with Multiple Stakeholders

Ensuring quality for import and trade is a shared responsibility among several U.S. agencies. However, these agencies face several important challenges and significant overlaps in addressing issues related to food safety, food defense risks, and market failures. The Food and Drug Administration (FDA) has in its purview all domestic and imported foods marketed in interstate commerce, including game and exotic meats, food additives, animal feed, and veterinary drugs (Buzby et al. 2008).

USDA-FSIS ensures the safety of all domestic and imported meats, poultry, and processed eggs. Within USDA there are multiple agencies with different responsibilities. It is a point of confusion and frustration for international officials and businesses that they may have to communicate with multiple agencies within USDA to address all of the issues with importing agricultural products. USDA inspected almost 16% of those imported foods in fiscal 2006.[2] Other limitations noted by Roth et al. (2008) include: (1) additional costs for oversight, logistics, pipeline inventory, and quality management; (2) heightened vulnerability and greater supply risks stemming from potential supply disruptions, lack of accountability, lower visibility, and quality failures; (3) issues concerning global financing and funds transfer; and (4) lower responsiveness due to longer lead times. These limitations are compounded by the multiple agencies involved and technology used to ensure food import quality. The involvement of multiple agencies responsible to ensure the safety of imported foods creates additional administrative challenges like information sharing and identifying high-risk imports from multiple-risk factors (e.g., pest, pathogens, chemical agents, drugs smuggling, and human trafficking sometimes associated with food trade).

The agencies involved with the inspection of imported food play a crucial role in the safety of the U.S. food system. However, the mandate of these agencies are diverse and risks are multiple and complex. There are several agencies on both sides of the border employing different inspection technologies that may or may not be coordinated. Among these agencies, the USDA-APHIS initiates inspections of imported produce at the farms in Mexico or their packing and processing facilities with a 24-h e-manifest rule (U.S. Department of Homeland Security 2003). The 24-h e-manifest enables Custom Border Protection (CBP) and USDA to combine their inspection and surveillance efforts. The 24-h rule requires sea carriers and Non-Vessel Operating Common Carriers (NVOCCs) to provide U.S. Customs with detailed descriptions of the contents of containers bound for the USA 24 h before the container is loaded on board a vessel.

The Food and Drug Administration (FDA) conducts pathogen testing at the POE at the same time as various other state and federal agencies, which are charged with providing protection from various other risk factors. However, FDA inspects about 1% of the imported foods it regulates at the border due to resource limitations down from 8% in 1992 when imports were far less common (U.S. CBP 2008a, b; Schmidt 2007). FDA determines violation of incoming shipment if pathogen performance standards are not met (U.S. Food and Drug Administration 2009).

U.S. Customs and Border Protection (CBP) uses alternative forms of intelligent and risk-based technologies to screen information on 100% of the cargo before it is loaded onto vessels bound for the USA. At the Port-of-Entry (POE) CBP inspectors work with specialized X-ray machines and gamma-imaging

[2] It should be noted that within USDA there are multiple agencies with different responsibilities. It is a point of confusion and frustration for international officials and businesses that they may have to communicate with multiple agencies within USDA to address all of the issues with importing agricultural products.

systems to determine anomalies associated with the cargo listed on the manifest (Agriculture Protection Program 2008). The inspection is intended to target not only the safety of the produce but also to detect any activities related to narcotics, fire arms, and/or human trafficking. When produce shipments reach the POE, the CBP officers collect and review documents accompanying the shipment to determine the risk category of the shipment. If the arriving shipment contains commodities identified in the list of fresh fruits and vegetables admissible under the Protocol of the National Agricultural Release Program (NARP), this shipment will be classified as a low-risk commodity and will be inspected under the Protocol of NARP. The commodities eligible for NARP can be fresh, processed, semi-processed, and frozen fruits and vegetables. However, criteria to determine low- and high-risk commodity do not explicitly incorporate food safety and defense risks. The emphasis is mostly on Animal and Plant Health Inspection Service (APHIS) pest risk-based ranking.

If an arriving produce shipment from Mexico is not categorized as an NARP commodity, a determination must be made if the shipment is admissible into the USA. APHIS and Plant Protection and Quarantine (PPQ) regulations provide a list of all approved fruits and vegetables imported from Mexico. Inspection officers use this list to make a decision. If the commodity is not on the list, then the shipment is refused entry into the USA and the officer will tell the importer why entry was denied. If the produce is not an NARP commodity and it is contained in the APHIS and PPQ list, then it is classified as an admissible high-risk produce (Hu 2008).

For such high-risk categorization, all the shipments will be inspected. Every shipment is offloaded and inspectors will randomly select a sample to determine if pests or contaminants are present. Generally, 2% is used as a standard sample rate; that is, CBP officers inspect 100% of the high-risk shipments with a sample size of 2% of the boxes of non-NARP high-risk commodities in the shipments. The sample amount (number of boxes sampled) may be increased for smaller shipments, for a shipper or commodity that has a limited background history, or for a first time shipper. Likewise, it may be decreased for large shipments following the hypergeometric risk-based sampling procedures (see Table 11.2). The hypergeometric sampling method is designed to detect a 10% actionable or reportable pest infestation rate with a 95% confidence level. Once inspectors detect any actionable pests or pathogens in the shipment, the commodity will be refused entry into the USA. A major challenge, however, is to develop mechanisms or policies/programs to facilitate coordination and information sharing between the multiple agencies regulating import quality and trade. It should be noted that there are multiple other stakeholders in other countries, which increases the complexity of imported food supply networks. However, the primary objective for all stakeholders and the policies and programs they implement should be to improve food import safety and enhance trade.

Table 11.2 Simulation results of hypergeometric sampling method

Total number boxes or cartons	Sample selected for inspection
1–6	100 % of the container
7	6
8	7
9–10	8
11	9
12–13	10
14–15	11
16–17	12
18–20	13
21–22	14
23–25	15
26–28	16
29–32	17
33–36	18
37–40	19
41–46	20
47–51	21
52–58	22
59–66	23
67–76	24
77–87	25
88–101	26
102–119	27
120–142	28
143–174	29
175–220	30
221–291	31
292–417	32
418–703	33
704–200,000	34

Source: U.S. Department of Homeland Security – U.S. Customs and Border Protection (2008)

Improving Import Quality with Public Policies and Private Programs

Several international and national policies have been developed and implemented to improve import quality and limit trade barriers over the years. Some notable provisions include the sanitary and phytosanitary measures by the World Trade Organization (WTO); the North American Free Trade Agreement (NAFTA); and most recently, the Food Safety Modernization Act of December 2010. The Agreement on the Application of Sanitary and Phytosanitary measures (the "SPS Agreement") entered into force with the establishment of the WTO on January 1, 1995. The SPS Agreement reaffirmed that no member country should be prevented from adopting or enforcing measures necessary to protect human, animal, or plant life or health, subject to the requirement that these measures are not applied in a manner which would constitute a means of arbitrary or unjustifiable discrimination or restriction on international trade. It allows countries to set their own food safety or quality standards. But it also says regulations must be based on science (WTO 1998).

Paggi (2008) presented a detail comparison among standards for producers, industry, and government related to food safety policies and programs for North American agricultural producers and NAFTA. Four different standards, indicating different levels of organizational authority, were examined. First, FDA guidelines for Good Agricultural Practices (GAPs) in addition to standard operating procedures (SOPs), good management practices (GMPs), and sanitation operating procedures (SSOPs) programs represented national level authority. Second, firm's Hazard Analysis Critical Control Points (HACCP) and the California Leafy Green standard were used to provide examples of voluntary grower, packer, and shipper initiative. Third, the Food Safety Leadership Council On-Farm Produce Standard represented retail and buyer groups. Finally, the Global Gap standard represented the international standard perspective. Standards were compared as they relate to soil and water hygiene, animal risk factor, worker hygiene, traceability, and compliance costs. In December 2010, President Obama signed into law the Food Safety Modernization Act (FSMA). One major component of this provision is import compliance verification. The FSMA provides FSIS more authority on ensuring food safety from domestic or imported sources. Knutson and Ribera (2010) noted the law requires that importers perform risk-based foreign supplier verification analyses to assure that imported foods are produced in compliance with HACCP procedures, are not adulterated or misbranded, and foreign facilities operate in a manner that ensures compliance with U.S. food safety standards. FDA is authorized to enter into arrangements with foreign governments to inspect foreign facilities, suppliers, and food types, to ensure required safety and quality for food imports are met.

Having multiple domestic and import programs could lead to the challenge of overlapping import and inspection policies. Policies that may be intended to reduce unsafe food imports (Type II error) may increase Type I error. Type I disruptions would lead to increased seller's risk, since the seller is exposed to the risk that safe products will be incorrectly devalued. Type I errors are seldom publicly recognized, since they do not affect consumers, but they can have real economic costs to industry. An example of a Type I disruption would be losses incurred when a produce shipment is delayed or destroyed at a Port of Entry (POE) due to preliminary false positive "swab" that could be different from a detailed "culture test." Another example could be a producer initiated mass recall of finished products, rather than a targeted or limited recall, due to ineffective traceability.

Type II disruptions would lead to an increase in buyer's risk, since the buyer experiences the costs associated with the resulting illnesses or deaths. Examples of Type II disruptions are failures to detect accidental contamination from food-borne pathogens, counterfeiting, and adulteration. Some obvious recent examples of

Type II disruptions are the melamine adulteration in powdered milk and the 2006 *Salmonella* contamination of spinach, both of which led to multiple fatalities. The melamine adulteration episode resulted from an inspection system's failure to detect an intentional, commercially motivated set of actions by some individuals. A "control-oriented" system is presented as an alternative to improve allocative efficiency of limited inspection resources and minimize inspection system failures.

A Control-Oriented Systems Alternative

In a business-to-business supply chain that "exceeds" minimal government requirements, it is possible for management to design surveillance systems to detect, prevent, and respond to food risks in the food supply networks by learning from error-based disruptions. While the overarching goal of a control-oriented security system is to simultaneously minimize Type I and Type II errors, system improvement can take the form of a reduction in one or both types of error-based disruptions or from achievement of cost reductions. Control-oriented systems differ fundamentally from systems designed to protect against disruptions caused by uncontrollable rare events such as hurricanes, strikes, or earthquakes. One way that this difference can be understood is to note that error-based disruptions only occur if there are inadequate detection and diagnostic processes intended to control potentially disruptive defects or events (Lee and Wolfe 2003). Once a detection or diagnostic system fails, the normal function of the supply network delivers the defective product to the consumer. This type of problem is thus qualitatively distinct and is further complicated by the complexity of the supply network system.

Error-based disruption requires understanding of transborder food supply networks. These networks meet the requirement of including distributed inspection, diagnosis, and prevention systems that can be the focus of continuous improvement in control. Transborder food supply networks are also distinct as they might be easier targets for food terrorism or be subject to multiple risk factors, including smuggling drugs and human trafficking. The first issue to address is that of threat. Assume, drawing on the threat-vulnerability-consequence model (Cox 2008; Nganje et al. 2009), that threats are the risk of a food safety outbreak or food terrorism attack arising in any part of the supply network. The kinds of security problems that give rise to threats may be unintentional, as most food-borne pathogens contamination appears to be, or intentional, as in adulteration episodes by disgruntled employees or terrorist actions. Food adulteration, whether as a terrorist act or a commercially motivated one, is a principal concern in this kind of security system.

The motivations of the individuals or groups who engage in these behaviors may be political or economic. In either case, the intention is to pass unsafe product through the system without detection. This is a significantly important issue because, in adulteration episodes, intentional concealment can be designed to exploit weaknesses in existing security systems. One favorable aspect of intentional behavior is that it often has a point source that, if identified, can lead to the elimination of the

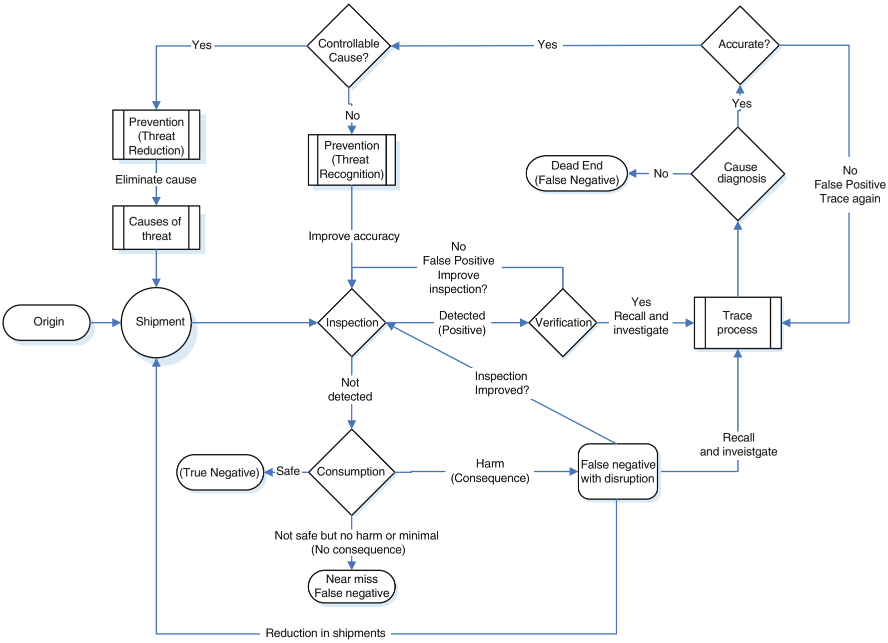

Fig. 11.1 Control-oriented supply network security process map

threat. Many more error-based disruptions will be unintentional, resulting from combinations of events in the food supply network or from normal conditions. Because the cause of these threats can be complex (i.e., have no point source) and because contributing events can be dispersed across the supply network, detection and prevention of unintentional, error-based disruptions can be very difficult.

Figure 11.1 presents a control-oriented process map of shipment, inspection, detection, trace, and prevention in the transborder food supply, identifying error-based disruption points and subsequent opportunities for improvement. There are potential failure points in the flow in terms of risk, protection, and safety, and there are patterns of response that can improve prevention and thus reduce risk while increasing food protection (safety and defense).

The product is shipped and inspected, as shown in the central horizontal axis of Fig. 11.1. Inspection can be performed by a third party (government inspectors at a port of entry), by the carrier, or by the buyer. Every inspection has the potential to generate an error-based disruption (Baker and Schuck 1975; Fortune 1979). The risk that inspection will generate an error is termed vulnerability in the threat vulnerability and consequence (TVC) model (Cox 2008). This model will be extended to include the preventive actions management could implement to mitigate Type I and Type II errors associated with food protection.

Inspection can fail to detect a threat or can incorrectly identify a threat. If a threat is identified, it can either be verified (as in a two-stage inspection process) or not. A positive test that is not verified represents a potential false positive or Type I error.

If a threat is detected, the shipper and buyer are likely to take action to remove the supposedly unsafe food product from the system, resulting in the loss of the load and, potentially, in the disruption of all products from the source associated with the threat. This is the seller's risk of inspection (Nganje et al. 2009).

Every Type I error that occurs and is detected in verification represents an opportunity to improve the inspection system (Scazzero and Longenecker 1991; Stewart et al. 2007) in ways that directly reduce cost. Because systems that are overly sensitive will generate a larger number of Type I errors, the resulting opportunities for continuous improvement in inspection are more likely to focus on increasing accuracy and timeliness rather than on increasing sensitivity (Baker and Schuck 1975; Fortune 1979; Scazzero and Longenecker 1991; Stewart et al. 2007). More accurate systems may require more frequent sampling or information sharing between stakeholders and more timely results may require the colocation of testing facilities with inspection stations. Because Type I errors only occur when an inspection system has a specific target, the frequency of these errors also depends on the variety of threats the inspection systems are designed to detect. Most inspections at borders are primarily concerned with agricultural pests and trafficking in people or contraband (Nganje et al. 2009). Because more encompassing, more accurate, and timely inspections presumably increase costs, managers will assess the risk of these disruptions relative to those costs. Because the cost of a false positive may be low (no illness or deaths) relative to other types of disruptions, managers may accept the cost of these disruptions rather than improving the inspection system to prevent false positive results. This may be especially the case when defect rates are very low, since low defect rates may be associated with a greater incidence of Type I errors, such as swab pathogen tests, which catch borderline cases.

If a threat is correctly detected during inspection and verified (a true positive), the threat will be removed and the system may initiate an investigation into the failure to prevent the threat, as we discuss in greater detail below. This should be a normal practice in a continuous improvement orientation in supply chain security (Lee and Whang 2005). In a complex supply network, continuous improvement will require an improvement process that extends to the carrier, the supplier, and any intermediate agents.

If a true threat is not detected in inspection, the potential for a disruption resulting from a Type II detection error is created. For an actual disruption to occur the product must both be consumed and consumption must show recognizable consequences, such as a reported food-borne illness or death. In a food supply system, products that are not consumed will not cause illness or deaths. In addition, some defective products may be consumed without actually creating consequences. These scenarios represent near misses—Type II errors that are non-consequential but still represent opportunities for continuous improvement.

Therefore, the consequences of Type II errors are driven by the risk that an error will be costly—that it will actually have a noticeable effect. These food risks are characterized by Class I, II, and III recalls by the FDA. A Class I recall is a situation in which there is a reasonable probability that the use of, or exposure to, a contaminated food product will cause serious adverse health consequences or death. A Class II recall is a situation in which the use of, or exposure to, a contaminated food product may cause temporary or medically reversible adverse health consequences or where the probability of serious adverse health consequences is remote. A Class III recall is a situation in which use of, or exposure to, a contaminated food product is not likely to cause adverse health consequences (USDA-FDA 2009).

Based on studies of accidents in other complex systems (Perrow 1999; Sagan 1993; Weick and Roberts 1993), it is very possible that lapses in inspection programs represent the majority of Type II errors in food supply systems. This is because the observed rate of disruptions is a function of the effectiveness of inspections, as influenced, in part, by the low rate of inspections; the consumption rate; and the use of alternative risk-reduction strategies such as cooking the product well. If the severity of Type II errors is underestimated, it leads to inaccurate assessments of systemic risk which, in turn, influences decision processes concerning internal and external security policy (Cox 2008; Nganje et al. 2009; Verduzco et al. 2001; Voss et al. 2009a, b). Inaccurate assessment of Type II severity is a potential major failing in many food supply chain security systems, with frequent occurrences of food recalls resulting from the system failing to identify contaminated products.

The most extreme consequence of a Type II disruption in the food supply system is that one or more consumers get sick or die. Product recalls and supply disruptions are the almost inevitable consequences of Type II disruptions. Far more than Type I disruptions, Type II disruptions lead to calls to improve inspection systems. Unlike inspection improvement efforts resulting from Type I disruptions, efforts following Type II disruptions nearly always involve increasing the sensitivity and scope of both inspections and policy. Once supply chains, brands, and firm survival are threatened by a Type II disruption, managers become much less concerned with the cost of inspection and prevention improvements. The need for inspection to be seen as taking action can create new occasions for increased seller's risk because the actions taken will not necessarily improve diagnosis, inspection, or prevention (Verduzco et al. 2001). For example, the Bioterrorism Act of 2004 only requires improvements in record keeping that improve traceability, without requiring changes in inspection or prevention methods. Traceability improvements may create opportunities for improved protection and safety, but these opportunities must be exploited to achieve actual improvements. This risk of ineffective controls legitimizes our emphasis on cost because it provides a basis for making choices between investments in inspection, diagnosis, and prevention.

Investments following Type II disruptions resulting from inspection errors can be aimed at improving inspection or at diagnosing causes, thereby enabling prevention-oriented investments aimed at reducing threats. Diagnostic processes, which are usually called traceability processes, have the potential to fail, which we call diagnostic risk. Diagnostic systems can produce false positives (Type I diagnostic error) and false negatives (Type II diagnostic error).

How likely a Type II diagnostic error is to occur depends in large part on the structure of the supply network. Because traceability involves identifying and verifying the components and chronology of events in all steps of a process chain, Skilton and Robinson (2009) propose that its effectiveness is a function of the level of complexity in the supply network, on one hand, and the degree of tight coupling within the supply network, on the other hand. In systems where supply networks are relatively simple and tightly coupled through integrated process structures and coordinated information exchange, traceability is a relatively straightforward process. Systems with these characteristics, which are associated with branded goods and processed food, are also likely to have relatively low levels of diagnostic risk. Although Ponomarov and Holcomb (2009) argue that the risk of disruption is greatest for such firms, we suggest that, because the consequences of disruption are perceived as greater, these firms are more likely to have systems that allow accurate diagnosis of errors. These food supply networks will be able to quickly trace the causes of disruptions. As network complexity increases, diagnostic risk will tend to increase, particularly if complexity reduces the timeliness and accuracy of information flows, or compliance with security measures. Because traceability and diagnosis will be less effective, fewer opportunities for improvement will emerge. Supply chain managers will be confronted with a need to trade-off the benefits of network complexity against the costs of tight coupling and information coordination, which enable rapid traces and accurate diagnosis.

Diagnostic risk will be greatest in supply networks that are loosely coupled and complex (Skilton and Robinson 2009). In these networks, which are relatively common in the commodity sectors of the food supply system, it can be very difficult to accurately diagnose the causes of disruptions. Because networks are complex and entangled, inaccurate diagnosis can create Type I diagnostic errors that compound the cost of the initial disruption. One example of a Type I disruption in tracing was the incorrect association of tomatoes with *salmonella* contamination in 2007. This false positive diagnosis led to a nationwide tomato recall that cost growers and packers more than $30 million.

Although the risk of diagnostic errors is greater in complex, loosely coupled networks, security efforts are often substantially lower in these networks because the participants have significantly lower investments in brand and reputation to protect, reducing the perceived severity of failures. These factors combine to make this the sector most exposed to consequential error-based disruptions. Reduced prevention and inspection increase the likelihood of Type II errors, and a loose network structure will impede traceability and improvement efforts. This environment also invites intentional food contamination. While food terrorist actions have been infrequent (Chalk 2003; Engel 2000), intentional adulteration for commercial reasons was the source of the Chinese infant formula melamine poisoning event (Chao 2007) and is probably more common than is generally recognized. The threat of supplier opportunism should be as much a consideration in supply chain security as terrorism is (Roth et al. 2008; Voss et al. 2009a, b).

When an accurate trace is carried out and the source or agents are identified, the system has an opportunity to improve prevention. In the food supply network, preventive security measures include supplier selection standards, supplier development and certification, facility design and protection processes, employee screening and training, shipment tracking, process integration, and process monitoring (Closs and McGarrell 2004; Lee and Whang 2005; Roth et al. 2008; Voss et al. 2009a, b;

Williams et al. 2008). The presence of known inspection processes may serve to prevent some kinds of threats from being deployed (Chao 2007), but tests that are too narrow may invite other specific kinds of threats. Supply chain security personnel should remain aware that intentional threats in particular will tend to adapt to changes in security systems (Chalk 2003; Cox 2008). When intentional disruptions occur and can be traced, managers are faced with the dubious luxury of having an identifiable point source of a set of actors who can be prosecuted or whose access to the system can be removed.

Changes to preventive measures often follow from successful traces in response to Type II disruptions at the moment when cost-based resistance is least and the perception of risk is greatest. They are often adopted as governmental initiatives by U.S. Customs initiatives such as C-TPAT and advanced electronic notice of shipping manifests or industry initiatives such as California Leafy Greens Marketing Agreement; ISO 28000 standards, which address supply chain security; or the International Maritime Organization's International Ship and Port Facility Security Code. Governmental and industry level initiatives have the advantage of leveling the playing field in terms of implementation costs but may not provide enough incentives for all parties along the supply chain to fully adopt food risk mitigation strategies. However, smaller firms may be given more time to implement a policy or acquire more resources. Strong central players in supply networks can complement federal efforts by imposing their own more stringent standards on producers and distributors, such as Wal-Mart's sustainability and food safety initiatives (Rosenbloom 2008).

A Control-Oriented Framework to Assess Performance

Specific requirements exist for a comprehensive detection, prevention, and response framework that managers and policy makers could use to mitigate food risks and error-based disruptions. A comprehensive detection, prevention, and response framework must have four major components, to (1) identify the roles and synergies of multiple stakeholders, (2) establish procedures to assess threats, vulnerability, and consequences along the food supply chain, (3) identify incentives for management to adopt and implement control-oriented risk mitigation plans, and (4) develop a feedback system for response and continuous improvement.

A major challenge with having multiple stakeholders involves how to identify synergies, which may lead to developing consistent risk mitigation policies. One approach may be to use Scenario Method Analysis, a qualitative approach for determining drivers and dependent variables. Scenario Method Analysis provides a qualitative approach to identify influence and dependent factors for the short run (direct effects) and long run (indirect effects with second- and third-order interaction) to enable all stakeholders determine what synergies and contributions in mitigating food risks should be considered. The Micmac Scenario Method is based on the formulation by Godet (1987). The analysis involves developing a database of important variables/factors from existing literature or survey, determining the relationship between factors, analyzing and classifying variables into four major quadrants: strong dependent and influence variables, strong dependent and weak influence variables, weak dependent and strong influence variables, and weak dependent and influence variables. The method derives second- and third-order interactions between factors from three environments: internal firm environment, external policy environment, and the competitive market environment. This would provide a framework to avoid duplication but yet facilitate validation so that the cost and risks associated with Type I and II errors are minimal.

Figure 11.2 describes a conceptual framework to address the last three components of the threat-vulnerability-consequence model (Cox 2008; Nganje et al. 2009). The process map visualized in Fig. 11.1 and described above contains the elements necessary for a theoretical framework of control-oriented management in supply chain security systems. This framework defines the varieties of risk inherent in security systems and relates them to the investments and commitments necessary to achieve a balance between security costs and benefits. Figure 11.2 provides a systemic view of costs and risks and the relationships between them. How managers respond to opportunities for controlling threats and costs governs the evolution of supply chain security systems. Figure 11.2 provides a road map for the definitions and propositions that follow.

Beginning in the upper left corner of Fig. 11.2, threats have causes as indicated by the + notation. In most security-oriented studies, the causes of threats are treated purely as exogenous. In Fig. 11.2 control-oriented framework, this is not the case. The causes of threat may initially be poorly understood, but an important goal of a control-oriented system should be to understand causes of contamination in order to eliminate or control them (Bohn 1994; Lee and Whang 2005). Improved knowledge of control factors achieved through diagnostic processes often results in preventive measures, to which we will return at the conclusion of this section.

Threats are defined as the perceived risk of a defect or attack in a specified supply chain. Vulnerability is defined as the risk of errors in detection systems. Threats can arise at any point in a supply chain. For convenience we will conceptualize threats to be associated with shipments, but threats could equally be associated with facilities or personnel. The whole purpose of control-oriented supply chain security systems is to estimate and control threats. This means that threats must be perceived, since a threat that is not anticipated cannot be estimated, controlled, or defended against.

Proposition 1: The relationship between threat, vulnerability, and investment in detection will be nonlinear but positive, so that investment will grow less quickly as threats increase.

Arguments for Proposition 1: Assume, as many others have, that as threats increase, participants in supply chains will increase their investments in systems designed to detect defects and attacks before they reach the markets. This contrasts to a protection-oriented supply chain security systems that invest in hardening targets or creating back-up systems. In control-oriented supply chain security systems,

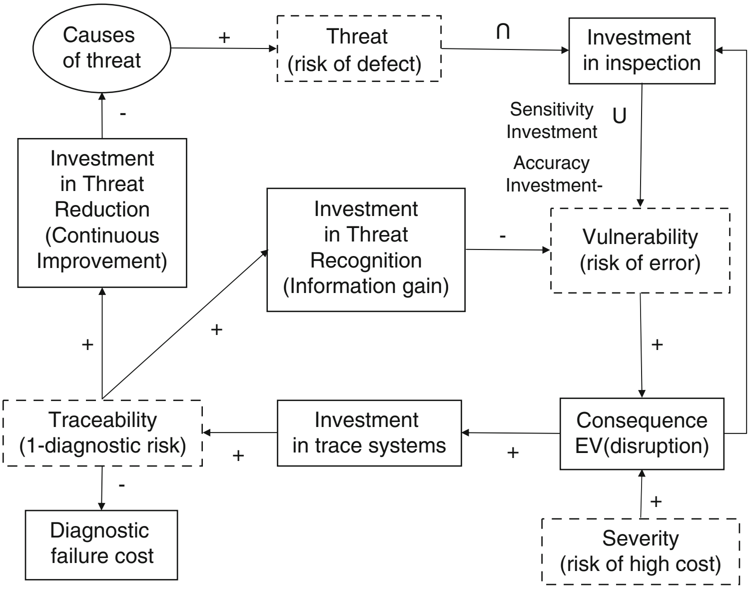

Fig. 11.2 Conceptual model of control-oriented supply network

investments relate primarily to inspection systems. Such investments can improve the sensitivity of inspections, the accuracy of inspections or both. We further propose that there are decreasing returns to detection systems such that, as the probability of defects or attacks increases, improvements in detection resulting from additional investments will diminish. When the threat is low, the benefits of additional investments in inspection systems, such as frequent sampling, will be constrained by the likelihood that greater sensitivity will increase the Type 1 error rate. As threats increase, benefits from additional investment will initially rise, and then plateau. Highly probable defects will be easier to detect with lower sampling rates and lower levels of investment, so that the form of the relationship between threat and investment in detection is likely to take an inverted U shape (presented in Fig. 11.2). This could be illustrated best with the knowledge that increased investment in sampling and testing for pathogens could produce both Type I and Type II errors. Investing in a more sensitive inspection system will decrease the likelihood of Type II errors while potentially increasing the likelihood of Type I errors. The real question here is whether investing in detection systems increases the net risk of combined Type I and Type II errors. Arguably, in control-oriented systems, investments to improve accuracy will decrease Type II errors without increasing Type I errors because the efficiency of all control units will be improved. On the other hand, investments in the detection of contamination will increase Type I errors while reducing Type II.

Proposition 2: Vulnerability is positively related to consequences.

Arguments for Proposition 2: Consequences, defined as the expected cost of disruptions, are positively related to vulnerability. The more vulnerable a security system is, the more likely it is that an error will occur resulting in a system disruption. How consequential a disruption is depends on the ways the product is used and by whom. A market failure resulting from a Type I error that leads a producer to withdraw a product that is actually safe could be as consequential as a complete market failure resulting from a terrorist poisoning a food supply.

Proposition 3: Consequence is positively related to investments in detection systems.

Arguments for Proposition 3: As a practical matter, one would expect greater consequences, realized or perceived, to be positively related to investments in detection systems. Unlike the relationship between threats and investments in detection systems, this relationship will likely be linear. Where consequences are very large, managers will take corresponding steps to invest in and improve detection. This is a central tenet of research on high reliability systems (Sagan 1993; Weick and Roberts 1993). Finally, consequences need not be realized to influence behavior. The perception that consequences will be high can lead to action.

Moving beyond consequences, the remainder of the model deals with prevention (Nganje et al. 2009; Lee and Whang 2005). One of the principle contributions of this chapter is the inclusion of diagnostic systems designed to trace the root causes of disruptions. This is a key element in a prevention and control orientation generally. Diagnosing the causes of errors leads to a control-oriented system of supply chain security. The framework can also serve as a launching point for empirical research. Several of the propositions should be easily tested with the right empirical data. Finding support for this or an alternative model of these relationships will have important implications for practice in control-oriented supply chain security management. This is an important opportunity because most supply chain security managers are first and foremost supply chain managers. They will have a natural interest not only in achieving control of supply chain security but, also, in finding ways to simultaneously mitigate threat and control the costs of errors.

Case Assessment of Allocation Efficiency and Information Gain

The ideal inspection strategy is to inspect all shipments at the highest level possible at the inspection station when they arrive at the POE. This would ensure that all produce entering the USA is 100% free from pest and food-borne illness diseases. However, due to limited resources and facility constraints, it is not possible or optimal to sample every shipment and package that crosses the border. In the case of fresh produce, time limitations due to the perishable nature of the product also make it less feasible to select large representative random samples from all arriving shipments. In an attempt to minimize error-based disruptions, smart, adaptive, intelligent

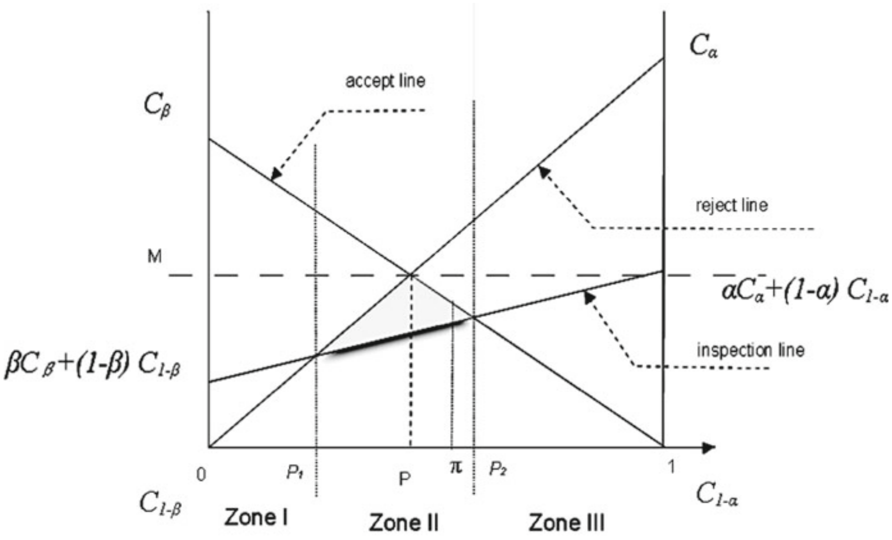

Fig. 11.3 Zonal classification of cost model

inspection procedures could be used to identify high-risk shipments as indicated in Fig. 11.3. In Fig. 11.3, the product containers are classified into three zones. The zonal division is according to the level of risk associated with containers. Zone I is determined based on the safe probabilities (π). The product containers with safe probability below $P1$ ($\pi > P1$) are categorized under high-risk zone. For example, this may be products from origins that have a history of outbreaks or major recalls, no CTPAT/FAST certification, no recognized global certification standard like Global Gap, and falls under EPA high-risk classification for insects and pests introduction. The products with safe probability between $P1$ and $P2$ ($P1 > \pi < P2$) come under moderate-risk zone. For example, this could include producers that have good private certification but no publicly enforced standard or regulation. The product containers with probability greater than $P2$ are categorized as low-risk zone. For example, growers who implement strong private certification programs, operate under enforced public standards and procedures, and meet EPA low-risk categorization. This zonal division of produce containers approach has many advantages. It helps in sorting of the containers according to risk level. It makes efficient use of the inspection resources by concentrating more on high-risk produce and gives more scope to reduce the classification errors or Type I and Type II errors.

Using dynamic intelligent inspection systems, a 100% inspection rate of containers could be possibly attained if the inspection efforts focus on high-risk shipments. Intelligent systems that are part of existing trace-back and tracking applications begin at the production (farm) level. This level of available information can be incorporated into a comprehensive border inspection/surveillance process for produce. The use of adaptive inspection applications has been studied and applied in manufacturing environments (Verduzco et al. 2001). As a component of this study, an expansion and specific adaptation of the existing dynamic inspection allocation models is applied to the fresh produce border inspection problem. See Appendix 1 for a detailed description of the model.

Case Results and Discussion

The results of firms with C-TPAT/FAST program are presented in Table 11.3 for pepper, watermelon, and tomato. The results show that, in order to appropriately mitigate food safety and defense risks, approach rates (sample sizes) for these commodities should be approximately 24% for peppers, 44% for watermelons, and 44.3% for tomatoes. These are significantly higher than the current less than 1% inspection level. Further, foods that have experienced food safety outbreaks and recalls in recent years like peppers and green onions are not viewed as high risk under the current system's focus on crop pest risks. Moreover, the total cost for those firms using the C-TPAT/FAST program is lower than those that do not use the program, indicating these programs could be cost-effective if implemented effectively.

Results of the sensitivity analysis for optimal control method are shown in Table 11.4. Market risks, or the cost of Type I and II errors (buyer and seller risks), decrease as the probability of contamination decreases. On the other hand, investing more (doubling or halving the cost of the C-TPAT/FAST implementation) does not significantly affect buyer and seller risks. Furthermore, the cost of diversion has similar effects as the cost of joining the C-TPAT program. A change in the cost of diversion does not impact buyer and seller risks; however, the certain equivalent increases while the cost of diversion increases.

Implications

Undesirable food quality could result from ineffective surveillance of food imports and error-based disruption. Error-based disruptions and risks that managers have opportunities to control are probably the most common types of disruption in food supply networks. Because food risks from an individual firm are relatively infrequent, managers are often reluctant to commit to permanent overhead costs to prevent them. As with uncontrollable disruptions, however, the consequences of allowing disruptions to take place may be much greater than anticipated. Not only can revenue flows be interrupted, often for long periods, but also the value of brands can be seriously impaired when consumers become sick or die from food hazards.

This chapter has pointed out a number of factors that make perceptions of the risk of error-based disruptions inaccurate. First, Type I disruptions are often not considered as failures of the security system, when in fact they are. Shipments that are delayed, blocked, or recalled when they are actually safe may be the major

Table 11.3 Base case-random testing result from TVCP model

	Peppers	Watermelons	Tomatoes	Orange	Green onion	Broccolis
Utility	1.2004	1.2004	1.2004	1.2004	1.2004	1.2004
% Sampled	23.77 %	43.71 %	44.27 %	44.27 %	44.27 %	44.27 %
Buyer risk	0	1.983E−06	1.680E−06	2.364E−04	4.888E−03	1.323E−03
Seller risk	0	4.435E−06	7.415E−06	0	0	0
Volume diverted (lbs)	0	1,760	3,760	0	0	0
Cost of testing	0.00063	0.00375	0.00375	0.00063	0.00064	0.00063
Cost of C-TPAT	0	0	0	0	0	0
Cost of quality loss	0	1.126E−06	8.737E−06	0	0	0
Total costs ($/lb)	0.00063	0.00375	0.00376	0.00063	0.00064	0.00063
Certainty equivalent ($/lb)	0.00063	0.00375	0.00376	0.00063	0.00064	0.00063

Table 11.4 Pepper model: sensitivity to probability of contamination, cost of C-TPAT and cost of diversion (participating C-TPAT program)

Variables	% Sample	Buyer risks	Seller risks	Certainty equivalent
Probability of contamination				
Pr 0.1	**23.77 %**	**2.480E−05**	**1.344E−04**	**0.00391**
Pr 0.01	23.77 %	2.562E−06	1.636E−05	0.00378
Pr 0.001	23.77 %	2.327E−08	4.814E−07	0.00377
Cost of C-TPAT/FAST ($/truck)				
0.052, 0.308, 0.513	23.77 %	2.480E−05	1.344E−04	0.00017
0.103, 0.615, 1.026	**23.77 %**	**2.480E−05**	**1.344E−04**	**0.00391**
0.206, 1.230, 2.052	23.77 %	2.480E−05	1.344E−04	0.00394
Cost of diversion ($/lb)				
0.17–0.93	31.40 %	2.48E−05	1.344E−04	0.00385
0.33–1.85	**23.77 %**	**2.48E−05**	**1.344E−04**	**0.00391**
0.65–3.70	23.77 %	2.48E−05	1.344E−04	0.00409

Bold indicate base values

Table 11.5 Summary of the intelligent system experiment

	Total picked items for inspection	"Unsafe" items included	Efficiency index
Intelligent strategy	5.77	2.38	41.3 %
Current random inspection strategy	6.12	1.71	27.9 %
Ratio (intelligent system/random inspection)	0.943	1.392	

controllable cost in supply network security. This is an area where costs arise from compliance with regulations that are too sensitive or where tests are too sensitive or both. Type I errors represent an important opportunity for continuous improvement in inspection systems, an area that both managers and scholars may have overlooked for too long.

Second, the perceptions of risks relating to Type II disruptions may be systematically underestimated if their severity is characterized by a high proportion of near misses. We quantify and model these unseen costs and risks using the case of imported produce from Mexico. In the particular case of fresh fruits and vegetables imported from Mexico, we have approximately three COOLTRAX and ACR Smart Button units installed on trucks to collect additional "journey-based" data. Each unit cost approximately $880 ($680/unit and $200 for installation and monthly data access). We set up an experiment and collected thousands of data points, accessed directly on a secured location in the internet. This approach may facilitate information sharing by multiple agencies and interested stakeholders. Data can also be used to evaluate performance of the system by improving delivery times and by minimizing temperature fluctuations that may encourage pathogen growth. The real-time data is used to compare the efficiency of quality assurance with current import strategies and the intelligent system.

Results indicate that intelligent systems could minimize the cost of Type I and Type II errors (Table 11.5) by identifying more unsafe import cargoes.

Our experiment showed that on average 5.8 out of 8 trucks (with multiple data points recorded) were identified for inspection by the intelligent system strategy compared to 6.1 trucks of 8 trucks from the current random import inspection strategy. However, 2.4 of the trucks were determined to be "unsafe" with intelligent inspection compared to 1.7 for the random inspection strategy; when Type I and Type II errors were set at 5%. Although the intelligent system model generated strategy picked fewer trucks for inspection, it did identify more "unsafe" trucks to inspect (1.4 times compared to the randomly inspection strategy). These results are very important. They indicate that it is possible to better channel limited inspection resources to fewer higher risk imports and simultaneously determine the risks associated with the entire shipment in a more efficient manner, 41.3% compared to 27.9% with the current random import inspection strategies. It improves the reliability of the inspection routine to detect the unsafe imports. The results show that intelligent systems could minimize inspection errors and facilitate efforts to allocate limited inspection resources in a "smart" manner.

Inspecting every container arriving at U.S. POEs would be neither physically possible nor cost-effective. The US cannot build border facilities that will enable the inspection of all produce shipments from around the world, due to resource limitations and subsequent facility constraints. Policy debates leaning toward increasing sample size and number of microbial tests will not optimally improve the safety of imported foods unless we can test approximately 44% of imports, up from the 1% we currently test. Participants along the import supply chain should be encouraged to obtain C-TPAT/FAST certification or voluntarily implement portions of these programs in combination with real-time intelligent technologies. Placing sole emphasis on improving the current inspection system, without consideration for intelligent systems, might not resolve issues with counterproductive policies and regulation, such as drug interdiction and food safety/defense or import quality. Illegal drug interdiction poses a major challenge to effectively implementing programs like C-TPAT/FAST. Trucks with C-TPAT/FAST certification may be targeted for fast delivery of drugs. Real-time journey-based information could help mitigate these risks.

Could a system be developed to assist multiple agencies and stakeholders to share information, improve import quality and safety? This is possible with intelligent surveillance technologies. Intelligent systems could be adopted to enable agencies to develop a common database where information is shared amongst inspection facilities at the POE, researchers, and industry stakeholders. One major limitation of the current inspection system is that requirements in other nations are different from those in the USA. Even within the USA, local, state, and federal inspection agencies face significant challenges with information sharing and in determining what information is accepted. Research should be encouraged to advance the science of real-time intelligent systems to collect data on microbial and chemical contamination. This approach could significantly improve the allocative efficiency of operation of multiple agencies, with uniform policies and programs. It is neither possible nor optimal to inspect all produce at the POE due to limited inspection resources. Control-oriented systems with real-time tracking capabilities could simultaneously help with reducing Type I and Type II errors and improve allocative efficiency of limited inspection resources.

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Model to Assess Operational Efficiency and Information Gain

The concept of information gain (IG) introduced by Verduzco et al. (2001) to generate a dynamic inspection strategy becomes the framework for this sampling design. Ideally, the inspection strategy that will be generated is based upon the information provided by the various tracking and tagging devices that have been placed along the produce supply chain. This inspection strategy generation problem is a particular case of an inspection effort allocation that has dynamic and real-time characteristics. For the purposes of this discussion, the devices that provide information about the container or the cargo being transported will be classified under the generic term of "sensors." Each one of the sensors will provide a certain amount of information that can be used to make inspection decisions.

However, the information provided by any sensor is subject to classification errors, which should to be avoided completely which is operationally impractical. For instance, based on the information of a single sensor, a container can be declared "safe" and allowed to proceed into the USA when in fact the contents of the container are not safe. This type of error, discussed earlier, is a Type II error and its associated probability is represented with the Greek letter β. On the other hand, based on the information of the same sensor, a container can be declared "not-safe" and impede its importation into the USA when in fact the contents are safe. This second type of inspection or classification error is a Type I error and the associated probability of this error is represented with the Greek letter α. To design an effective sampling process for border produce inspection requires a plan that minimizes the costs caused by both types of errors. This approach conforms to the current border inspection objective of minimizing the expected total cost associated with a particular inspection procedure.

One of the approaches explored in this chapter is to develop inspection strategies that capture the problem faced by the federal agents at U.S. POE, based on the concept of IG. Under the concept of IG, the quality of the information provided by a particular sensor is not the same for all the objects being targeted. For instance, consider that two containers are being inspected using the same sensor, if linear misclassification costs are assumed, then a cost structure similar to the one depicted in Fig. 11.3 can be obtained. The shaded triangle represents the reduction in cost when the information of an additional sensor is included to assess the container. Thus, this shaded region represents the value of the information gained by including information from an additional sensor in the decision-making process. Notice that the level of IG is, through Π, dependent on the characteristics of the sensor being considered, the information provided by other sensors already used, and the probability that the content of the cargo are safe. Also notice that in some cases the information provided by a sensor does not contribute at all to minimize the total cost of the inspection and should be avoided.

Once IG values and the individual inspection time requirements are available for all sensors, the question that needs to be answered becomes what set of sensors need to be used to minimize the total cost of a potential misclassification. A proposed strategy to answer this question is based on including those sensors in the decision-making process that contribute to maximizing the overall IG. In particular, it is a problem of optimal control of partially observable Markov decision processes (POMDP). The approach is that for each one of the sensors being considered for inclusion in the decision-making process, the IG is computed. Once the IG is available for each sensor, a decision about which sensors to use will be made. A common constraint imposed on the problem is the total time available to reach a decision, or conversely, the maximum total time to use for inspecting a particular shipment. Let Y_i be a binary value such that $Y_i = 1, 0$ if C-TPAT and FAST are used or not. Then the problem becomes:

Maximize the total information gain (Z), where:

$$Z = \sum_{i=1}^{N} G_i Y_i \tag{11.1}$$

subject to:

$$\sum_{i=1}^{N} t_i Y_i \leq T, \tag{11.2}$$

where $Y_i = 0$ or $Y_i = 1$, T is the total sensing time available, N represents the potential sensors, G_i is the information gain for sensor i, and t_i is the time needed by sensor i.

The stochastic optimal control model of fresh produce flows in the handling system reflecting the structure of tracking and testing for contaminations along the supply chain is used to determine the aggregate tracking cost, cost of seller risks or Type I error and the cost of buyer risks or Type II error, and a risk premium to quantify efficiency gains (Saha 1993; Wilson and Dahl 2006). Tests can be conducted at different stages (from the farm to the POE) or nodes in Fig. 11.1 and at varying sampling intensities to determine the success effectiveness of current inspection policies and procedures. Optimal control models can determine optimal testing and sampling strategies (where to test and inspection frequency/intensity) that maximizes the expected utility of the certainty equivalent (CE) (Nganje et al. 2009).

Estimating the CE of wealth requires assumption of the firm's risk preference. The approach presented by Saha (1993) is adopted, where an expo power utility function is used to maximize the expected utility of the certainty equivalent. The objective is:

$$\mathrm{Max}\, EU(W_{\mathrm{CE}}) = E(\lambda - \mathrm{e}^{(-\Phi NR^{\eta})}) \tag{11.3}$$

$$\text{s.a.} \quad X_j \in Y_j,$$

where U is utility; W_{CE} is the certainty equivalent of the vertically integrated firm in fresh produce supply chain; λ is parameter determining positiveness of the function; E is expectation; e is the exponential function; Φ and η are parameters, which affect the absolute and relative risk aversion of the utility function; X_j is the decision variable vectors of the model (whose elements are T_j and S_j, representing where to test and how intensive to test); Y_j is the opportunity set of the model; and NR is the net revenue function (revenue minus system cost). The probability of X_j to determine a Type II error at the optimal sampling decision and intensity is given by a binomial probability distribution. An attractive feature of the binomial probability distribution is that acceptable probability of success could be used to derive the optimal sampling policy (whether or not to test at a particular node and at what intensity).

The advantage of using this utility function in the stochastic simulation model is that it is flexible and allows for changes in absolute and relative risk aversion. The parameters of the utility function λ, Φ, and η are fixed and set to 2, 0.01, and 0.5, respectively, following with an initial wealth of 500. In this model, the total system or aggregate cost is estimated. Stages along fresh produce supply chain where testing can be implemented include the farm, transport from farm to packinghouse, packinghouse, transport from packinghouse to warehouse, warehouse, transport from warehouse to retail stores, and retail stores. Costs for tests conducted at each stage can be estimated separately. The total system cost (C) for a particular tracking strategy is defined as:

$$C = \sum_{j=1}^{n} Tj \cdot \mathrm{TC}j \cdot Sj \cdot Vj + \mathrm{QL}j + C - \mathrm{TPAT} / \mathrm{FAST}, \tag{11.4}$$

where j is the stage for each economic agent where tests are conducted; T_j is binary variable indicating test/no test at stage j; TC_j is the cost of testing per unit ($/test) at stage j; S_j is the sampling intensity at stage j; V_j is the size of lots at stage j; QL_j is the volume diverted multiplied by quality loss cost per unit at stage j; and C-TPAT/FAST is the cost of participating C-TPAT/FAST program.

The advantage of optimal control model over alternative valuation models is that a risk premium or efficiency gain can be estimated with multiple stochastic variables or risk factors in the model (Nganje et al. 2009). As noted in the paper written by Nganje et al. (2009), the risk premium is the incentive or efficiency gains required by the vertically integrated firm in the import supply chain to offset potential risks from intentional or unintentional food contamination when they implement alternative policies and programs. It is a measure of the value of risk reduction of alternative risk reduction measures. In this chapter, the risk premium is derived for C-TPAT/FAST inspection procedures as the expected returns of the base case strategy (random testing) less the certainty equivalent of the C-TPAT/FAST procedure. The risk premium is defined as:

$$\pi = \mathrm{EV}_{\mathrm{BCM}} - \mathrm{CE}_{\mathrm{C\text{-}TPAT/FAST}}, \tag{11.5}$$

where π is the risk premium of the vertically integrated firm participating the C-TPAT/FAST program; EV_{BCM} is the expected value of the base case model with random testing only and no IG; and $CE_{C\text{-}TPAT}$ is the certainty equivalent of the firm joining the C-TPAT/FAST program, which is derived from (11.3).

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Chapter 12
Nonnative Pest Prevention and Control

Dannele E. Peck

Abstract The ability to efficiently produce and market US agricultural goods is contingent on keeping them relatively free of harmful weeds, insects, microbes, and diseases. Despite public and private investments of up to $15.5 billion a year in prevention and control, US agricultural producers still incur at least $98.7 billion in losses and damages to nonnative pests each year. Policies and interventions that prevent or control nonnative pests play a crucial role in safeguarding US agriculture. This chapter surveys a wide array of activities at international, federal, and public–private partnership levels, such as: sanitary and phytosanitary standards, agricultural inspections, off-shore preclearance programs, fees and fines for contaminated shipments, surveillance using sentinel plots, compensation for destroyed crops or livestock, certification based on biosecurity measures, animal disease traceability, disease insurance, compartmentalization, commodity-based trade, and regionalization. Each intervention is assessed according to four criteria: technical, allocative, and dynamic market efficiency; and nonmarket beneficial outcomes. Interventions commonly affect technical, allocative, and dynamic market efficiency, but few affect nonmarket beneficial outcomes. Efforts to address all four criteria are complicated, however, because some interventions improve one criterion at the expense of others.

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Introduction

The ability to efficiently produce and market US agricultural goods is contingent on keeping them relatively free of pests, including harmful weeds, insects, microbes, and diseases (of both plants and animals). Nonnative pests are of particular concern because domestic plants and animals' defenses might not be effective against them. Furthermore, natural predators and other limiting environmental factors might not exist in the United States, or agricultural producers and pest managers might not be trained to identify and control them as effectively as they do for native pests.

Approximately 50,000 nonnative species have been introduced to the United States throughout history (Pimentel et al. 2005). Although most species were introduced intentionally and continue to be beneficial, many were introduced accidentally and have become agricultural pests, including over 500 weed species, 500 insect and mite species, and 20,000 microbe species (Pimentel et al. 2005).[1] Once established in the United States, nonnative pests are rarely eradicated, despite multimillion dollar efforts to do so (Myers et al. 1998). Among the few exceptions are bovine babesiosis,[2] foot-and-mouth disease,[3] and American screwworm (a native pest whose eradication is a sufficiently rare success story to justify its mention) (Bowman 2006; Center for Food Security & Public Health 2008; Meyer and Knudsen 2001). Although these pests have been eradicated from the United States, the threat of their reintroduction persists.

Examples of nonnative pests that have defied nationwide eradication (although not necessarily local or regional eradication) or spread so quickly that eradication was never a feasible option include the emerald ash borer, gypsy moth, golden nematode, cheatgrass, yellow starthistle, wavyleaf basketgrass, citrus canker, soybean rust, karnal bunt, and bovine tuberculosis. Some pests have been successfully eradicated at local or regional scales but not nationwide; examples include tropical spiderwort and the Mexican fruit fly. Even when nationwide eradication is achieved, as with the Mediterranean fruit fly, boll weevil, khapra beetle, highly pathogenic avian influenza and bovine spongiform encephalopathy (BSE), re-emergence is a constant threat.

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[1] A species may be beneficial to one sector of society, but harmful to another. The ornamental plant industry, for example, may view an imported species as beneficial, whereas ecologists may view it as potentially invasive and thus harmful. From an economist's perspective, the benefits and costs of all members of society, including the ornamental industry, ecologists and others, should be considered in decisions to import or ban nonnative species.

[2] Bovine babesiosis, or "cattle tick fever," is caused by protozoan parasites of the genus *Babesia*. It is transmitted primarily by the tick species *Rhipicephalus microplus and R. annulatus* (Center for Food Security & Public Health 2008). Introduced to the New World in the sixteenth century through Spanish colonialists' livestock, babesiosis was widespread in the southern United States by the eighteenth century. It was eradicated from the United States in the 1960s, with the exception of a buffer zone along the Texas-Mexico border which remains under quarantine for surveillance purposes (Bram and George 2000; George et al. 2002).

[3] Foot-and-mouth disease is an RNA virus of the genus *Apthovirus* that affects domestic and wild cloven-hoofed species (Meyer and Knudsen 2001). Recognized in Europe since the sixteenth century (Casas Olascoaga 1984), FMD was first recorded in the United States in 1870 (Spear 1982; Sutmoller et al. 2003). Nine major outbreaks occurred in the United States thereafter (Casas Olascoaga 1984), the last of which occurred in California cattle and deer in 1929 (Spear 1982).

Despite investments of up to $1 billion a year in prevention and control by the United States Department of Agriculture Animal and Plant Health Service (USDA APHIS) and at least an additional $14.5 billion by other agencies and individuals, US agricultural producers still incur at least $98.7 billion in losses and damages to nonnative pests each year (Pimentel et al. 2005; USDA APHIS 2009b). This estimate comprises roughly $24 billion in losses and damages from crop weeds, $21 billion from crop pathogens, $19 billion from rats, $14 billion from livestock diseases, $13.9 billion from crop pests, $2.1 billion from forest pests, $2.1 billion from forest pathogens, $1 billion from pasture weeds, $0.8 million from feral pigs, and $0.8 million from starlings (see table 1 in Pimentel et al. 2005). Nonnative pests cause an additional $27 billion or more of broader environmental losses and damages each year, due to such things as lost recreational opportunities, property damage, and power outages (Pimentel et al. 2005).

As the quantities of imported goods and international travel to the United States rise, the task of preventing additional pest incursions becomes increasingly difficult. Furthermore, as the value of US agricultural products sold in international markets grows, pest prevention becomes increasingly important (USDA APHIS 2006). Policies that prevent or control nonnative pests play a crucial role in safeguarding US agriculture's market share in the global economy. The performance of a wide variety of policies that influence nonnative pest prevention and control is assessed below, based on four criteria—technical, allocative, and dynamic market efficiency; and nonmarket beneficial outcomes. The chapter concludes with a discussion of policy gaps and persistent challenges.

Why Are Nonnative Pests a Concern?

Nonnative pests cause significant agricultural production and marketing losses (both domestically and abroad), and trigger large investments in eradication and control programs. When BSE was detected in a Washington State dairy cow in December 2003, 30 trade partners closed their borders to US cattle and beef products (even though the infected cow was imported to the United States from Canada). The US share of world beef exports quickly fell from 8.7 to 1.7% (Marsh et al. 2008), and took over 4 years to recover (Johnson and Stone 2011).

When karnal bunt (caused by the fungal pathogen *Tilletia indica* Mitra) was first detected in US wheat fields in 1996, 37 trade partners refused wheat shipments originating from anywhere within the US (Rush et al. 2005).[4] Although USDA APHIS resolved most wheat export issues within 2 weeks of the first detection, the

[4] Mexico was among the trade partners who banned the import of US wheat, unless it was certified free of karnal bunt or fumigated with methyl bromide (Allen 2002). Ironically, areas of northwest Mexico experienced karnal bunt outbreaks in the late 1970s, long before the first US outbreak. In 1983, the United States banned wheat imports from Mexico to prevent the spread of karnal bunt. Mexico, in turn, restricted imports from the United States after the 1996 outbreak in Arizona. The two countries have since developed a protocol, under the North American Free Trade Agreement, to allow some Mexican wheat to enter the United States and vice versa (Allen 2002).

incidence led to a long-term nationwide karnal bunt surveillance, quarantine, and export certificate program to placate trade partners (Rush et al. 2005; Vocke et al. 2002). A subsequent karnal bunt outbreak in 2001–2002 triggered quarantines in several counties and cost wheat producers $25 million (Rush et al. 2005).

Global transport of goods is the primary mechanism by which nonnative pests enter the United States (di Castri 1989; Mack 2003). Commodities brought in on ships, planes, trains, and trucks account for numerous pest introductions, in part because inspectors are able to examine only a relatively small proportion of inbound shipments. Pests also arrive in international mail and packages, handled by either the United States Postal Service or private-sector delivery companies. As the volume, frequency, speed, and diversity of imported cargo and travelers to the United States grow, it becomes increasingly difficult to prevent and detect agricultural pest incursions (Ruiz and Carlton 2003).

Global agricultural trade increased 50% between 2001 and 2005, two times the growth rate experienced in the previous decade (Gehlhar et al. 2007). Between 1996 and 2003, agricultural imports to the United States grew nearly twice as fast as agricultural exports from the United States (Jerardo 2004). In 2008, a record $70 billion in agricultural products was imported to the United States (USDA ERS 2009a). Consumption of imported food in the United States increased from 215 lb per person per year in 1989 to 348 lb in 2008, a 62% increase (USDA ERS 2010). Although trade expansion does not conclusively increase the total cost of nonnative pests (Costello and McAusland 2003), it does increase US agriculture's exposure to them. More effective prevention and management tools are needed to maintain current levels of agricultural productivity and marketability in the face of expanding international trade.

International travel is an important mechanism for the introduction of nonnative pests. Fifty-eight million people visited the United States in 2008, a 25% increase from 2004 (UNWTO 2010). Thirty-two million of these visitors arrived by air, 25 million by road, and 0.5 million by sea. Proportions of visitors from various geographic regions were as follows: Canada (32%), Mexico (24%), Europe (23%), East Asia and the Pacific (11%), South or Central America and the Caribbean (8%), South Asia (1%), Africa (0.5%), and the Middle East (0.5%) (UNWTO 2010). Visitors from Canada and Mexico, or other countries with similar climates and ecosystems, might accidentally or intentionally introduce pests that are well adapted for survival in the United States. Visitors from regions with less-similar climates and ecosystems might introduce pests that are not as well-adapted to the United States, but are not well known and are therefore more difficult to detect, identify, and control. These pests might also be highly virulent to indigenous species, which are unlikely to have effective defenses against such foreign invaders.

US residents who travel internationally also have the potential to introduce nonnative agricultural pests upon their return home. US residents took 73 million trips abroad in 2008 (UNWTO 2010). Proportions of these visits to various regions were as follows: Mexico (25%), Europe (25%), South or Central America and the Caribbean (19%), Canada (17%), East Asia and the Pacific (11%), South Asia (1%), Africa (1%), and the Middle East (1%) (UNWTO 2010). Agriculture specialists with US Customs and Border Protection (CBP), and officers with USDA APHIS's Smuggling, Interdiction and Trade Compliance (SITC) Program, search baggage at ports of entry and confiscate agricultural items, but the volume of passengers is sufficiently large that some nonnative plant and animal pests enter the nation undetected. Detection is complicated by pests that can be carried inadvertently on clothing (e.g., foot-and-mouth disease virus in soil on the soles of shoes), or shipped intentionally to the United States through international mail (e.g., classical swine fever virus in smoked or salt-cured pork products). New pest incursions are inevitable, and the growing diversity and volume of potential vectors makes them increasingly likely and frequent.

The potential economic consequences of nonnative pest incursions are also increasing, due to the rising value of US agricultural exports, and growing concern among consumers (both domestic and international) and trade partners about sanitary and phytosanitary (SPS) issues. Nearly one-quarter of US agricultural products (by volume), valued at $82 billion or 13% of the nation's $635 billion food and fiber industry, were exported in 2008 (USDA ERS 2009a). The United States enjoyed record-setting export shipments from 2004 to 2008 because of GDP growth in emerging markets (Gehlhar et al. 2007; Shane et al. 2008). Nonnative agricultural pests, brought into the United States through imported goods and international travel, are a significant threat to the nation's growing share in agricultural export markets.

Numerous public agencies and private organizations engage in the prevention, control, and management of nonnative pest outbreaks in the United States. The remaining sections of this chapter discuss why policy interventions are needed; review current and emerging policies related to nonnative agricultural pests; assess their impacts according to four performance measures; and identify remaining gaps and challenges.

Why Is Government Intervention Necessary?

Externalities, public goods, and imperfect information prevent agricultural markets from achieving socially efficient levels of pest prevention and control. Government intervention can potentially improve efficiency by correcting or mitigating these forms of market failure. Before reviewing individual government interventions and assessing how well they perform, we first need to understand the market failures they attempt to address.

Externalities

The invasive nature of nonnative pests creates the potential for individual production and trade decisions to impose external costs and benefits on others. If an individual producer considers only the private benefits and costs from exporting an agricultural product that potentially harbors an invasive pest, they risk imposing external costs on their trade partners, and causing more pest-related damage than is socially optimal. Similarly, if an industry considers only their private benefits and costs of importing a nonnative species (e.g., a new ornamental plant), and ignores potential ecological implications of their decision (e.g., introduction of an invasive plant species or an insect or microorganism transported in the plant's soil), more invasive species will be introduced than is socially optimal. Likewise, if individuals weigh only their private benefits and costs of controlling pests, and ignore external benefits to their neighbors or trade partners, they will choose a socially inefficient level of control, usually too little.

The concept of externalities may seem more complex when individuals are making pest-related decisions based on imperfect information. Decision-making under uncertainty, after all, can result in unanticipated costs or benefits for both the individual decision-maker and third parties. Externalities only occur, though, if the individual makes their decision without considering the expected benefits and costs (i.e., probability-weighted benefits and costs) their decision may impose on others. If instead the individual considers these expected benefits and costs, but misestimates their magnitude due to imperfect information, the resulting decision does not technically cause externalities. As long as the individual made their decision based on the best-available information (or, more precisely, the socially efficient level of information) about expected social benefits and costs, their decision is socially efficient. Any difference between expected and actual (or realized) social benefits or costs should be attributed to imperfect information rather than externalities.

Government intervention in agricultural markets, through regulations, taxes, subsidies, bonds, or tradable permits, helps align private benefits and costs with social benefits and costs, and reduces market failures stemming from externalities. Regulation is the primary tool used in the United States, and around the world, to combat externalities that would otherwise lead to an overabundance of nonnative agricultural pests. Specific examples of regulatory approaches, and a discussion of their efficiency, appear later in the chapter; for now, it is sufficient to simply understand that externalities exist and that government interventions have been designed, in part, to counteract them.

Public Goods

Prevention and control of nonnative pests exhibit characteristics of a pure public good, another common cause of market failure. Economics defines a "pure public good" as a good that is both "non-rival" (i.e., the same unit of a good can be enjoyed by many people) and "non-excludable" (i.e., it is difficult to prevent people from enjoying the good, even if they have not paid for it). Free markets tend to under-provide public goods relative to their socially optimal levels because individuals have an incentive to "free-ride" (i.e., wait for others to provide the good because they know they will be able to enjoy it for free). When many people engage in free-riding, it collectively results in too little of a public good being provided.

In some cases, even if a person's private benefit from producing a good outweighs the cost they sometimes choose not to produce it. This is because their net benefit will be even greater if they wait until someone else produces it, and then enjoy the good for free (which is only possible because the good is non-rival and non-excludable). Imagine several cattle ranchers, for example, who share a common grazing allotment invaded by yellow starthistle, an unpalatable nonnative weed (DiTomaso et al. 2006). Suppose a single application of a common herbicide each year could control the weed, and that each rancher would benefit sufficiently from the herbicide to justify paying for it themselves. Individuals might still be tempted to free-ride, i.e., wait for one of their fellow ranchers to pay for the herbicide application, and then enjoy the resulting forage benefits for free. If every rancher attempts to free-ride, however, the herbicide will never be applied, and the individual ranchers will be worse off than if they had invested in the herbicide themselves.

One means to overcome this market failure, and achieve a level of herbicide application that is best for all of the ranchers, is to create a legally binding cost-share agreement between them that prevents free-riding. Grazing associations are one example of such an agreement. They have been used for decades to coordinate ranchers who share grazing allotments and encourage them to invest in range improvement projects (Culhane 1981, p. 251). The Hector Grazing Association of the Finger Lakes National Forest in New York, for example, secures grazing fee reductions from the US Forest Service for association members who help manage invasive species by mowing ragweed and goldenrod (United States Forest Service 2005).

For some public goods, the cost of providing the good is sufficiently high that no individual stakeholder's private benefit outweighs that cost, so no individual can justify producing it. Because the good is non-rival though, many people would benefit from having it, and the "social benefit" of the good (i.e., the sum of benefits across all individual members of society) would outweigh the cost. If provision of the good is left to individuals, the good will never be provided; not because people are free-riding, but because their personal benefit does not outweigh the cost. Society as a whole would be better off if the good were provided though. Collective action or government intervention is needed to overcome this type of market failure.

Inspection services at US ports of entry provide an example of this form of the public goods problem. Inspection services are non-rival and non-excludable; they benefit thousands of US agricultural producers and consumers who cannot be prevented from enjoying the benefits of inspection for free once the service has been provided. Inspection services are also sufficiently costly to provide that no individual's benefit outweighs the cost. As a result, no individual can justify providing inspection services, even though the social benefit might exceed the cost (i.e., society as a whole might be better off with inspection services).

One means of overcoming this version of the public goods problem is for the government to impose a user fee or tax on society to raise sufficient funds to pay for inspection services. Ideally, the fee or tax would only be imposed on those who benefit directly from inspection services, such as sellers and buyers of imported goods, and domestic producers whose goods need to be inspected to gain access to international markets. APHIS and CBP collect Agricultural Quarantine and Inspection user fees from the following clients to help cover the cost of inspection services: international passengers; incoming commercial vessels, trucks, railroad cars, and aircraft; live-animal importers; and domestic producers in need of export certificates (Code of Federal Regulations 7 CFR § 354.3 and 9 CFR § 130). Taxpayer dollars fund the remainder of the agencies' budgets.

Imperfect Information

Imperfect information is not technically a market failure, but it makes the prevention and control of nonnative pests more complicated and costly. Imagine how much easier it would be to prevent pest incursions if we knew exactly which shipments were contaminated. Imagine how much more effective our control efforts would be if we knew the exact distance, direction, and mechanism of a nonnative pest's spread. Consider how much more difficult it is, in contrast, to prevent and control pest incursions when information is imperfect. Although risk assessors use probabilistic approaches to mitigate information gaps, and may feel relatively confident about their policy recommendations, such analyses become increasingly difficult as the degree of uncertainty and imperfect information worsens.

Imperfect information makes it more challenging, for example, to determine whether additional resources should be allocated to prevention of avian influenza in domestic birds. Avian influenza viruses are native to water birds throughout the world, including the United States, but the highly pathogenic strain that emerged in 1997 (H5N1) originated in Hong Kong (Webby and Webster 2001). Many pieces of the avian influenza puzzle are uncertain, including the proportion of wild birds carrying the virus; how often they interact with domestic birds; the likelihood of disease transmission when they interact; and the probability of the strain being highly pathogenic.

Millions of dollars could be appropriately invested to reduce the probability of domestic birds contracting avian influenza from wild birds, or to intercept a larger proportion of goods smuggled from countries where this disease is prevalent. An outbreak could nevertheless occur due to imperfect information about the nature or timing of interactions and transmission at the domestic–wildlife interface, or a single undetected shipment of contaminated goods. This example highlights that, although good decisions can be made under uncertainty, the possibility of a bad outcome almost always remains. Good decisions can reduce the probability of a bad outcome, but they rarely eliminate it entirely.

In the absence of perfect information, a highly precautionary approach to pest prevention and control may be tempting. The government could, for example, require all poultry to be confined indoors as a means of reducing the probability of interaction with wild birds. Alternatively, every shipment of imported products originating from a country affected by highly pathogenic avian influenza could be inspected. These approaches ignore, however, the cost of constructing adequate facilities, enforcing regulations, and conducting inspections. These costs might exceed the benefits such activities would generate.

Before making pest prevention and control decisions, managers and policymakers should always weigh the costs and benefits of alternative levels and strategies (Kaiser 2006). Costs and benefits are more difficult to quantify, however, when uncertainty exists about underlying levels of risk or the extent to which alternative strategies reduce risk. Additional information could be gathered to reduce uncertainty, but this too is often costly, and should only be done if the benefit of having more complete information outweighs the cost of obtaining it.

Even if markets were free of externalities, public goods, and imperfect information, or if government interventions perfectly corrected these sources of market failure, socially optimal levels of pest prevention and control still might not be achieved. Although technical and allocative efficiency might be achieved, other goals, such as dynamic efficiency (e.g., innovation and ability to adapt to change over time) and nonmarket beneficial outcomes (e.g., equity, social justice, environmental health, and animal welfare) might not be achieved. Government interventions might still be necessary in such cases to reach society's desired balance between traditional measures of efficiency and other social goals.

How Is Government Intervening?

Extensive regulatory frameworks exist at both the international and national level to mitigate market failures in the prevention and control of nonnative agricultural pests. Major laws, regulatory agencies, and public–private partnerships that address nonnative agricultural pests are reviewed next. This sets the stage for subsequent discussions of how existing policies and programs improve efficiency, and what gaps and challenges remain.

International Programs

The World Trade Organization's Agreement on Sanitary and Phytosanitary Measures (henceforth the WTO's SPS Agreement) is the primary tool for ensuring that SPS measures are science-based, as opposed to unjustified barriers to trade. Enacted in 1995, the SPS Agreement seeks to balance trade liberalization with individual countries' sovereign right to ensure food safety for its citizens and prevent the spread of agricultural and ecological pests (WTO 2000). It promotes harmonization of SPS standards across countries and enables countries to challenge each other's SPS measures.

Responsibility for setting animal health standards lies with the World Organization for Animal Health, which was established in 1924 as the Office International des Epizooties but renamed in 2003 (although it is still known today as the OIE).

Roughly 178 countries are members of the OIE (World Organization of Animal Health 2012). The International Plant Protection Convention (IPPC; first adopted in 1951 by the Food and Agriculture Organization of the United Nations) is responsible for developing plant health standards, which are known officially as International Standards for Phytosanitary Measures (ISPMs). Roughly 177 countries are signatories of the IPPC (2010).

Member countries of the OIE and IPPC set SPS standards, monitor the spread and control of pests around the world, oversee dispute resolution procedures, and facilitate information exchange. Both organizations provide online databases and email notification services to promote timely and transparent reporting of global pest outbreaks. OIE maintains the World Animal Health Information Database, while the IPPC provides links on their homepage to pest reports, ISPMs, and country-specific legislation.

The OIE and IPPC support regional organizations, which encourage neighboring countries to share information, improve institutional capacity, and coordinate surveillance and control activities. Regional organizations are the most common means for individual member countries to communicate with the OIE and IPPC, although members are responsible for reporting pertinent information regardless of their Regional Plant Protection Organization's (RPPO) level of engagement.

The OIE has five "Regional Representations," one each in Africa, the Americas, Asia and the Pacific, Eastern Europe, and the Middle East. The United States is a member of the Regional Representation for the Americas, which includes 29 countries and focuses on three strategic areas: strengthening the capacity of national veterinary services, strengthening national health information systems, and harmonizing animal health standards (OIE RCA 2004).

The IPPC has ten RPPOs. The United States is a member of the North American Plant Protection Organization (NAPPO), along with Canada and Mexico. Several RPPOs across North, Central, and South America (including NAPPO) formed a coalition known as the "Regional Plant Protection Organizations of the Americas," which coordinates plant protection efforts across larger geopolitical scales (Regional Plant Protection Organization of the Americas 1998).

OIE's Regional Representation for the Americas, in contrast, sees a need to coordinate animal protection efforts at smaller geopolitical scales. It is otherwise difficult to meet the needs and interests of its diverse membership of 29 countries. Trade-offs clearly exist between achieving meaningful levels of coordination at the regional scale and identifying sufficiently focused agendas. Neither OIE nor IPPC's regional committees have found a completely satisfactory balance yet, but IPPC has attempted to address this organization challenge by establishing multiple levels of coordination that facilitate communication at several scales.

Effective communication and mutual trust amongst trade partners' national plant and animal health agencies are essential for preventing the spread of agriculture pests via international trade (Romano and Thornsbury 2006). Countries may agree on a set of risk management practices required for an agricultural product to be imported (e.g., fumigation at harvest, or cold treatment during transit), but such agreements are only meaningful if the importing country trusts the exporting country to implement those practices. Signatories to the IPPC are bound by its bylaws and required to abide by ISPMs, but results of worldwide surveys by the U.S. Department of State raise concerns about the willingness or ability of trade partners to enforce SPS standards (Reaser et al. 2003). A State Department survey in 1999 found "Few countries considered [nonnative pests] a high priority, had coordinated policies and plans in place specifically aimed at minimizing the problem, and were dedicating substantial resources to prevent and control the spread" (Reaser et al. 2003).

Developing countries interested in making invasive species management a national priority (if only to gain access to international markets) often lack the scientific, technological, and financial resources to do so (Reaser et al. 2003). In recognition of this, the IPPC has devoted more resources to technical capacity building in recent years. International visits and collaborative research on risk management techniques are other means by which the IPPC's member nations can attempt to strengthen trade partners' engagement in pest management, and build trust between countries' plant and animal health officials. One successful example is the placement of APHIS personnel abroad, where they work side-by-side with host countries' agricultural inspectors to validate proposed pest treatments, provide professional training, and verify correct implementation of mitigation measures. More investments abroad, ideally by benefactors of improved pest prevention and control, may still be necessary to increase less-wealthy trade partners' willingness and ability to manage pests and meet SPS standards.

Both the OIE and IPPC have voluntary evaluation programs to help countries assess their ability to meet SPS standards. Seventy-five countries have completed the OIE's Performance of Veterinary Services evaluation; an equal number have completed the IPPC's Phytosanitary Capacity Evaluation (WTO STDF 2009). Such evaluations help countries identify gaps and weaknesses in their national plant and animal health systems and develop priorities and strategies for improvement (WTO STDF 2009). They also enhance participating governments' understanding and acceptance of SPS standards and the WTO's awareness of constraints that prevent developing countries from meeting SPS standards (WTO STDF 2009). In the long run, programs like these will empower developing countries to better manage existing agricultural pests, implement risk management practices that satisfy SPS standards, and thereby reduce the spread of pests through international trade.

Federal Programs

The United States faces significant coordination challenges not only with trade partners, but within its own borders amongst the numerous federal agencies that address nonnative pest issues (Reaser et al. 2003). Three laws define the Federal government's role in preventing and controlling nonnative pests: the Plant Protection Act of 2000, the Animal Health Protection Act, and the Federal Seed Act (USDA ERS 2009b). These Acts give numerous federal agencies authority to implement a wide variety of tools to prevent and control nonnative pest outbreaks in the United States (USDA ERS 2009b). Agencies with primary responsibility for pest prevention and control are discussed briefly.

The USDA's Animal and Plant Health Inspection Service (USDA APHIS) has primary responsibility for protecting agriculture from nonnative pests. Four programs within APHIS address this objective: Veterinary Services (VS), Plant Protection and Quarantine (PPQ), Biotechnology Regulation Services (BRS), and International Services (IS) (USDA ERS 2009b). These programs implement a variety of tools authorized by federal legislation, including monitoring, surveillance, training, testing, quarantine, treatment, management, eradication, and compensation to agricultural producers for crops or animals destroyed for pest management purposes (Magarey et al. 2009; USDA ERS 2009b). They also analyze SPS risks associated with the import and export of agricultural products (Magarey et al. 2009; Cavey 2003). Much of the risk analysis work is conducted at APHIS Headquarters in Riverdale, Maryland and the APHIS PPQ Center for Plant Health Science and Technology in Raleigh, North Carolina. After risks are analyzed, either qualitatively or quantitatively (Hayes 2003), APHIS decides which products should be allowed into the United States, from what regions of the world, and under what risk management protocols.

As required by the SPS Agreement, APHIS uses risk analyses as the basis for scientific justification of SPS measures that protect US agriculture from nonnative pests. Many SPS issues are resolved informally through bilateral negotiations with trade partners. APHIS's on-going international outreach efforts facilitate such negotiations, indirectly, by: (1) improving trade partners' understanding of SPS risks, and thus perhaps their willingness to accept SPS standards, and (2) strengthening trade partners' capacity to manage agricultural pests and diseases, and thus potentially reducing US agriculture's exposure to nonnative pests (Magarey et al. 2009; Reaser et al. 2003; USDA APHIS 2009a).

Agricultural inspections at US ports of entry and border crossings are another vital tool for preventing nonnative pest invasions. Historically, APHIS was responsible for conducting these inspections; however, the Department of Homeland Security's Customs and Border Protection (USDHS CBP) assumed responsibility in 2003 in the wake of terrorist attacks on the United States in 2001. CBP collaborates with APHIS to fulfill agricultural inspection tasks, but their new partnership has not been easy. A joint task force review in 2007 revealed concern among stakeholders and APHIS employees that CBP had not sufficiently incorporated agriculture into their primary mission, which is to prevent terrorists, terrorist weapons, illicit drugs, and illegal immigrants from entering the United States (USDHS CBP and USDA APHIS 2007).

Recommendations for raising agriculture's profile within CBP's mission included more effective joint planning efforts between CBP and APHIS, and an increase in the number and level of staff that support the agricultural inspection mission (USDHS CBP and USDA APHIS 2007). CBP also indicated a need for more agriculture specialists in their 2006 performance and accountability report, particularly at ports of entry and border stations (USDHS CBP 2006). They have since increased the number of agricultural inspectors from 1,560 to 2,360; they have also expanded the agricultural canine program from 75 to 114 teams, enhanced the level to which agricultural inspectors can be promoted, and developed new pest detection modules for continuing education of inspectors (USDHS CBP 2011). Performance is thought to have improved as a result, although some deficiencies certainly remain (Harriger 2011; USDHS CBP 2009, 2011, 2012).

Exclusion is another important concept in the prevention of nonnative pest outbreaks. Exclusion refers to the detection and elimination of pests before they reach US shores. APHIS directs several programs that help identify pests in other countries and prevent them from being exported to the United States. OPIP (Offshore Pest Information Program) and EPICA (Exotic Pest Information Collection and Analysis) were developed separately, but eventually merged, to systematically gather, assess, and synthesize information about pests and diseases in other countries, and communicate it to APHIS personnel and partners through electronic newsletters and searchable databases (USDA APHIS 2010a, b). This flow of information about pests and recent outbreaks in other countries allows APHIS personnel to anticipate potential pest risks before they reach US shores, initiate preparedness planning, and adjust inspection procedures when risks are deemed sufficiently high to justify regulatory action.

APHIS also develops, implements, and maintains offshore agricultural commodity preclearance programs at dozens of locations around the world (USDA APHIS 2007). The Commodity Preclearance Program, for example, inspects, treats, and certifies agricultural goods within their country of origin to reduce the risk of pests reaching the United States (USDA APHIS 2002). Qualified APHIS personnel supervise preclearance inspections and treatments on-site, and inspectors conduct integrity checks at US ports to ensure compliance (USDA APHIS 2007). An industry wishing to establish a preclearance program must work closely with their home country's plant protection service and APHIS to propose, develop, test, and maintain adequate facilities for the inspection, treatment, packaging and certification of agricultural commodities (USDA APHIS 2002). Preclearance programs in Chile provide an example of the coordination and technical complexity involved in operating a preclearance facility (Silagyi 2010).

In addition to preclearance programs, APHIS also works in other countries to help trade partners manage pests that pose a serious threat to US agriculture. APHIS manages a center in northern Mexico, for example, that releases sterile Mexican fruit flies (*Anastrepha ludens*) to suppress (and perhaps someday eradicate) this pest along the Texas-Mexico border (USDA APHIS 2010c). This effort directly benefits eradication efforts in the Lower Rio Grande Valley of Texas, but similar efforts are also underway in more distant locations. APHIS tracks the distribution of tropical bont tick, for example, in the Caribbean and provides assistance to countries trying to eradicate it (Bram and George 2000). APHIS hopes to prevent this nonnative tick, which is a vector of *Cowdria ruminantium*, the causative agent of a deadly ruminant disease known as heartwater, from reaching southern Florida and its livestock populations (USDA APHIS 2010c). Offshore investments like these are representative of APHIS's efforts to prevent nonnative pest outbreaks by detecting and eradicating them before they reach the United States.

Other USDA programs and divisions as well as other federal agencies provide valuable data, research, training, and financial support, which help protect US agriculture from nonnative pests. USDA's Agricultural Research Service (USDA ARS), for example, manages national research programs on animal health, plant diseases, crop protection, and quarantine (USDA ARS 2010). These programs address a variety of nonnative pest issues, including exotic citrus diseases such as citrus tristeza virus; the epidemiology of *Xylella fastidiosa* (which causes Pierce's disease in grapes); biological control agents for yellow starthistle; quarantine services for emerald ash borer; management of invasive beetles in horticultural, turf, and nursery crops; improved control of invasive fruit flies and Asian citrus psyllid; control of zoonotic avian viruses and foreign diseases of swine; vector competence of North American mosquitoes for Rift Valley Fever virus; immunity enhancement against foot-and-mouth disease; and effective alternatives to methyl bromide, a common soil and postharvest treatment phased out under the Montreal Protocol and the US Clean Air Act (Schneider et al. 2003; USDA ARS 2010).

USDA ARS research provides information critical to APHIS's risk analyses, rule-making processes, and prevention and control policies. APHIS scientists, in many cases, work side-by-side with ARS personnel to develop new SPS treatments. The APHIS PPQ Center for Plant Health Science and Technology is actively involved, for example, in developing methyl bromide alternatives (USDA APHIS 2011a).

So many federal agencies share responsibility for the prevention and control of invasive species, or otherwise influence the introduction and distribution of invasive species, that an official means of coordination is necessary. The National Invasive Species Council (NISC) was created in 1999 to develop a coordinated network among federal agencies to document, evaluate, and monitor invasive species' impacts (Reaser et al. 2003). The NISC was also tasked with developing recommendations for international cooperation; encouraging planning and action at regional, state, tribal, and local levels; and preparing a National Invasive Species Management Plan (The White House 1999). Secretaries and Administrators from 13 federal departments and agencies sit on the Council and the Secretaries of the Interior, Agriculture, and Commerce serve as cochairs.

The NISC's 2008–2012 National Invasive Species Management Plan defines five long-term strategic goals (NISC 2008). The objectives and tasks associated with these goals reveal a wide array of challenges that federal agencies face in the battle against nonnative pests. Example objectives from the 2008 to 2012 National Invasive Species Management Plan include improving and expanding domestic and international risk analysis processes; developing fair and practical screening processes to evaluate species moving through trade; incorporating invasive species issues into free trade agreements; improving US participation in the Global Invasive Species Information Network and the Inter-American Biodiversity Information Network; integrating agency data sets to improve invasive species threat assessment; improving economic modeling of invasive species; developing a process to identify high-priority invasive species; identifying mechanisms to fund rapid response efforts; and creating citizen-based networks to monitor new invasive species (NISC 2008). These objectives highlight the diverse set of activities (from prevention to management) that must be coordinated both within and across multiple scales (from local to international). Coordination is essential for efficient prevention and control of nonnative pests.

Public–Private Partnerships

Public–private partnerships provide a valuable link between government agencies that regulate activities capable of spreading nonnative pests, and stakeholders who engage in such activities or are affected by nonnative pests. These partnerships help improve government agencies' ability to identify new pest-related issues; gather data about emerging or on-going pest outbreaks; develop and test innovative management tools; design pest prevention and control policies that are sensitive to stakeholders' concerns; convey educational materials to appropriate audiences; and leverage funds for research, outreach, and program implementation. More public–private partnerships for nonnative pest prevention and control exist than can be covered in one chapter. A few examples are given, however, to provide a sense of their composition, goals, and accomplishments.

USDA APHIS partners with universities, industry groups, state agencies, and other natural resource protection organizations to manage the Cooperative Agricultural Pest Survey (CAPS). CAPS is a national program that surveys, identifies, monitors, and prioritizes over 400 plant pests (USDA APHIS 2005a). Pest surveyors collect climatic, environmental and pest-specific data, upload them to state databases, and then transfer them to the National Agricultural Pest Information System. CAPS focuses both on pests already present in the United States and potential threats that have not yet arrived. Data regarding existing pest incursions help APHIS determine which locations require quarantine and which can be declared pest-free (a declaration that has important trade implications). Data regarding potential invaders informs emergency preparedness and response planners and off-shore pest exclusion programs (USDA APHIS 2005a).

CAPS sponsored the development of NAPPFAST, a computer model that uses climatic and environmental data to predict when and where a pest incursion might occur in the United States (Magarey et al. 2007). CAPS uses this model, as well as input from the National CAPS Committee, National Plant Board, APHIS PPQ, and industry groups, to identify plant pest priorities each year (Cooperative Agricultural Pest Survey 2009). Although CAPS provides a means for state and federal agencies to coordinate pest surveillance and monitoring efforts, the extent to which private industry is engaged (aside from providing access to agricultural fields for surveillance purposes) is less clear. Magarey et al. (2009) suggest more incentives are needed for industry to share pest data with state and federal agencies. This would help reduce the cost of data collection, which is an important barrier to more effective pest surveillance.

USDA also collaborated with the United Central Soybean Board and state extension service offices to develop a national monitoring system for soybean rust, a fungus introduced to the United States in 2004 by the winds of Hurricane Ivan (Aultman et al. 2010). The soybean rust monitoring network comprises several hundred sentinel soybean plots around the country, which state extension personnel manage exclusively for the purpose of detecting rust. Leaf samples are sent regularly to land grant university's labs for testing. Test results are made available to the public through the IPM PIPE website, which publishes a weekly map of confirmed rust cases. Soybean producers can sign up for automatic email alerts when rust is detected in their region (Aultman et al. 2010). Researchers have also developed a model to predict the spread of rust based on atmospheric forecasts for the upcoming week (Isard et al. 2007). With up-to-date outbreak data and weekly forecasts, producers have more complete information with which to choose preventive, reactive, or no action to protect their fields.

Because soybean rust has generated smaller losses than originally predicted, the USDA and Soybean Board have reconsidered the sentinel plot program's scale. Partnering with scientists at the University of Minnesota, they are working to determine the economically optimal number and location of sentinel plots (Aultman et al. 2010). This research provides a good example of innovative pest management tools that arise from effective public–private partnerships. In this case, technical experts generated information directly applicable to producers' pest management decisions and conveyed it to producers in a highly accessible and timely manner. APHIS has similar public–private partnerships with many other stakeholders and research universities with whom they work collaboratively to develop effective pest monitoring and control strategies.

USDA APHIS also partners with private industry to address animal disease issues. They work with livestock producers and state animal health officials, for example, to collect data for the National Animal Health Monitoring System (NAHMS), a nationwide survey of animal diseases and health management practices (USDA APHIS 2010d). As described by Bullis (1977), they partner with the poultry industry and state animal health agencies to manage the National Poultry Improvement Plan (NPIP). NPIP establishes disease evaluation standards for poultry breeding stock and hatchery products, and administers a certification system that facilitates trade (Code of Federal Regulations 9 CFR § 145–147; Rhorer 2004). Originally created in 1935 to address pullorum disease (caused by *Salmonella pullorum*), the NPIP now monitors US flocks for H5 and H7 low pathogenic avian influenza (AI) viruses, and certifies that operations supplying poultry products for international shipments are free of avian influenza (Bullis 1977; Hall 2004).

Unlike other pests mentioned in this chapter, low pathogenic AI is indigenous to the United States. It has sufficiently important implications though for marketing of US poultry products, both domestically and internationally, to justify a brief discussion. Each year, a small proportion of US poultry becomes infected with low pathogenic AI, along with 10% of migratory water birds (Hall 2004). Trade partners are concerned about the ability of low pathogenic AI to mutate to highly pathogenic forms. Such mutation was first observed in the United States during an outbreak in

Pennsylvania in 1983 (Hall 2004). Similar mutations have occurred in other countries as well, including Mexico, Italy, France, Denmark, the United Kingdom, South Korea, and Japan (Hall 2004; World Organization for Animal Health 2010).

Backyard or free-range poultry flocks pose a serious challenge to AI prevention efforts in the United States because they are at greater risk of contracting diseases from wild birds than are confined flocks typical of most commercial operations (Hall 2004). Fortunately, commercial operations with good biosecurity practices have a low probability of contracting diseases from neighboring backyard flocks (Garber et al. 2007). OIE's recent adoption of a concept known as compartmentalization (i.e., biosecurity practices that allow commercial poultry to be considered separate from backyard flocks for purposes of trade) has further reduced the extent to which disease outbreaks among backyard flocks disrupt commercial trade (Garber et al. 2007).

NPIP is an excellent example of a highly organized campaign by private industry, in partnership with federal and state agencies, to improve animal disease management for the purpose of enhancing product marketability. The organization's successful control of pullorum disease and fowl typhoid (*Salmonella gallinarum*) provides insights relevant not only to current poultry diseases (e.g., low pathogenic AI and *Salmonella enteritidis*), but to other agricultural industries as well.

The National Pork Board, following NPIP's example, has engaged in a similar partnership with USDA APHIS for over a decade to develop a voluntary Trichinae Certification Program (TCP) (Code of Federal Regulations 9 CFR § 149; Pyburn 2003). *Trichinella* spp. are parasitic roundworms that can be transmitted from swine to humans through consumption of infected meat that is not properly frozen or prepared (Centers for Disease Control 2008). Some trade partners require all fresh pork imported from the United States to be tested for *Trichinae* spp. Such testing is sufficiently costly that it makes the market economically inaccessible to US pork producers. Producers are working to gain access to these markets by proving that the TCP provides equivalent safety assurances at lower cost (Rogers and Brownlee 2007). TCP certifies that participating producers implement best management practices to minimize the risk of *Trichinella* spp., and that pigs from certified operations are processed in separate facilities from pigs produced in uncertified operations (USDA APHIS 2008). Certification, based on the adoption of best management practices and separate processing facilities, is in some sense a form of compartmentalization. Certification distinguishes low-risk operations from high-risk operations and, therefore, qualifies them for different testing requirements and less-severe trade restrictions during an outbreak.

It is too soon to determine whether TCP will create significant new export opportunities for US pork producers, but some experts believe this farm-level approach to food safety is superior to the traditional approach of testing individual animals at slaughter (Pyburn 2003). If this is shown to be true, farm-level certification programs might be a practical means to standardize animal health practices in the beef industry as well. Standardization is more challenging in the beef industry because operations tend to be more heterogeneous in type, size, and location. The beef industry is also less integrated, both horizontally and vertically, than the pork and poultry industries. It has multiple producer organizations that do not share the same opinion on issues such as animal identification and marketing strategies. Given the beef industry's disparate and disaggregated nature, it is more difficult to gain the necessary momentum for industry-led initiatives. Programs directed at individual producers, such as certification, might be successful, particularly if they are flexible enough to accommodate highly diverse beef operations.

USDA APHIS and state agencies also partner directly with agricultural producers by offering them financial incentives to invest in pest prevention and control. APHIS and state agencies provide cost-sharing to producers who adopt best management practices for the prevention and control of high-profile pests. Cattle producers in the Greater Yellowstone Area, for example, receive free testing and adult-booster vaccination for bovine brucellosis, which is indigenous to the United States (Peck 2010). APHIS has also compensated some producers in the past for crops or livestock destroyed during pest eradication campaigns (e.g., citrus canker, karnal bunt, plum pox, exotic Newcastle disease). Compensation encourages producers to report pest outbreaks to government officials, who can then implement appropriate control techniques more quickly. In the absence of compensation, producers might attempt to sell infected crops or livestock, or manage outbreaks on their own, to avoid uncompensated destruction. Given the ability of many nonnative pests to spread quickly, illicit or elusive behavior by producers might be more costly to the government than compensation.

Federal agencies other than USDA APHIS also engage in public–private partnerships to prevent and control nonnative pests. The U.S. Geological Survey's Biological Informatics Office, for example, partnered with the World Conservation Union's Invasive Species Specialist Group, universities, nonprofit organizations, and other federal agencies to create the Invasive Species Information Node (ISIN) (National Biological Information Infrastructure 2008). ISIN provides a single web portal through which numerous sources of information about nonnative pests can be accessed. It is intended to serve as an early detection and rapid response information system for invasive species control in the United States. When fully functional, it will house: invasive species identification tools, such as the Global Invasive Species Database; predictive models of vulnerable habitat and future spread of invasive species; tools for reporting and mapping invasive species occurrences; automated delivery of early detection information to managers and decision-makers; a search interface that accesses multiple invasive species databases; and data collection standards to promote interoperable databases (National Biological Information Infrastructure 2010). When fully developed, ISIN will facilitate information exchange and help coordinate invasive species detection and control nationwide.

The NISC also collaborates with private industry to identify high-priority and emerging issues that require a coordinated response from multiple federal agencies. More specifically, NISC seeks input from the Invasive Species Advisory Committee (ISAC), a board comprising 32 nonfederal experts and stakeholders who represent state, tribal, local, and private concerns (ISAC 2006). ISAC's member list in recent years included representatives from a diversity of organizations, such as the

American Seed Trade Association, Michigan Nursery and Landscape Association, Chamber of Shipping of America, Pet Industry Joint Advisory Council, Defenders of Wildlife, and producers from the crop, livestock, and aquaculture industries. The Committee also included numerous technical experts from universities, and state agricultural and environmental agencies (ISAC 2010). The Advisory Committee meets twice annually to discuss emerging challenges and advances in invasive species management. They also provide input for the National Invasive Species Management Plan, and produce guidance documents for federal agencies (NISC 2008). Assuming ISAC is sufficiently representative and influential, it affords stakeholders a single efficient avenue to influence the invasive species management activities of 13 federal departments and agencies.

Numerous other programs, partnerships, tools, and activities exist to enhance the prevention and control of nonnative agricultural pests. A description of them all would fill an entire book. Several prominent and representative examples have been described, however, to provide case studies for subsequent discussions of how government and public–private interventions affect the efficiency of pest prevention and control.

Do Existing Interventions Improve Market Performance?

Government interventions and public–private partnerships fulfill two roles in pest prevention and control. They create incentives for individual producers, consumers, and trade partners to make socially optimal decisions about pest prevention and control. They also help mitigate any remaining gaps between socially vs. privately optimal levels of pest prevention and control after incentive programs are implemented. This section explores how various interventions described above enhance the market performance of pest prevention and control, and agricultural production and marketing in general.

Four criteria are of interest, three of which address market efficiency and another which involves nonmarket outcomes: (1) technical efficiency (maximum output achieved from a given set of inputs); (2) allocative efficiency (inputs allocated to outputs such that a socially optimal bundle of outputs is produced); (3) dynamic efficiency (markets readily adapt to changing conditions); and (4) nonmarket beneficial outcomes (achievement of social goals outside traditional definitions of market efficiency, such as social justice, animal welfare, and human nutrition/health).

Because individual government interventions can affect more than one criterion, this section is organized by interventions. Interventions are grouped together under the same headings used in the previous section: "International Programs"; "Federal Programs"; "Public–Private Partnerships." Table 12.1 summarizes how interventions address different forms of market failure and affect various performance criteria.

Table 12.1 A synthesis of government and public–private interventions according to the market failures they address (x) and their effects on various performance categories

	Market failures addressed			Performance categories affected			
Intervention	Externalities	Public goods	Imperfect information[a]	Technical efficiency	Allocative efficiency	Dynamic efficiency	Nonmarket outcomes
SPS agreement[b]	x	x	x	+	+	+	+/–
Import inspection and fees	x	x	x	+/–	+	+	n/a
Research and data collection	x	x	x	+	+	+	n/a
Data sharing and research coordination	x	n/a	x	+	+	+	n/a
Certification	x	n/a	n/a	+	+/–	+	+
Compensation and cost-sharing	x	n/a	n/a	n/a	+/–	n/a	n/a
Contingent compensation and pest insurance	x	n/a	n/a	+/–	+	n/a	n/a
Animal disease traceability	x	n/a	x	+/–	+	+	+
Improved screenings and risk assessments	x	n/a	x	+	+	+	n/a

Positive (+), negative (–), ambiguous (+/–), or not applicable (n/a)

[a]Imperfect information is not actually a market failure. Efficient decisions can still be made given imperfect information if market failures such as externalities, public goods, and asymmetric information are absent. Social net benefit arising from efficient decisions is simply lower than it would be if perfect information were available

[b]Sanitary and Phytosanitary Agreement

International Programs

Two interventions at the international scale have sufficiently important effects on US agriculture's market performance to justify further discussion: the World Trade Organization's Sanitary and Phytosanitary Agreement, and a trio of trade-enhancing concepts known as regionalization, compartmentalization, and commodity-based trade.

Sanitary and Phytosanitary Agreement

The World Trade Organization's SPS Agreement improves the *technical* efficiency of US agricultural marketing by indirectly encouraging information exchange and strengthening trade partners' plant and animal health infrastructure. In an unregulated trade environment, we might expect pest-related information and pest prevention and control services to be underprovided because of their public good characteristics. Governments typically address this market failure by providing information and services themselves using taxpayers' dollars or user fees. Some governments are unable or unwilling to do so though, in which case the market failure persists, and both the country and its trade partners suffer. The SPS Agreement provides an impetus for other countries to help trade partners achieve socially optimal levels of pest prevention and control.

Information exchange helps ensure trade partners have the best available scientific information about US agricultural product safety. This alleviates problems arising from imperfect information and reduces the amount of resources (e.g., administrative paperwork, diplomacy, and inspections) needed to gain market access for US products. Strengthening of trade partners' plant and animal health infrastructure, through activities such as scientific exchange, program evaluation, professional trainings, and preparedness exercises, increases their ability to control agricultural pests within their own borders. This reduces the amount of pest prevention necessary at US ports of entry, although much effort is still required, and increases the technical efficiency of the import process.

The SPS Agreement also increases *allocative* efficiency by encouraging trade partners to remove SPS measures that are inconsistent with scientific evidence. This reduces external costs that politically motivated trade barriers might otherwise impose on trade partners and creates opportunities for consumers who place the highest value on agricultural goods to actually obtain them. In general, the SPS Agreement liberalizes international trade, which increases competition in the global market for agricultural products and reduces the ability of individual buyers or sellers to manipulate market prices and quantities.

The SPS Agreement improves some aspects of *nonmarket beneficial outcomes* by creating access to agricultural markets for more countries, which increases wealth and income equality at a larger geographic scale. Similarly, by increasing the number of countries from which a given agricultural good can be purchased, the

SPS Agreement creates more flexibility during times of crop failure or political instability (either domestically or abroad). This enhances *dynamic* efficiency and thereby reduces the impact such events have on a country's economy.

One potential drawback of harmonization, as perceived by some stakeholders involved in actual SPS negotiations, is that once OIE or IPPC has accepted an SPS standard, it is more difficult for a country to impose stricter SPS standards, even when such standards are scientifically justifiable. Although the SPS Agreement's primary benefit is the singling out of unjustifiable SPS standards, some argue it also increases the cost of defending legitimate standards. Presumably though, any decrease in the *technical* efficiency of administering legitimate SPS standards is offset by gains in the *allocative* efficiency of international trade.

The SPS Agreement strives to eliminate the use of politically motivated SPS standards, but it cannot remove politics from the equation entirely. Trade partners may be tempted to engage in strategic behavior, such as "greasing the wheels" for future negotiations by relaxing certain SPS requirements below official standards, or "retaliating" against a trade partner who enforces a scientifically justifiable SPS requirement that exceeds OIE or IPPC's minimum standard (Feinberg and Reynolds 2006). Strategic behavior of trade partners during SPS negotiations, such as "reciprocity" or "tit-for-tat," does not necessarily prevent socially efficient outcomes from being achieved (Norwood and Lusk 2008, p. 284); however, they can sometimes lead to "mutually harmful conflict" (Keohane 1986). Implications of strategic behavior for the technical and allocative efficiency of SPS requirements and international trade are ambiguous because they depend on which strategies trade partners adopt.

Regionalization, Compartmentalization, and Commodity-Based Trade

Three related pest management tools have become increasingly important means for WTO member countries to meet SPS standards: regionalization, compartmentalization, and commodity-based trade. These tools reduce negative externalities that pest-infested agricultural operations impose on pest-free operations by differentiating them. Pest-free operations, as a result, can market their goods internationally despite the presence of pest-infected operations within their home country.

Regionalization draws boundaries around pest-infested regions that are geographically isolated from pest-free regions, and applies trade-restrictions only to them (Livingstone et al. 2006). Recent applications include regionalization for foot-and-mouth disease in South Africa (Bruckner et al. 2002); citrus canker in Argentina (Romano and Thornsbury 2006); highly pathogenic avian influenza outbreaks among domestic poultry in Canada (Loppacher et al. 2008); and bovine tuberculosis, bovine brucellosis, potato cyst nematodes, and others in the United States (Ito and Clever 2010; Livingstone et al. 2006; USDA APHIS 2009b).

For situations in which pest-infested subpopulations cannot be geographically isolated, it might still be possible to reduce their trade impacts on pest-free operations through compartmentalization. Compartmentalization isolates pest-free subpopulations from pest-infested subpopulations through the use of biosecurity measures

(Gemmeke et al. 2008). Livestock operations that use OIE-approved biosecurity measures may apply for permission to participate in international markets. This approach underlies the National Poultry Improvement Program and the pork industry's TCP. It is also used to separate commercial poultry flocks from backyard flocks, the latter of which are more likely to carry avian influenza (Garber et al. 2007). Compartmentalization generally requires monitoring and verification of individual operations, so it is most easily implemented in highly integrated industries.

Commodity-based trade emphasizes the process by which goods are produced, rather than their region of origin, when deciding whether to allow them to be imported. Some animal diseases, for example, spread by fresh meat but not frozen meat, or by bone-in meat but not deboned or cooked meat. These characteristics might therefore be more relevant than the product's country of origin or biosecurity measures in place at the source farm (Thomson et al. 2009). Commodity-based trade allows agricultural products to be imported if they are processed in ways that eliminate risk, regardless of the originating country, region, or farm's pest status (Rich et al. 2009). The United States implements commodity-based trade already, allowing several products from pest-affected countries to be imported if they have been properly treated prior to or upon arrival at ports of entry. APHIS, for example, revised federal regulations in 2009 to allow the importation of cooked pork skins from regions affected with foot-and-mouth disease, swine vesicular disease, African swine fever, or classical swine fever (e.g., Brazil) if they have been cooked using approved methods (USDA APHIS 2009c).

Regionalization, compartmentalization, and commodity-based trade improve the *technical* efficiency of global markets by reducing the cost, in terms of foregone marketing opportunities, of ensuring pest-free imports. They enhance the *allocative* efficiency of global markets by removing barriers to trade for pest-free operations, which allows additional pest-free goods to flow to their highest valued uses and increases competition in global markets. These tools also increase the *dynamic* efficiency of the SPS Agreement by enabling boundaries between pest-free and infected operations to be adjusted more easily in response to changing conditions, as compared to a system that assigns a single pest classification to an entire country. Similarly, compartmentalization increases dynamic efficiency by encouraging biosecurity measures that reduce an operation's vulnerability to future emerging diseases.

All three tools improve certain aspects of *nonmarket beneficial outcomes* (e.g., social justice) by reducing the number of pest-free operations punished for outbreaks on other operations whose management practices are beyond their control. Effects on other aspects of nonmarket beneficial outcomes, such as animal welfare, are more ambiguous. Biosecurity measures associated with compartmentalization, such as indoor confinement of commercial poultry, improve animal welfare by preventing the spread of nonnative diseases via backyard flocks and wild birds. Confinement might also reduce commercial poultry's welfare, however, by preventing benefits from being outdoors (e.g., natural exercise and foraging opportunities), and exacerbating the spread of endemic diseases within the flock. Similarly, game-proof fences in southern Africa that separate foot-and-mouth disease infected areas from uninfected areas improve livestock health in uninfected areas, but also impede wildlife migrations which provide various market and nonmarket goods and services.

Regionalization, compartmentalization, and commodity-based trade are attractive tools for less integrated industries, such as beef, relative to highly vertically and horizontally integrated industries, such as poultry and pork. The inherent diversity of operations in less integrated industries tends to stymie efforts to define and achieve industry-wide pest eradication and management goals. These three tools enable individual pest-free operations in such industries to market their goods internationally regardless of the industry's status as a whole.

Federal Programs

The US government participates in many programs that affect agricultural production and marketing. It has sole responsibility though for inspection of imported goods to prevent nonnative pest incursions. Inspection services mitigate several forms of market failure, and affect every market efficiency category. Because of this broad scope, a thorough discussion follows of inspection services' impacts on market performance, as well as challenges to future efficiency gains.

Inspections at US Borders and Ports of Entry

Inspection of imported goods by US CBP personnel, with assistance from USDA APHIS's SITC unit and other federal, state, and county agencies, increases the *allocative* efficiency of the inspection "market" by mitigating the public goods problem that would otherwise result in private markets under-providing these services. Given the high cost of inspections, and the non-excludability of its benefits, no individual's private benefit is sufficiently high to justify providing these critical services themselves. If the social benefit of inspection outweighs the cost, however, the service should be provided. The federal government fulfills this role by providing inspection services to the public. User fees and fines collected at ports of entry help offset some of the financial burden of providing these services; taxpayer dollars offset the rest. Provision of these services presumably moves us closer to a socially optimal level of inspection and, thereby, increases allocative efficiency.

In the absence of inspection services, foreign goods would be imported to the United States without full consideration of the costs they impose on domestic agricultural producers through nonnative pest incursions. Too many pest-infested foreign goods would be imported in this scenario, relative to a social optimum, and allocative efficiency in the market for imported goods would not be achieved due to negative externalities. The presence of government-sponsored inspection services decreases the number of pest incursions by detecting contaminated shipments and, thereby, increases the allocative efficiency of the imported goods market.

Provision of inspection services may seem costly to the general public, but the economic consequences of allowing devastating nonnative pests, such as foot-and-mouth disease or Mediterranean fruit fly, to freely enter the United States would surely be much higher.

Fees and fines of any reasonable magnitude also have the potential to increase allocative efficiency in the imported goods market by reducing negative externalities imposed by pest-infested imports (Mérel and Carter 2008). USDA APHIS currently charges a user fee to each commercial vessel, aircraft, truck, rail car, and airline passenger entering the country (7 CFR § 354.3). The State of Hawaii charges 50 cents per 1,000 lb of any imported product (State of Hawaii 2008), and California charges $850 for each foreign vessel that enters their ports (State of California 2009). The resulting revenue helps defray the cost of agricultural inspection and quarantine services (USDA APHIS 2009d). Fees also increase the cost of crossing US borders and should therefore reduce the volume of international traffic and associated pest incursions, at least in theory. It is unclear, however, to what extent current fees affect trade volumes, in reality.

Fines for contaminated shipments and other SPS-related transgressions, such as misrepresenting shipment contents, mishandling potentially infected garbage, or tampering with official stamps and seals, are a common tool in the United States (USDA APHIS 2005b, 2012). Contaminated shipments are also regularly treated, rejected (i.e., re-exported), or destroyed at the owners' expense. It is unclear whether the threat of fines, treatment, rejection, or destruction of contaminated or prohibited goods provides sufficient incentive for foreign exporters to invest in pest prevention.

Subversive behavior, such as smuggling of illegal goods or fake certifications, is observed regularly, which suggests that at least some importers believe it is cheaper to ignore SPS standards and break laws, at the risk of being fined, than to comply with them. Perhaps the probability of being caught, or the penalty if caught, or the probability of a penalty being successfully enforced, or all of the above, is too small (Mérel and Carter 2008).

The probability of a penalty being enforced is certainly less than 100%. In 2011, limited resources for investigating violations and collecting fines forced APHIS's Investigative Enforcement Services to select just 600–800 cases to pursue from a backlog of over 2,000 open investigations (Parham 2012). The other 1,200–1,400 cases were dismissed simply due to a lack of resources. In addition to limited investigation and enforcement resources, imperfect information about the probability and cost of pest incursions for various imported goods also makes it difficult to determine the appropriate number and value of fines to impose and enforce.

Returning to inspection services' effects on market efficiency, these services enable consumers to obtain their desired bundle of imported products while imposing fewer nonnative pest incursions on domestic agricultural producers. With fewer nonnative pest incursions, domestic agricultural goods can be produced with less input (e.g., herbicides, pesticides), and marketed more successfully abroad as pest-free, particularly to countries that are also free of the same pest and wish to remain so. Inspection services therefore increase the *technical* efficiency of domestic agricultural production. Inspection services also increase the *dynamic* efficiency of pest control and management by acting as sentinels of future pest incursions. Successful interception of a new nonnative pest at a port of entry, before it has an opportunity to spread, may trigger new research and preparedness planning. Given sufficient advanced warning, researchers and pest managers may be able to devise effective prevention and control strategies before another contaminated shipment causes an incursion.

Although port inspection services increase efficiency in several markets, it is not clear whether they themselves are provided in a *technically* efficient manner. When CBP first took over inspection services in 2003, APHIS raised concerns about the new agency's ability to adequately detect agricultural pests. Additional training and hiring was necessary to achieve historical inspection performance rates. CBP was eventually able to achieve these levels (USDHS CBP 2009), but it is unclear whether CBP consumes more or fewer resources than APHIS did in this same role. Agricultural inspectors are required to report pest-relevant interceptions to the Agricultural Quarantine Activity System (AQAS) for use in the Agricultural Quarantine Inspection Monitoring (AQIM) program (USDA APHIS 2011b); however, it is difficult to extract concrete conclusions about CBP's technical efficiency from this complex dataset.

Suppose, for example, that the number of intercepted agricultural products declined between 2 years. This decline could be due to a variety of factors, such as a reduction in the number agricultural inspectors or the hours they worked; a decrease in inspectors' level of skill or vigilance due to high employee turnover; a reduced volume of goods and people flowing into the United States due to an economic downturn; or an increase in the proportion of cargo or people in compliance with SPS standards due to improved public outreach. It may be difficult to control for these and other effects in the data to determine whether technical efficiency has changed under CBP's leadership. Regardless, we should remain open to the possibility that any decrease in technical efficiency of agricultural inspections that may have occurred could be partially or completely offset by related increases in the technical efficiency of terrorism prevention or enforcement of drug and immigration laws.

Four years after CBP assumed responsibility for agricultural inspections, a review revealed several shortcomings. Many ports of entry, for example, had deficient pest sampling, documentation, and disposal practices (USDHS OIG 2007). Some district field offices and preclearance locations reported lower inspection and interception rates (USGAO 2007). CBP has since taken steps to address these shortcomings, but measures of improvement are not yet readily available. The need might still exist to improve implementation of existing inspection protocols, enhance agricultural inspectors' scientific knowledge, and emphasize the importance of agriculture within CBP's multifaceted mission.

The volume and diversity of goods and people entering the United States through ports and borders have increased tremendously over the last decade. Therefore, the *dynamic* efficiency of inspection services, in addition to their technical efficiency, is of concern. Dynamic efficiency reflects how quickly and effectively inspection services adapt to constantly evolving trade flows and pest threats. Screening technologies and risk assessment procedures must evolve for CBP and APHIS to keep pace with the increasing volume and diversity of international travel and trade. Decision support systems that more quickly and accurately predict the risk of pest incursion associated with individual passengers and cargo are also needed.

Scientists with APHIS PPQ are currently developing such tools, including a model that assigns risk ratings to individual countries' cargo and airline passengers based on recent outbreaks in the country of origin, past SPS violations, and flight information (USDA APHIS 2010b). These tools will increase APHIS's responsiveness to changing trade patterns and emerging pest threats and, therefore, increase the dynamic efficiency of pest prevention. Technologies that increase the proportion of passengers and cargo CBP and APHIS SITC personnel can screen are also needed. The incredible volume and diversity of plant species and plant-derived products imported to the United States make plant pest prevention an increasingly daunting task. The small number of agriculture specialists stationed at US ports of entry (roughly 2,000) simply cannot inspect a sufficiently large proportion of cargo, passengers, and mail to detect all potential invaders or even the highest priority invaders.

Within the relatively small proportion of shipments agriculture specialists are able to inspect, pests may be overlooked because it is infeasible to examine every square inch of a shipment. It is too time-consuming to off-load its entire contents, and materials at the center of a chosen pallet are difficult to access. Furthermore, pests can hide in packaging materials that are not properly treated with heat or methyl bromide. International standards exist for treating wood packaging materials (USDA APHIS 2004), but materials are sometimes improperly stored in pest-infected locations and reused without being retreated. Additionally, some importers falsify documents to avoid packaging material treatment costs. Subversive behaviors such as this make agriculture specialists' jobs even more complicated and daunting.

Continued improvement of high-throughput screening, advanced detection technologies, and more fraud-proof documentation may help overcome some of these inspection challenges. Such improvements might increase technical efficiency, assuming they enable inspectors to detect more pests using fewer resources. Alternatively, some inspection challenges could potentially be addressed by hiring more inspectors, SITC officers, and canine teams. By placing more boots on the ground, CBP and APHIS might be able to achieve higher rates of inspection and detection without making large upfront investments in expensive new technologies.

Technical efficiency of international trade might also be improved in more subtle ways, such as the development of affordable substitutes for wood packaging materials (e.g., rubber or plastic pallets). Environmental benefits and costs of alternative materials would need to be weighed carefully though. Rubber or plastic packaging materials might slow the spread of nonnative wood-boring insects, but have a bigger environmental footprint than wood packaging materials (e.g., carbon emissions). Research and development costs would also need to be considered carefully. If the economic value of resources used to develop a new technology exceeds the value of resources conserved by that technology, then that technology might actually decrease technical efficiency rather than improve it.

Animal pests present some unique challenges for agriculture specialists, as compared to plant pests. A smaller volume and diversity of animal species, products, by-products, and pests move through international trade relative to plants, so animal-pest incursions are likely to occur less frequently. One potential downside of this otherwise positive characteristic is that agency personnel might encounter fewer animal pests during their careers than plant pests and, therefore, have less experience detecting them. Experiments by Wolfe et al. (2005) show that if human subjects do not find what they are looking for relatively frequently, they often fail to notice it when it does appear. This suggests that if animal pests are encountered less frequently than plant pests, inspectors may have a higher chance of failing to detect animal pests when they are actually present (Wolfe et al. 2005).

The potential for detection errors is mitigated to a large extent by import rules that are based on regions-of-origin and product characteristics rather than actual pest detection (USDA APHIS 2011c). Veterinarians are also available at most ports of entry to assist CBP inspectors whenever questions arise. The ability of inspectors to identify and detect animal pests is still important, however, because animal products may be intentionally mislabeled to conceal their true region-of-origin. On paper, a product may appear to be from a pest-free region, but it may have been smuggled from a pest-infected region into a pest-free region (for example, across a regionalization boundary) before being transported to the United States (Loppacher et al. 2008). Similarly, animal products from pest-free regions could become contaminated during transit if ticks move from one cargo container to another (USDA APHIS 2011c). If an inspector rarely sees ticks during their typical work day, research suggests they might fail to notice ticks when they are indeed present (Wolfe et al. 2005).

Another potential downside of relatively infrequent nonnative animal pest outbreaks in the United States is that animal health officials depend heavily on lessons learned from hypothetical outbreak exercises, outbreaks in other countries, or indigenous pest outbreaks (e.g., bovine tuberculosis and low pathogenic avian influenza). Although more effective screening and risk assessment tools would enhance animal pest prevention, more frequent and effective training of animal health experts in pest recognition and outbreak preparedness might also be beneficial.

In the future, dynamic efficiency will be critical to the success of CBP and APHIS's pest prevention and detection efforts, not only because of increasing volumes of international trade but also because of global climate change, which may change the distribution of international trade and nonnative pests. Changes in temperature and precipitation will likely affect the distribution and frequency of pest outbreaks, especially those associated with insects and migratory animals. The potato psyllid from Mexico, for example, is now capable of overwintering in California and hence inflicting more damage on the potato, tomato, and pepper industries (Trumble and Butler 2009). The geographic range of arthropod-borne diseases, such as Rift Valley fever, is also closely tied to climatic conditions and therefore expected to shift or expand in the future (Gould and Higgs 2009). The spatial distribution of migratory animals and diseases they carry (e.g., migratory waterfowl with avian influenza, or whitetail deer with tick-borne diseases) will likely also change (Gilbert et al. 2008; Hoberg et al. 2008).

Prediction of future geographic distributions of nonnative pests is matched in difficulty by the prediction of climate change's possible impacts on supply and demand of agricultural goods, and subsequent patterns of international trade. APHIS is collaborating with scientists at partner institutions to develop forecasting systems that allow them to incorporate climate change scenarios into pest risk models (USDA APHIS 2010b). Socioeconomic impacts of climate change must be considered simultaneously, however, with physical and biological impacts to accurately forecast future pest risks and identify efficient adaptations of inspection services.

Some possible socioeconomic impacts of climate change, such as political instability, may have indirect but important implications for nonnative pest risks. For example, escalation of violent crimes in northern Mexico caused APHIS to close three agricultural inspection stations just south of the US-Mexico border to protect employees' safety. These closures changed the location and volume of cattle entering the United States from Mexico; hampered efforts to inspect cattle for fever ticks; and prevented monitoring and fumigation of Mexican fruit flies (Smith-Anderson 2010). More broadly, these events interfered with long-term efforts to maintain a buffer zone at the US-Mexico border between uninfected and infected regions. This unfortunate situation demonstrates the potential for socio-political instability in other countries, whether driven by climate change or other factors, to reduce APHIS's ability to protect US agriculture from nonnative pests. Given the complexity, interdependence, and uncertainty of international trade patterns and associated pest risks, including those possible under climate change, dynamic efficiency will be critical to APHIS's ability to protect US agriculture from nonnative pests in the future.

Public–Private Partnerships

Prevention and control of nonnative agricultural pests is a monumental task, one that the US government cannot undertake alone. Partnerships with non-governmental organizations, such as producer associations and university researchers, provide a critical means to improve the market performance of pest prevention and control efforts. Four types of public–private partnerships, and their associated impacts on market efficiency and nonmarket beneficial outcomes, are discussed in this section: research and data collection; data sharing and research coordination; certification; and compensation and cost-sharing.

Research and Data Collection

Applied research and data collection efforts through the USDA's AQIM program, NAHMS, Agricultural Research Service (ARS), CAPS, and soybean rust monitoring program, potentially increase the *technical*, *allocative*, and *dynamic* efficiency of pest monitoring and control and, hence, the efficiency of US agricultural production and marketing. ARS's applied research improves our understanding of pest biology and the effectiveness of alternative management practices. It also leads to innovations that achieve the same pest control outcomes with fewer resources, or better outcomes with the same resources. In doing so, it increases the technical efficiency of pest control.

Research often exhibits public goods characteristics because the knowledge it produces is non-rival and non-excludable. Private investment in research therefore suffers from free-riding, which results in less research being conducted than is optimal for society. Public investment in research is needed to fill this investment gap, but it is difficult to determine exactly how much research is needed. Such investment improves the allocative efficiency of the market for research on pest prevention, detection, and control. Publically funded research also enhances dynamic efficiency by generating knowledge and technology that raises awareness of emerging pest issues and enables stakeholders to respond and adapt more quickly and effectively.

Allocative efficiency is improved because publicly funded research results are typically available to all producers, both nationally and abroad. Private research by large agribusiness firms, in contrast, is rarely made available to all producers. This places large firms, who can afford to invest in private research, at an advantage over smaller, less wealthy firms. Publicly funded research reduces the knowledge and technology gap between large and small firms, and therefore mitigates circumstances that would otherwise exacerbate market power.

Publicly funded research is vulnerable, however, to macroeconomic forces; when economic growth slows, research funds dwindle. If funds for pest-related research diminish for too long, the risk increases of falling too far behind rapidly evolving patterns of pest distribution, international trade, and agricultural producers' needs. Cold treatments and methyl bromide fumigation methods, for example, were developed many decades ago. Since then, packaging techniques have evolved towards tightly packed pallets and cargo containers, which impede the ability of cold treatments and methyl bromide fumigation to reach materials located in the center. New treatment methods are needed to help maintain technical efficiency in pest prevention and control, but funds for research are becoming increasingly difficult to secure.

Pest surveillance and reporting generally suffer from public good characteristics and positive externalities, which reduce the allocative efficiency of markets that provide these services. Government-funded programs and public–private partnerships that collect data on pest abundance and distribution (e.g., NAHMS, CAPS, soybean rust monitoring network) mitigate these market failures. They also move society towards more complete information. Imperfect information often results in too few or too many inputs being allocated to pest prevention and control relative to the quantity allocated if perfect information were available. By improving the availability of information, data collection increases the magnitude of potential benefits from pest prevention and control.

Data Sharing and Research Coordination

Although data collection increases allocative efficiency, government agencies must either find more technically efficient ways to collect data or find ways to extract more benefit from existing data. Public–private partnerships and the services they provide, such as the NISC and its ISIN, provide low-cost ways for disparate agencies, programs, researchers, and citizens to share and access data. Online information databases, such as ISIN, increase awareness among researchers of data already collected or currently being collected, which reduces redundancy in data collection efforts, thus, increasing *technical* efficiency.

By improving the technical efficiency of data collection, ISIN also increases the technical efficiency of pest detection and control and, hence, the technical efficiency of US agricultural production and marketing. The same is true for NISC's effort to coordinate research projects and priorities across agencies. Coordination increases the net benefit gained from limited research dollars by reducing redundancies and by identifying projects with the greatest expected net return. Research dollars conserved can then be redirected to support additional projects. This process increases the *technical* and *allocative* efficiency of pest-related research.

Data sharing and research coordination also enable scientists to compare and combine datasets and ideas in new ways, which generates new insights about pest prevention and control and fosters development of new technologies and management strategies. Free markets cannot achieve the socially optimal level of data sharing and research coordination because private vs. social benefits and costs of these activities are not equal. It can be difficult, for example, to enforce intellectual property rights to information or research ideas once you have shared them with others. This is especially true when information or ideas are shared online, where they quickly become non-excludable goods. A lack of enforceable property rights creates a disincentive for individuals to share information and ideas, even if the resulting insights and breakthroughs would benefit society as a whole. NISC and ISIN help mitigate this public goods problem by establishing ground rules that protect intellectual property rights and by lowering the private cost of data sharing. Ultimately, more open sharing of data and ideas increases both the *technical* efficiency of data collection and the *allocative* efficiency of pest research.

Data sharing and research coordination also increases the *dynamic* efficiency of pest prevention and control by providing quicker access to additional and more diverse information. This enables agencies to respond more quickly and effectively to new pest threats and outbreaks. One of the biggest challenges in pest prevention and control is anticipating new threats. Access to a global database of pests and pest experts, through online resources such as ISIN, will increase APHIS's awareness of emerging pests and enable them to connect more quickly with relevant experts. By learning from other countries' experiences and experts, the United States will be better able to anticipate, prevent, and control emerging pests.

Certification

Individual producers' pest management decisions often impose benefits and costs on others. Such externalities prevent the free market from achieving socially optimal pest prevention and control levels, and decrease its allocative efficiency. A variety of tools can be used to equilibrate private and social benefits and costs. The National Poultry Improvement Program (NPIP) and TCP represent novel ways of rewarding poultry and pork producers who implement best management practices for specific animal diseases.

Producers who meet the NPIP or TCP's management and monitoring criteria are allowed to place a label on their product certifying it as disease-free. Certification makes it easier to market their product to consumers, particularly those in international markets. Access to additional consumers implies higher demand for the product and, potentially, a higher price received or larger quantity sold. The opportunity for higher profit through certification increases producers' incentives to invest in pest prevention and control. This partially mitigates externalities in the market for pest prevention and control and thereby increases *allocative* efficiency.

Voluntary certification programs affect other types of efficiency as well. By raising producer awareness of best management practices in pest management and control, certification increases the *technical* efficiency of agricultural production. Producers with better training and more information should be able to achieve greater pest prevention and control from a given set of resources. Improved pest prevention and control can also enhance *nonmarket beneficial outcomes* by reducing disease incidence among animals (perhaps humans as well) and subsequently improving animal and human welfare.

The public–private framework in which NPIP and TCP operate might also enhance the *dynamic* efficiency of pest prevention and control. The NPIP was originally created to address pullorum disease in poultry. After producers reduced the disease's prevalence to satisfactory levels, NPIP shifted emphasis to other diseases of concern, most recently low pathogenic avian influenza and *S. enteritidis*. The NPIP's partnership between producers, their national association, and government agencies provides an effective communication channel through which producers and researchers can inform each other about emerging pests, and collaboratively identify and implement effective responses. Ideally, the TCP will evolve, as the NPIP has, to address emerging pest issues in the pork industry long after trichinosis is defeated.

Certification's effect on market power and hence *allocative* efficiency is less clear. Large producers might be more interested in gaining access to international markets than small producers and, therefore, be more likely to participate in certification programs. As large companies export more of the product abroad due to certification, small producers in the exporting country might benefit from decreased supplies and higher output prices in the domestic market. Producers in importing countries, in contrast, might be harmed by certification in the United States as supplies in their domestic market increase and output prices decline. Falling prices in the importing country's domestic market could potentially affect small operations more severely than large, in which case certification might cause consolidation in the importing country's agricultural industry.

Overall, certification increases global competition and therefore increases allocative efficiency on a global scale. Its net effect on social welfare and income distribution at smaller geographic scales, however, is more ambiguous. Subversive behavior, such as falsification of labels, negatively affects certification programs' technical efficiency and ability to improve the allocative efficiency of international trade. Technical efficiency is reduced because valuable resources are used not only to undermine the certification system, but then to control pest outbreaks caused by falsely certified products and develop fraud-proof labels. Falsification of certification labels reduces certification's ability to improve the allocative efficiency of international trade by undermining a program's reputation among trade partners. If trade partners do not trust certification labels, they may revert back to individual animal testing requirements, which would push producers out of the market who have already invested in best pest-management practices. This would reduce the allocative efficiency of international trade in certain agricultural products.

Looking towards the future for certification programs, one hopes the poultry and pork industries' successes with a "partnership approach to pest management" will not be thwarted by subversive behavior and will eventually inspire the beef industry to adopt a similar framework. Some adaptations may be necessary to accommodate the beef industry's more heterogeneous and disparate structure. One significant barrier to adoption is that certification would require an animal disease traceability system capable of clearly and easily tracing beef products back to the packing plants, feedlots, and cow-calf operations from which they originated, along with the pest management practices in place there. Unified support for a mandatory national animal identification system (NAIS) does not currently exist in the beef industry, but support is relatively strong for development of a national policy that enhances animal disease traceability. This topic is discussed in more detail towards the end of the chapter.

Compensation and Cost-Sharing

Compensation for crops or livestock destroyed during control or eradication campaigns, and cost-sharing for the adoption of best management pest prevention and control practices increase the *allocative* efficiency of pest control by mitigating market failures that arise from negative externalities. When deciding whether to report a pest outbreak or adopt best management practices, a producer might consider only the private benefits and costs of doing so, and fail to consider benefits and costs to the industry as a whole. In the case of reporting or adopting, a producer underestimates the social benefits of their actions and, therefore, chooses to undertake these activities too infrequently.

The tendency to underreport pest outbreaks is exacerbated if government agencies respond to outbreaks by destroying entire fields or herds without compensating the owner. This increases the private cost of reporting, and reduces the likelihood a producer will choose to report. Compensation for destroyed crops and livestock, in contrast, reduces the private cost of reporting, increases the likelihood a producer will report and, therefore, improves the government's chance of successfully controlling the pest. The same is true for cost-sharing to encourage adoption of best management practices.

Compensation for destroyed crops and livestock has some negative consequences though. It reduces an affected producer's private cost of pest incursion, and thus provides a disincentive for them to invest in prevention. This unintended consequence has the potential to decrease the allocative efficiency of pest prevention and control. Government agencies have historically accepted this trade-off between increased reporting and decreased prevention. As budgets tighten during times of economic recession though, agencies increasingly look for compensation mechanisms that not only increase reporting but also increase prevention. Compensation mechanisms that generate their own source of funding, such as user fees at ports of entry that help fund agricultural inspections, are also needed so agencies can guarantee compensation regardless of the size of the government's general fund.

Compensation raises questions about nonmarket issues, such as equity, social justice, and animal welfare. Taxpayer dollars are often used to compensate agricultural producers for pest-related losses and pest eradication efforts. These activities increase the allocative efficiency of pest control, primarily to the benefit of the agriculture industry, but are costly and sometimes detrimental to other members of society. Some people may view this wealth transfer as inequitable and hence detrimental to nonmarket beneficial outcomes.

Residents of California, for example, expressed concerns about the potential health and environmental effects of USDA's plan to spray an unregistered pesticide over residential areas to control the light brown apple moth (a nonnative pest of trees and agricultural crops). Public outcry resulted in a delay of the light brown apple moth eradication program until the pesticide's ingredients and potential health effects were made public (Kay 2008; Van Rein 2007). In a different case, homeowners whose backyard citrus trees were destroyed to protect Florida's commercial citrus industry sued the federal government over inadequate compensation (Kamprath 2005). Similarly, California residents affected by the culling of exotic pet birds and backyard poultry during an outbreak of exotic Newcastle disease protested emergency response actions they perceived as inhumane and unconstitutional (Daley 2003). These examples underscore the relevance of equity, social justice, and animal welfare issues to pest control efforts and compensation. They also highlight the potential for trade-offs between market efficiency and nonmarket beneficial outcomes, which should be considered in the design of pest control plans.

Emerging Tools

New incentive-based approaches for reducing market failures are constantly being developed and refined. Economists and policymakers have been working for some time to design and deploy two particular sets of tools that may improve the market performance of pest prevention and control: (1) contingent compensation and pest insurance and (2) a NAIS. Neither set has been implemented successfully in the United States yet, beyond a pilot or voluntary scale. This may be due, in part, to the complex and somewhat ambiguous impacts they are anticipated to have on various categories of market efficiency and nonmarket beneficial outcomes.

Contingent Compensation and Pest Insurance

Efforts are underway to improve the allocative efficiency of existing government compensation programs for crops and livestock destroyed during control and eradication campaigns by making them contingent on a farm's biosecurity and pest control practices, or how quickly the operator reports an outbreak (Horst et al. 1999). Contingent compensation would encourage producers to invest more in pest prevention even in the presence of government safety-nets, and report potential outbreaks as soon as symptoms are detected. The financial sustainability of contingent compensation could be enhanced by requiring producers to contribute a fixed dollar amount per operation or per unit of product sold, similar to an existing beef check-off program (Horst et al. 1999).

Pest insurance has been proposed as another means to achieve a self-sustaining compensation program (Grannis et al. 2004; Gramig et al. 2009). Compensation in this case would be contingent on enrollment in a pest insurance program, rather than adoption of biosecurity or pest control activities. This might reduce verification costs associated with compensation, but pest insurance would likely suffer its own suite of market failures, such as adverse selection, moral hazard, and asymmetric information (Gramig et al. 2009).

Adverse selection occurs when individuals who face high levels of risk purchase insurance to a greater extent than low-risk individuals. This imbalance in the insurance pool increases the probability insurance companies will have to pay claims, which drives up the price they charge and causes even fewer low-risk individuals to purchase coverage. Adverse selection makes it difficult for insurance companies to enroll a sufficiently diverse and abundant pool of customers to be profitable. If adverse selection is sufficiently severe, or if pest outbreaks are sufficiently widespread, pest insurance might not be financially self-sustainable. It might instead suffer the same fate as the federal crop insurance program, which relies on highly subsidized premiums to achieve the government's desired level of producer participation (Glauber 2004).

Moral hazard occurs when people take greater risks because they have insurance coverage and believe it reduces the financial consequence of their risky behavior. A crop producer with pest insurance, for example, might spend less time scouting fields for weeds, insects, and diseases. A livestock producer with pest insurance might undertake fewer biosecurity measures when introducing new animals into the herd. Moral hazard can be reduced by imposing a deductible, or making coverage contingent on adoption of best management practices. The latter might require verification of practices before claims are paid though, which would increase the program's administrative costs.

Asymmetric information occurs when insurance customers know more about their risk-taking or risk-reducing behaviors than do insurance companies. This makes it difficult for insurance companies to distinguish between high and low-risk customers; detect moral hazard; determine the appropriate price to charge individual customers for coverage; and identify fraudulent claims. Asymmetric information exacerbates the effects of adverse selection and moral hazard, making it even more difficult to design effective pest insurance products (Gramig et al. 2009).

If an effective insurance product could be designed, it would increase the *allocative* efficiency of pest prevention and control by allowing producers who are less willing to incur the financial consequences of pest outbreaks to transfer that risk to insurance companies who are better able to manage it. An effective insurance product would also provide a self-sustainable means of encouraging more pest prevention and reporting compared to levels achieved under existing unconditional compensation programs. Inefficiencies would still exist, however, because the decision to purchase insurance would itself suffer from externalities. Producers would make their pest insurance decision without consideration for the benefits and costs it imposes on other people; therefore, the socially optimal level of pest insurance coverage would not be achieved.

Pest insurance might not increase the *technical* efficiency of pest prevention and control either. Agricultural insurance programs often incur large administrative costs and taxpayer-funded subsidies. Any efficiency gains that pest insurance could generate might be achieved more cheaply through other interventions discussed in this chapter.

Animal Disease Traceability

In the wake of a foot-and-mouth disease outbreak in the United Kingdom, and terrorist attacks on the United States in 2001, USDA APHIS began collaborating with animal health experts and livestock industry representatives to design a mandatory NAIS (Anderson 2010). Mandatory NAIS would enable officials to quickly trace an individual animal that tests positive for a disease or other agent of concern to the farm of origin, and identify all contact herds. Complete traceback within a 48-hour period would empower officials to act more quickly and effectively during an animal health emergency (Murphy et al. 2008). This would reduce the extent to which foreign animal diseases spread before quarantines can be put in place. It would reassure domestic and international consumers that US livestock products are traceable and therefore relatively safe, and encourage international trade partners to keep borders open during an outbreak (Murphy et al. 2008).

The US Animal Identification Plan, first released in 2003, proposed to assign a unique identification number to each livestock operation, sale barn, and packing plant; permanently affix a unique identification number to each individual animal or group of animals; and create an animal tracking database to which relevant livestock movements would be reported (Murphy et al. 2008). The proposal triggered significant opposition, especially from the cattle industry (Anderson 2010; Knutson 2010), due to concerns about the government's ability to protect the confidentiality of farm-level data; the cost to individual producers of purchasing the required technology and reporting livestock movements; and the lack of, or unequal distribution of, benefits to individual producers (Anderson 2010).

USDA APHIS eventually abandoned the idea of a mandatory system. A voluntary program existed for a brief period, but only 40% of the 1.4 million premises in the United States with livestock chose to register (USDA APHIS 2010e). Much higher levels of enrollment would have been necessary to realize the full benefits of traceability. Low enrollment in this voluntary program was not unexpected. A producer's private benefit from registering is less than society's benefit (i.e., enrollment generates positive externalities); therefore, we would expect fewer producers to enroll in a voluntary system than society would like (Knutson 2010). Premiums for livestock from registered farms, or price penalties for livestock from unregistered farms, would have been necessary to increase enrollment to socially optimal levels (Anderson 2010; Schulz and Tonsor 2010).

Given the unpopularity of premise registration, USDA APHIS revised the emphasis of their proposed program to focus on animal disease traceability, particularly for interstate livestock movements. A draft rule put forward in 2011 would improve traceability by establishing minimum national official identification and documentation requirements for livestock moving interstate (USDA APHIS 2011d). Its first requirement is that animals moved interstate would have to be officially identified. Some species would have a unique identification number, while others would be identified as a group or flock. Several identification methods and devices would be acceptable, and states could agree to approaches not included on the national list. This would accommodate states that already have an animal identification system in place (e.g., registered brands and official brand inspectors). For states without established systems, a national minimum standard would provide guidance on acceptable forms of animal identification and encourage harmonization of requirements.

A second requirement of the draft minimum standard is that livestock being moved across state borders would have to be accompanied by an interstate certificate of veterinary inspection (USDA APHIS 2011d). The certificate would contain information about the animals' origin and destination. It might also contain individual animals' official identification numbers, particularly in the case of breeding, rodeo, and recreational livestock, which are relatively long-lived and might have greater potential to spread disease (as compared to steers and spayed heifers being shipped to feedlots or abattoirs, for example).

Animal identification and documentation, in general, generate more benefit for society as a whole than for individual livestock producers (i.e., they generate positive externalities). Therefore, in the absence of regulations or incentives, too few producers will undertake them and the *allocative* efficiency of animal disease traceability will be reduced. A national minimum standard for animal identification and documentation would enhance allocative efficiency by requiring producers who move animals across state borders to participate in these activities. This is assuming the cost of program administration does not exceed the expected benefits (see USDA APHIS 2011d for estimated costs of the proposed rule).

The proposed animal traceability rule's primary benefit would be the reduction of economic losses during future livestock disease outbreaks. Quicker traceback capabilities would reduce uncertainty about infected animals' herd of origin, and herds they may have contacted. This would enable emergency responders to quarantine or cull fewer herds, which would improve animal welfare and, hence, *nonmarket beneficial outcomes*. Similarly, the ability of animal health officials to respond more quickly and effectively to emerging diseases would improve the *dynamic* efficiency of US agricultural production and marketing.

The *technical* and *allocative* efficiency of animal disease response and control, however, would not necessarily improve. Recall that imperfect information is not a market failure. Animal health officials' decisions might already be efficient given the limited information available to them. Nonetheless, the magnitude of losses during animal health emergencies would decrease, and if these cost savings exceed the cost of implementing the rule, society's well-being would increase (i.e., the size of the economic pie would grow). One final note about the proposed national minimum standard is that it offers individual states tremendous flexibility when choosing their preferred animal identification methods and devices. This would afford each state the opportunity to identify *technically* efficient solutions for their unique circumstances and needs, although it would not guarantee such an outcome.

What Have Interventions Achieved Overall?

Externalities and public goods reduce the ability of free markets to achieve socially optimal levels of nonnative agricultural pest prevention and control. These market failures hamper the technical, allocative, and dynamic market efficiency of US agricultural production and marketing, and may also impact nonmarket beneficial outcomes. Imperfect information reduces the economic benefits possible from limited resources available for pest prevention and control. A variety of government interventions attempt to correct or mitigate market failures and imperfect information. Table 12.1 summarizes the types of market failures each intervention addresses, and how each intervention affects various market efficiency and nonmarket beneficial outcome criteria.

Nearly every intervention explored in this chapter attempts to fix or mitigate externalities. Externalities are abundant in pest prevention and control due to pests' ability to spread from one agricultural operation to another and because individual producers' activities affect the overall pattern of pest occurrence. Without the many interventions that target externalities, the allocative efficiency of US agriculture would decline.

Although public goods and imperfect information are less ubiquitous than externalities, they create equally difficult challenges for efficient pest prevention and control. Fewer interventions exist to address these challenges because their underlying causes are harder to address than those underlying externalities. Interventions that address public goods and imperfect information (e.g., the SPS Agreement, import inspection, and research and data collection) consist primarily of government provision of goods and information that free markets are unwilling to supply. Provision of public goods and information at a socially optimal level increases the allocative efficiency of pest prevention and control. It also increases the technical, allocative, and dynamic market efficiency (and, in some cases, nonmarket beneficial outcomes) of US agricultural production and marketing. In summary, the few interventions available to address public goods and imperfect information problems are sufficiently effective that no obvious policy gaps remain.

Based on the right half of Table 12.1, existing interventions seem to target technical, allocative, and dynamic efficiency more commonly than nonmarket beneficial outcomes. The lack of emphasis on nonmarket beneficial outcomes should be scrutinized more carefully to determine if policy gaps truly exist. One should not immediately conclude that more should be done to enhance nonmarket beneficial outcomes. It could be that few interventions have been developed to address the lack of nonmarket beneficial outcomes because little evidence exists of a need to increase them. Additional investigation could be undertaken to identify specific cases and causes of underprovision of nonmarket beneficial outcomes in pest prevention and control. A more plausible explanation for the lack of interventions that affect nonmarket beneficial outcomes is simply a lack of awareness. Even economists, whose discipline specializes in identifying socially optimal outcomes, lack technical training in concepts outside the traditional realm of technical and allocative efficiency. A synthesis of this book's individual chapters may help substantiate or refute this hypothesis.

An alternative and perhaps most-plausible explanation could be that potential net gains from improving nonmarket beneficial outcomes have historically been small relative to those from addressing market inefficiencies. Economic theory suggests that limited resources for improving social net benefit from pest prevention and control should be allocated to the market or nonmarket performance criteria in which they would generate the biggest benefit per dollar invested. Many existing pest prevention and control interventions were developed at a time when nonmarket beneficial outcomes were viewed as less important, relative to market efficiency challenges, to justify investment. Now that many technical and allocative efficiency challenges have been addressed, nonmarket beneficial outcomes might finally have the largest payoff per dollar invested. For example, given the small amount of resources invested thus far in animal welfare, relative to the amount invested in import inspections, the next dollar invested in animal welfare (to enhance nonmarket beneficial outcomes) might generate more benefit than another dollar invested in inspections (to enhance allocative efficiency).

Efforts to allocate scarce resources amongst the various market efficiency categories and nonmarket beneficial outcomes, based on their relative payoff, are complicated though by interdependencies. Some interventions improve one category at the expense of others. Compartmentalization of the poultry industry, for example, increases allocative efficiency, by reducing externalities between backyard and commercial flocks, but potentially reduces nonmarket beneficial outcomes by confining birds to indoor facilities that potentially reduce animal welfare. Similarly, animal disease traceability may increase dynamic efficiency, by enhancing preparedness for disease outbreaks, but potentially decreases allocative efficiency by imposing disproportionate costs on small operators and thereby enhancing large operators' market power. Such trade-offs should be considered carefully before resources are allocated to new interventions, or reallocated amongst existing interventions. An intervention that decreases technical, allocative, or dynamic efficiency is not necessarily bad, as long as it generates sufficiently valuable increases in nonmarket beneficial outcomes. Conversely, an intervention that increases non-market beneficial outcomes is not necessarily good if it generates sufficiently large reductions in technical, allocative, or dynamic market efficiency.

A final observation from Table 12.1 is that some interventions generate broader and less ambiguous impacts than others. The purpose and impact of the SPS Agreement, for example, are easier to classify than those for pest insurance. The purpose and impact of research and data collection are easier to classify than those for animal identification. Interventions with narrower and more ambiguous impacts are not necessarily inferior. It is more difficult, however, to determine whether their net impacts are positive. It is also easier to lose sight of the original motivation for an intervention, and invest resources in ways that do not serve the original purpose. Greater scrutiny of interventions, including open discussions of their purposes and capabilities, is needed to determine whether they actually enhance the social net benefit arising from pest prevention and control.

Policymakers can critique a proposed intervention's ability to enhance market performance by seeking answers to the following questions: (1) Is this intervention actually needed; what market failure would it address? (2) Would this intervention generate more benefits than costs? (3) Would investment in some other pest-related intervention generate greater net benefit than the proposed intervention? (4) Would investment in some other aspect of agricultural production and marketing, unrelated to pests, generate greater net benefit than the proposed pest intervention? (5) How would the intervention affect not just technical, allocative, and dynamic market efficiency, but nonmarket beneficial outcomes as well?

Question (1) reminds us that in the absence of market failures, free markets are capable of achieving efficient outcomes on their own; therefore, an intervention should not be imposed without justification. Questions (2) through (4) help assess an intervention's allocative efficiency, a goal that economists continue to focus on, and perhaps for good reasons. Question (5) reminds us, lastly, that technical, allocative, and dynamic market efficiency as well as nonmarket beneficial outcomes are all important goals, but that trade-offs between them could exist and should be weighed carefully.

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Part IV
Market and Consumer Information, Risk Management

This part recognizes the general worldwide agreement that the USA has had the most comprehensive and reliable agricultural market information system. However, as markets have evolved from spot markets to integrated value chain systems, data have become more difficult to collect and questions have arisen over what data should be collected. In some instances, mandatory reporting has replaced voluntary systems. Concurrently, futures markets have become more important in price discovery and determination of market prices. Option markets have joined futures markets as tools to manage price risk. Regulating the competitiveness and integrity of these markets has evolved from a USDA agency to the Commodity Futures Trading Commission, which also regulates futures and options markets for a wide variety of commodities and currencies.

While standards of identity, quality, and fill for food are not new, ingredient labeling and nutrition labeling are products of the consumer revolution that began in the 1960s. The controversy surrounding reliability of private sector information and of the best method of conveying nutrition quality continues. The ever-increasing demand for processed, convenience, and away-from-home food sales complicates this policy issue.

In Chap. 13, Lusk describes food information policies directed at improving consumer choice and welfare. He critically evaluates the traditional economic justifications for food information policies, including asymmetric information, quality uncertainty, and moral hazard. Lusk explores how policy makers have responded to these motivations for food information policies and how well the policies have performed, and then considers several policy options for improving the performance.

In Chap. 14, Parcell and Tonsor explain how the economic efficiency with which marketing channel functions perform is based on the market institutions available. Entities using these functions rely on market institutions to limit transaction costs, including search costs; to facilitate quality and price negotiations; and to monitor markets. The authors offer recommendations for the future of public information policy and the collection of public data.

In Chap. 15, Roberts discusses why fundamental differences in agricultural and food production, compared to other parts of the economy, require different methods of risk management. He reviews the primary tools available to producers for the management of price and quantity risk, including insurance, government programs, and market-based instruments. Some of the prominent current policy and market controversies are addressed.

Chapter 13
Consumer Information and Labeling

Jayson L. Lusk

Abstract This chapter describes the current landscape surrounding food information policies directed at improving consumer choice and welfare. It critically evaluates the economic justifications traditionally given for food information policies, including asymmetric information, quality uncertainty, and moral hazard. The basic model economists have used to conceptualize the value of information policies is also presented. The chapter describes how policy makers have responded to these motivations for food information policies and asks how well the policies have performed. It also considers several policy options, including facilitating more voluntary labeling programs such as process certification programs and standards, facilitating more mandatory labeling programs, banning "low quality" products, and pursuing more education or information provision programs. It compares each option to pursuing a more laissez faire approach relative to the status quo. Throughout the chapter, specific examples of information policies related to country of origin, biotechnology, hormones, nutritional content, and organics are discussed. The conclusion contains some discussion on future research needs and some thoughts on how food information policies might be made more effective.

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Introduction

The urbanization of America means that fewer and fewer people are connected to agriculture or are knowledgeable about where their food comes from or how it was made. The detachment from agriculture is often decried by popular food writers and farmers alike. But it is a marvel that we now need to devote so little attention to a task which once consumed our ancestor's waking hours. Instead, time and energies have been redirected to other more profitable endeavors. Although most people know little about the origins of their food, it would be a mistake to assume that our current food system is irrational or ill informed; market prices and norms contain an immense amount of information and knowledge. As Hayek (1988, p. 14) put it:

> In our economic activities we do not know the needs which we satisfy nor the sources of the things we get. Almost all of us serve people whom we do not know … and we in turn constantly live on the services of other people of whom we know nothing. All this is possible because we stand in a great framework of institutions and traditions.

Nevertheless, there is a downside to the public's altered connection with agriculture and their lack of information about the bewildering number of food choices now available. Accordingly, consumer activists have increasingly called for a host of food information policies. Retailers have responded to the increased demand for information too, and their activities have been facilitated by labeling claims and standards established by the United States Department of Agriculture (USDA) and the Food and Drug Administration (FDA). The result is an increasing degree of product differentiation—even in food categories that were seen as generic commodities as recently as a few decades ago. Indeed, some people argue that the problem is one of too much information and choice, rather than too little (e.g., Iyengar and Lepper 2000; see also some counter-evidence in Arunachalam et al. 2009). Others, however, have shown that regulations facilitating the provision of information can spur innovation and lead to healthier food choice (e.g., Ippolito and Mathios 1990).

The purpose of this chapter is to describe the current landscape surrounding food information policies directed at improving consumer choice and welfare. It discusses the traditional motivations for regulating information provision, describes how policy makers have responded to these motivations, and asks how well the policies have performed. The conclusion contains some discussion on future research needs and some thoughts on how food information policies might be made more effective.

Motivations for Food Information Policies

Economic Motivations

This chapter begins by critically evaluating the economic justifications traditionally given for food information policies, including asymmetric information, quality uncertainty, and moral hazard. It then sketches the basic model economists have used to conceptualize the value of information policies.

Asymmetric Information

One of the original economic motivations for information provision policies was the "market for lemons" problem brought to light by George Akerlof in 1970. The work by Akerlof, Spence, and Stiglitz, which was awarded a Nobel Prize in 2001, described how markets can fail to efficiently allocate goods when there is an information asymmetry—i.e., when the buyer or seller knows more about quality than the other. In Akerlof's original example, used-car sellers have more information about the quality of the car (whether it has been in an accident, whether the engine runs well, etc.) than does the prospective buyer. The buyer, unsure of whether the car is a lemon, is at an information disadvantage to the seller. In the most extreme case, the buyer refuses to buy a used car for fear that sellers are only getting rid of lemons, and there ceases to be a market for used cars at all despite the fact there are buyers and sellers willing to engage in mutually beneficial trade.

The potential for an information asymmetry to cause market failure has led to proposals for government regulation. For example, if sellers were required to report whether used cars had been in an accident or had undergone major repairs, then buyers would be able to differentiate between the lemons and good buys. Or, as has actually taken place in some states, buyers might be given a cooling off period in which they can, without cost, return the car to the dealer if they subsequently regret their decision or find that the car falls apart on the way home.

Although government regulation can, in theory, help solve the information asymmetry problem, there was an active market for used cars well before Akerlof wrote his now famous paper. Market participants can develop norms and rules to help solve information asymmetries. For example, shoppers currently in the market for a used car who are worried about buying a lemon can simply send the vehicle identification number to an independent third-party business, such as CARFAX, to learn about the car's history. The success of private companies like CARFAX has facilitated the development of large online markets for used cars where buyers and sellers easily transact without ever meeting face-to-face or physically inspecting the vehicle. My point here is not that government regulation is always unneeded (in fact CARFAX relies in part on public registration and accident records). Rather, the existence of information asymmetries need not axiomatically result in market failures when there are opportunities for enterprising entrepreneurs to facilitate trade.

Quality Uncertainty

In less extreme cases, information asymmetries—or rather quality uncertainty—can lead to less efficient market outcomes than what might be achieved if consumers had more knowledge. Consider, for example, the arguments of Bureau et al. (1998). They describe the case of hormone use in beef production in the context of the European Union's decision to ban imports of hormone-treated beef. If consumers prefer beef from cattle that have not been administered growth hormones, and if there is no label on beef that informs consumers whether beef has been produced in such a manner, then consumers will buy less beef than they otherwise would if knew all beef was produced without growth hormones.

Without any information, consumers must make an assessment about the quality of beef on the market, and they are likely to assume that—absent labels—there is some chance quality is high (no added hormones) or low (added hormones). In such cases, consumers can sometimes be made better off if the lower quality beef (hormone-treated beef in this example) is banned from the market because the ban lets consumers know—for sure—the quality of the product and as a result their willingness-to-pay increases. In fact, some economic research suggests that without any label at all, consumers should expect firms to sell the low quality (Grossman 1981). Whether consumers ultimately benefit from a ban depends on the relative cost savings provided by use of growth hormones compared to consumers' willingness-to-pay to have "hormone free" beef.

Even if hormone-treated beef isn't banned from the market, Bureau et al. (1998) show that consumers might be made better off with mandatory labeling policies because the labels let those consumers concerned about the issue pay the higher price to get the product they want, and allows consumers who are less concerned about hormone use to buy the cheaper product that they want. Whether such a labeling policy is ultimately beneficial depends on the costs of the mandatory labeling system compared to the benefits of letting consumers chose those products that best fit their preferences. Similar models exploring the benefits of food labeling policies have been studied in the context of genetically modified food (Fulton and Giannakas 2004), food safety (Crespi and Marette 2001), and animal cloning (Lusk and Marette 2010), just to give a few examples.

Reputation and Moral Hazard

Given the preceding discussion, one might question why—if some consumers really are willing to pay higher prices for beef from cattle that have not been administered growth hormones—producers and grocery stores do not voluntarily produce and label such products. While it is true that such practices are indeed taking place (see Ward et al. 2008a, b), advocates of labeling policies argue that private companies lack the credibility to label their own products. That is, consumers may not believe a grocery store claiming to be selling "hormone free" beef. This is particularly true for so-called credence goods; goods for which consumers cannot ascertain whether the claims were truthful even after consumption. For example, if a grocery store advertises "guaranteed tender" beef, a shopper will soon learn, after a few minutes on the BBQ grill, whether the claim had merit. By contrast, the consumer will never learn whether the steak was "hormone free" even after his plate is clean. For this reason, Caswell and Mojduszka (1996) argue that food labeling policies are most likely to benefit consumers in the case of credence goods.

Firms strategically choose which quality levels to produce. The existence (or lack thereof) of labeling policies has an influence on firms' behavior. Producing a higher quality product requires a firm to incur higher costs. As a result, firms must be able to recoup these additional costs by charging a price premium. Consumers will only pay a price premium for higher quality if the quality signal (e.g., a label) is credible. Without a credible means of communicating quality, firms will choose the lowest-cost, lowest-quality production method.

One mechanism for achieving credibility is reputation. Credibility can also be garnered by obtaining third-party certifications that are trusted by buyers. Roe and Sheldon (2007) argue that firms selling credence goods have an incentive to hire private certifiers as well as paying for mandated government labels when the government's quality benchmark substantially deviates from firms' private quality choices.

Ippolito and Mathios (1990) argue that competition among food suppliers and consumers' skepticism about suppliers' claims can lead to well-informed consumers. For example, if consumers are concerned about sodium intake, a supplier with a product low in sodium would advertise the attribute. If consumers were also concerned about fat, a supplier with a low-sodium, low-fat product would advertise both attributes. Perceptive consumers would know that a low-sodium product that does not make a low-fat claim is likely a higher-fat product. And any product that is silent on both attributes is higher in sodium and fat. So, while competition among firms might lead to uniformly low-quality outcomes if quality cannot be credibly signaled, the ability of firms to advertise and maintain a reputation might lead to informed consumers having a variety of products from which to choose.

Conceptualizing the Value of Information

Foster and Just (1989) provided the conceptual foundation for understanding the value of information to consumers—a value often calculated when evaluating the consequences of government labeling and information provision policies (see also Leggett 2002). They point out that consumers make food purchasing decisions without perfect information. As a result, consumers often make decisions that differ from what they would have made were more information available. Consumers make decisions based on their *perceptions* of quality, but the utility consumers actually receive from a product is based on *actual* quality. In such cases, consumers suffer from a "cost of ignorance" related to the difference between the value of the choices they actually made and the value of the choices they would have made in retrospect had they been better informed. The dollar value of the difference is the cost of ignorance, which is equal to the value of information multiplied by negative one.

Given this framework, researchers have, for example, looked at the choices people made before and after nutritional labels were added to food packages to infer the value of the nutritional information (Teisl et al. 2001). As Teisl et al. (2001) show, it is not necessary for people to make healthier choices to be made better off; the information provided by nutritional labels allows people to readjust purchases given the new information. The value of nutritional information was small for the products they studied.

Noneconomic Motivations

In addition to the more conventional economic motivations previously discussed, it should be noted that there are other noneconomic motivations for consumer information policies that arise during labeling debates. One is that consumers have a "right to know" where their food comes from. It is unclear how far proponents of this argument believe these rights should extend and at what point the right should be balanced against the costs of information provision, but such an argument has been made in reference to policies on country of origin labeling, rBST use in milk, and nutritional labeling, just to name a few examples.

Sometimes food information and labeling policies are advocated to promote the interests of a particular group of consumers or producers. For example, advocates of "food miles" labels are often interested in promoting the welfare of small, local farmers. Even if it could be shown that such policies lower the efficiency of food production (e.g., the sum of consumer surplus and all local and nonlocal producers' surplus), some advocates of the label would be undeterred because they view the policy as a redistributive mechanism that reduces perceived inequalities. Scholars have debated the relative merits of efficiency vs. equity for decades, and although economists have primarily been concerned with the former, it should be noted that there are those who are concerned with the later even when it comes to food information policies.

Paternalistic concerns also motivate consumer information policies. Although an economic approach typically respects individual's choices as revealing their best attempt to make themselves better off given their preferences, income, and food prices, there are some who argue that consumers are either not well enough informed or are too short-sighted to make "good" food choices. Paternalistic policies are those which aim to restrict consumer choice for the purpose of benefitting the consumer themselves. Proponents of paternalistic policies often seek to restrict the alternatives available to consumers, but sometimes paternalism manifests itself in information and labeling policies. For example, cigarette cartons in many European countries are required to carry, in large, bold typeface a label reading "SMOKING KILLS." It is hard to imagine such a label is conveying information that smokers do not already know, and thus it is probably most natural to view this information policy as a type of paternalism. Educational campaigns aimed at reducing obesity or "stop light" nutritional labels on foods might, under certain circumstances, be motivated on paternalistic grounds. Such paternalistic policies are meant to counteract self-control problems and encourage individuals to more seriously consider their future selves.

Finally, externalities and other-regarding behavior can motivation information policies. An externality occurs when an individual does not consider the effect of their production or consumption decisions on others uninvolved in a market transaction. In some cases, public information and labels can help consumers better understand and appreciate the effects of their consumption decisions on others. For example, products with "green" or "eco friendly" labels provide information to consumers about the relative impacts of their consumption decisions on the environment.

Antismoking information campaigns seek to inform smokers about the effects of second-hand smoke. Nutritional labels might cause people to eat healthier and reduce public health care costs imposed on others (Bhattacharya and Sood (2011) provide a nice discussion on whether obesity causes an externality).

Traditionally, economic models worked under the assumption that consumers are purely self-interested, but mounting evidence suggests people exhibit various forms of other-regarding behaviors stemming from motivations such as pure and impure altruism, reciprocity, inequality aversion, and trustworthiness. The evidence suggests people are concerned about the effects their food consumption choices have on others (e.g., see Lusk et al. 2007; Chang and Lusk 2009). As a result, information policies have the potential to partially reduce the negative effects of externalities by making people aware of the impacts their behavior has on others.

Regulators' Responses to Motivations for Food Information Policies

Federal and state regulators have responded in a variety of ways to the aforementioned motivations for food information polices. Responses range from full-out educational campaigns to mandatory labeling of certain products to establishing standards for marketing claims.

Mandatory Labels

One response to the aforementioned information asymmetries is to require producers to label certain products or qualities in an effort to let consumers decide for themselves which products they buy (see Golan et al. (2001) for an extensive discussion on the economics of food labeling). The Nutrition Labeling and Education Act of 1990, for example, gave the FDA authority to require foods regulated by the agency (essentially all nonmeat products) to carry nutritional labels. The result is that almost all packaged foods are now mandated to carry a standardized label conveying information about nutritional content—a major exception is fresh fruits and vegetables (fresh meat was originally excluded as well, but mandatory nutritional labeling on meat went into effect in late 2010). The effects the nutritional labeling act in the United States and similar nutritional labeling policies in Europe have been widely studied (for examples and reviews see Drichoutis et al. 2006, 2008; Grunert and Wills 2007; Nayga 2008; Variyam 2008).

Another recent and prominent example is mandatory country of origin labeling (COOL). COOL requires retailers to provide labels with information on the source of certain foods including fresh beef, veal, pork, lamb, goat, and chicken; wild and farm-raised fish and shellfish; fresh and frozen fruits and vegetables; peanuts, pecans, and macadamia nuts; and ginseng. COOL was signed into law as a part of the 2002 Farm Bill. Regulations for fish and shellfish became effective in 2005, and the final rule for the other commodities went into effect in 2009.

Although these laws exclude certain commodities, the aforementioned mandatory labels are noteworthy in that, given that a commodity is included in the law, the labeling applies to every type of the commodity. For example, all fresh ground beef products must carry a label of origin—not just ground beef products outside the United States. In contrast to these laws, some groups have pushed to use mandatory labeling to, essentially, single out a particular attribute, either through the use of positive labeling indicating "this product contains X" or negative labeling indicting "this product does *not* contain X." For example, the Food Allergen Labeling and Consumer Protection Act of 2004 requires food products that contain certain allergens, such as peanuts, to indicate as such on the label either in the ingredient list or in a statement indicating "this product contains peanuts." However, advocates of such ingredient-differentiating, mandatory labeling policies have, by and large, not been particularly successful in passing laws supporting their cause.

For example, when some producers began using recombinant bovine somatotropin (rBST) to boost milk production, some consumer activists wanted required labeling on milk produced from treated cows. The push to mandate labels such as "produced with rBST" ultimately failed because regulators determined that rBST is a naturally occurring substance, and as a result, it was misleading to provide labels inferring that milk was free of rBST. Even state-level efforts to require mandatory labeling have been blocked by industry-led law suits. Because rBST is naturally occurring, the courts ruled that the law did not protect safety but only "satisfied consumer curiosity." Firms have been able to voluntarily label rBST use in some states, but only with the provision that the label states "no significant difference has been shown between milk derived from rBST-treated and non-rBST-treated cows." For more on the history of rBST labeling see Runge and Jackson (2000).

One of the consequences of the rBST controversy is that labeling of this attribute largely eliminated the use of rBST in the USA. Paradoxically, the push to require labels to increase consumer choice has resulted (through a mix of supply-side and demand-side interactions) in a market outcome in which consumers do not actually have a choice. A similar outcome has occurred in the European Union with respect to mandatory labeling laws on foods containing genetically modified ingredients. This is despite the fact that many European consumers would prefer the lower-cost biotech alternative (e.g., see Noussair et al. 2004).

Labeling Claims and Standards

As indicated, consumers might distrust a private company's attempt to label certain food attributes—particularly credence attributes. As a result, regulators have sought to facilitate means of increasing the credibility of private labeling efforts. This has been accomplished through two primary means: forcing firms to justify labeling claims and helping to develop labeling standards. Although claims and standards are closely related, the former are largely aimed at ensuring the truthfulness of a label (e.g., whether a product with high level of calcium can actually claim to lower risks of osteoporosis), whereas the latter are often aimed at standardizing what a particular label or claim implies (e.g., what does "natural" mean?). The FDA has issued advice and rules on the appropriateness of numerous marketing claims related to the link between fat intake and cancer and to the link between sodium and hypertension, just to mention a couple examples.[1]

Marketing standards can be useful in giving consumers information on precisely what it is they are buying. Take, for example, the claim that a meat product is "natural." Does this mean the animal was raised without added growth hormones? On a prairie? Fed grass? According to the USDA, the answer to each of these questions is—no. If a package of beef contains the label "natural," it means it is minimally processed. Although some might argue that this degrades the meaning of the word "natural," the reality is that "natural" means different things to different people. For producers to accurately convey to consumers the attributes a meat product does and does not possess, it is often useful to have a third party, the government in this case, give a universally agreed upon definition of "natural." Similar efforts have resulted in standards for words such as "organic," "no hormones administered," "grass fed," and the like.[2]

Meat producers can also add credibility to a production program by completing various process certification and export verification programs with the USDA, Agricultural Marketing Service (AMS). A prominent example of this type of labeling is the Certified Angus Beef program. With such programs, a producer or group of producers specifies all the criteria that must be met in order for a product to achieve the certification. In these cases, the USDA does not normally set the criteria. They simply facilitate the process of certification and provide credibility to the certification process. One important exception to this rule is the USDA organic certification program in which the agency was actively involved in setting the criteria and standards that must be met for a product to be labeled "organic."

It should be mentioned that the USDA, through the AMS, has long tried to facilitate trade between buyers and sellers by implementing uniform grades and product standards. Grades and standards, like marketing claims, help consumers know what they will receive when they request "number 2 yellow corn" or "USDA Choice beef." By providing a universally accepted definition of certain words, the potential for asymmetric information is diminished. Grades and standards are only briefly discussed here as they are the primary topic of Chap. 9 of this volume.

Finally, whereas the theory of credence goods indicates that consumers will not trust private firms to credibly label the attributes (since the outcome is not verifiable by the consumer), the reality is that branding is a prevalent, private means of signaling quality—even the quality of credence attributes. Firms rely on reputation and trust as the mechanisms to facilitate credibility. Nevertheless, some firms—such as farmers or farmer-owned agribusinesses—may be too small to develop the brand equity needed to establish such reputation, and it is here that government voluntary labeling programs (such as the aforementioned AMS process certification programs) can be used.

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[1]For example, see http://www.fda.gov/Food/LabelingNutrition/LabelClaims/HealthClaimsMeetingSignificantScientificAgreementSSA/default.htm.

[2]For example, see http://www.fsis.usda.gov/factsheets/Meat_&_Poultry_Labeling_Terms/index.asp.

Product Bans

Product bans are not typically interpreted as consumer information policies. However, if consumer demand for a product is affected by uncertainty about the quality of a product on the market, then banning a "low" quality product can send information to consumers about the average quality up for sale. For example, consider the reaction of Japan in the wake of the discovery of BSE in the United States. Japan banned imports of US beef. Although such a move might be interpreted as a protectionist measure, it might also be interpreted as an effort by the Japanese government to maintain consumer demand for beef by assuring the Japanese public that domestic beef was safe to eat. Although US producers no doubt suffered from the ban, Japanese producers benefited and their consumers might have too (depending on how large was the price increase resulting from the supply shift relative to the size of the downward shift in the demand that would have occurred if Japanese consumers were fearful of imports).

Similar arguments have been made to justify bans on "low quality" products from the domestic market. Some commodity organizations, for example, implement minimum quality standards through federal or state marketing orders (see Chap. 6). Minimum quality standards only allow a product to be sold if it meets a quality threshold. Bockstael (1984) has shown that although producers might gain from such a strategy, consumers are almost certainly worse off if they can distinguish the quality of a product prior to purchase, i.e., if the product is not a credence good. Such a case exists for fruits or nuts in which only products of a certain size are allowed to be sold. Leland (1979) has shown, more generally, that minimum standards can, in some cases, benefit all parties involved. Such motivations have led some to argue that products made with biotechnology, cloning, or irradiation should be banned lest consumers infer that existing producers are of "too low" quality. Conceptually, product bans are most likely to enhance social welfare when there are demonstrable safety risks associated with the "low quality" that cannot be ascertained by the consumer prior to purchase. This is one reason why, for example, the FDA regulates the introduction of new drugs and medicines (however, see Higgs (1994) for some economic arguments that FDA drug approval process actually harms producers and consumers).

Information Provision Policies

One strategy regulators use to address information asymmetries is to provide information through educational campaigns. Take, for example, the federal government's dietary guidelines, developed by the USDA and the Department of Health and Human Services (DHHS), which have been in existence since the 1980s. One of the most widely known results of the dietary guidelines was the food pyramid, which was introduced in 1992. The pyramid provided suggestions on the amounts of different foods that should be consumed to achieve a healthy diet. Information about the food pyramid was widely distributed among the general population and even taught in public schools. The newest nutritional guidelines replace the "one size fits all" pyramid with a web site that allows users to develop a personalized eating plan differing by one's age, gender, weight, and physical activity.[3]

The federal government also provides a host of other information dissemination services. For example, the USDA-AMS reports weekly and daily prices and shipments for the major livestock, grain, fruit, and vegetable markets (see Chap. 14 in this volume for a discussion of information and market institutions). Working with other government agencies such as the Bureau of Labor Statistics, the USDA Economic Research Service (ERS) helps make available information on certain retail food prices. These policies are, in part, designed to help producers know whether the price they are offered is a "good deal." Moreover, the USDA and FDA actively disseminate information about "controversial" technologies, such as cloning, irradiation, and biotechnology. On each of these topics, the agencies have detailed web pages with answers to "frequently asked questions," discussions of how the agencies regulate the technologies, and the web sites contain links to current research. Such efforts not only provide the public with information about the agencies' mandates but also seek to inform consumers about the technologies.

International Differences in Information Policies

A detailed discussion of worldwide differences in information policies is beyond the scope of the current chapter; however, it is worth noting that governments in different parts of the world have arrived at different conclusions regarding the appropriateness of different food information policies. To provide a feel for some of the differences that exist, consider a few examples from Europe.

In the late 1980s, the European Union decided to ban the subtherapeutic use of growth hormones in beef cattle production, and subsequently banned imports of beef grown using added hormones (see Lusk et al. 2003). By contrast, nearly all feedlot cattle in the USA are administered growth hormones, and there is no requirement that meat be labeled as such. US retailers and producer groups can voluntarily label beef as "no hormones administered," provided certain documentation provisions are met, but at present, the vast majority of beef products sold in the USA do not contain such a label (see Ward et al. 2008a).

Another striking example is the difference in USA and European government responses to information about biotechnology. Whereas many types of genetically engineered seeds are approved for use in the USA, there are no requirements to label foods produced with such products. In the European Union (EU), many fewer genetically engineered crops have been approved and there are mandatory labeling laws. As indicated by Carter and Gruère (2003), "The first GM labeling requirements for food products were introduced by the European Union (EU) in 1997 (Regulation EC No 258/97) as an application of the precautionary principle.

[3] See http://www.mypyramid.gov/index.html.

The EU recently revised its rules on GM labeling to include feed and most food products derived from GM crops (even if there are no detectable GM genes in the final product) and lowered the threshold level for adventitious presence of GM material." The result of the stringent mandatory labeling policies has been a virtual ban on foods produced with genetically modified ingredients in the EU as retailers have voluntarily refused to stock such items even though they are allowed by law.

It is impossible to know, with any degree of certainty, exactly why the USA and the EU have responded so differently to issues such as growth hormones and biotechnology. Differences result, among other factors, from differences in consumer preferences, differences in the political power of competing lobbying groups, and desires to protect domestic agricultural producers from international competition.

Given the preceding discussion, it might appear that European countries are uniformly more aggressive in pursuing information and labeling policies than the United States. However, this is not so, as evidenced by nutritional labels. Although nutritional facts panels are required on most foods sold in the United States, the same is not true in every European country. There are requirements regarding the format in which nutritional information must be displayed if they are present, but there is no requirement that a nutritional facts panel be present. In the UK, for example, many producers and retailers voluntarily provide nutritional information, and using government guidelines many retailers also follow a "traffic light" labeling system for certain nutrients, but these activities are not compulsory.

Effectiveness of Food Information Policies

Stating that food information and labeling policies *can* be beneficial in theory does not mean that they actually are in practice. As such, it is prudent to discuss the effectiveness of various food information policies. It must be noted that there are so many different food labeling and information policies that it is impossible to provide any kind of comprehensive discussion. Moreover, the effectiveness of a particular policy is likely to vary on a case-by-case basis, making it difficult to make overarching conclusions. Still some general conclusions can be reached.

For example, in a comprehensive assessment of food labeling policies, Golan et al. (2001) concluded

> Federal intervention in food labeling is often proposed with the aim of achieving a social goal such as improving human health and safety, mitigating environmental hazards, averting international trade disputes, or supporting domestic agricultural and food manufacturing industries. Economic theory suggests, however, that mandatory food-labeling requirements are best suited to alleviating problems of asymmetric information and are rarely effective in redressing environmental or other spillovers associated with food production and consumption.

They go on to argue that the effectiveness of food labeling depends on firms' incentives for information provision, government information requirements, and the role of third-party entities in standardizing and certifying the accuracy of the information.

Table 13.1 Expected performance of policy options

	Efficiency or performance criteria			
	Technical	Allocative	Dynamic	Nonmarket
Facilitate more voluntary labeling programs (e.g., process certification programs, standards)		+	+	+
Facilitate more mandatory labeling programs (e.g., COOL labeling)				+
Ban "low quality" products	–	–	–	+
Pursue more education or information provision programs		+		
Pursue a more laissez faire approach relative to the status quo	++	±	++	–

In this section, some information policy options are discussed along with my beliefs on how they perform on the performance criteria used throughout this book. This is followed by discussion of the different ways in which effectiveness can be ascertained in the context of some specific examples.

Expected Performance of Policy Options

Because of the multiplicity of information policies, the discussion here is at a more general level related to five different policy options: (1) facilitate more voluntary labeling schemes, e.g., process certification programs, (2) facilitate more mandatory labeling schemes, e.g., mandatory country of origin labeling, (3) pursue more education or information provision policies, (4) ban "low quality" products, or (5) pursue a more laissez faire approach relative to the status quo.

Table 13.1 considers each of these options in terms of the performance criteria used throughout this book. I ask whether each policy option improves technical efficiency (does it minimize cost?), allocative efficiency (does it properly allocate resources to their most valued uses?), dynamic efficiency (does it respond to changing conditions and encourage innovation?), and what are the implications of policies involving government intervention into markets which reflect nonmarket social values (does it produce other beneficial outcomes?). My assessment is both qualitative and subjective. In table 1, a "+" is meant indicate my belief that the policy option will lead to more of the particular type of efficiency, and "–" is meant indicate my belief that the policy option will lead to less of the particular type of efficiency or nonmarket beneficial outcome, and the absence of a "+" or "–" implies that I am either unsure of the effects or that the type of efficiency or nonmarket beneficial outcome does not apply to the particular policy option.

I rate voluntary labeling programs highly on almost all performance criteria. They give consumers information, helping them select products that best match their preferences and budget constraints (and in so doing improving allocative efficiency). Because the labels are voluntary, they are dynamically efficient in the sense that the extent of their use depends directly on the prevailing conditions. The labels improve potential economic gains for smaller producers by providing them a means to credibly signal quality, and simultaneously allow consumers to select items that might improve the environment, animal welfare, or health.

I rate mandatory labeling programs as slightly less efficient. Relative to voluntary programs, they do not necessarily improve allocative efficiency because, as previously discussed, they can lead to firms eliminating certain choice options altogether and because the framing of the label (e.g., does contain vs. does not contain) might have a substantive impact on how resources are allocated. Mandatory labels are not as dynamically efficient as voluntary labels because firms are required to use the labels regardless of changes in technology, costs, and consumer preferences. Moreover, mandatory labels, which are implemented through regulation, create an opportunity for interested parties to stop or slow change that would adversely affect their profitability.

In general, I do not rate product bans highly on any of the efficiency measures or in providing nonmarket beneficial outcomes. The banned products are often controversial new technologies which are cheaper and removing choice options can only serve to reduce allocative efficiency. Bans also perform poorly in a dynamic sense because they are difficult to undo once enacted. On the plus side, product bans might produce some nonmarket benefits, such as increasing consumer confidence in the food system, or improve some health or environmental outcomes.

Overall, I see information provision policies as relatively innocuous. Additional information can help people make more informed choices (improving allocative efficiency), but are not likely to do much more. It is also possible that they can do some harm if consumers have limited attentions, are boundedly rational, or suffer from "information overload" (Arunachalam et al. 2009; Iyengar and Lepper 2000; Lusk and Marette 2012; Roe and Teisl 1998).

Finally, consider a more "free market" or laissez faire approach in which the government moves out of the information and labeling business. Such a move would have positive and negative consequences. I expect such a move would be beneficial in the sense that markets would rapidly respond to changing circumstances in a least-cost manner (improving technical and dynamic efficiency). As we know from the Fundamental Theorem of Welfare Economics, markets efficiently allocate resources to their most valued uses, so I give the policy a "+" in this regard; however, if there are particularly large externalities or information asymmetries associated with the good in question, a more laissez faire approach might score worse on allocative efficiency. Freer market outcomes are less likely to generate outcomes that external observers would deem "fair" as it would heavily reward the most productive and low-cost producers, and by its very nature a more market-oriented policy approach would not likely produce nonmarket benefits absent the emergence of some cultural norms.

Table 13.1 is, of course, a simplified depiction of labeling options. Reality is more complicated. The government's involvement in regulating food labels and information sometimes comes with an implied or explicit ban on claims not authorized by the government. The precedent of government involvement in food regulation often makes it difficult for firms to use claims in what would otherwise be perceived as a laissez faire situation by outside observers. For example, the USDA does not currently authorize health claims on meat and poultry products. As a result, industry participants have interpreted this position as meaning that such labels are prohibited. However, consumers might benefit from lean products labeled with a claim of improved heart health resulting from reduced intake of saturated fat. The implicit prohibition against otherwise truthful information is a cost associated with the mere presence of government involvement in regulating labeling claims.

Having considered the performance criteria at a very general level, it is now instructive to treat each issue individually and look at some specific examples.

Technical and Allocative Efficiency

For economists, the standard approach to evaluate the effectiveness of a policy is to study *economic* efficiency—or the extent to which the policy increases the overall size of the pie. Quite simply, the efficiency criterion says a policy is effective if the sum of the benefits to all parties involved exceed the sum of the costs to all parties involved. In this sense, economic efficiency can be seen as a combination of technical and allocative efficiency. New federal regulations that are expected to have substantive economic impacts are required to undergo cost–benefit analysis; however, the outcome of a cost–benefit test does not dictate whether a regulation becomes law. Although a cost–benefit analysis is required, there is a surprising amount of variability in the quality and depth of the analyses.

Again, it would be impossible for current purposes to determine whether every (or even the average) food information policy passes a cost–benefit test. Nevertheless, it is useful to consider some of the evidence on COOL, one of the most recent and widely discussed food information policies, to provide some sense for how the efficiency criterion is employed in evaluating a food labeling policy.

Going back at least as far as 1999, researchers began estimating the costs and benefits of the proposed labeling policy.[4] In part because the exact implementation rules were unknown, initial cost estimates of the policy to the beef and pork industries were all over the board, ranging from a low of $69 million to a high of $5.6 billion (see the discussion in Lusk and Anderson 2004). The consulting firm, Informa Economics recently produced one of the few *ex post* estimates of the costs of COOL. They estimate that aggregate costs to the beef industry are about $1.1 billion and aggregate costs to the pork industry are around $200 million.[5]

[4]Darrell Mark at the University of Nebraska maintained a web page containing links to the most important developments and studies since 1999. See http://agecon.unl.edu/mark/country_of_origin.html.

[5]http://www.informaecon.com/COOLStudyUpdate2010.pdf.

The key question is how these costs compare to the aggregate benefits that arise, in theory, from improved consumer choice made available from added information on origin. This question has been perhaps the most controversial one in the debate. Despite the fact that numerous studies had been conducted to determine consumer willingness-to-pay for meats from different origins, the USDA's final rule, released in 2009, practically ignored this information. When discussing the cost–benefit analysis of the policy in the final rule, the USDA concluded, "The expected benefits from implementation of this rule are difficult to quantify. The Agency's conclusion remains unchanged, which is that the economic benefits will be small and will accrue mainly to those consumers who desire country of origin information."[6] The USDA's final rule also estimated that the first year start-up costs for all covered commodities would be $2.6 billion, and aggregate annual costs would dissipate to about $212 million in 10 years after implementation. By assuming that consumer demand would be essentially unchanged and that costs are non-negligible, the USDA's final rule indirectly asserted that COOL failed the cost–benefit test.

There are many studies showing that consumers are willing to pay premiums for beef or pork of US origin relative to meat from other origins such as Mexico. However, this is not the same thing as showing that consumers are willing to pay for COOL labels. The value of the mandatory label depends on what qualities consumers think they are currently buying and what qualities are available to them after the label policy is in place. A couple studies have tried to address this issue. For example, Loureiro and Umberger (2003) found in a survey of Colorado shoppers that the average household was willing to pay an extra $184 annually in taxes to have a mandatory label on beef and pork indicating origin. If these households can be presumed to be representative of the average US household, the implied aggregate value (given that there are approximately 120 million households in the USA) is about $22.1 billion. Of course, the geographically restricted nature of the study, coupled with the fact that people often say—in hypothetical surveys—they are willing to pay more than they actually do in practice, gives some reason to suggest that the $22.1 billion benefit figure is overstated. To my knowledge, Kuchler et al. (2010) represents the only peer-reviewed study published using actual grocery store sales data to indicate how consumers have responded to COOL labels. Their study showed that consumption of shrimp was unchanged after the implementation of COOL for seafood.

Although there is diversity of opinion on the matter, most agricultural economists view COOL as ineffective on economic efficiency grounds. There are several reasons for this prevalent (but not unanimous) belief. First, existing USDA certification programs could easily have been used to allow firms to voluntarily advertise origin, but the fact that so few firms did so is indicative of the lack of overall demand for the information. Second, the way the policy has actually been implemented in the beef and pork sectors also suggests little value for the label. Many retailers place the origin labels in small print on the back of the package. If it were really so valuable, why don't retailers display the information more

[6] http://www.ams.usda.gov/AMSv1.0/getfile?dDocName=STELPRDC5074925.

prominently? Moreover, many ground beef products simply have a label indicating, "product of USA, Mexico, and Canada," which is not particularly informative. Third, there is evidence to suggest that much of the demand for COOL that has been witnessed in consumer surveys stems from demand for food safety and quality or from ethnocentrism (a type of patriotism manifested in purchase behavior) (see Lusk et al. 2006).

One final note about COOL is instructive. Canada and Mexico have petitioned the WTO arguing that COOL violates WTO rules governing bilateral trade. Mexico and Canada have argued that COOL has caused a drop in their cattle prices, leading to losses for Mexican and Canadian producers. The USA has not, so far, challenged the argument that Mexican cattle prices have fallen, but claims that the impacts have resulted from US consumers' free, informed choices rather than the law per se.

The fact that COOL may fail a cost–benefit test should not be taken to imply that all food labeling and information policies are inefficient or that COOL might not perform highly on some of the other performance measures listed in Table 13.1. Arguably, the government's decision to thus far refrain from requiring mandatory labeling of genetically modified foods has been one that would correspond with the results of many cost–benefit analyses (e.g., see Lusk et al. 2005). Moreover, nutritional labeling on meat is one that appears to pass a cost–benefit test (Federal Register 2009).

Dynamic Efficiency

Do food information and labeling policies respond promptly to changing market conditions, and do they help promote growth? Stated differently—are the policies dynamically efficient? There is little academic research addressing this question, but a few observations may be useful.

In many ways, the USDA-AMS process verified and certification programs are an ideal mechanism to help facilitate credible labels, while allowing innovation to arise from bottom-up decision making. Aspiring entrepreneurs can create whatever processes they believe consumers will find desirable and create a certified program. Ultimate success or failure depends on market outcomes rather than a bureaucratic process. Likewise, the FDA's willingness to permit firms to make food claims—so long as they are not deceptive—allows firms to strive to find those products and claims most appealing to consumers.

An area where regulation has perhaps not been as dynamically efficient is in setting standards for labeling claims for "natural" and "organic." The problem is that these claims carry certain connotations that are not actually covered by the standard, and as such, there seems to be a constant evolution of the need for ever-more precise claims to suit the needs of interested niches. For example, the word "natural," for many people meant a production system that used minimal off-farm inputs using traditional varieties and production methods. However, when the "natural" claim was determined by the USDA to mean "minimally processed," some firms continued to use the claim as a marketing tool despite the fact that consumers believe the term means something other than what the USDA says it means. While the USDA can control the use of the word “natural” on meat products, they cannot readily change the vocabulary definition available to most consumers.

Producers wanting a stronger term to delineate production systems with non-synthetic input usage rallied around the “organic” claim. The final organic certification primarily rested on defining production practices that utilize non-synthetic pesticides and herbicides. But, yet again, many consumers believe organic means much more than this—that it promotes small farms that are not part of the “industrialized” food chain (see Chang and Lusk 2009 for some evidence on this fact). The reality is that many organic farms are just as large as nonorganic farms and that large agribusinesses own many of the most well-known brands selling organic products. Thus, certain producers are, again, seeking to further differentiate to provide food from a system that seems—well—more “natural.”

The current trend seems to be toward the local food movement. The point here is that by the federal government establishing labeling standards, the door is open for consumers to be deceived by the label, which was exactly the problem that standardization was supposed to solve. Moreover, standardizing a labeling claim often creates new and unintended markets for producers that are dissatisfied with the criteria used to set the standard. Perhaps, this cycle of development is a sign of regulation being dynamically efficient, but it rather seems like the result of unintended consequences. The process can be contrasted to the situation in which firms develop their own brands, and where their reputations depend on their own internally set standards. While some firms invariable choose poor labels and fail, the adverse effects are at least limited to the firm’s share holders. When the government makes a poor decision, the effects are more broadly felt.

Finally, USDA grain standards and meat quality grades are perhaps less useful than they once were, in large part because they have changed so little since their inception. Although a large majority of beef products are quality graded, there is ample evidence that the grading system hasn’t changed in ways that would reward producers for producing those cuts desirable to consumers. In particular, the current USDA beef quality grade system rewards cuts that are high in marbling, but numerous studies have shown that marbling is only weakly correlated with one of the key factors determining eating satisfaction—tenderness (e.g., see Lusk et al. 2001). Moreover, it appears that in increasingly vertically coordinated industries, such as the pork and poultry sectors, USDA grades are much less important than they once were as vertically integrated firms set their own internal standards to meet what they perceive to be the demands of the consumer. Thus, it seems clear that the USDA grading programs have not been dynamically efficient.

Nonmarket Beneficial Outcomes

As previously indicated, some proponents seek food information policies to correct what they see as growing inequities in the food supply chain. Information and marketing policies to promote local food, for example, through the recent Know Your

Farmer, Know Your Food Initiative of the USDA can be thought of as a way to try to increase local and regional farmers' share of the retail dollar. As mentioned, organic labels were also once thought to be a means of promoting small farms. The problem with such policies is that they do not limit the programs to farms (or agri-businesses) of certain sizes. Thus, one would expect that over time, firms will learn to meet whatever the labeling standard is (assuming it is desirable to enough consumers) in the most cost effective means possible—which typically means growing to sizes that are undesirable to those who advocate policies to reduce inequalities.

There have been attempts to market regional products using marketing claims or brands to promote the interests of producers in a certain areas. For example, only producers within a 20 county region in Georgia can legally claim to produce a Vidalia onion. In 1986, Georgia's state legislature gave the Vidalia onion legal status defined by a particular geographic area, and in 1989, producers in the area established a Federal Marketing Order with the USDA to further define "Vidalia onion" at the federal level. Although such programs have some potential to increase returns to those producers within the promoted region, as discussed by Hayes et al. (2004), unless there is some mechanism for supply control, there is little reason to believe that the programs will lead to higher long-run profits.

As another example of regional programs, the Oklahoma Department of Agriculture facilitates a "Made in Oklahoma" branding program for firms producing agricultural products within the state. Such programs are probably limited in their effectiveness in promoting nonmarket beneficial outcomes. One reason is that many states operate such programs. For example, Texas has a "Go Texan" brand. So, while firms in Oklahoma are trying to win business from Oklahoman's with their "Made in Oklahoma" claim, they might be losing customers in Texas who want to buy a product advertised as "Go Texan."

Some information policies seek to promote nonmarket benefits for consumers as well. Higher income and more educated consumers are likely to have better knowledge and access to information than poorer, less educated individuals. As such, some view information policies as dealing with some of the consequences of income inequality.

Externalities are often generated in the production or consumption of certain foods. Operating a hog farm might impose costs on the environment, human health, or the animals that are not captured in the price of pork. A strict interpretation of traditional economic theory would assert that if consumers are presented with two products, a traditional product and a more costly product claiming to have avoided some externality (e.g., cage free eggs), then most consumers will free-ride and buy the cheaper product. However, many consumers are more charitable than some of these economic models suggest. As a result, policies that provide information to consumers about potential externalities can alter consumption habits, and labels that advertise reduced externalities can pick up sales. For example, one of the purported benefits of organic foods is lessened pesticide and herbicide use. The fact that many consumers are willing to pay higher prices for organic foods and that sales of organics have grown rapidly for years, suggests that labeling standards and information can produce some nonmarket benefits.

Looking Toward the Future

In this concluding section, some thoughts on the academic research that needs to be done to better understand how consumers respond to information and labels, and some thoughts on future food information regulation are presented.

Academic Research Needs

The conventional academic view of labeling is that labels allow consumers to better choose the products that fit their needs. For example, in most models of consumer demand, adding a label such as "produced without genetically modified ingredients" simply serves to generate a new demand curve for this product, and allows consumers who sufficiently value the attribute to be better off than they were before the label was in existence. Some evidence is beginning to suggest that this view of consumer decision making is too simplistic. In particular, adding a "GM free" label not only gives consumers a new option to buy, it might change their demand for the preexisting product, making it less clear whether the label actually increases consumer welfare (see Lusk and Rozan 2008).

It is widely recognized that the "quantity demanded" of an existing product will fall when a new product comes on the market. What is less well appreciated is that the introduction of a new product can also fundamentally change preferences. New products have the potential not only to cause movements along a demand curve but also to change the location of the demand curve as well. It is this latter effect which is often omitted from traditional economic models.

For example, consider the results of Kanter et al. (2009). In their study, consumers bid in an auction to buy one quart of milk. Some consumers initially bid on a plain quart of milk without any information that there would be other types of milk for sale. Other consumers also bid on the plain quart of milk but with full knowledge that organic and rBST milk was also available for sale. The results showed that the first group of consumers was willing to pay about $1.28 on average for the plain milk, while the second group, knowing simply of the existence of organic milk bid, on average, about half as much, $0.61. The experimental design was constructed so that the difference cannot be attributed to the fact that the two groups of consumers might have thought there were more options available, but rather the difference is a result of the fact that the mere existence of organic milk stigmatized the plain, non-organic milk. In fact, whereas about 80 % of the participants were willing to pay some positive amount for the plain milk when there were no labels present, only about 50 % were willing to pay some positive amount for it when they had previously seen an organic label.

These results are important because they show that allowing a new label might radically alter consumers' demand for the preexisting products. In fact, it is conceivable that a traditional economic model of labeling, which assumes willingness-to-pay for the preexisting product is independent of which labeling policy is in place, will arrive at a very different conclusion on the costs and benefits of a policy than a model in which willingness-to-pay for the conventional product falls when a new label is introduced. More research is needed to understand how consumer demand dynamically changes in response to labeling policies.

A second area in need of future research relates to conceptualizing consumers' value of information. The conceptual framework introduced by Foster and Just (1989), while quite useful, seems to be most logically employed for experience goods—those goods for which people can ascertain quality after consumption. For credence goods, however, the framework is somewhat muddled. The reason is that the cost of ignorance in the Foster and Just (1989) model arises from a difference in the utilities people actually experience (with less information) and what they would experience with more information. But, by definition, when a credence good is consumed, a consumer never knows whether the attribute was what they thought it to be.

For example, if a consumer incorrectly believes the eggs they buy come from cage-free farms, then eating an omelet the next day never imposes a cost on the individual; they can continue on their merry way without ever knowing they ate something different than what they thought they were eating. This is something quite different from the case of an experience attribute like beef tenderness. If a consumer believes they are buying a tender cut of beef, and find out later it is tough as nails, the welfare loss is immediate and obvious—the consumer suffered from a cost of ignorance. This does not mean that information is not valuable when dealing with credence goods, only that its effect might need to be reconceptualized. For example, providing the egg consumer with information on how the hens were raised might be justified as preventing a *future* welfare loss. That is, the consumer may eventually find out how eggs are produced and will experience regret over all the previous decisions. Alternatively, some credence-type attributes actually have effects that consumers experience—only probabilistically and far into the future. Egg eating is believed to increase cholesterol, which might ultimately lead to a heart attack; however, this is not an effect egg consumers will experience after tomorrow's breakfast. Valuing information on cholesterol might entail discounting the future welfare losses that would be incurred if behavior is unchanged today.

Finally, more research is needed to value the effects of government information campaigns. It is common in studies which analyze consumer preferences for a particular technology, such as genetically modified food, to claim that what is needed is "more education." However, rarely do such authors actually compare the benefits of such education with the costs of provision. We know that consumers respond to third-party information on biotechnology in an experimental setting (e.g., see Rousu et al. 2007), but what we don't know is whether government education campaigns actually reach the targeted audiences and how people perceive these messages in the context of everyday life. Economists clearly possess the tools to do this sort of analysis, as the body of literature is replete with studies on the effectiveness of generic advertising; however, these tools haven't been put to as much work on evaluating government information provision.

Future Food Information Regulation

Problems related to food safety, human health, animal welfare, and the environment do not appear to be dissipating anytime in the near future, and many people are increasingly turning to the government to play a role in solving such problems. A question often asked is whether current food information policies can be made better, and if so, how?

The historically close connection of the USDA with the agricultural production sector has made it, at times, perhaps less sensitive to demands of the food consumer. One example is that which was previously mentioned: the inability to officially recognize any of the research on consumer demand for products of different origins in its cost–benefit analysis of COOL. It seems almost obvious that cost–benefit analyses of food information policies should include an estimate of the *benefits*.

The difficulty is that traditional demand estimation approaches are often useless in calculating the *ex ante* benefits of a policy. However, survey and experimental methods are now well-established in the economics literature. Indeed other government agencies, such as the Environmental Protection Agency, routinely use survey-based estimates to assess values of morbidity and life for use in benefit estimation, and private companies spend millions of dollars annually on survey research to make product adoption and pricing decisions. The increasing number of policies directed at improving consumer welfare can only properly be evaluated when *ex ante* consumer impacts—whether they are positive or negative—are seen to be just as important as the costs.

One challenge rests in the multiplicity of approaches used to estimate consumer benefits, and the lack of clear direction and consensus among those dealing with food policies regarding the appropriateness of different approaches. For example, the benefits of the aforementioned meat nutritional labeling law were calculated using assumptions about how consumers will change purchasing behavior after the new labels were added. These assumed behavioral changes were used to calculate expected changes in fat and cholesterol consumption, which was in turn used to estimate changes in rates of mortality from cancer and heart disease. The economic benefit was calculated by multiplying the projected number of lives saved by the value of a statistical life (VSL) determined from hedonic wage regressions (see Federal Register 2009).

Underpinning the entire calculation are consumers' answers to survey questions in which they were simply asked to *say* how they use nutrition facts panels. This is not necessarily a bad approach, but it is unclear whether it is any better than directly asking people what they are willing to pay to have the labels. It is also unclear whether consumers in an economic experiment would actually behave any differently with and without the labels. In short, consumer information policies might be improved if greater attention was given to the quality of the data underlying the benefit estimates.

One of the downsides associated with the current food information policies is that they often give very little attention to the way consumers actually make decisions. Research shows that subtle cues and changes in the way information is presented can have large effects on behavior (Wansink 2006). These observations are beginning to be taken seriously in other policy areas. For example, The Bureau of Consumer Financial Protection was recently created in the Department of the Treasury. Among other duties, the new Bureau is tasked with ensuring financial documents are transparent and understandable for consumers. One of their current activities involves conducting consumer experiments and focus groups to find ways to make lengthy credit card agreements more understandable (Joffe-Walt 2011). Recent regulations now require credit card companies to report the time until a balance is paid off if only minimum payments are made. The regulations also require credit cards to itemize fees. Such regulations seek to meet the consumer "where they are at." Likewise, future food information policies might go beyond simply asking, for example, whether a meat nutritional label passes a cost–benefit test, and instead ask *what kind* of meat nutritional label would pass the cost–benefit test? Answers to such questions would require concerted efforts to study how consumers respond to color, size, and location of labels in different environments.

With looming deficits and calls to better coordinate the federal government's food regulatory efforts across the FDA and USDA, changes are likely to come. Only time will tell what such changes will mean for the future of food information policy. Nevertheless, at least one constant will remain. Consumers will continue to demand information from farmers and retailers about the foods they consume, and there is a role for the government to play in ensuring such information is available, truthful, and transparent.

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Chapter 14
Information and Market Institutions

Joe Parcell and Glynn Tonsor

Abstract Information flows from producer to consumer in the form of product and quality information and from consumer to producer in the form of payments and consumer preferences. The economic efficiency by which marketing channel functions (e.g., lending, contracts, packaging, storage, transportation, or marketing) perform is based on the market institutions available for a particular function. Entities using these functions are considered institutional players. They rely on market institutions to limit transaction costs, including search costs, facilitate quality and price negotiations, and monitor markets. Institutional players use information to increase efficiency within market institutions. If public agencies help to generate information that contributes to consumer welfare, then consumers should be advocates for public agencies continuing their information production. Yet, increasing public scrutiny concerning the role that public agencies play in providing information to the agricultural industry has been a factor recently. This chapter details some of the issues for which the public is at odds with how to value public information. The authors offer recommendations for the future of public information policy and the collection of public data.

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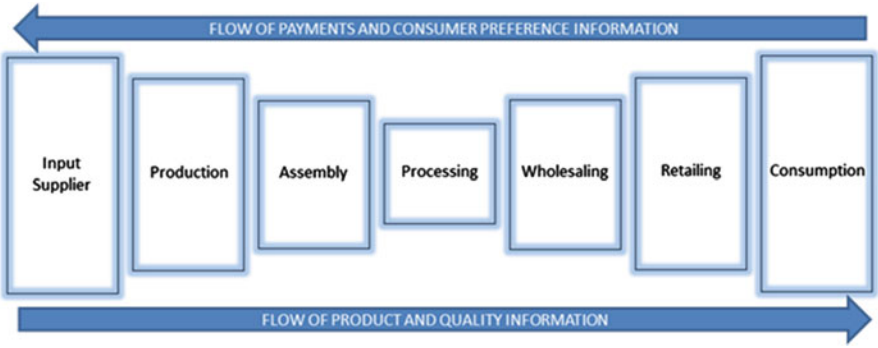

Fig. 14.1 Stages in the agricultural marketing channel. Recreated from Rhodes et al. (2007)

Information flows from producer to consumer in the form of product and quality information and from consumer to producer in the form of payments and consumer preferences (Fig. 14.1). The economic efficiency by which marketing channel functions (e.g., lending, contracts, packaging, storage, transportation, or marketing) perform is based on the market institutions available for a particular function. Entities using these functions are considered institutional players. They rely on market institutions to limit transaction costs, including search costs, facilitate quality and price negotiations, and monitor markets (North 1991; McMillan 2002). Institutional players use information to increase efficiency within market institutions. Access to information should decrease transaction costs incurred by institutional players, and thus, it affects transaction price, quantity and quality attributes of commodities and products. Consumer welfare increases when the agricultural marketing channel becomes more efficient. If public agencies help to generate information that contributes to consumer welfare, then consumers should be advocates for public agencies continuing their information production. Yet, increasing public scrutiny concerning the role that public agencies play in providing information to the agricultural industry has been a factor recently. This chapter details some of the issues by which the public is at odds with how to value public information.

Information may be derived from either the public or private sector and is used by private sector participants for strategic planning and by public sector participants to inform policymaking and regulatory decisions. Accordingly, information and underlying data can be distinguished as public or private in origin, source, or availability. Although the importance of this distinction may not be apparent to the casual reader of the *Wall Street Journal*, it is important to market institution participants. Generally, public information is publicly available. Private information may (often at a fee) or may not be available to the public. Availability and accuracy of information have important implications for economic performance. Public and private information employed in strategic planning by private sector participants drives the productive or technical efficiency of markets—efficient use of resources to generate goods and services. While public sector provision of information supports the achievement of such efficiencies by freely operating competitive markets, the public sector is also charged with the role of ensuring societal concerns of allocative efficiency—allocating resources to maximize aggregate social welfare including distributing information to those who have the greatest need for it—through policy-making and regulatory decisions.

The United States Department of Agriculture contributes significantly to information access for the agricultural industry and supporting industries. This information is used by various industry participants to make strategic and operational decisions. For example, sellers and buyers of boxed lamb cuts use Agricultural Marketing Service (AMS) boxed lamb price reports to establish prices, agricultural lenders rely on World Agriculture Supply and Demand Estimates (WASDE) price projections when determining client repayment capacity, a new organic soybean processor looks to National Agricultural Statistics Service (NASS) crop surveys to determine the best location to build relative to organic soybean production, or producer associations use Economic Research Service (ERS) marketing margin trends to approximate market fairness among producers, wholesalers, and retailers.

Chapter 1 identifies the structural change occurring within the agricultural industry. Structural change has, and will continue to have, an impact on the functions carried out within the agricultural industry. Structural change stimulates the need for new information, diminishes the need for certain information, can deteriorate or enhance data access, and amplifies the need for researchers to access data to study how structural change impacts the role of market institutions on marketing functions and on institutional players. Although the data may or may not represent a form of information (e.g., the number of farms with more than $1 million in sales is information, but the value of sales for each individual farm with more than $1 million in sales is data), the quality and consistency of reliable data is important to deriving credible and relevant information. This chapter cannot begin to address all issues associated with ongoing structural change in the agricultural industry. The chapter focuses on information issues from the historical perspective of lessons learned and how these lessons learned may benefit future leaders and decision makers as they assess policies and programs providing publicly generated information.

We focus our discussion in this chapter on the role of public information in ensuring agriculture market efficiency. Assessing the impact of private information has been more difficult because of limited public access to and historical records of such private information. Exceptions, for which analysis has been possible, include firm press releases or other voluntary public announcements. The supply of and demand for private information is market driven, and the availability and form of private information developed is conditional on the availability and form of public information provided. Collectively, public agents focus on developing information to respond to society's desire for allocative efficiency. Public agents include opinion leaders via the voice of voting constituents, public servants via university faculty and government employees developing a research agenda, and public nongovernmental organizations via philanthropic activities.

Significant agricultural market institution changes are at the forefront of society's need to continually reevaluate allocative efficiency. Agricultural market institutional changes observed during the past 20 years are unlike those experienced at any period in the modern era of global agriculture. As changes in the market system occur to match end-user wants with producer supply, resources are reallocated to improve efficiency. Agricultural marketing system changes have created new demands for private information, brought about new agendas for public information development, and caused society to reflect on public information's role within agriculture. For example, the rapid adoption of production and marketing contracts in the animal agriculture industry has garnered significant societal concern. Although some firms argue that vertical coordination and vertical integration are necessary to ensure the efficient management of resources across levels of the marketing system (i.e., technical or productive efficiency), portions of society express concern that technical efficiency erodes allocative efficiency. What balance is needed between public and private information providers to meet private sector participant wants and society needs, and what role should the public sector have in data availability and public information development given the dynamic changes of the agricultural marketing system?

Public information generally is considered unbiased, credible, reliable, and relatively freely accessible to society. Government employees, who collect data, create information, and present information, have no financial incentive to act nonobjectively. Examples include USDA NASS price, supply, and demand data; Census of Agriculture data; WASDE data; AMS market news reports; and ERS Agricultural Resource Management Survey (ARMS) data. Nongovernmental organization employees and academic researchers are sometimes accused of research bias due to funding opportunities or personal agendas. These perceptions are often debated in a public forum by which the public is allowed to evaluate a researcher's results. Parcell et al. (1999) find that extension (deliver information) and research (develop information) marketing economists differ on many issues but also agree on some issues. Their results indicate the differences in perception are strongest for factors linked to producer marketing practices. They also report that extension and research marketing economists rarely collaborate. Agriculture and Food Research Initiative (AFRI) requests for grant applications now encourage integration of multiple land grant missions, and this has created incentives for research and extension economists to collaborate. The results of incentivizing collaboration are yet to be identified.

Credibility refers to the research team's integrity and information development documentation. Credibility is one area in which public information has a comparative advantage. For example, the NASS publishes procedures for developing crop forecasts, and this lends transparency to the process and credibility to the forecasts (Vogel and Bange 1999). Credibility is of general interest to society and decision makers. The agricultural press observes and reports on the process used to develop NASS crop forecasts (e.g., Hill 2010), and this news coverage seems indicative of society's thirst for understanding the process. Yet, society's thirst seems to be quenched by a few summary paragraphs instead of a 17-page document. Credibility refers to a different meaning depending on the audience, and the level of credibility relates to data reliability behind the information.

Data reliability is critical for public information development. The WASDE report, a monthly production of the Office of the Chief Economist, includes reliability measures in the appendix of each report. Although extension and research marketing economists generally agree about producer use of futures/options marketing strategies, Parcell et al. (1999) find that extension marketing economists do not believe marketing strategies need be based on statistically significant findings; on the other hand, research marketing economists believe statistically significant findings are important for developing producer marketing strategies. Extension economists view marketing from an individual producer risk-management perspective, in which the producer's objective is to obtain a profitable price for production in the individual year that is involved and avoid serious cash-flow problems in that year. Research economists view marketing from the aggregate standpoint, or on the average. They believe that the data determine the confidence in a decision-making context. Regardless, ensuring credibility of the information and reliability of data comes at a cost to society.

In discussion of the effective allocation of information resources to meet private and public sector needs, the focus is on public information agents' role, public information's value as measured by market price reaction, and the distinction between public data and public information. Many economists beleive that more information is preferred to less, and that private information providers continue to utilize public data, but not exclusively, for creating private information. This chapter provides a brief review of the relevant literature on how information affects markets, a review of studies related to market efficiency and public information, and a review of studies assessing the role of public information and data. Throughout the chapter, anecdotal examples assist in telling the story of the relationship between public information and market institutions. The chapter concludes with thoughts related to future balance between private and public information and to public–private information collaborations.

History of Public Information in Agriculture

Public information and access to public information has been a steadfast part of American history and helps to remind us of where we have been and where we might be heading as a society, as an industry, or as a business. Technological innovations have strong implications for information and data collection and delivery methods. Note the distinction here between information and data. Information is developed from data, and the agenda for what data to collect is regularly dictated by the type of information sought. The divergent information segments then flow to the market where market participants assess and digest the information. The market, as an institution within the value chain, is dynamic in that participants, industry structure, consumer demands, and geographical scope change over time so that resources are allocated efficiently to ensure market efficiency. The availability of diverse data

Table 14.1 Summary statistics from survey of journal articles relative to the use of data, public data, and USDA data

	(%) of articles referencing data[a]	(%) of articles referencing public data[b]	(%) of articles referencing USDA data
1980			
AJAE	78	54	30
JARE	86	52	19
FDRS	50	21	11
1990			
AJAE	80	51	21
JARE	100	74	39
FDRS	57	34	18
2000			
AJAE	81	46	22
JARE	88	76	53
FDRS	71	32	19
2008			
AJAE	83	61	24
JARE	85	56	26
FDRS	85	44	29

[a]Data originating from both public and private sources. Examples include public data from government sources to proprietary data from private sources such as the National Panel Diary (NPD group)
[b]Examples include futures data, non-USDA government agency data, or survey data from surveys initiated by public servants

serves educational, research, policy analysis, and firm- and industry-level strategic planning objectives. Questions of data consistency (e.g., changes in data specifications to reflect industry changes) and data reliability (e.g., reporting errors, data smoothing, and representative sample size) abound when discussing data and public information. Is not the very debate over reliability and consistency of data used to develop public information a sign of value?

Zilberman and Heiman (1997) make the case for the value of agricultural economics research, and they acknowledge that resulting information outputs are closely tied to policy and technology adoption that collectively benefit agriculture. As an applied economics profession, agricultural economics is heavily data driven. We wondered how agricultural economics researcher data use has changed over time, so we conducted a survey of journal articles published in the *American Journal of Agricultural Economics*, *Journal of Agricultural and Resource Economics* (formerly *Western Journal of Agricultural Economics*), and *Journal of Food Distribution Research Society* for the years 1980, 1990, 2000, and 2008. These journals were selected because each was published during the entire time period, and they vary in scope (international, regional, and discipline) and diversity of topics (theory, applied, and strategy). The time period covered reflects a period of significant structural change throughout the profession and throughout the agricultural industry.

Survey results (Table 14.1) confirm that agricultural economists continue to rely heavily on data for publishing scholarly research (column 2) and that researchers have not reduced their dependence on public data or USDA data to test hypotheses (columns 3 and 4). Our survey of public data use does not account for the difference in the methodologies used by researcher scientists or the change in issues analyzed. However, we conclude that reliance on public and USDA data has not waned over time.

Current Provisions of Public Information

At the time of this writing, the USDA has 17 agencies, which each providing public information of relevance to agricultural markets. This information includes a host of well-known traditional products such as WASDE reports, AMS market news reports, ERS farm income and costs summaries, and NASS census of agriculture. Over time, the USDA has also added public information relevant to new social concerns. For instance, USDA's Food Safety and Inspection Service (FSIS) provides food recall data; USDA's Animal and Plant Health Inspection Service (APHIS) provides data on BSE (Bovine Spongiform Encephalopathy) surveillance programs; and USDA's Grain Inspection, Packers and Stockyards Administration (GIPSA) provides information regarding US standards being met on a host of agricultural commodities.

The availability of agriculture-related public data can be traced to the first US census in 1790, though specific enumeration of agriculture began with the 1840 census of agriculture (see historical years in http://www.agcensus.usda.gov). The US Census Bureau expanded on this initial census survey and continued to conduct the agricultural census until 1992 when the census administration was passed to USDA's NASS. The 1997 US Census of Agriculture was the first conducted and published by NASS. The USDA was formed in 1862 by then President Lincoln, and in the year following, the Division of Statistics was formed to track agricultural data. The Office of Farm Management was organized in 1905. The Bureau of Agricultural Economics, which is known today as the ERS, was established in 1922. The first Agricultural Outlook Forum was held in 1923, and it brought together the most important authorities in agriculture, a tradition the remains in force today. Other USDA agencies serve an equally important role of providing data and reports including producer [e.g., ARMS and National Animal Health Monitoring System (NAHMS)] and agribusiness surveys (e.g., NASS ethanol industry trends), food recalls (e.g., FSIS meat recalls), mandated price reporting (e.g., AMS lamb mandatory price reporting), special congressional reports (e.g., wholesale pork mandatory price reporting assessment by AMS), market summary reports [e.g., AMS Oklahoma City feeder cattle summary or river terminal crop prices or USDA Foreign Agricultural Service (FAS) export intentions summary], or privately purchased data (e.g., ERS retail meat price series from scanner data).

State-level departments of agriculture contribute or collaborate to ensure the availability of local or regional information. Examples of state and local information include the reporting of local sale barn prices and volume, retail fish market prices, or biofuel coproduct prices. All branches and levels of government make available data and information for public access. These include federal agencies, such as the Environmental Protection Agency, Department of Energy, Department of the Interior, Forest Service, or National Park Service, or global governmental agencies, such as the World Bank, the Food and Agriculture Organization of the United Nations. They play an important role in making available public data and information for use by all persons, including agricultural economists.

Impacts of Information on Markets and Knowledge

The study of interrelationships between information and the performance of agricultural commodity markets has a long-standing tradition of assessing the effect that information has on market prices. The approach is appropriate in (perfectly) competitive price-mediated markets, where prices are reflective of supply and demand, and only a handful of informed traders are necessary to arbitrage prices to true values and thereby allocate assets optimally (Grossman and Stiglitz 1976). However, as market concentration, product differentiation, and alternative marketing arrangement use increases, other concerns and informational needs come to the forefront.

The effects of information on market prices provide a proxy for effects on market institutions and the marketing system. Grossman and Stiglitz (1976) noted that the assumption of perfect competition is convenient because a handful of informed traders performing arbitrage make prices reflect true values, and price signals thereby allocate assets optimally. Hayek (1945) concluded that the importance of prices depends on the cost of information acquisition. When information is not costly (as in a perfectly competitive market), information will have little real value. This argument was formalized by Fama (1970, 1991) in his development of the efficient market hypothesis.

Fama's efficient market hypothesis provides the theoretical principles underlying the analysis of market response to information, and the theoretical underpinnings of the efficient market hypothesis lie with the belief that investors have rational expectations (Muth 1961). The underlying premise of the efficient market hypothesis asks "To what degree do prices reflect available information?" An efficient market, in which prices reflect market equilibrium for a point in time, will "fully reflect" all available information (Fama 1970). Fama supported his argument by analyzing investment return anomalies. He defined three levels of market efficiency tests: strong-, semi-strong-, and weak-form.

Weak-form tests refer to a data series reflecting only historical trends. Semi-strong-form tests refer to a data series that reflects, in addition to weak-form qualities, all available public information. Strong-form tests refer to a data series that reflects, in addition to weak- and semi-strong-form qualities, access to proprietary information. Subsequent higher levels of market efficiency, if available, would then yield noncompetitive rates of return. The strong-form efficient market model refers to a market where all available information is reflected (Fama 1991). Disproving that a market is strong-form efficient serves as the base premise, i.e., the market is strong form unless proven otherwise.

While extension and research marketing economists generally perceive the efficient market hypothesis to not hold for commodity futures markets (Parcell et al. 1999), the efficient market hypothesis is supported for agricultural commodity markets in general (for example, see Bessler and Brandt 1992; Garcia et al. 1988; Kastens and Schroeder 1995, 1996; Kolb 1992), and research generally indicates that commodity futures markets forecast better than extension economists (e.g., Colino and Irwin 2010; Kastens et al. 1998) and sophisticated econometric models (Park and Irwin 2010; Just and Rausser 1981). Tomek and Robinson (1990) note that futures markets are not perfect but are generally competitive. They also note that exchange-imposed trading price change limits allow traders ample time to assess new "radical" information. Their summary also notes that though the statistical evidence of futures market efficiency is mixed, the model development costs prohibit traders from adequately profiting in the long term from short-term market inefficiency (Rausser and Carter 1983). They conclude their summary of how information affects market prices by noting that the agriculture industry's dynamics and biological lag factor mean that information affects prices differently depending on the time of season and the relative size of inventories.

Grossman and Stiglitz (1976) identified that the value of information is high when no one is informed, and the value of information is low when everyone is informed. They further argued that the marginal individual must be indifferent from being informed versus uniformed because for that individual, the marginal utility of being informed is equal to the acquisition, analytical, and interpretation cost of being informed. Thus, there is a fraction of society for which the marginal utility exceeds the marginal cost from access to public information. Or, the specialization by traders provides for diverse knowledge and diverse perceptions (Working 1958, 1967). Even for competitive markets, Grossman and Stiglitz (1976) concluded, prices and allocations will be imperfect because of arbitrage costs, and for decentralized governments, bureaucratic costs will cause market imperfection. Thus, neither a centralized nor a decentralized organization will be efficient in the face of costs.

The Impact of Market Information on Market Prices

The market price discovery process occurs when participants have divergent opinions for how to interpret information. Divergent interpretations lead to consensus views and market equilibrium. Because opinions are dynamic, the consensus view is dynamic and constantly changing. See Irwin et al. (2002) for an example of how professional commodity market advisers market strategy recommendations change over time. Information affects market institutions by adjusting beliefs and perceptions held before the release of the new information, commonly referred to as updating. Devine and Marion (1979) use experimental economics to show how information corrects for market imperfections. To determine if consumers respond to information, they offered consumers information for stores that offer price differences for homogeneous products. They find product prices adjust in response to demand, or

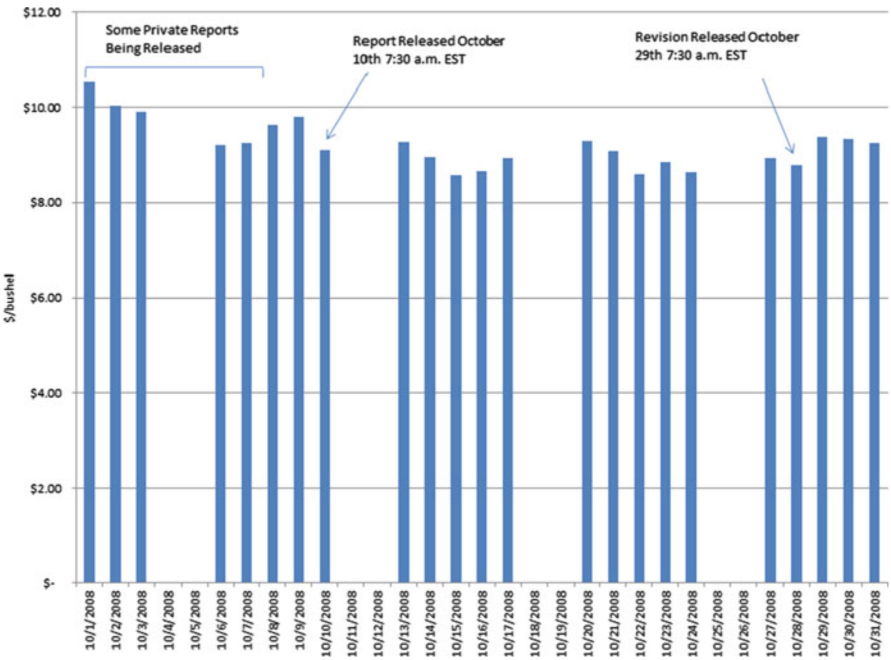

Fig. 14.2 Timeline of USDA crop report release and revision and Chicago Mercantile Exchange nearby soybean futures contract prices for October 2008

lack of demand for the product. Other instances of questioning reported data have led to report revisions. For example, the USDA NASS released a revised report 18 days after the initial report for the October 2008 crop production estimates. The soybean market, and competing crop markets, responded immediately to this update (Fig. 14.2). The point being, USDA information is observed by market participants, and market prices respond. Academics may see this reporting fault as the perfect experiment to prove a hypothesis and find positive long-term value to society, the value of the reporting fault to society is negative in the short run. But, does the new public information consistently affect market price levels, or is this information already factored into the market prior to the report? Before reviewing literature on price response to public releases of information, consider a process example.

This example follows the release of the September 2010 USDA NASS Crop Production Report and WASDE World Supply and Demand Outlook on September 10, 2010. Market participants position themselves (balance risks through buying and selling futures contracts versus cash obligations) relative to the expectations for the report. For up to 2 weeks prior to the report release, a series of private firm pre-report estimates are released (Table 14.2). The prereport estimates offer fodder for speculation as to the relative level of USDA values versus private firm estimates (Table 14.3). On September 10, 2010, the USDA Crop Production Report is released, and market advisers begin to offer comment as to futures market price direction in response to the new information (Table 14.4). Most important is the price level

Table 14.2 September 2010 USDA NASS Crop Production prereport estimate profile released by private firms up to 2 weeks prior to the September 10, 2008, report date

	Corn production	Corn yield	Soy production	Soy yield
ABN Amro	13.325	164.5	3.448	44.2
ADM Inv Services	13.251	164.0	3.433	44.0
AgResource	13.032	160.9	3.360	43.4
AgriSource	13.170	162.6	3.397	43.6
Agrivisor	13.204	163.0	3.373	43.3
Allendale	13.147	162.3	3.370	43.2
Citigroup	13.410	165.9	3.403	43.8
Doane	13.282	164.3	3.400	43.7
Farm Futures	13.203	163.0	3.430	44.1
FC Stone	13.195	162.9	3.390	43.5
Globl Cmd Anlytics	13.165	161.8	3.361	43.2
Informa	13.349	164.8	3.437	44.1
Kropf and Love	13.245	163.0	3.354	43.0
Linn Group	13.016	160.7	3.399	43.6
Midco	13.145	162.7	3.372	43.3
Midwest Mkt Solutn	n/a	163.5	n/a	44.1
N. Am Risk Mgmt	13.164	162.5	3.392	43.5
Newedge	13.156	162.8	3.395	43.7
PFG Best	13.210	164.4	3.390	43.8
Prime Ag	13.365	165.0	3.471	44.5
Pro Farmer	13.290	164.1	3.500	44.9
Prudential Bache	13.200	162.9	3.433	44.0
Risk Mgmt Comm	12.880	160.0	3.360	43.5
RJ O'Brien	13.132	162.1	3.450	44.2
US Commodities	13.244	163.5	3.417	43.8

Table 14.3 Anticipation of USDA crop production report proceeding the September 10, 2008 report date (Newsome 2010)

US crop production (million bushels) 2010–2011						
	USDA September	Private estimates Average	High	Low	USDA August	USDA 2009–2010
Corn		13,199	13,410	12,880	13,365	13,110
Soybeans		3,406	3,500	3,354	3,433	3,359
US average yield (bushels per acre) 2010–2011						
Corn		163.1	165.9	160.0	165.0	164.7
Soybeans		43.8	44.9	43.0	44.0	44.0

OMAHA (DTN)—Normally, USDA's September Crop Production and World Agricultural Supply and Demand Estimates (WASDE) reports receive little fanfare, suffering from "Middle-Child Syndrome" compared to the much-ballyhooed August (first official field surveys) and October (month of the many surprise revisions) reports. However, this year could be an exception, given the hugely debated production estimates for US corn and soybeans and the ongoing tightening of world coarse grain and wheat fundamentals

The reports will be released at 7:30 a.m. CDT on Friday (September 9, 2010)

On the domestic side, the most logical place to start is expected production as a function of yield. For the time being, it seems acreage has been put on the back burner, to be taken up again in the October report. That being the case, both US corn and soybean production projections are expected to decrease, according to prereport estimates

Darrin Newsome, DTN Senior Analyst, September 8, 2010

Table 14.4 USDA Crop Production report released at 7:30 a.m. EST September 10, 2010 (shaded cells reflect report totals versus estimates and prior USDA values)

US crop production (million bushels) 2010–2011						
	USDA	Private estimates			USDA	USDA
	September	Average	High	Low	August	2009–2010
Corn	13,160	13,199	13,410	12,880	13,365	13,110
Soybeans	3,483	3,406	3,500	3,354	3,433	3,359
US average yield (bushels per acre) 2010–2011						
Corn	162.5	163.1	165.9	160.0	165.0	164.7
Soybeans	44.7	43.8	44.9	43.0	44.0	44.0

This morning's USDA numbers are seen as being supportive for corn, negative for beans, and neutral for wheat. The USDA pegged corn yield slightly below the average trade guess, but still well above recent estimates from many private groups. There was nothing surprising in the numbers for corn demand. World carryout down 3.64 mmt. After a $1.20+ rally since the June 30 report, it is tough to say that this morning's numbers justify higher prices initially

A solid increase in soybean yield kept carryout projections above analyst estimates. World soybean carryout down 1.12 mmt. An increase in bean export demand is friendly; however, the production increase really makes it a nonissue. Beans should trade lower today barring any major rally in corn or wheat

Wheat carryout fell modestly and was slightly below the average trade guess. World wheat carryout up over 3 mmt. This morning's numbers should be seen as mostly neutral for wheat. Look for another wide trading range today

Via Agweb.com comments and Joe Vaclavik and Doug Bergman, Advantage Grain

response to the market information (Fig. 14.3). As one can see from viewing Table 14.4 and Fig. 14.3, it is difficult to extract whether the release of the USDA information had any direct impact on the corn market price for the day of the release beyond the general uptrend in the market price. Might have the USDA Crop Production Report confirmed this price trend? Agricultural economics researchers analyzing the impact of public information capture futures price data, prior market sentiment, and released data, to evaluate the total (not just one day) effect that specific information has on market prices.

Information Affects Prices

The impact of information is often measured relative to the improved accuracy of a forecast. Commodity futures markets represent one type of such forecast model, for which it is relatively easy to evaluate information effects on forecast accuracy and market price bias. Commodity futures market contract prices are important for most agricultural value-chain participants because firms base short-term buy and sell decisions on expected prices and resource allocation decisions using deferred prices. Stein (1981) shows that the optimality of resource allocation depends on the accuracy of the forecast at the time a decision is made. As Armstrong (1985) notes, the value of improving forecast accuracy depends on what decisions are affected and the current level of forecast accuracy. However, Clement (1999) argues that stable

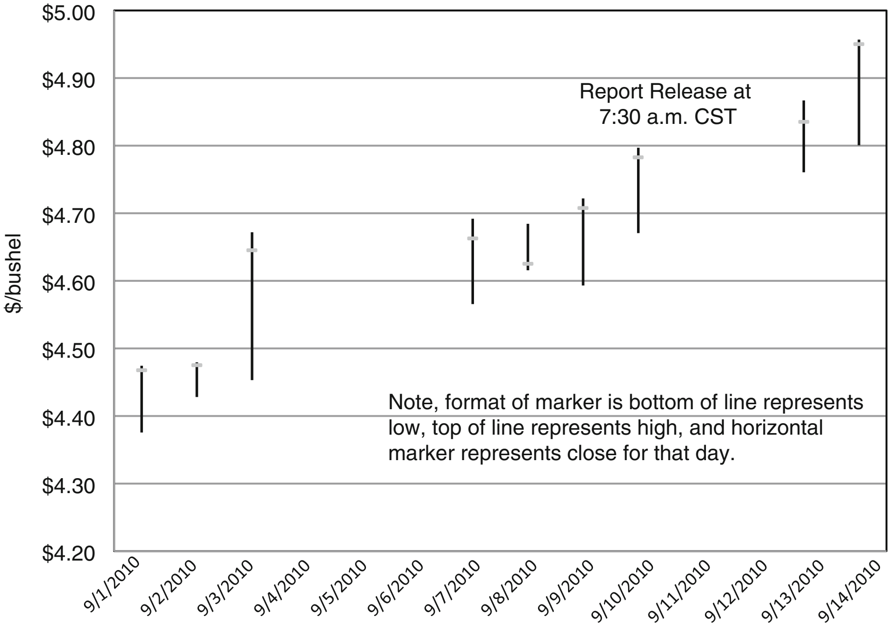

Fig. 14.3 Tracking the Chicago Mercantile Exchange December corn futures September 1–14, 2010

forecasts protect the credibility of forecasters (Isengildina et al. 2004), and Nordhaus (1987) theorizes that public servants may purposefully smooth forecasts so not to report unstable results.

Extensive literature exists on the evaluation of futures price response to information from public crop report releases (e.g., Colling et al. 1996; Patterson and Brorsen 1993; Fortenbery and Sumner 1993; and Kastens and Schroeder 1996), for public livestock reports (e.g., Colling and Irwin 1990; Grunewald et al. 1993; Schroeder et al. 1990) and for additional commodity reports (e.g., Baur and Orazem 1994; Roll 1984; Ward and Kilmer 1989). Readers interested in how information affects market prices are encouraged to review proceedings papers from the NCCC-134 Applied Commodity Price Analysis, Forecasting, and Market Risk Management annual research conference. The most typical conceptual model is to test market price efficiency by analyzing futures market price changes. As we have previously noted, the general consensus from the literature is that markets are efficient. Therefore, commodity futures market price responses to information, and not just public information, are generally limited.

Accuracy in agricultural forecasts is similarly of high importance. Economists have a long history of assessing USDA forecasts in terms of information content (Carter and Galopin 1993), accuracy (Kastens et al. 1998), and market impact (Sumner and Mueller 1989), dating back more than one half century to Baker and Paarlberg (1952). Gunnelson et al. (1972) found crop forecasts to have improved from 1929 to 1970, but they also concluded that the USDA tends to underestimate crop size and year-over-year production changes, and it tends to under compensate for errors in prior forecasts when making revisions. Good and Irwin (2003) found the forecast accuracy between 1970 and 2003 is consistent for both corn and soybeans. They also found that USDA corn production forecasts are more accurate than private firm forecasts for the time period and that private firm soybean production forecasts are more accurate than USDA soybean production forecasts early in the growing season. A concise summary of this work would be that USDA forecasts provide incremental information that influences agricultural markets. It should be noted that multiple studies suggest futures market-based forecasts are more accurate than those provided by the USDA. However, it is important to further note that futures markets inherently reflect information provided by the USDA as the futures markets internalize all available information (private and public) as the "longs" and "shorts" engage in futures market transactions (Manfredo and Sanders 2004). Moreover, agricultural sectors operating without futures market forecasts available to them may benefit from well-devised forecasts from the USDA (Manfredo and Sanders 2004). Accordingly, the role of USDA information in agricultural markets, even for commodities with sound futures markets, should not be quickly dismissed.

A markedly smaller body of research exists on the influences of private information. Here, a number of studies on the impacts of public announcements by private firms are reviewed. Research by Lusk and Schroeder (2002), Parcell and Kalaitzandonakes (2004), and Robenstein and Thurman (1996) offer examples of how firm-level information sharing, in the form of public releases and media announcements, affect market prices. Lusk and Schroeder (2002) found that meat recall announcements had little impact on livestock futures prices. Parcell and Kalaitzandonakes (2004) found no evidence that firm-level bans against bioengineered crops significantly influenced domestic soybean futures prices and the Tokyo Grain Exchange conventional and non-GMO futures prices. For a portfolio of livestock futures contracts, Robenstein and Thurman (1996) found no statistically significant price adjustment to media announcements associating concerns of heart health with red meat consumption. These three studies are examples of the broader research interest in how information released to the public by the private sector affects price levels. Next, consider the impact of public information on market price levels.

Information Affects Knowledge

The type of information provided by the USDA and its market impact has certainly changed over time. With the transition from commodity to value added or differentiated products has come growth in the use of alternative marketing arrangements and erosion of traditional price-coordinated spot markets for some agricultural products. In relation to efficiency measures, these events have generated concern that reported spot prices may no longer be reflective of actual trade and raise questions about efficiency measures.

Such occurrences have been particularly evident in the livestock industry and have resulted in changes in public information provision to inform and monitor these markets. Availability and analysis of voluntarily reported market prices and receipts in thinning markets for cattle and hogs provide insights regarding current and future reliability of market prices as representative of industry trade (Tomek 1980; Franken and Parcell 2011). Koontz and Ward (2011) provide a detailed summary of research outputs related to voluntary and mandatory price reporting. Livestock voluntary price reporting preceded the 1999 Mandatory Price Reporting Act (MPR). Voluntary price reporting is based on the premise that sellers report in good faith, sales volume and price for separate transactions to the AMS, USDA. Transactions may be confirmed with buyers and all transactions for a reporting period are aggregated to keep reported information confidential. By definition, voluntary price reporting allows any seller to opt out of reporting all together or opt out of reporting certain transactions. Livestock mandatory price reporting requires that all transactions be reported. Primary support for mandatory price reporting is that no transaction goes unreported and the public views price and sales information reported from mandatory collection of data to be unbiased and representative.

Enactment of MPR for large markets in these sectors may have enhanced market participants' reliance on and trust in some spot price series. Pendell and Schroeder (2006) find improved price responsiveness to supply and demand shocks among spatially dispersed cattle markets following MPR. Franken et al. (2010) find evidence that pricing in declining volume hog markets stems from price discovery in the mandatorily reported Iowa–Southern Minnesota regional market. Additionally, a study by Lee et al. (2010) indicates that MPR of alternative marketing arrangement prices for cattle and hogs may have shifted market participants' focus to these reports as sources of reliable market information. Analyses of USDA ARMS data indicate that production contracting arrangements in the hog industry increase total factor productivity (Key and McBride 2003), and regulations limiting the use of such contracts would impose substantial welfare losses on risk-averse producers (Zheng et al. 2008), which speaks to concerns about allocative and distributive efficiencies.

Regardless, if livestock transaction data is reported voluntarily or required under congressional mandate, many factors have to be taken into account when creating reporting and interpreting information from the data. Only relevant and viable data should be used to create informational reports. For example, a load for pork or beef trade refers to 40,000 pounds. This is a typical transaction quantity unit. Small buyers or quick sales are negotiated for quantities less than a load, and these transactions may have the bias of representing product unrepresentative of typical trade. Thus, it is important to filter such transactions out of the data. Or, if the data contains many international transactions where the cost of business is different and the product is priced differently, then these transactions must be filtered to allow for information that is reflective of transactions for the relevant market, i.e., North American trade. Consider that price data is reported as a plant price. Meat production across the United States, but a national report aggregates across location. Suppose a morning report has 60% of transactions based on west coast processors and the afternoon report has 60% of transactions based on east coast processors. As you can envision, price change may be representative of more than supply–demand factors. The above discussion is used to illustrate the complexity of converting data into useful information and the challenges of interpreting data to draw conclusions for strategic planning.

Another "hot topic" example is the impact of recall information provided by the USDA's FSIS. For instance, Marsh et al. (2004) found meat demand to be adversely influenced by FSIS recall announcements. This example illustrates the impact that USDA information can have on factors besides expected production quantities, annual prices, and others of traditional interest. In particular, the USDA is increasingly providing information that may impact consumer perceptions of agricultural product quality and may, hence, influence agricultural markets (Tonsor et al. 2010).

Agricultural economists are broad creators of public information, which helps to facilitate and validate new theories, oftentimes using public data but also relying on private data at times. Fredrick Waugh (1928), a US government employee, for example, surveyed farmers' market vendors to examine the price variability across different ranges of a set of quality attributes. Waugh's research on the price–characteristic relationship for tomatoes is one of the earliest research pieces for what is known today as the hedonic pricing model (Ladd and Martin 1976; Ladd and Suvannunt 1976; Rosen 1974). Zvi Griliches (1957) utilized public USDA information to empirically prove his theory of technological innovation in agriculture. Nineteenth century agricultural policy researchers used public data to provide credibility to the analysis of policy implications (e.g., Tweeten 1980) and to examine the role of market functions (e.g., Breimyer 1957). These studies represent a small sample of past research that uses public data to develop public information, empirically verify new theories, or motivate policy changes. All studies ultimately lead to implications for explaining or predicting institutional market changes.

Anderson et al. (1998) examine the effects of limiting information on cattle prices by conducting experiments using the Fed Cattle Market Simulator. They find that reducing information creates inefficiencies and increases price variability. They find that a loss of market information leads to diminished technical/productive efficiency within the beef value chain and that allocative efficiency may erode over time. Their results are particularly interesting because their data are derived from in-class observations of student actions. This is a quintessential example of how information impacts knowledge and learning.

Future of Public Information Provisions

Public information is broad in scope, ranging from corporate quarterly earnings reports (e.g., John Deere earnings outlook), SEC filings (e.g., Berkshire Hathaway stock sale or purchase), news of a firm on industry innovation (e.g., iPhone 4), tragedy (e.g., Deepwater Horizon explosion), surveys from the private sector [e.g., Pro farmer/John Deere crop tour or monthly National Oilseed Processors Association (NOPA) oilseed crush report], private sector outlook reports (e.g., Informa Economics Crop Production forecast), and reports from government agencies (e.g., NASS monthly hogs and pigs report, monthly WASDE global supply and demand crop outlook, AMS weekly mandatory price reporting live cattle price and volume summary, NASS cattle on feed reports, or FAS export intentions). Each public information source listed provides society with free access to information, but interpretation and evaluation is not costless. And, is the right information being developed?

Transactions occur at each level of the agricultural marketing system, where buyers and sellers set prices for a given level of product quantity for a set quality. The twenty-first century industrialization of agriculture adds substantially to the number of transactions as commodities flow from producers to end-users and consumers as multitudes of food, fiber, fuel, health, and industrial products (Schrimper 2001). As the number of levels in the marketing system increases and as the number of differentiated products increases, the cost of collecting sufficient data to accommodate all value chains and marketing system levels is beyond budgetary justification. The historical argument for sustaining historical data availability (AAEA Data Task Force 1999) seems almost mute relative to the question of which data series to maintain to meet future needs and effectively deliver public information to meet societal demands.

The value of public information is well researched and debated (e.g., Hayami and Peterson 1972; Smith and Scherr 1973; Farrell 2006; Gardner 1997; Just 1983; Schneeberger 1982). And, this line of literature has spawned an entirely new research agenda for those interested in how agricultural marketing system participants value private versus public data and their preferred sources of data (e.g., Fausti et al. 2007; Just et al. 2002; Salin et al. 1998; Schroeder et al. 1998). Hopefully, this chapter has added to the debate and now seeks to leave the reader with some final thoughts for how to improve public information availability in the future.

Public Data and Information

> [Ninety-five percent] of the information our firm provides to clientele originates from public (USDA) data sources and the other 5 [percent] of information is from proprietary data. While the 5 [percent] proprietary data differentiates our firm from the competition, it is the business' presentation of the public data that makes our firm.
>
> Paraphrased from Anonymous Consultant, 2008

This statement seems to reflect the general consensus among private and non-governmental public information providers. Access to data seems to be the critical factor, but we also note there are potential pitfalls associated with the mandated information collection. If so, an important consideration moving forward is to ensure the appropriate data are being collected for both public and private entities to generate adequate information to maximize the distribution of welfare benefits relative to the costs associated with data collection and processing.

Even as the domestic agriculture industry changes due to consolidation, vertical integration, vertical coordination, consumer preference, and globalization, access to public data is critical for developing baseline analyses and confirming observed trends or structural shifts. For example, researchers with the multi-institutional Food and Agricultural Policy Research Institute rely heavily on access to public data to develop long-term forecast models and accurately assess policy implications. The five data issues discussed below will increasingly shape the quantity and quality of public information.

Confidentiality

USDA confidential data restrictions can lead to biased information. USDA data users have become far too acquainted with the notation (D), which indicates USDA cannot publish data due to confidentiality restrictions. For fast-changing industries, e.g., pork and poultry, the exchange from a reportable value to (D) may happen at any time. Unavailability of such data can bias information derived from the data. Although understanding the need for confidentiality, it seems logical to assume industry insiders are keenly aware of a competitor's production and business footprint in the agriculture industry. If that assumption is true, then society is worse off by not having access to the confidential data. Moreover, the specific details required to protect confidentiality likely vary across agriculture industries. Accordingly, additional information is needed to assess the benefit and harm to society created by modifying current USDA confidentiality regulations. Such information could be made available only to academic and governmental research professionals who sign confidentiality agreements. Such release would allow these individuals to make policy recommendations based on the data but not disclose individual firm data.

Thin Markets

Thin markets lower the power of hypothesis testing. Anderson et al. (2007) express concern as to whether cash market transactions accurately reflect the market for sectors heavily reliant on alternative marketing agreement use. Congressional creation of the Livestock Mandatory Price Reporting Act of 1999 has alleviated some of this concern for the meat sector, but many agricultural sectors still lack publicly available transaction data. Other private firms, such as Urner Barry, have become more important for facilitating price discovery within thin markets. However, interaction with wholesale pork primal buyers and sellers found consensus that USDA AMS voluntary pork primal price reporting is the established contract base price even though some AMS pork primal price quotes represent less than 5% of trade for the week and some reported pork primal prices go unchanged for weeks at a time. Industry participants seem to trust and prefer publicly released price data, but they use private data sources as a means of checks and balances.

Consistency

Consistency of data as product form changes may bias information. For some agriculture commodities and products, product form changes substantially over time. Thus, a historical price series may not be reflective for developing current information or laying out further scenarios. Moulton (2001) lays out the hedonic model framework used by the Division of Labor's Bureau of Labor Statistics for computing deflator indexes. These indexes deflated nearly 20% of US GDP final expenditures for that time period, and this percentage has increased. Why has not the agricultural economics research community adopted similar practices in plotting historical prices or price indices? Similarly, commodity product form changes over time to reflect market supply–demand forces. For example, a review of the American Soybean Association's annual soybean quality reports finds a strong upward trend in percent oil content per bushel from 2003 to 2009. The average soybean bushel today is not the same as the average soybean bushel 6 years ago. Thus, soybean prices in 2003 and 2009 reflect the same commodity, but the commodity's inherent characteristic levels have changed over time. This suggests the need for more agricultural economics research that assesses the effects and validity of adjusting prices for commodity quality levels over time.

Relevance

Relevance of data allows for timeliness of information. Agricultural economists, as social scientists, incorporate perceptions, demographic factors, risk preferences, and general attitudes into their research. The speed by which agricultural economists conduct research is paramount for addressing policy issues, studying market participant behaviors, assessing technical efficiency innovations, and ensuring allocative efficiency. There are almost 6,000 US farmers markets, but there is no mass collection of vendor or transaction data to develop rigorous economic evaluation on a routine basis. For example, Hahn et al. (2009) find that though proprietary retail meat price scanner data provides more price information than the US Department of Labor's Bureau of Labor Statistics retail meat price series, access and timeliness issues with the proprietary scanner data cause the information to be less useful. Alternatively, Roberts and Schimmelpfennig (2006) find considerable value from real-time information, provided via a web-based information platform, related to the potential for soybean rust outbreaks. This suggests that USDA facilitate and support the development of electronic means to gather and distribute information. Some agencies may develop survey instruments to track perceptions and attitudes over time. Perhaps it is time that the Agricultural and Applied Economics Association membership, in conjunction with USDA personnel, again convene a Data Task Force to assess the current and future relevance of USDA data.

Globalization

The *Globalization* of agricultural market institutions increases the impact that global supply–demand factors have on the performance of domestic markets and the operations of market institutions. Two well-documented examples give credence to the need for global-based information enhancement. In 2009, nearly 20% of US pork production was exported, up from 1% in 1984. The marketing year 2009 soybean exports to domestic soybean production ratio was 44%, which compares to a level of 32% in 1984, but the price level today is 161% of the price level in 1984. Global trade of fruit, nuts, and vegetables is increasingly more dramatic. Domestic market price response is not only tied to domestic factors but also global economic factors. This suggests that an increase in the quality and reliability of public global price and supply–demand information collection and reporting, will have a positive net welfare gain to society.

Information and a New Society

This chapter concludes with thoughts on six alternative approaches for sustaining the public–private data access and information availability in the future. These approaches span the spectrum from being "fully public" to "fully private" in nature.

Public Data: Public Information

Certain USDA reports (e.g., crop production reports, WASDE forecasts, etc.) will likely maintain political support, though constrained, which will ensure their persistence into the future. There may be increased scrutiny of these forecasts' cost–benefit ratios, as most research finds market prices typically do not react to such reports. It appears that the value, through confirmation, to ensuring allocative efficiency far outweighs the cost to society for maintaining these models and publishing information. Likely characteristics of these public data, public information approaches include commodities produced over wide geographic areas (i.e., corn is produced in most US states) and operational sizes (i.e., data relevant to the cow–calf sector may persist as operations vary widely in size).

Private Data: Public Information

Like all entities, the USDA has limited resources and, at times, is best served by purchasing data from others rather than collecting them itself. One example is the USDA purchasing retail meat scanner data from private firms. As public pressure to reduce the relative resources available to the USDA mounts, these private data, public information approaches may increase in prevalence. Of course, this approach is susceptible to short-term budget shortfalls by USDA as witnessed by the current lag in retail meat scanner data purchases. Society seems more willing to accept private data with public involvement in assessing data credibility and reliability. The caveat to this information model, which is a concern as Hahn et al. (2009) note, is whether timely data delivery allows for sufficient relevance.

Public Data: Public–Private Information

An alternative approach is for public data to be compiled by non-USDA entities in a manner that adds value to the data beyond that typically provided by the USDA itself.

For instance, the Livestock Marketing Information Center (LMIC) is a cooperative effort among land grant university extension specialists, USDA economists, industry collaborators, and center staff. The LMIC provides a "one stop shop" for a host of economic education, data, and information resources that largely originate from USDA sources (i.e., public data). This resulting data and information is public–private in nature as portions are available for free use by the public, and portions are available only to subscribing parties. It is easy to envision growth in the predominance of this approach in the future for other agricultural sectors. An increase in public funding is necessary for growing this type of data–information model.

Public Data: Private Information

Several agricultural consulting firms have a competitive advantage in capturing public data upon release and converting the data into information for clientele strategic planning. Outlook firms, profiled in Table 14.2, depend on historical data for developing private crop forecasts. Other firms, e.g., Doane, Informa Economics, and Soyatech, rely on some public data for developing multiclient studies. Technology has further allowed for information innovations. InnovoSoy recently released *Global Food Demand in 3D,* which combines public data with proprietary software for putting decision makers face to face with multidimensional information delivery. This information delivery mode is unique by incorporating the psychology of new-generation learning, much like the 3D games of today, to allow for decision making. This model of data–information will likely expand in the future, and the USDA may need to consider subscribing to such services to help facilitate agency and interagency information development.

Private Data: Private Information

Given budgetary uncertainty with public data and information approaches and the increasingly complex and multifaceted relationships in most modern agriculture industries, the growth in firms collecting, generating, and dispersing data and information privately is hardly surprising. One example is CattleFax, a member-owned information organization that conducts research, gathers data, and disperses information to subscribing members. CattleFax has been carrying on this function effectively for more than 25 years, and industry participants pay to access the information. Another example is AgriStats, which serves the pork and poultry production and processing sectors with cost, profit, and productivity data. The concentration of the pork and poultry industries suggests that the fee work AgriStats provides to clientele is consistent with society expectations for clientele to pay when only a few benefit. Consistent with the role of private firms in the preceding approaches, additional growth in private data/information relationships can be anticipated in the future. However, caution suggests that government not look heavily to these private firms for data to analyze public concerns. This confidentiality issue is much different from the confidential data issue we outline in the prior subsection.

Case Studies

Case studies may provide a viable alternative for developing information that targets underserved areas of the agricultural marketing system. Data access drives a considerable public information portfolio, but case study information better fits situations of limited data, directed objective, and firm/situation centered. Hayenga (2001) recognizes the challenges of commodity research associated with differentiation and fewer data observations. He suggests case studies as a viable alternative when too few data points exist for practical analysis. He also advocates for researchers to enhance their dependence on event analysis to offset information shelf-life degradation due to markets and industries in transition. Case study development requires better individual knowledge of particular industries and situations.

Concluding Comments

Access to information and the role information plays in increasing efficiency with which market institutions function is important for how players in the marketing system convert information into profits and for how consumers benefit from lower prices and better access to goods. Information relates to sending quantity and quality signals from producer to consumer and in the form of sending payment and preference signals from consumers to producers. How information costs are allocated between the public and private sectors is a dynamic argument. The agricultural sector has, and will continue to, undergo structural change. The agricultural structural change causes continued public debate as to the cost–benefit of the need for information (benefits efficiency of market institutions) versus the want for information (oversight and monitoring of an industry sector).

Free access by society is not the same as costless to society. Data collection, data analyses, and public information development and distribution are generally paid for by taxpayers. Efficiently allocating resources in a dynamic market setting to support productive efficiency and ensure allocative efficiency are likely long-term sources of debate.

As agricultural industry diversification occurs, public information providers must rethink their efforts. Researcher roles seem to already be changing by redefining the future of collaborative efforts [see Boland and Akridge (2004) for a discussion of how departments must play niche roles in agribusiness], changing curriculum objectives [see Boland and Daniel (1999) for a discussion of what employers seek in new employees], and facilitating new research relationships [see Schroeder (2004) for a discussion of how academics might leverage consulting opportunities as part of their academic responsibility].

Agricultural sector cost–benefit research on public or private information has not been conducted to date. Hayenga (1979) issues the challenge for agricultural researchers to examine the necessary sample size for relevance in decision making in the agricultural industry. No researcher has yet to respond to his challenge, yet each year public debate of thin markets and structural change continues. The credibility of the decision-making process is often data drive, and often the decision-making process is criticized for a lack of data. Where is the point in which insufficient data exists to reach objective decisions? Henderson et al. (1983) provide the most recent overview of the challenge with maintaining public information and the effect of structural change on the quality and relevance of public information. Their thoughts pertained to public price reporting. More recently, Koontz and Ward (2011) reviewed the public price reporting literature for voluntary and mandatory livestock price reporting. Both manuscripts offer thought-provoking insights as to the industry value, societal impacts and unintended consequences of public price reporting. However, the breadth of public information is far greater than public price reporting and is much broader than prices. More research is necessary to expand on the value of information.

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Chapter 15
The Policy of Risk Management

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Abstract Agricultural and food production is fundamentally different than other forms of production in the economy, and the differences require alternate methods of risk management. This chapter reviews the primary tools available to producers for the management of price and quantity risk, including insurance, government programs, and market-based instruments. Each of these tools is explained in both historical context and for how it impacts on market function. Current controversies in policy and markets and marketing are then discussed, as are recent research findings and proposed solutions. Some of the controversies addressed are the impact of speculation, packer ownership of cattle, and planting restrictions for decoupled payments.

The peculiarities of agricultural production dictate that risks be managed, and governed, differently from other industries. Risk is randomness in quantity, quality, and price outcomes that makes a difference to those involved. Most individuals and businesses are risk averse, meaning that they prefer certainty over randomness when things are otherwise the same.

The production and distribution of food has often been treated differently than that of other commodities. As food is a necessary ingredient to life, there is an emotional dimension to the different treatment, but there are also economic reasons that production and distribution of food should be treated, if not differently, at least as exceptions to other goods and services. There are many reasons that food and agricultural production can be viewed differently than other products:

- Most foodstuffs degrade with storage
- Output risk is a very real component of the risks faced by agricultural producers

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- Output realizations are often highly correlated across producers, meaning that local production shocks typically imply that regional or national production shocks are more likely
- Demand is inelastic, so shocks have recognizable price impacts
- Production of many agricultural goods is annual, but consumption is continual, and therefore storage is required for year-round availability
- Much of the expenditure for production is spent early in the production cycle, and only weeks or months later does the harvest occur
- Food commodities can be a vector of disease transmission

The risk involved in this set of factors and the price volatility that results create difficulty not only for producers but for all members of the value chain. Processors must worry about pricing as well as inventory risks. Price volatility can affect consumers, especially the poor, as increased prices reduce the budget share available for nonfood purchases. For these reasons, specific mechanisms have evolved in agricultural markets to transfer and mitigate price and production risk.

The risk management options offered to the food system, especially the producers of basic agricultural commodities, are more varied than those of nearly any other industry. In fact, many of the risk management tools currently enjoyed by other commodity and financial industries had their genesis in agricultural production—Aristotle referred to what are now known as option contracts in Book I of *Politics*. Futures markets, as they are now known, originated with the trading of grains in Chicago and rice in Tokyo in the nineteenth century. Only later were such contracts extended to other commodities and financial instruments. Now, a decade into the twenty-first century, the markets for financial derivatives are much larger than the agricultural derivatives markets.

Until the late 1990s, most of the risk management options available to producers were either production based, insurance based upon realized production, or price based, which allowed producers to "lock-in" prices. Beginning in the 1990s, a new class of insurance products became available that insured revenue risk—the total revenue of the operation. These insurance policies were an important advance, as previous "price only" or "yield only" contracts could not account for the "natural hedge"—the fact that when yields were decreased, prices tended to increase, partially offsetting the loss. By insuring only price or yield, the production risk faced by the producer was underinsured. By insuring both price and yield separately instead of revenue, risks were over-insured.

Insurance

Farmers in 2010 have more tools than ever to manage the production and price risk that they face. Farmers today can also manage the risk of production for more crops than ever before. With whole-farm insurance, almost all production and price risk can finally be insured at some level. But the tools available, the cost of coverage, and the ability to manage risk for specific products still vary dramatically by sector. Broadly the availability of insurance improves farmer outcomes. By pooling risk among producers, insurance permits farmers to spread negative outcomes, and approach production with less need to manage in a highly risk averse, and therefore, less productive, manner. Producers of program row crops, such as corn, soybeans, wheat, and cotton, continue to have the most options and the lowest coverage prices, while livestock and specialty crop producers have significantly less ability to manage their risks. Insurance itself provides an important tool, and increases the technical and allocative efficiency of agricultural markets. By pooling risk, producers can behave in a more risk-neutral manner when it comes to production decisions, and respond to market price signals more quickly. However, the current coverage of the insurance types offered creates some nonmarket inefficiencies, namely, that the products offered for row crop production are much more varied in their structure than those for fruits and vegetable production, and so therefore indirectly promote staple crops at the expense of more nutrient dense fruits and vegetables.

Insurance products available to row crop producers were simplified in 2010, as two revenue products, revenue assurance and crop revenue coverage, were combined into a new revenue protection product. As of this writing, there are four different insurance products offered to crop producers.

Actual Production History (APH) coverage is the most traditional form of crop insurance. The producer insures 50–75% of yield at 55–100% of a reference price set by the Risk Management Agency (RMA) of the USDA. APH indemnities are triggered solely by yield shortfalls, and therefore, APH is commonly referred to as "yield insurance." APH insures against yield losses caused by drought, flooding, hail, wind, frost, insects, and disease.

Yield Protection (YP) coverage is a variant of APH in which a "Commodity Exchange Price" is used to calculate indemnities instead of an RMA reference price. This commodity exchange price is calculated with commodity futures prices during the harvest period. This allows the price used in indemnity calculation to better match the price of lost production, in the event of large increases in crop prices throughout the growing year.

APH provides excellent protection against production losses, but it does not provide any protection against large declines in price during the growing season. For example, in a year in which the Western Corn Belt had record production, resulting in lower market prices for the nation, a producer in North Carolina who had average or slightly below average production might incur a significant revenue loss but yet not receive an indemnity under APH or YP.

Revenue Protection (RP) insures the crop revenue against losses from drought, flooding, hail, wind, frost, insects, and disease. Insured revenue per acre is calculated as the product of historical yield and the greater of the harvest futures price during the sign-up period and futures prices during the harvest period. Producers may generally insure up to 75% of their revenue. Because RP is highly tailored to the production risk of the farm, it provides the closest alignment of indemnity and loss. This comes at a cost, however, and, in general, RP plans will have the highest premium-per-dollar insured of crop insurance policies. One way to reduce the cost of RP is to use whole-farm coverage, in which the revenue target is calculated for all land and crops in a given county, diversifying the risk and lowering the premium for a given level of coverage.

An alternative method of insurance, one that not only potentially offers lower premiums but also eliminates the moral hazard potential of APH and RP plans is the Group Risk Plan (GRP). GRPs are similar to APH plans, but instead of calculating indemnities based on the farm yield shortfall, indemnities are based on the failure of the county average yield to meet its historical average. While this lowers the correlation between the payments and losses to a particular farm or field, it also significantly reduces the premium, even if the coverage level is increased to the maximum 90%. An additional advantage is that since indemnities are paid based on county-level yield, the farmer is no longer required to prove yields annually, or to maintain records at the field or farm level. Group Risk Income Protection (GRIP) is revenue insurance, similar to RP, but whose yield history and realization are based upon county-level averages, like GRP.

Livestock Gross Margin (LGM) policies are available for cattle, dairy, and swine producers. Livestock gross margin insurance provides producers of covered types of livestock with an insurance guarantee on the difference between the value of the output and feed costs—gross margin. The output price and input costs are all based on futures prices. However, LGM does not cover livestock losses, only losses in the value of the livestock due to market fluctuation. The advantage of LGM over the construction of a private-market contract for production is that LGM policies, like other policies offered by the RMA, offer a premium subsidy, which makes purchase through the RMA less expensive than a market-based instrument.

Livestock producers also have livestock risk protection (LRP) policies available. LRP policies are offered for feeder cattle, fed cattle, lamb, and swine. LRP policies indemnify producers against declines in market prices only, not against mortality or other production losses. The feeder cattle prices are based on CME futures prices. For fed cattle, lamb, and swine, prices used to calculate indemnities are based on USDA-AMS regional cash price series, in order to increase the correlation between the prices received by the producer and the prices on which the insurance policies are based.

Finally, Adjusted Gross Revenue (AGR) and AGR-Lite policies provide insurance for a farmer's Schedule F—the Internal Revenue Service form used to report farm earnings—income for commodities not coverable by other insurance programs. These programs provide producers of specialty and nontraditional crops potential protection against a variety of losses. Additionally, because the AGR and AGR-Lite are based on Schedule F revenue, they also cover production risk, not just price risk, for agricultural producers.

An important dimension of understanding crop insurance participation is the realization that many of the premiums are subsidized. The crop insurance programs administered by the RMA are required to be "actuarially sound"—have an expected payout equal to the premiums collected. But this applies to the premiums *after* premium subsidies. Over time, the subsidy rates have varied, to emphasize different priorities in RMA thinking about crop insurance. During the mid-2000s, the Group plans (GRP and GRIP) had relatively large premium subsidies, to encourage producer enrollment. This emphasis was thought to be the result of the large reduction in moral hazard in these types of plans. As pressures to reduce the US federal deficit have increased, these subsidy levels have come under increased scrutiny. From an efficiency standpoint, such a subsidy program, in which premium subsidies rise with the level of coverage, reduces allocative efficiency, as producers may be encouraged to take out higher-than-optimal levels of insurance, which may result in higher levels of risk being assumed. According to Babcock, a reversion to a pre-2000 premium subsidy scheme, in which farmers received a fixed per-acre premium subsidy, could reduce total cost of the program by up to $2 billion.

Government Programs for Risk Management in Agriculture

Through the passage of legislation, the United States has many programs that affect agricultural producers. In this section, only those programs that directly affect profit risk are discussed, such as Direct Payments (DPs), Loan Deficiency Payments (LDPs), and Milk Income Loss Contracts (MILC). Programs such as Environmental Quality Incentives Program (EQIP) and the Conservation Reserve Program (CRP), which offer payments for the provision of environmental amenities or practices, do not aim to directly affect the profitability of agriculture for its own sake, but instead to offset the cost of agricultural practices desired by the US Government and its agencies.

Row crop producers have five government programs related to profitability, Direct Payments, LDPs, Counter-Cyclical Payments (CCPs), Average Crop Revenue Election (ACRE), and Supplemental Revenue Assistance (SURE). DPs were originally known as Agricultural Market Transition Assistance (AMTA) and were introduced in the 1996 Federal Agricultural Improvement and Reform Act. They were to provide compensation to producers in exchange for ending all government programs over the life of FAIR. However, the FSRIA continued AMTA payments and renamed direct payments, as the low prices of the late 1990s eroded the political will for ending farm support. A further advantage of DPs to the writers of the FSRIA was that because they were based on historical yields and acreage allocations, they were "decoupled" from production decisions and therefore fell into a category of support payments that had no limits under the World Trade Organization, known as "green box." DPs today are fixed per-acre payments based upon the historical production of a given farm, and are paid regardless of the current use of the farm, unless it is used for fruit or vegetable production. If not for the fruit and vegetable proscription, DPs would not affect allocative efficiency, as they don't affect production decisions. However, they do adversely affect allocative efficiency, as payments are made regardless of any other decisions made by the producer.

LDPs are effectively price supports in place to guarantee minimum prices to producers of covered crops. Instead of providing an explicit guarantee to purchase the crop at a price, the LDP program makes payments to producers based on the difference between the price of the commodity when it is sold or when a loan is taken against its value and the "loan rate" or guaranteed price. One particularly controversial provision of the LDP program is that crops can be put "under loan" which fixes the price on which payments are based, without actually selling the crop. This provision gives producers the ability to set the price on which deficiencies are paid at harvest, when cash prices are lowest, and then actually selling later, when cash prices have risen. Based upon the prevailing crop prices in 2010, the guaranteed price is far below market prices, and therefore the LDP program has played little role in the agricultural policy debate since prices began rising in 2006. LDPs were always seen as highly distorting and inefficient, and have been the target of multiple WTO actions. By effectively setting a price floor, they distort price signals and encourage overproduction during periods of low prices. LDPs reduce technical and dynamic efficiency by blunting the incentive to improve production practices, and are allocatively inefficient as they can, and have, make substantial payments in high revenue years in which prices are very low but output is very high.

CCPs were reintroduced in the 2002 FSRIA to provide additional support to growers in times of low prices, ostensibly in replacement for the disaster payments made to producers in the late 1990s after the Asian currency crisis, which greatly reduced Asian demand for the US crops, and their prices. CCPs used a target price system, in which farmers were paid the difference between the target price, which was set above the cost of production, and the average annual commodity price, as determined by the USDA. The size of the direct payment was subtracted from the CCP, and the resulting per-bushel payment level was paid based on historical acreage and production levels. CCPs were claimed to be decoupled payments at the time of their inception, because they were based on historical acreage allocations and production levels. In this way, they are similar to DPs; their efficiency implications are identical to DPs.

The ACRE payment system was introduced in the 2008 Food, Conservation and Energy Act. The ACRE program is designed to assume the risk of systematic, multiyear declines in commodity demand that result in lower prices while continuously updating price levels. One criticism of previous support mechanisms, such as CCP and DP, is that the support levels are set in statute, therefore requiring action by Congress to alter them in response to changing market conditions. After the increase in commodity prices that began in 2006, CCP target prices and loan rates used to compute LDPs were far below market prices, and therefore offered little support. For each crop year, ACRE calculates a target revenue, based on state yields, and the 5-year Olympic average of prices. Payments are made to farmers if they suffer an actual yield loss and if the product of national price and state yield is below the ACRE revenue target. The use of the 5-year Olympic mean of prices prevents the prices being guaranteed by ACRE from ever becoming irrelevant if prices move upward over a number of years. This also presents the very real danger, from a producer's perspective, that prices may fall well below the cost of production over a number of years, and ACRE will not necessarily provide them long-term support. From this perspective, ACRE payments are more dynamically and allocatively efficient than LDPs, as the payment levels do not fully insulate growers from market price signals. However, they are still less allocatively and dynamically efficient than an undistorted market, as they spread large price changes over a matter of years. The fact that ACRE benefits are provided freely (even though producers must give up LDPs, CCPs, and a portion of their DPs, the producers do not bear any cost for those programs) reduces the overall allocative efficiency of the marketing system, as it underprices the risk protection that ACRE provides.

The final major Federal program to help producers manage risk is the MILC, which was introduced in the Farm Security and Rural Investment Act of 2002 and reauthorized with changes in the 2008 FCEA. After the 2008 reauthorization, MILC provides payments to milk producers based on the difference between milk prices and the price of a reference feed ration, thereby making the MILC contract a true "profit" insurance contract. Because it partially insulates producers from periods of low profitability—reducing incentives to modify methods, shrink, or expand in response to changing market conditions—MILC reduces technical and allocative efficiency.

Market-Based Instruments

Futures contracts are the oldest forms of risk management available to producers. All of the major row crops have futures contracts, in which the majority of price discovery and risk transfer occur at low transaction costs. While direct futures contract usage by farmers has typically been low, futures contracts are used by elevators to manage the risk arising from forward and hedge-to-arrive contracts. Elevators similarly use options contracts to manage the risk of "minimum price" cash contracts, which in many cases are simply repackaged options contracts whose premium is offset by the basis differential offered by the elevator.

Futures are one area in which livestock producers are on a roughly equal footing with row crop producers. There are futures markets for both live and feeder cattle, as well as lean hogs. Dairy producers and processors also have a number of futures contracts that can be used for risk management, although the contracts vary drastically in their trading volume, and, therefore, usefulness in risk management. Futures, options, and other exchange-traded instruments increase allocative efficiency by providing price signals to producers and consumers not only for nearby prices but also for prices in the future, in some cases two or three harvest cycles in the future.

While futures contracts have successfully served as a mechanism for price risk transfer, repeated attempts for contracts to transfer other risks faced by agricultural producers have not fared as well. Most notably, futures contracts on state-level yields were offered in the 1990s, but they never achieved significant trading volume and were eventually discontinued. Futures contracts on fertilizer were also introduced, but suffered a similar fate. There have been attempts to use weather derivatives to manage production risk, and although Turvey (2001), Vedenov and Barnett (2004), and Chen et al. (2006) found that weather derivatives can be used to offset production risk, there is little evidence that agricultural producers have begun to use them in any volume.

Cash Contracts

Cash contracts, agreements in which physical delivery of the commodity is a fundamental component, are the primary private method of agricultural risk management. The contracts take many forms, depending on the commodity involved. Grain contracts are often simple contracts to deliver at a future date, with a price fixed at the time the contract is initiated. Contracts in the poultry industry, however, often require the buyer to supply the chicks, feed, and other inputs to production, and compensate the grower based on the weight gained and condition of the birds when they are delivered back to the buyer.

Livestock producers have the fewest options for cash contracts. Because of potential asymmetry of information regarding animal quality, packers are reluctant to agree to purchase livestock far in advance. Instead, purchases are made for immediate delivery. Producers of pork and poultry face similar information asymmetries, but the lower capital requirement for entry has made contract production very common in both industries. As discussed below, contract production is a contentious issue, but from a risk management standpoint, the producer assumes very little market risk—the integrator purchases the feed, supplies the young animals, and markets the grown animals. The actual grower is left only with operational risk—the risk of conditions that result in suboptimal growth of the supplied animals, such as disease, climate, or fire.

Grain producers have a multitude of options for cash contracts. Along with the simple cash forward contract, in which prices are set in advance for deferred delivery of the commodity, there are hedge-to-arrive contracts, in which the futures price is fixed, but basis remains unset until delivery. Alternatively, there is the basis contract, in which a future delivery of grain is contracted, but only the basis portion is fixed, and the futures price portion is left until later. There are also minimum-price contracts, which combine a forward contract with a put option, guaranteeing growers a floor price for their grain. Forward, hedge-to-arrive, and minimum price contracts, even though they are largely repackaged futures or options contracts, are much more common because the elevator typically assumes much of the management required of the exchange-traded security, including the variation margin. Like market-based contracts, cash contracts increase allocative efficiency. They also provide price signals to producers about the value of current and future production and consumption, but because they can be customized to particular locations and grades that are not covered by futures markets, they have the potential to provide even more accurate price signals.

Current Controversies

There are a number of unsettled controversies involving risk management options for producers and marketing firms.

Price Impact of Speculative Activity

Beginning in 2006, a broad swath of commodity prices began climbing. In everything from crude oil to rice, markets rallied almost incessantly from 2006 to 2008, and began climbing again in late 2010. These high prices, especially during 2008, drew attention from all quarters of society. Food riots erupted sporadically in developing nations. Some governments enacted export bans, as policy-makers sought to understand the causes of the higher prices. Others attempted to fix blame for problems on various individual causes, or apportion impact attributable to the various potential sources.

Many blamed speculation for the increases in prices. While blaming speculation for price increases has a long history, the run-ups since 2006 had a new potential villain: the commodity index trader (CIT). Gorton and Rouwenhorst (2006) showed that investing a portion of a diversified investment portfolio into a broad index of commodities can significantly reduce the risk of the overall portfolio. Pension funds and insurance companies were the first to incorporate these findings in their portfolio. However, such investments would still be subject to the position limits that apply to speculators in the futures markets. In 2002, the CFTC granted an exemption to swap dealers, which allowed them to treat hedging of swaps with futures as bona fide hedges—releasing them from speculative limits. This permitted CITs to skirt speculative position limits by purchasing swaps on commodity prices, which the dealers could then hedge, free of speculative position limits. By 2006, billions of dollars had flowed into the commodity markets because of CITs, and many commentators were very blunt in blaming these flows for rising prices. Masters and White (2011) typify this sentiment, "Congress should take the additional step of prohibiting or severely restricting the practice of commodity index replication. This practice represents a new threat to the markets because it inflates commodities futures prices, consumes liquidity and damages the price discovery function." Others have joined in laying blame on CITs, including Robles et al. (2009). Academic studies, however, have found no link between CITs and prices. Sanders et al. (2010) found "that long-only index funds may be beneficial in markets traditionally dominated by short hedging." Irwin et al. (2009a) state "a number of facts about the situation in commodity markets are inconsistent with the existence of a substantial bubble in commodity prices," and "available statistical evidence does not indicate that positions for any group in commodity futures markets, including long-only index funds, consistently lead futures price changes."

Energy/Agricultural Price Correlation

Energy price increases, transmitted through biofuels production, have also been blamed for the rise in commodity prices. Many studies have pointed out the increase in the correlation of agricultural and energy prices. Given the size differential of the two markets, it is therefore implied that increases in oil prices pulled grain prices higher, which, through competition for land and other resources, pulled other commodity prices higher, as well. Numerous studies have documented the increased correlation of energy and various agricultural prices, including Hertel and Beckman (2010) and Tyner and Taheripour (2008). As energy prices have historically been much more volatile than agricultural prices, the increased linkage means increased volatility in agricultural prices.

Convergence Problems

In 2006, users of the Chicago wheat market began to notice wider and wider *basis* levels—differences between futures prices and cash prices. At the expiration of the futures contract, cash prices at the Toledo, OH, delivery point were \$0.50 or more below the futures price, far greater than the historical difference at expiration of about \$0.05 or \$0.10. The process of cash and futures prices convergence had seemed to break down. Without convergence, there is no guarantee that futures prices are reflective of the cash market, which calls into question the utility of the futures market for either price discovery or risk transfer. During 2007 and 2008, as all commodity prices increased more rapidly, convergence in Chicago wheat deteriorated further, and CBOT corn and soybean futures also began to demonstrate convergence problems. While the CBOT corn and soybean futures convergence improved in late 2008 and thereafter, the CBOT introduced changes to the wheat contract in 2009 to improve convergence performance. Irwin et al. (2009b) and Garcia et al. (2011) document the convergence performance of futures contracts during this time period and suggest potential solutions.

Contract Pork and Poultry Production

The rise of contract production in pork and poultry has been very contentious. While studies have shown that contracting does reduce the risk to producers, the relatively low number of integrators operating in some areas has prompted charges of monopsonistic market power abuses. The integrators assert that this production method reduces variability in animal quality, and results in a more favorable financial situation for producers, as they have a very transparent income stream resulting from the production contracts. Growers counter that the integrators have a wide latitude to set facility requirements, and require costly upgrades, that can be used to punish growers, or cancel contracts early (see Chap. 4 for further discussion).

Packer Ownership of Cattle

In a similar vein, the issue of packer ownership of cattle prior to slaughter has also caused controversy. In order to smooth the flow of animals through packing plants, and to reduce price risk, some firms began to purchase feeder cattle, and contract their feeding, instead of buying fed cattle from feedlots. Some producers have vociferously complained that this practice allows packers to exercise market power by strategically timing purchases, and better managing their purchases. Packers have pointed out that there is no evidence that such behavior has any adverse impact on the market, and it is simply a way of managing their input price risk. Lawrence et al. (2001) and Koontz and Lawrence (2010) both examine these issues and identify the price impacts and effects on price risk and market power.

Government Program Eligibility and Planting Restrictions

In response to the creation of the World Trade Organization, and its limits on agricultural subsidies, the 1996 and 2002 Farm Bills both increased the amount of *decoupled* support—payments that were not directly tied to production decisions or prevailing prices, and so therefore should not distort allocations of land or other resources. One example of a fully decoupled payment is the Direct Payment, discussed above. However, in these acts, as well as the 2008 Act, one restriction remained on decoupled payments such as the DP and CCP, namely, that these payments would not be made for land on which fruits or vegetables were grown. There is no requirement that the land be in production, it may lie fallow and still be eligible, but fruit or vegetable production results in the land being ineligible for such payments for the duration of the policy contract (Johnson et al. 2006).

Farm Program Overlap

The farm programs that exist today, such as ACRE, SURE, and crop insurance premium subsidies, were often created to meet the needs of producers of specific crops, or to ameliorate the risk of very specific events. As they were not designed as a whole, there may be areas in which the various policies overlap. O'Donoghue et al. (2011) point out the ways in which the current slate of systems make multiple payments to farmers for the same loss, which they term Type I overlaps. These overlaps not only reduce the efficiency of farm support payments, but they may also incentivize inefficient behaviors and make the entire suite of programs more politically vulnerable during periods of budget pressure.

Policy Options and Their Consequences

It is possible to identify some potential policies to address some of the controversies cited above. This section briefly explores those options and their likely consequences.

Speculation

While these issues were certainly not off the radar previously, in 2009, the new administration made them a greater priority. The combination of higher commodity prices from 2006 to 2008 and the ensuing recession—events that have been hypothesized to be related (Hamilton 2009)—led to the Wall Street Reform and Consumer Protection Act of 2010 (commonly known as Dodd–Frank). While the central aim of the Act was to reform the financial institutions to reduce the probability of a 2007–2008-style financial crisis, the Act touched nearly all aspects of domestic financial markets, including commodity markets. In particular, the Act brought nearly all over-the-counter derivatives trading under the jurisdiction of the Commodity Futures Trading Commission, and required the CFTC to place position limits on speculators in these commodities under the assumption that excessive speculation creates systemic risk and impedes price discovery. In response to its legal responsibility, the CFTC has proposed a number of rules to limit the size of speculative positions. While position limits would almost certainly reduce the impact of speculation, it is not clear that any such changes would be for the better. Futures markets have long relied on speculators to absorb the risk that commercial participants seek to shed. There is some question, however, on whether CITs actually do participate in this risk transfer, as they simply purchase futures and hold them, mechanically moving from nearby to deferred contracts as expiration approaches. Further, there is concern that, if position limits are too restrictive, they may incentivize CITs and others seeking exposure to commodity markets to take positions in the physical commodities instead—purchasing grain stored in elevators, for example. Such cash market participation may impede commodity flows, especially in times of relative scarcity, therefore resulting in the exact opposite effect of what was intended—limiting the impact of speculation on cash prices. If, as has been demonstrated in the literature, "excess" speculation does not ultimately affect price discovery, then position limits that are too small may reduce allocative efficiency by reducing the speed at which information about prices is incorporated in the market.

Biofuels Policy

The primary vector of price volatility transmission from energy markets to agricultural markets is the biofuels market, especially the US ethanol market. In 2010, the USDA estimated that approximately 35% of the US corn production was used to make ethanol, which is both a complement and substitute for gasoline. However, because of the large difference in size between the two markets—the USA consumed approximately 140 billion gallons of gasoline in 2009, and 13.5 billion gallons of ethanol—increases in gasoline prices increased the price of ethanol. Two policies contributed to both the growth of the ethanol industry and, therefore, its role in price linkage. Ethanol consumption is mandated through the renewable fuels standard portion of the Energy Independence and Security Act of 2007, rising from 9 billion gallons in 2008 to 15 billion gallons in 2015. The Volumetric Ethanol Excise Tax Credit (VEETC) provides a $0.46/gallon of ethanol credit against federal excise taxes for firms that blend ethanol with gasoline for sale as transportation fuel. The combination of these two policies has created a large derived demand for corn that is sensitive to the relative prices of gasoline and corn. Outside of repealing either the RFS or VEETC, the only other proposal that has been suggested is repeal of the tariff on imported ethanol, which is currently $0.54/gallon. Changes to any of these policies will obviously reduce the demand for the US-produced ethanol, and therefore, corn, resulting in lower grain prices and reduced economic activity in areas with significant amounts of ethanol production. On December 31, 2011, the VEETC and the import tariff on ethanol were both allowed to expire, and in the following months, ethanol production margins and, therefore corn demand, have weakened. This simultaneously reduced feed costs to animal producers, which would offset some of the losses in economic activity. Reductions in VEETC, the RFS, or import tariffs will also affect gasoline consumption in the United States, potentially changing domestic demand for imported energy sources. As has been shown by DeGorter and Just (2009), among others, the current raft of biofuels policies is highly inefficient. The mix of subsidies and mandates reduces allocative and dynamic efficiency. The effect on nonmarket outcomes is unclear, as there remains considerable debate on the environmental effects of biofuel production and consumption.

Convergence

Lack of convergence has repeatedly drawn the attention of legislators, though there has been little actual legislative activity on the topic. The CFTC has had multiple hearings on convergence in agricultural futures, and has instructed exchanges to remedy the problem. In late 2009, the CME Group proposed changes to the Chicago wheat futures contract. Instead of using a fixed daily storage charge for grain that is being stored while registered for delivery to the exchange, the CME Group proposed a new "Variable Storage Rate" system. Under VSR, the rate changes when the price of the first deferred futures contract remains above 80% of "full-carry"—the theoretical cost of carrying wheat from the maturity of the nearest contract to the next nearest contract, comprising the storage cost and the opportunity cost of money. When the spread is wide, the storage charge allowed by the exchange will increase in $0.035/month increments. It is thought that the higher storage charge will disincentivize the holding of inventories in deliverable position, which should permit more arbitrage to occur between spot and nearby futures contracts, thus improving convergence performance. More recently, the Kansas City Board of Trade, in response to poor convergence performance in 2009 and 2010, introduced a system of "seasonal storage rates" in which the storage charge is $0.06/month from December through June, and $0.09/month from July through November. The seasonal nature of the changes is meant to reflect the higher storage demand during those months while providing certainty to physical users of the markets—they need not worry about unforeseen changes occurring over the life of a hedge, as can potentially occur with VSR. However, if the SSR rates are not high enough, they may not force convergence, whereas the VSR can continue to increase until convergence occurs. Other suggested changes to improve convergence are to change the contracts to cash settlement—where instead of the physical commodity being exchanged at futures expiration, payments would be made between parties based on the final price of a specified index, such as the average cash price of corn in the USA. While cash settlement provides convergence by design, it is not without its flaws. Indices must be very carefully designed to prevent manipulation, and to provide price discovery and risk transfer. A lack of convergence reduces allocative welfare in an economy, as the market is no longer providing accurate price signals to participants. It also potentially reduces productive efficiency by increasing the cost of shifting risk among market participants.

Integrator Ownership

Contract production of pork and poultry and packer ownership of cattle are frequently discussed together, under the broader topic of market power in agriculture. In late 2010, the Grain Inspection, Packers, and Stockyards Administration issued proposed rules on contract production and packer ownership based on Title XI of the Food, Conservation and Energy Act. The rules "provide further definition to practices that are unfair, unjustly discriminatory or deceptive … [and] establish new protections for producers required to provide expensive capital upgrades to their growing facilities." The proposed rules also "prohibit packers from purchasing, acquiring or receiving livestock from other packers, and communicate prices to competitors;" and "require that companies paying growers under a tournament system provide the same base pay to growers that raise the same type and kind of poultry, including ensuring that the growers pay cannot go below the base pay amount" (USDA 2010). Such rules would increase transaction costs in the meat processing industry. One provision requires packers to be able to justify why different prices are paid for different animals, which would reduce technical efficiency, and may have nonmarket efficiency impacts, as well, as it could blunt incentives for payment of quality premiums by packers, homogenizing the quality of meat available. The provision banning the sale of animals between packers means that for producers who own packing facilities, a middleman would need to be introduced to legitimize the sale, reducing technical efficiency. Finally, some practices of tournament pricing for growers would be outlawed, increasing the costs to integrators (Informa Economics 2010).

Elimination of Planting Restrictions on Decoupled Payments

Eligibility for CCPs and DPs is rescinded if the land is used for fruit or vegetable production. This subsidy affects the allocation of land between crops and fruit and vegetable production, which creates both allocative efficiency and nonmarket welfare losses, as it contributes to the underproduction of more nutrient-rich fruits and vegetables. In the 2008 Farm Act, the Planting Transferability Pilot Project was introduced, which permits small amounts of acreage to be exempt from these restrictions in order to better understand the actual effects.

Opportunities for Improved Industry–Government Collaboration

Four areas that would benefit from industry–government partnerships are apparent from the above discussion: improving crop insurance, shifting risk to markets, better understanding of success/failure of futures, and better understanding of futures delivery mechanisms. Since 2000, crop insurance has become the primary method of risk mitigation for row crop producers, especially for risk that arises from changes in weather. However, the options for other agricultural producers remain much more limited. Whole farm revenue insurance does offer at least some protection to all producers. With increased variability in inputs stemming from generally increased commodity prices, and specifically increased energy prices, revenue insurance that is based on historical revenue levels may provide substantially less financial protection than expected or desired if input costs rapidly increase in a short period of time. However, creating insurance on profit margins can induce moral hazard—the situation where insurance changes the incentives of the insured to "game the system."

A better route to provide increased protection from volatile input prices is to better understand factors that cause futures markets to succeed or fail, and encourage the creation of more complete futures markets for inputs, such as diesel fuel and fertilizers, or their chemical components—such as nitrogen, potassium, and phosphorus. The commodity exchanges themselves have strong incentives to support the creation of new contracts, as does the agricultural community. A related opportunity is the exploration of mechanisms to shift the risk from crop insurance into markets. To the extent it is possible for crop insurance risk to be repackaged and sold through markets, there is less need for the federal government to be the insurer of last resort to the crop insurance industry.

Finally, understanding the way in which farm programs overlap for growers of various crops and in different regions and seeking to reduce or eliminate that overlap in future programs can reduce not only costs of the farm program for both the government and/or farmers but also production-distorting incentives.

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Part V
Societal Issues

This part recognizes that as consumer incomes increase and the technologies of food production take on industrialization characteristics, societal lifestyle concerns have become cutting-edge marketing policy issues. As a result, programs and policies have emphasized a desire to create alternatives to supermarket, restaurant, and fast food chains. Marketing diversity is being encouraged by supporting the creation of a competitive fringe composed of smaller farm organic and local food marketing through farm stands, farmers markets, and local market intermediaries. These trends directly conflict with the use of the products of biotechnology to expand food production and improve the nutritional and antioxidant content of foods. It also contradicts efficiency-oriented methods of producing eggs and baby pigs in cages. Therefore, this part ends with a discussion of the tradeoffs involved with the demands of various interest groups for process regulations on livestock and poultry production and slaughtering methods.

In Chap. 16, McFadden discusses factors driving new markets, programs, and brands for organic, local, and other sustainable foods intended to differentiate products, segment consumer demand, and gain a competitive advantage. She explores the potential efficiency tradeoffs of food systems that constrain production and distribution choices compared to models that may provide environmental, social, or other community benefits.

In Chap. 17, Phillips addresses the role and potential of genetically engineered herbicide- and insect-resistant plants. Those traits, incorporated into most varieties of soybean, corn, and cotton grown in the USA, have resulted in greater productivity with less environmental risk. Phillips evaluates issues, policies, regulations, and options affecting the use of agricultural biotechnology in the food and marketing system.

In Chap. 18, Blandford explains why welfare of farm animals is an increasingly important issue for the food and agricultural industry. Increasingly tighter regulation at the state level will increase production costs. A combination of strengthened voluntary actions, supported by more stringent penalties for those who fail to follow accepted practices, could satisfy the welfare concerns of the vast majority of Americans.

Chapter 16
Local Food, Organics, and Sustainability

Dawn Thilmany McFadden

Abstract There are a diverse set of factors driving new markets, programs, and brands for organic, local, and other sustainable foods. Certain groups of agricultural producers and the food industry are increasingly sharing information about production practices and the source of foods to differentiate products, segment consumer demand, and gain a competitive advantage. Marketing efforts are increasingly focused on the promotion of food attributes so that producer–consumer interaction in direct markets and food labels in more conventional food retail venues are increasingly important to market performance. By exploring the potential efficiency trade-offs of food systems that constrain production and distribution choices against models that may provide environmental, social, or other community benefits, this chapter provides an important synopsis of key criteria for policy discussions. An overview of the marketing programs that may play a role in shaping sustainable food system supply chain approaches concludes the chapter.

Introduction

Over the past two decades, consumer demand for sustainable products, including organic and other sustainable claims, has grown substantially (Whole Foods 2010; USDA AMS 2010). Local foods are now commonly framed as part of the sustainable food category, even though there is no clear production criteria, and food miles is an imperfect sustainability indicator (Weber and Matthews 2008). There are several potential drivers for the growth in this segment within the marketplace, including

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producers adopting less input-intensive systems; consumers seeking foods with less perceived health risks; producers seeking a way to differentiate themselves in the marketplace; and consumers trying to vote with their dollars for presumed more beneficial food production systems.

Organic and sustainable food systems are defined in the marketplace through a set of production and handling standards managed by public and private programs, with influence from the industry. The rigor of these standards solves some market failures, such as asymmetric information, but also creates new challenges in the development of relevant processing criteria and communicates how such criteria influence the outcomes buyers may seek. These challenges are particularly relevant in current concerns about local food systems because there are highly promoted outcomes, particularly lower energy use through decreased food miles, without any programs to develop standards, oversee processes, or evaluate outcomes.

Exploring the motivations behind consumer behavior in the organic, sustainable, and local food segments—buyers voting with their food dollars—provides important context about perceived product attributes which are being sought or market failures that are being addressed with standards, certifications, or promotional marketing programs. This chapter initially focuses on growth in these segments, along with discussion of what demand-side factors may drive such growth to describe the evolution of marketing programs. Then, an overview of the producer and supply chain issues that have emerged from the private sector, or been developed in the public sector to address barriers to the formation of market innovations—national standards, research, market information—follows. The chapter concludes with a discussion about the development of effective marketing policies and programs, and the complex set of challenges to those framing, overseeing, and evaluating food system performance.

Overview of Organic, Sustainable, and Local Food Segments

Sustainable agriculture integrates three main goals—environmental health, economic profitability, and social and economic equity. "Sustainable agriculture" was defined by Congress in the 1990 Farm Bill ((the Food, Agriculture, Conservation, and Trade Act of 1990), Public Law 101–624, Title XVI). Under that law, the term sustainable agriculture means an integrated system of plant and animal production practices having a site-specific application that will, over the long term:

- Satisfy human food and fiber needs
- Enhance environmental quality and the natural resource base upon which the agricultural economy depends
- Make the most efficient use of nonrenewable resources and on-farm resources and integrate, where appropriate, natural biological cycles and controls
- Sustain the economic viability of farm operations
- Enhance the quality of life for farmers and society as a whole

Fig. 16.1 An overview of food product certification programs

For this chapter, sustainable food marketing programs are assumed to meet at least one criterion related to the differentiating attributes of the above definition. These include environmental impacts, interactions with the broader ecosystem—including animal welfare—or addressing some perceived economic or market barrier to producers who are smaller scale, have limited resources, or operate within a geographic area of interest to some set of consumers—such as local, protected denomination of origin, or rural areas.

The most clearly defined marketing standards in this segment are USDA organic certification. This program provides a benchmark, at one end of the product differentiation continuum, where almost all production, handling, and processing standards are well defined through a public–private partnership. There are also a growing number of certification programs whose development has been led by producer organizations or nongovernmental organizations (NGOs), but which have sought verified process status with USDA (Fig. 16.1). These programs provide a range of criteria, such as those related to animal treatment, fair trade, or family farmed. In contrast to organic programs, where the U.S. could benefit from international recognition of standards, these other programs are defined at the level that private stakeholders determine they can benefit from the differentiation in the marketplace. Because these standards suggest that consumers may be seeking food systems aligned with their values, which may or may not influence eating or sensory quality, marketing programs in this realm may seek to provide more assurances on outcomes which consumers value.

Most sustainable food segments are ill-defined, with no commonly accepted specifications, in contrast to organics. Such vague standards represent a significant challenge to tracking sales trends and to developing marketing programs and policies that influence performance. Local foods are such a segment, and the discussion of local food trends, standards, and programs is more blurred.

The USDA has historically provided grades and standards as a service to producers and marketing firms. But grades and standards may also be helpful to consumers, who may value information on the quality of foods they purchase. However, the complexity of standards for most food categories has proliferated greatly over the past few decades. Coalitions of producers seek more private marketing standards and supply chain specifications that adapt to changing consumer demand, so that product information can be credibly communicated to buyers. In some cases, such private initiatives may seek partnerships with USDA to improve their credibility and efficacy in providing accurate price and product quality signals to buyers at the wholesale, retail and/or household levels.

Growth in Organic Sales and Sustainable Food Programs

Industry sources (Whole Foods 2010; Siegel 2010) indicate that sustainable food sectors have seen double-digit annual growth over the last decade, based on the significant growth of organics—one of the more clearly defined and monitored sectors. The majority of sustainable food programs outlined in Figs. 16.1 and 16.2 do not publicly report sales trends, so one can only infer that their presence is evidence of either increased buyer interest among consumers or retailers seeking supply chains with sustainable values, or increased producer interest in differentiating away from commodity markets.

In general, credence attributes which refer to product traits not readily obvious to consumers even after consuming a food, such as environmental or local economic benefits, create several challenges to food supply chains since there are additional costs of defining, measuring, promoting, and verifying them to consumers. In response, private industries have invested in their own brands to build a reputation among consumers, sometimes partnering with the government which oversees certification programs to guarantee adherence to specified characteristics. There has been a rapid growth in certifications over the past 20 years (Fig. 16.3). Most of the initiatives are growing in size. For example, the membership of Biodynamic (http://www.biodynamics.com/) has tripled in the last 3 years, and fair trade organizations have steadily increased their membership size and member sales figures over the last 5 years (Raynolds et al. 2009). Moreover, the Fairtrade Labeling Organization International's sales grew 43% between 2003 and 2008 and the Food Alliance has reported an average growth of 20% per year of certified clients.

Retail sales of organic foods grew to almost \$39 billion in 2010 from \$3.6 billion in 1997 (Packaged Facts 2011). The 9% growth rate outpaced the 2% growth in conventional groceries, which is particularly notable given a sluggish economic recovery. Globally, organic sales doubled from \$25 billion in 2003 to almost \$51 billion in 2008, still a small share of global food sales, given that organic foods are most prominent in high income countries of Europe, in Japan and the United States.

	Organic Production	Animal Welfare	Locally Grown	Ecologically Sustainable	Labor Issues	Family/ Co-op Owned	Products
American Grassfed		✓					Livestock
American Humane Certified		✓					Livestock
Animal Welfare Approved		✓				✓	Livestock
Certified Humane		✓					Livestock
Certified Naturally Grown	✓		✓	✓			Crops & Livestock
Demeter Biodynamic	✓			✓			Crops & Livestock
Domestic Fair Trade				✓	✓	✓	Crops & Livestock
Family Farmed		✓	✓	✓		✓	Crops & Livestock
Food Alliance		✓		✓	✓		Crops & Livestock
Predator Friendly		✓		✓			Livestock
Protected Harvest				✓			Crops
Buy Fresh, Buy Local			✓				Crops & Livestock
USDA Organic	✓						Crops & Livestock

Fig. 16.2 Food label program assurances: an overview of programs

Organic crop and pasture represents less than 1% of the total land in production, but 4% of retail food sales because of the prevalence of higher value crops.

For local foods, there is less data on trends, partly because the segment was only recently defined by the U.S. Congress in the 2008 Food, Conservation, and Energy Act, as: the total distance that a product can be transported and still be considered a "locally or regionally produced agricultural food product" is less than 400 miles from its origin, or within the State (Martinez and Hand 2010). Since some consumers may also associate local foods with marketing channel, direct-to-consumer sales by producers is also considered in the realm of local foods. USDA's Agricultural Marketing Services (2010) reported the number of farmers markets doubled between 2000 and 2010. Moreover, community-supported agriculture (CSA) projects, in which consumers provide payment to a farm early in the season in exchange for a share of the farm's produce, have expanded from 1 to more than 2,500 participating farm operations in the last 25 years (LocalHarvest 2010). While producers have responded with greater supplies to alternative marketing channels, actual sales and revenue data are not monitored for these direct outlets, and it is not clear what share of sales in the venues are foods relative to other local goods. Thus, the strength of demand for local foods is difficult to establish.

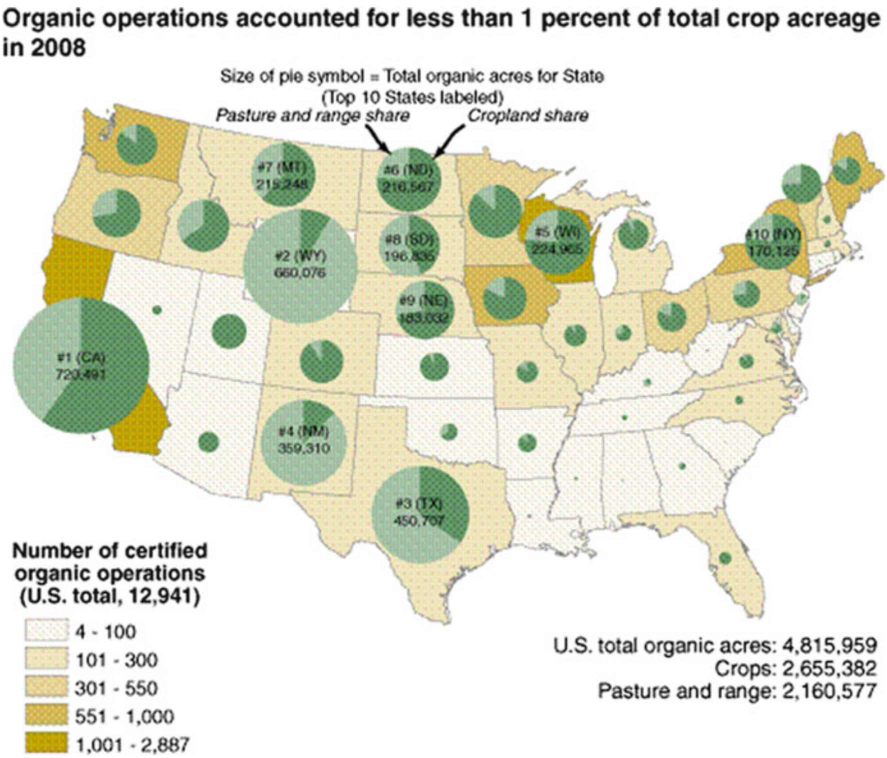

Fig. 16.3 Organic producers in the United States, 2008

Direct-to-consumer sales estimates collected from producers in the 2007 U.S. Census of Agriculture indicate that 136, 817 farms (6% of all farms) sold a little over $1.2 billion in agricultural products directly to consumers in 2007. Since this self-reported estimate is thought to be very low, the USDA Economic Research Service developed a more targeted data collection process related to local foods that are directly marketed and updated the sales number to over $4.8 billion in sales for 2008 (Fig. 16.4). The significant increase is partly because they chose to include direct sales through regional distribution channels that market to retailers, restaurants, and other food buyers, and still, the share of food sales through direct channels remains relatively low. (Low and Vogel 2011). This new definition of direct sales by USDA follows from work by the Agriculture of the Middle research group that touches on the need for growth beyond farmers markets in local food systems, allowing mid-size farms to "scale up" their local distribution strategies to larger, institutional buyers [Stephenson and Pirog (2008)]. Currently, there is better data available on direct-to-consumer sales than on any broader definition of local foods.

There is also an apparent interface between local and direct food marketing and farm size (Fig. 16.4). In the USDA-ERS study on direct marketers, 134,000 farms reported 199,000 instances of using direct, face-to-face, or direct-to-retail marketing channels in the 2008 USDA Agricultural Resource Management Survey (ARMS)

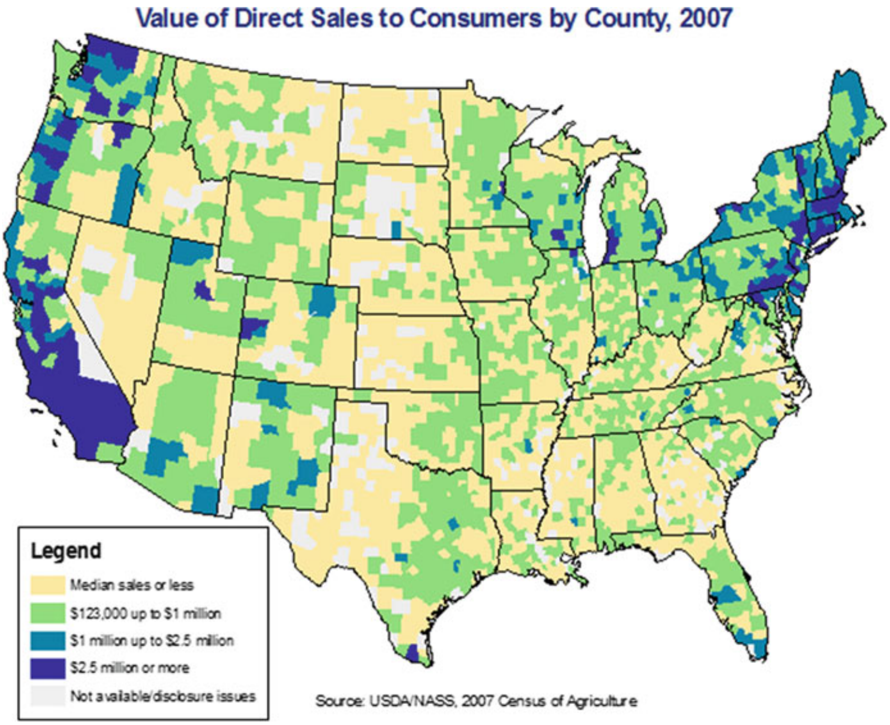

Fig. 16.4 Direct sales by US producers, 2007

(Low and Vogel 2011). They found that small farms comprise 80% of direct sales food farms and are more likely than an average producer to use face-to-face marketing channels such as farmers' markets and roadside stands. They argue that small farms fill an important role of introducing consumers to farmers and local foods, and that some producers value non-economic benefits such as consumer interaction.

In contrast, large commercial farms represent only 3% of all direct sales farms and primarily use regional marketing outlets such as direct sales to a restaurant to sell local foods. These farms use economies of scale in the regional marketing of local foods, reducing their labor per dollar of sales.

One final indicator of the marketing strength of a segment is the persistence of price premiums for certified products. Again, the best data is available for organics, and Fig. 16.5a, b illustrate the relative prices of conventional and certified organic prices in recent years. Figure 16.5a is from the NewFarm.com website run by the Rodale Institute, while data in Fig. 16.5b is part of the USDA's AMS new organic price reporting efforts. It appears that organic produce does secure premiums in wholesale markets. Consumer research on organics and other sustainable segments may shed some light on how marketing standards and messages affect consumer willingness to pay.

For local foods, Martinez and Hand (2010) provide a table on willingness to pay for a variety of local food products in various markets (p. 31). It shows a range of

a

Vegetables		New York		Los Angeles	
Quality	Qty	Certified	Conv	Certified	Conv
Artichoke					
PQ	18 Ct	na	na	$ 36.00	$ 22.00
Asparagus					
PQ	11#	$ 71.45	$ 25.00	na	$ 26.00
Avocado: Hass					
PQ	48 Ct	$ 84.10	$ 57.00	$ 75.50	$ 52.00
Bok Choy					
PQ	20#	$ 38.25	$ 18.00	$ 31.00	na
Broccoli					
PQ	14 Ct	$ 14.00	$ 18.00	$ 21.00	$ 15.00
Cabbage, Green					
PQ	40#	na	$ 12.00	$ 23.50	$ 10.00
Carrots					
PQ	24x2#	$ 42.05	na	$ 37.50	$ 21.00
Cauliflower					
PQ	12 Ct	$ 36.80	$ 22.00	$ 39.50	$ 19.00
Celery					
PQ	24 Ct	$ 53.40	$ 28.00	$ 29.00	$ 16.00
Cucumber					
PQ	20#	$ 75.35	na	na	na
Garlic: Super Col					

b

Wholesale market and fruit	Months offered	Organic price	Conventional price	% Difference
Boston				
Apples	Jan	65.57	34.39	90.7%
Apples	Feb	56.95	35.00	62.7%
Apples	Sept	68.00	39.71	71.2%
Strawberries	May	26.60	15.42	72.5%
Strawberries	July	18.23	12.28	48.5%
Strawberries	Aug	21.40	14.10	51.8%
Strawberries	Oct	33.86	14.36	135.8%
Strawberries	Nov	37.64	20.50	83.6%
Strawberries	Dec	50.62	30.78	64.5%
San Francisco				
Oranges	Jan	28.33	12.04	135.3%
Oranges	Feb	26.00	10.40	150.0%
Oranges	March	26.00	11.85	119.4%
Oranges	Nov	29.67	19.52	52.0%
Oranges	Dec	28.71	14.98	91.7%
Pears	Feb	44.29	26.77	65.4%
Pears	Oct	54.00	32.20	67.7%
Pears	Nov	51.53	30.29	70.1%
Pears	Ded	44.19	31.37	40.9%

1/ Simple monthly averages of daily prices reported by the Market News Service.
* Fewer than 8 days reported.
Source: U.S. Department of Agriculture, Agricultural Marketing Service.

Fig. 16.5 (**a**) Representative price premia for organic vegetables as viewed in Newfarm.com Website, May 2011. (**b**) Representative Price Premia for Organic Fruits in select markets, 2008; as viewed at USDA AMS website, May 2011

9–50% above conventional prices. There is currently no official price series for local foods, with the exception of some farmer market price reports from USDA-AMS and localized price reports from some state Extension services.

The Consumer Role in Growth of Local and Sustainable Food Markets

Since many agree that consumer demands have been the primary driver behind growth in this sector, understanding consumer attitudes is important. Consumers' perception of quality is influenced by the product's intrinsic attributes as well as by extrinsic indicators and cues provided by the seller of the product (see Caswell, Chap. 9).

Consumer behavior is often framed in terms of choices in response to market innovations and shocks that influence confidence, perceptions of quality, and values associated with the food choices households make, given their personal lifestyles. One challenge for those crafting marketing programs lies in understanding how consumers develop their beliefs. Since the role of standards is partly to influence and give confidence to or dispel myths held by consumers, an appropriate role for governmental and private programs is "policing" use of labels, upholding the veracity of claims, and providing education to maintain strong consumer confidence. As Caswell discusses, the appropriate places for public intervention vary depending on the food system issue addressed and market dynamics.

Consumer Values and Beliefs

Lusk and Briggeman (2009) explored the underlying food values driving consumer choices and found that safety, nutrition, taste, and price were among the most important to consumers. Yet, they report heterogeneity across consumers: naturalness, fairness, and the environment food values were significantly related to stated and revealed preferences for organic food. In short, organic may be a "gateway" product category that initially leads a consumer with certain values into more loosely defined sustainable food markets. For this reason and the existence of standards for and data on organics, they are the focus of much of this discussion on sustainable food markets.

Dentoni et al. (2009) explored attitude formation and how any credence attribute could have "spillover" effects on other label claims and the role of food product familiarity in food choices. Similarly, Onozaka et al. (2011) examined the psychographic attitudes of food consumers by marketing channel. They found that those buying direct from farmers were more likely to believe they could impact their health as a private attribute, and the economy, environment, and socially fair business practices as public and credence attributes, with their food purchases.

Cloud (2007) discusses the dilemma that environmentally conscious consumers might have when choosing between locally grown conventional products and imported organic products, suggesting competition between organic and local claims. This illustrates the challenge to sustainable marketing program managers—in the mind of consumers, organic is a defined certification system that is being directly compared to local foods for which there are no specified production criteria to assure sustainable outcomes. Perhaps the nature of the sales channel is part of the marketing strategy, as Onozaka et al. (2011) report that those buying in direct markets value local relatively higher than organic, and discount imports less when they are fair trade certified.

Food Sector Initiatives and Differentiation Strategies

The nature of credence attributes, and increasing interest in the consumer "confidence" afforded by various certifications and marketing strategies in the food system, all lead one to suspect that there is a market failure that marketing programs could address. Of particular relevance to credence attributes is the asymmetric information between food producers and consumers about production and handling processes. Again, there are two extremes in this continuum: at one end, a credible, third party can manage process verification programs, such as USDA organic, to uphold standards that align with consumer expectations. At the other extreme, consumers may feel a need to have more direct buying relationships with shorter supply chains, and this is why local foods are considered here. Beyond the claims made about their sustainability, local foods are commonly sold through more direct marketing, which may build consumer confidence because of more transparent information on the producer of the foodstuffs.

One could argue that dynamic efficiency is a guiding force in the development of programs in the sustainable food realm, since almost all of the marketing programs discussed here have been established in the last two decades and continue to adapt to the marketplace's demands. To simplify this discussion, there are four major categories in the sustainable food realm: organics, arguably the leading element of the sustainable sector; other standard-based certification, including the broad set of programs that have formalized standards on input usage, animal care, worker treatment and environmental impacts; membership commitments, involving marketing messages formed by producers with a unified set of practices and values but with no formalized criteria or standards; and local, more broadly defined as local and regional since geographical standards are not well defined (Clancy et al. 2010).

USDA Organic Certification

Generally, organic certification can be earned by producers if they comply with organic standards set by national governments and international organizations. In the United States, organic production is a system that is managed in accordance with the Organic Foods Production Act (OFPA) of 1990 and regulations in Title 7, Part 205 of the Code of Federal Regulations. The National Organic Program (NOP) developed national organic standards, taking international standards into consideration, and established an organic certification program based on recommendations of a 15-member National Organic Standards Board (NOSB). The NOSB, appointed by the Secretary of Agriculture, is comprised of representatives from the following categories: farmer/grower, handler/processor, retailer, consumer/public interest, environmentalist, scientist, and certifying agent. This mix is indicative of the private–public partnership guiding the NOP.

USDA organic certification standards establish the requirements that organic production and handling operations must meet to become USDA-accredited certifying agents, which can be private or public entities. The information that an applicant must submit to the certifying agent includes the applicant's organic production and marketing system plan. This plan describes, among other things, practices and substances used in production, record keeping procedures, and practices to prevent commingling of organic and non-organic products. The certification standards also address on-site inspections. Producers and handling/processing operations that sell less than $5,000 a year in organic agricultural products are exempt from certification, but they cannot display the USDA Organic seal.

Implementation of the Regulations began on April 21, 2001; all organic certifiers, producers, processors, and handlers had to be in full compliance by October 21, 2002. The relatively slow formalization of the national standards should be noted; because of the differences in opinion about standards, and large public response to some issues, it took many years to establish the Rules and List of Allowed Substances, and modifications of those rules continue to cause dissension within the organic industry. This likely set a precedent that challenged other sustainable food segments to consider how complex the process of developing standards and organizing programs might be.

Standard-Based Certifications

Certification initiatives are the most plentiful and appear to be growing most rapidly in the food and beverage sector due to the salience of this sector to consumers and because environmental and social concerns intersect so clearly here. Initiatives vary along a continuum in their rigor and enforcement. At one end are *Membership Commitments,* where members agree to support broad collective goals—returned to later in this section; at the other are *Standard-based Certifications*, where participants are certified as meeting clearly defined expectations and compliance is regularly monitored.

There are a number of private and NGO-managed programs in the sustainable food sector, many of which are listed in Fig. 16.1 and details on the criteria used in the certification are detailed in Fig. 16.2. This set of verification criteria involve two factors: the definition of sustainable and how tenets of the sustainable movement are reflected in standards; and, the broadly framed USDA Process Verification that allows private or nongovernmental industry initiatives to develop a marketing program that supports their industry's marketing efforts to differentiate products through third party certification.

"Sustainable agriculture" was defined in the 1990 Farm Bill, as discussed earlier. So, the organics and local programs discussed in detail here, and included in Fig. 16.1 listings, all must be considered in the context of whether programs exist to verify outcomes inferred in the definition of sustainable.

At the federal level, the USDA AMS has established process verification systems as a service to industry groups. The USDA Process Verified Program uses the International Organization for Standardization's ISO 9000 series standards in order to provide companies the opportunity to assure customers of their ability to provide consistent quality products or services. Companies with approved USDA Process Verified Programs are able to make marketing claims associated with their process verified points—these include animal age, source, feeding practices, or other raising and processing claims—and market their products with the use of the "USDA Process Verified" shield and term. A listing of currently approved programs can be found at http://www.ams.usda.gov/AMSv1.0/processverified.

Membership Commitments

At the other end of the spectrum, there are still more informal marketing efforts and programs by various associations of producers. This set of programs is too large to list, and generally not monitored directly by any federal, state, or local programs.

In these cases, labels and logos are widely used to brand participating products and organizations, bolster market shares, and capture price premiums. This includes the state branding programs that have arisen for local foods and discussed further below, as well as numerous localized or product-specific alliances that have formed to promote geographically differentiated food as a means to increase returns to producers.

Initiative principles and standards are typically established by NGOs. While some rely on self-reporting and peer review, many have more formal monitoring processes involving audits by the standard setting organization or by an independent third party certifier. This evolution to more verifiable claims has led to USDA engagement to establish standards and process verification to increase the credibility with customers of food retailers who may pursue more standards based claims in their marketplaces.

Local Foods

Although local foods are not directly tied to sustainable food segments, local designations are commonly framed in this realm or bundled with other sustainable programs. Almost every state has a "buy local" program, and there are an increasing number of municipalities, counties, and regions creating their own programs.

Local is a primary focus here not only because it is now cited as the most important food claim in consumer studies (Hu et al. 2009; Bruhn et al. 1992; Brown 2003;

Giraud et al. 2005; Carpio and Isengildina-Massa 2009), but also because of the high visibility it is receiving in industry and government circles. Partly with encouragement from USDA's Know your Farmer, Know your Food program launched in 2009, consumers are increasingly aware of and participating in local food systems, commonly tracked by growth in direct markets.

Differentiation related to production location—domestic versus imported products—was originally explored in the food marketing literature in the context of "country of origin labeling" which is arguably a complement to local foods programs (e.g., beef in Umberger et al. 2002; apples and tomatoes in Mabiso et al. 2005). Hu et al. (2009), Loureiro and Hine (2002), and Bond et al. (2008b) all did comparative valuations of various food claims, including state-based labeling programs.

Within domestic markets, there is some question as to what degree of local matters. The federal definition of local established by the U.S. Congress in the 2008 Food, Conservation, and Energy Act was noted earlier. However, private interests may be adapting the definition to serve their own marketing strategies. Emerging concepts associated with local food systems that could help to frame standards and criteria are "food miles" and "carbon footprint." The term "food miles" was coined in the media and marketplace as a measure of how far food travels from where it was grown to where it is consumed, and used as a proxy for the environmental impact of food transport. But critics have used data to challenge the validity of food miles as an indicator. Consequently, "Carbon footprint" is a term increasingly used to represent a thorough assessment of greenhouse gas emissions throughout the lifecycle of a good, from production through consumption (Weber and Matthews 2008; Morgan et al. 2007). This new metric may be used to quantify the degree of local and outcomes many consumers expect from more local food supplies, and to undergird new sustainability programs of large retailers, such as WalMart, but remains a fairly academic concept with hard-to-measure, ill-defined criteria.

One nonprofit program that has tried to formalize the local food marketing designation is the FoodRoutes Network (FRN) and their "Buy Fresh, Buy Local" campaign that includes local chapters throughout the U.S. (http://www.foodroutes.org/mission.jsp). FRN is a national nonprofit organization that provides communication tools, technical support, networking and information resources to organizations nationwide that are working to rebuild local, community-based food systems. But it does not have any clearly delineated criteria for chapters or members to follow, suggesting that place-based decisions on what is local may be needed.

State branding programs also have grown over the past decade and may overlap or substitute with other local branding. Almost every state has a program, generally run with support from the state's department of agriculture. These programs are often based on traditional core crops—Idaho potatoes, Florida citrus, or on state pride—Colorado Proud, but with less structure than the marketing orders that have operated in the produce sector for decades. Still, these state programs face challenges including how to define a state product and what the criteria for eligibility should include: must it be grown in state? processed in state? what about products processed in state, but with mostly out-of-state ingredients?

Related to the discussion of local foods, one must consider direct sales marketing strategies, which are often confounded with local foods, but can also be bundled with other sustainable segments. For example, the fourth Organic Farming Research Foundation (OFRF) survey showed that the share of organic products marketed directly to consumers reached almost 50% in 2001 (Walz 2009). In short, local is prevalent in the marketplace, but some of the growth may be due to ease of entry and lack of standards for those using the local claims, and unless more research is completed which verifies public perception of benefits from local foods, there will be challenges to sustaining this segment.

Exploring Impacts on Economic Efficiency

Although global food security concerns continue to elevate increased yields as a priority for agricultural systems, changing consumer preferences and attitudes are placing new demands on food supply chains and production systems. One important consideration to the sustainable food segments considered here is consumers' evolving attitudes, value formation, and changes in consumer behavior in the food system. There is a great deal of consumer research examining how sustainable and public dimensions of food systems are changing market dynamics (Lusk and Briggeman 2009; Dentoni et al. 2009; Onozaka et al. 2011; Hartmann Group 2009; Bond et al. 2008a, b; Cloud 2007).

Federal policies and programs responded to the changing market environment in the 2008 Farm Bill with some notable steps toward addressing the program gaps and technical support needs of producers and organizations that want to supply the growing consumer demand for sustainable and local foods.

In terms of programs specifically targeted at the organic sector, a full portfolio of programs is emerging or increasing in scope. There was a significant increase in cost-share assistance for the transition period required in organic certification, and new programs to provide technical and financial assistance for organic conversion contained within the Environmental Quality Incentives Program of the Conservation Title of the 2008 FCEA, which also provided newly targeted insurance products, new data products, and research programs. The USDA Organic Agriculture Research and Extension program targets research on: use of advanced genomics, field trials, and other methods to identify desirable traits; classical and marker-assisted breeding to develop public varieties optimized for organic systems; identification of marketing and policy constraints on expansion of organic agriculture; advanced on-farm research into organic farms, including production and socioeconomic conditions; segregation of data on the organic sector in ongoing data collection on agricultural production and marketing; and facilitation of access to organic research conducted outside the U.S. These priorities show there are production, economic, and information concerns within the industry which helped to frame these initiatives.

Marketing and technical assistance were requested by several sustainable, organic, and other farm organizations based on perceptions that too little of the available support from government, academic, and NGO entities were effectively targeted at production and marketing systems that were organic, direct marketing, low-input or sustainable in their approach. In this case, most resources were targeted at strengthening existing programs. Appropriate Technology and Transfer for Rural Areas (ATTRA), a keystone technical assistance project for this sector, received more solid funding and the Sustainable Agriculture Research and Education (SARE) program received greater funding to provide, among other things, professional development and producer grants to finance technical assistance and on-the-ground production and marketing research.

The USDA has quickly expanded the programs that are available to support local food systems. In their ERS report on local foods, Martinez and Hand (2010) provide an appendix of grant programs meant to help local food suppliers in overcoming infrastructure barriers, and scale or other inefficiencies. Yet, some of these programs are also challenged by ill-defined standards; each has attempted to define what local is, some by state boundaries, and others by miles—without recognizing that all miles are not created equal.

The Farmers Market Promotion Program (FMPP) was created through a recent amendment of the Farmer-to-Consumer Direct Marketing Act of 1976. The grants, authorized by the FMPP, are targeted to help improve and expand domestic farmers' markets, roadside stands, community-supported agriculture programs, agri-tourism activities, and other direct producer-to-consumer market opportunities.

The Federal-State Marketing Improvement Program (FSMIP) provides matching funds to state departments of agriculture and other appropriate state agencies to assist in exploring new market opportunities for U.S. food and agricultural products, and to encourage research and innovation aimed at improving the efficiency and performance of the marketing system. This does not only pertain to sustainable food segments, but a perusal of recently funded projects shows that sustainable markets are commonly included.

The 2008 Farm bill also funded organic data collection to collect and distribute comprehensive reporting of prices relating to organically produced agricultural products; conduct surveys and analysis and publish reports relating to organic production, handling, distribution, retail, and trend studies (including consumer purchasing patterns); and, develop surveys and report statistical analysis on organically produced agricultural products. This, together with some new USDA-AMS price data initiatives, has alleviated some of the missing market and economic information needed for the development of organic and local markets, in particular.

Small and Mid Sized Farms is one of 12 topic areas in the USDA Small Business Innovation Research (SBIR) program. Funded research concentrates on the development of new technologies and information that will help improve the viability and profitability of small and mid-size farms and ranches. Although it is not clearly related to sustainable food segments, it is likely that this program will support local food systems, since Martinez and Hand (2010) showed that most local, direct marketers are small. Similarly, the Agricultural Food Research Initiative (formerly National Research Initiative) program area focused on Agricultural Prosperity for Small and Medium-Sized Farms funds interdisciplinary studies to improve understanding of the interactions between the economic and environmental components important to the long-term viability, competitiveness, and efficiency of small and medium-sized farms—including social, biological, and other components, if necessary.

In addition to these market development programs, there are other programs that indirectly support more localized food industries. The Local and Regional Food Enterprise Guaranteed Loans program has morphed into a Healthy Food Financing Initiative, partnering the Departments of Agriculture, Health and Human Services and Treasury (http://www.hhs.gov/news/press/2010pres/02/20100219a.html). The overarching goal is to fund enterprises that process, distribute, aggregate, store, and market local and regional foods, while also addressing new concerns about market access and food deserts. This program and the USDA Rural Development's Value-Added Producer Grants Program's (VAPG) new focus on local distribution as an eligible value-added activity are programs that will provide money to study and capitalize private food initiatives.

Technical or Productive Efficiency

Any efficiency discussion usually begins with a focus on production at minimum cost, for given resource prices and levels of output. Conventional wisdom is that sustainable food segments, like organics, lose ground in this efficiency measure because they exclude some technologies, such as modified genetics and synthetic inputs, which may impact yields in the short-run. Still, advocates of organic agriculture and other sustainable methods argue that organic approaches will build the soil ecosystems, spur innovation in natural pest management and soil fertility processes, reduce negative impacts of synthetic inputs on water quality and wildlife, and provide more nutritious foods for consumers. So sustainable food systems may involve a trade-off between short-term and long-term productive efficiency, where yields are an imperfect measure.

Using organic earnings equations that control for producer and farm characteristics, Lohr and Park (2010) revealed that organic farmers who are involved in local sales achieve lower earnings, but producer involvement in local sales has little impact on observed technical (or productive) efficiency of organic farms. Unfortunately, there is little other research from which to draw conclusions, but several of the programs listed previously—AFRI, SARE, new organic data collection—provide the studies we can reference on this topic.

One indication of producer perceptions about the competitiveness of organic systems is the small share of U.S. production that is certified organic (Fig. 16.3). Even with more rapid adoption over the past 20 years, organic crop and pasture represents less than 1% of the total land in production, but 4% of retail food sales because of the prevalence of higher value crops. The land that is certified for organic production is primarily for crops in the Midwest and East, with larger pockets of certified pasture in the West. Adoption rates may continue to grow rapidly if research on technical efficiency in organic systems and more effective Extension programs on best practices can provide some optimistic and consistent conclusions. Another interesting trend is the growth in urban food systems, many of which are using low-input, sustainable methods in very place-based strategies to reclaim lands for production.

Research does provide some evidence on efficiency. Badgley et al. (2007) compiled results from hundreds of research studies on organics and concluded that, for most food categories, the average ratio of organic to conventional yields was slightly <1.0 for studies in the developed world and >1.0 for studies in the developing world. So, any premia that exist are at least partly based on the yield shortfalls that do still occur, and also on the costs of the secondary marketing infrastructure that has developed to support the special handling requirements. The potential of marketing system participants to capture excess profits due to consumer perceptions is more difficult to measure.

The research on livestock products is more limited. According to one 2009 USDA, ERS study by McBride and Greene, organic dairies produce about 30% less milk per cow than conventional dairies. Organic dairies are generally smaller than conventional dairies—82 cows compared with 156 cows average—and use more pasture-based feeding than conventional dairies—63% compared with 18%. So, delineating whether the production shortfalls relate to production practices rather than to scale inefficiencies is more challenging. In studies on other organic production systems, Serra and Goodwin (2009) and Lohr and Park (2006) report increasing returns to scale for organic farmers. This implies that technical efficiency may improve with continued growth in this segment.

Beyond technical efficiency impacts, one must consider broader economic efficiency. Organic dairies paid $7.65 per cwt more than conventional dairies in total operating, capital, and economic costs, including transition costs, in 2005; yet, the average price premium for organic milk was $6.69 per cwt. So, the market is signaling greater value for organic milk; but in this case, the premium paid is not sufficient to cover losses in production efficiency, at least during the year of analysis which was in era of higher prices in conventional dairy markets.

The USDA-ERS study on organic dairies also sheds light on the technical efficiency of different farm sizes, and found that there were significant cost disadvantages to small scale dairies (McBride and Greene 2009a, b). The relationship between average production costs and operation size for organic dairies was similar to what was already reported for conventional dairies.

While there is now ongoing research to examine technical efficiency, what is still unknown is how efficiency may improve with the technical assistance, research and education programs that were only prioritized recently for this segment. The Alternative Farming Systems Information Center (AFSIC) collects, organizes, and distributes information on alternative agriculture through the National Agricultural Library. For outreach, the National Sustainable Agriculture Information Service provides hundreds of publications related to sustainable practices and is inclusive of all marketing segments discussed here.

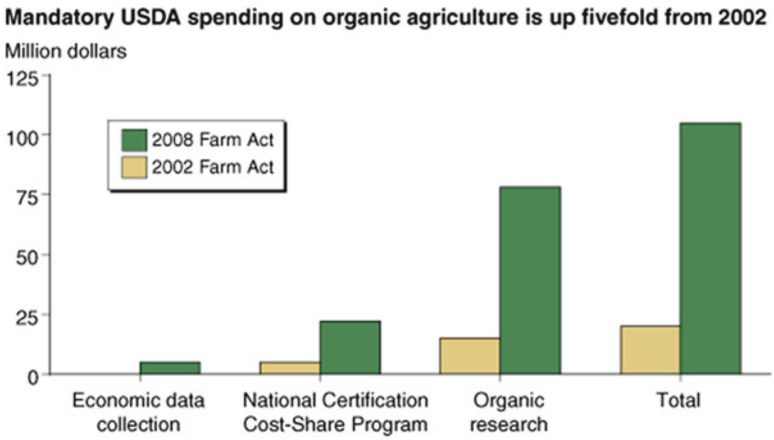

Fig. 16.6 Organic research spending

These programs recognized early on that there was a need for a broad continuum of research and information from basic research on the system-wide outcomes related to sustainable approaches down to place-based applications of new technologies and practices. Figure 16.6 shows that USDA funding for organics jumped significantly between the 2002 and the 2008 Farm bills, primarily through the Organic Agriculture Research and Extension Initiative (USDA-NIFA 2012).

Allocative Efficiency

As discussed previously, market signals can be thwarted by asymmetric information or inequality of bargaining or market power among firms. For this reason, marketing policies often include some provision for better market information and private producer groups have responded by requesting USDA support in developing new verification programs (Figs. 16.1 and 16.2). Little research has been done on consumer confidence in these programs, but early evidence is that third party certification on sustainable programs does increase consumer confidence that their food dollars are going to food systems they support (Onozaka et al. 2011).

For organics, the National Organic Program's standards continue to evolve in response to market signals from consumers and customers, and producers are concerned that USDA's consideration of adjusting some standards, such as allowing GMOs, may weaken their market position (Walz 2009). Several programs—including FSMIP, Value Added grants, AFRI and SBIR—are now available to support the market research needed to determine if consumers believe and value the information they get from organic, local, and certification programs.

As one example for environmental externalities, local food systems are assumed to have lower food miles and a smaller carbon footprint, due to the shorter transportation distance. However, several cases are reported where imported products are shown to have lower levels of overall carbon emissions, when local or domestic production involves energy-intensive practices, such as heated greenhouses (for example, AEA Technology 2005). Analyses have also shown that growing produce on large scale, efficient farms in California and trucking it across country is more carbon efficient than producing it on small scale local farms where it is then transported in small lots to markets. This is consistent with allocative efficiency gains from using scarce resources to maximize social welfare. Weber and Matthews (2008) go further to conclude that a larger environmental impact could be made in shifting U.S. diets to less frequent red meat consumption, relative to switching a share of diet to local, fresh produce.

Dynamic Efficiency

The value chain modifications that have emerged in response to changing consumer preferences (Fig. 16.2) influence the food production system at various points in the supply chain. For this reason, the organic standards address inputs and production practices, but have well-defined handling standards as well. This may require an entirely different marketing infrastructure than conventional crops, and this recreated set of marketing channels may have value to some customers and consumers.

In response, government programs such as FSMIP, SBIR, and the USDA Rural Development Value Added Grants fund feasibility studies so that producers and producer organizations can explore new market strategies before investing. The outcome indicators businesses must provide to these programs, such as increased revenues or jobs created, suggest they will be linked to broader U.S. economic development goals, but the eligibility to compete is evolving to be inclusive of sustainable and local producers.

Nonmarket Benefits

It is not clear how well the marketing system delivers on new marketing programs' potential to address non-market beneficial outcomes. Yet, there are numerous claims made in sustainable and local food programs about the positive spillovers to rural development, humane treatment of animals, protection of public health, as well as social justice. For example, the Center for Disease Control now identifies rethinking the structure of the current food system as one potential mitigation strategy to address diet-related disease. Within the marketing programs that have evolved, and the government programs to support them, criteria to achieve intended outcomes range from very specific, such as a measurable nutritional quality; or broadly defined in a systems-based approach, as in designating family farms or local ownership as a criteria, with the underlying assumption that it improves rural development outcomes.

As an example of another type of certification, and how policies may form to support its growth, fair trade certification is one marketing program that has garnered consumer attention (Pelsmacker et al. 2005). International programs that certify farmers in developing countries for fair and sustainable practices are somewhat well-known among U.S. consumers, especially in coffee and chocolate niche markets. Now domestic fair trade certifications are also under development, addressing fair treatments of domestic farmers and farm workers (Brown and Getz 2008). Similar to organics, which initiated certification processes through a network of NGOs and a few state organizations before a national certification program was established, fair trade has a rather specific set of standards, certification process and oversight, so it is likely to parallel the organic marketing policies and programs now managed by the USDA.

One tension among the sustainable marketing programs emerges when their intended outcomes run directly counter to the intended outcomes of other programs. An example of unintended consequences was reported in the United Kingdom, where attention to food miles and carbon footprint increased demand for domestic products, resulting in a boycott on products from "the poorest and most vulnerable countries," such as those in Sub-Saharan Africa (Muller 2007). In these cases, consumers are implicitly forced to decide between supporting local and domestic farmers or the distant poor, and the distributive justice issues that might suggest. These findings are but one example of the complex competitive environment that is emerging as the use of carbon-friendly criteria becomes more common and the non-market benefits of food systems receives more attention.

The farm size criteria often included in sustainable marketing programs suggest that many segments are targeted at consumers who value more open market access and egalitarian markets. Although cooperatives have addressed this concern for many decades, new generation cooperatives and marketing alliances are emerging, some with certification processes, but others rely on simple membership commitments. Values-based supply chains are a new type of organization that uses membership commitments to retain negotiating power with producers in the supply chain, and there is a growing set of research on whether such organizations improve distributive justice (Stephenson and Pirog 2008).

There is limited research and documentation linking sustainable food programs to outcomes, yet consumer sentiment has shifted an increasing number of food buyers to alternative food markets to benefit non-market outcomes (Onozaka et al. 2011). Low and Vogel (2011) show that direct markets seem to be an important market access point for small and beginning farmers. So, programs targeting farmers markets, regional distribution networks, and innovative marketing schemes seem to be a good solution for distributive justice issues, but understanding the impact on long-term viability for producers under these initiatives may require continued research under the Small and Mid-size Farm programs. With less tangible criteria, and inferred linkages to broader ecosystems or societal systems, this challenge to evaluate the veracity of marketing claims will be difficult to manage. AFRI Organic, Small and Mid-Sized Farms and SARE programs allow for production and marketing research to verify whether outcomes translate to competitive advantage in the marketplace, but the funfing for this research is slight in comparison to what remains to be discovered.

Recommendations and Adaptations

Howard and Allen (2010) conclude that consumers are interested in a food system that addresses broader political and ethical values. As a result, private industry and government-sanctioned labeling programs have proliferated greatly to create a new set of standards that are reliant on credence attributes and process verification systems to assure consumers of outcomes they desire (see Fig. 16.1).

Probably the largest dynamic shift in sustainable food segments has been the innovative producer responses to consumer concerns about the environment, local farms and land preservation, social justice and animal welfare (Raynolds et al. 2009). But there is growing contention about whether claims made by some food industry stakeholders are accurate, and there is too little long-term research on most outcomes to inform the debate.

Information Gaps and Research Needs

One clear message from this chapter is that marketing performance in the organic, local, and sustainable food segments can only be assessed after more research is conducted to analyze a variety of outcomes from their underlying food systems. Many of the allocative and non-market efficiencies expected from sustainable certification programs are based on credence attributes and consumer expectations of benefits from these attributes. Research is beginning to identify what consumer perceptions and values are important (Lusk and Briggeman 2009; Onozaka et al. 2011), so now the systematic documentation of outcomes associated with those values should be prioritized.

Specific to marketing programs, it is imperative that researchers provide analyses on which to base organic regulations, the importance of food miles and carbon footprints, and a wide array of sustainable methods being bundled in various claims (Fig. 16.2). Such research will provide rationale for differentiation and regulation, identify where there may be unsubstantiated claims, and guide those marketing in sustainable segments on how they might overcome, or respond to, any critiques of their marketing messages. For those enterprises targeting export market growth, research may be needed to address concerns about how market niche criteria may be viewed as technical barriers to foreign trade.

For organics, and some other production-specific claims, the industry will need to assess long-term impacts of whole-farm systems, both for their impact on farm productivity and on economics. They must also relate whole-farm systems to social and environmental benefits including: rural community stability, biodiversity conservation, energy use and efficiency, carbon sequestration, soil conservation, and air and water quality.

In a broader sense, there is a need to evaluate the economic, business and social aspects of various organic, local, and sustainable production systems to assess grower returns, evaluate the efficiency of various marketing programs and strategies intended to increase consumer demand, and analyze the performance of emerging supply chains.

Opportunities for Industry–Government Collaboration

It is likely that the government will continue to react to the market innovations occurring in sustainable food systems. But several of the programs and processes established in recent years will increase the likelihood of industry and government collaborations on several fronts.

Clearly, the organic industry will continue to be guided by producer, food industry, and government partnerships to manage standards—such as the NOSB, grow domestic and international markets and spur food innovations. But the challenge in this partnership is to retain the negotiating power at all levels of the supply chain to avoid fragmentation by those who feel they are not represented.

New programs to spur regional food systems, value-added agricultural activities, and small business innovations allow private stakeholders to bring ideas to the government, gain support to finance early stage development, and report on the outcomes that will inform the public dialogue on what models may or may not be viable. Continued refinement of these programs to make sustainable food producers eligible—or prioritized if the intended outcomes align, as would be the case with programs targeting small businesses—along with transparent selection criteria, seem warranted.

Market information should be a priority. Any market assessment needed to examine enterprise viability needs price, production, and marketing channel data. The small inroads made in the 2008 Farm Bill seem to have had impacts already for the organic industry, so providing more information on differentiated markets would be a good role for the government, but it is industry that should frame what types of information are needed.

Finally, the process verification programs are a valuable innovation which could be linked more with research and technical assistance programs. They allow the producer stakeholders to define the differentiable attributes of their product, and its position in the market. It seems appropriate that some of the programs to look at feasibility, finance, and pilot projects should lean on the verification process as a way to assess eligibility or assess measurable outcomes, preferably after a pilot phase.

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Chapter 17
Agricultural Biotechnology Issues

Michael J. Phillips

Abstract With the advent of biotechnology in agriculture, the science of crop improvement has evolved into a new realm. The results have been greater productivity with less environmental risk from chemical use. In the future, there are greater possibilities in both plants and animals. However, these advances in science and technology along with other factors are placing many new demands on policies and programs designed in an earlier era. Advances in agricultural biotechnology have clearly outstripped changes in policies and programs and as a result threaten the promise that the technology has to offer. This chapter evaluates issues, policies, and options affecting the use of agricultural biotechnology that include (1) the role of the technology in minor crops, (2) the reality of adventitious or low level presence of biotech crops, (3) the structure for regulation of the technology, and (4) the impact of the technology on seed industry concentration.

Although the process of plant and animal improvement has been continuous throughout the history of agriculture, an important change in agriculture resulted from the application of more advanced scientific approaches to plant breeding. This developed from the recognition of the cell as the primary unit of all living organisms. Recent developments in scientific plant breeding have resulted from discoveries in molecular and cellular biology in the second half of the twentieth century that laid the foundation for the development of agricultural biotechnology plants. In 1973, the American biochemists Stanley Cohen and Herbert Boyer were among the first scientists to transfer a gene between unrelated organisms successfully. They cut DNA from an organism into fragments, rejoined a subset of those fragments,

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and added the rejoined subset to bacteria to reproduce. The replicated DNA fragments were then spliced into the genome of a cell from a different species, and this created a transgenic organism, that is, an organism with genes from more than one species.

DNA-recombination techniques opened the possibility of augmenting plant genomes with desirable traits from other species. These techniques took the science of plant breeding to a stage in which improvement is no longer constrained by the limits of genetic traits within a particular species but rather by the limits of discovery of genes and by the ability to transfer these traits from one species to another.

With the advent of biotechnology in agriculture, the science of crop improvement has evolved into a new realm. Advances in molecular and cellular biology now allow scientists to introduce desirable traits from other species into crop plants. The ability to transfer genes between species is a leap beyond crop improvement through previous plant breeding techniques, whereby desired traits could only be transferred between related types of plants. The most commonly introduced genetically engineered (GE) traits allow plants either to produce their own insecticide, so that the yield lost to insect feeding is reduced, or to tolerate herbicides, so that herbicides can be used to kill a broad spectrum of weeds without harming crops. Those traits have been incorporated into most varieties of soybean, corn, and cotton grown in the United States. The results have been greater productivity with less environmental risk from chemical use. In the future, there are greater possibilities in both plants and animals.

This chapter, like the others in this book, focuses on the evolution of the policies and programs affecting food and agricultural marketing systems that were designed in the early and mid-1900s. Today advances in science and technology along with other factors are placing many new demands on these policies and programs. This chapter identifies and evaluates issues, policies, regulations, and options affecting the use of agricultural biotechnology in the food and marketing system.

Genetic Traits in Crops

For agricultural crops, the first generation of agricultural biotechnology plants has targeted traits that increase the efficacy of pest control. Since the introduction of crops derived through biotechnology, new seeds have provided pest control in one or more of three forms:

- Herbicide tolerance
- Insect resistance
- Virus resistance

GE herbicide-tolerant (HT) crops contain transgenes that enable survival of exposure to particular herbicides. In the United States, crops are available with tolerance to glufosinate and glyphosate, but most HT crops grown in the United States are resistant only to glyphosate, a nonselective chemical that has a low impact on the environment. Glyphosate also has low soil and water contamination potential because it binds readily to soil particles and has a relatively short half-life in soil (Duke and Powles 2008).

Insect-resistant (IR) plants grown in the United States have genetic material from the soil dwelling bacterium *Bacillus thuringiensis* (Bt) incorporated into their genome that provides protection against particular insects. Bt produces a family of endotoxins, some of which are lethal to particular species of moths, flies, and beetles. An insect's digestive tract activates the ingested toxin, which binds to receptors in the midgut; this leads to the formation of pores, cell breakdown, and death. Individual Bt toxins have a narrow taxonomic range of action because their binding to midgut receptors is specific; the toxicity of Bt crops to vertebrates and many nontarget arthropods and other invertebrates in US agricultural ecosystems is effectively absent. The first Bt crops that were introduced produced only one kind of Bt toxin. More recent varieties produce two or more Bt toxins; this enhances control of some key pests, allows control of a wider array of insects, and can contribute to delaying the evolution of resistance in target pests (NRC 2010).

Gene sequences of pathogenic viruses have been inserted into crops to confer protection against related viruses—to make them virus resistant (VR). Most transgenic VR plants resist viruses through gene silencing, which occurs when transcription of a transgene induces degradation of the genome of an invading virus. Potential unwanted environmental effects of VR crops include exchanges between viral pathogens and transgene products that could increase the virulence of viral pathogens, food allergenicity, and transgene movement through pollen, which can create VR weeds. However, adverse environmental effects of commercialized VR plants have not been found (Fuchs and Gonsalves 2008).

HT and IR crops are the principal targets of most efforts to develop GE crop varieties and account for the bulk of acres planted in GE crops in the United States. Consequently, this paper focuses on these types of GE crops. HT varieties of soybean, corn, cotton, canola, and sugar beets and IR varieties of corn and cotton were grown commercially in 2009. Herbicide tolerance and insecticide resistance are not mutually exclusive; a number of crop varieties that contain both types of resistance have been developed. GE corn and cotton may also express more than one type of Bt trait. Plants with multiple GE characteristics are referred to as "stacked cultivars."

Herbicide tolerance and insect resistance were commercialized because of the relative simplicity in gene transfer and the utility for growers. The expression of those traits requires manipulation of the genetic code at only one site, a relatively straightforward process compared with such traits as drought tolerance, which involve the action of many genes. Furthermore, because corn, soybean, and cotton production accounts for the bulk of pesticide expenditures in the United States, herbicide tolerance and insect resistance provided important market opportunities. Those GE crops fit easily into the traditional pest-management approach of mainstream US agriculture: reliance on the continual emergence of technological advances to address pest problems, particularly after development of resistance to an earlier innovation. Therefore, the familiarity of the chemicals used, the size of the market for the seeds of and pesticides for GE crops, and the ease of manipulation of the genes for the traits contributed to HT and IR seeds to be the first GE products to emerge in large-scale agriculture (NRC 2002).

Genetic Traits in Animals

A GE animal is one which has had a deliberate modification made to its genome. Genetic engineering allows scientists to precisely transfer beneficial genes from one species to another. Research is on-going to provide solutions to transform public health through biomedical, environmental, food production, and animal welfare applications. GE animals currently under development include pigs, sheep, goats, chicken, fish, and cattle. Three broad areas of scientific development define the area (Gottlieb and Wheeler 2009).

Advancing Human Health

GE animals are integral to the development of new diagnostic techniques and drugs for human disease while delivering clinical and economic benefits that cannot be achieved with any other approach. Through the use of this technology, scientific research to produce therapeutic proteins to use in treating cancer, heart disease, hemophilia, and rheumatoid arthritis among other diseases is very promising. In addition, scientists are researching the possibility of using these animals to grow transplant organs that can be used when other options are exhausted.

Enhancing Foods Through Healthy Animals

GE animals can help improve food production. For example, salmon have been genetically engineered to grow to their mature size more quickly, increasing the efficiency of food production and alleviating stress on wild fish stocks. Work is also underway to improve the nutritional value of foods. For example, by changing the metabolism or uptake of cholesterol and fatty acids in genetically engineered animals, the content of fat and cholesterol in meats, eggs, and cheeses could be lowered. There is also the possibility of introducing beneficial fats such as omega-3 fatty acids from fish or other animals into livestock.

Animal Welfare and the Environment

Genetic engineering is also being used to lessen the environmental impacts of livestock production. One example is the EnviroPig which produces dramatically lower levels of phosphorous emissions than traditional pigs. Finally, genetic engineering can also improve animal welfare by imparting resistance to disease and enhancing overall health and well-being.

GE animals are required to undergo a strict safety review by the appropriate federal agencies before they are approved for commercialization. To date, no GE animal has been approved. However, there are more than two dozen drugs in development derived through genetic engineering of farm animals and numerous agricultural animal applications with beneficial environmental and husbandry attributes suitable for commercialization that are in various stages of the regulatory process.

Adoption of Agricultural Biotechnology Crops

Driven by growers' expectations of lower production costs, higher yields, and reduced pesticide use, the rate at which US growers adopt agricultural biotechnology crop varieties has increased dramatically. In the United States, by 2011, over 70 plant varieties had been commercialized. Ninety-four percent of all US soybean, 90% of all upland cotton, and 88% of all corn acres were planted with GE seed varieties, according to USDA's National Agricultural Statistics Service (Fig. 17.1, Table 17.1).

It is estimated that about 395 million acres of GE crops with herbicide tolerance and/or insect resistance traits were cultivated worldwide in 2011, an 8% increase over acreage in 2010, and US acreage accounts for about 43% of the worldwide

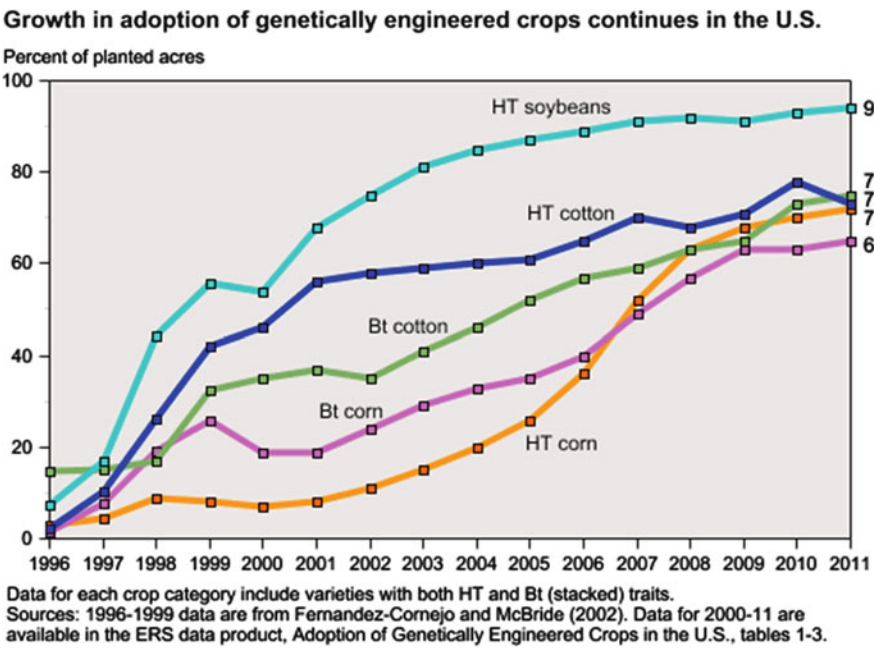

Fig. 17.1 Adoption of GE crops in the United States 1996–2011

Table 17.1 US Acreage in major GE crops, selected years

	Corn		Cotton		Soybeans	
Year	Acres (millions)	Percent of total planted	Acres (millions)	Percent of total planted	Acres (millions)	Percent of total planted
1996	2.9	4	2.2	17	4.2	7
2000	19.9	25	9.5	61	40.2	54
2005	42.4	52	11.1	79	63.8	87
2011	81.2	88	12.4	90	70.7	94

Source: USDA-NASS. *Acreage Report*, 2000, 2005 and 2011. 1996 data from Fernandez-Cornejo and McBride (2002)

total (ISAAA 2011). The actual benefits in terms of costs, yields, and pesticide use vary with the crop and engineered trait.

According to surveys conducted by USDA in 2001–2003, most farmers (59–79%) adopting GE corn, cotton, and soybeans indicated that they did so mainly to "increase yields through improved pest control." The second most cited aim was to "save management time and make other practices easier" (15–26%, except for Bt corn, which was much lower); the third reason was to "to decrease pesticide costs" (9–17% of adopters). Hence, the most important factor leading to adoption of GE crops was the anticipation of increased economic profitability by increasing revenues per acre or reducing costs (USDA 2009).

Market Conditions and Policies Influencing Commercialization

Most research and development of GE crops are conducted by private firms. Private companies must produce profits for their shareholders, so the marketability of a crop plays a determining role in decisions as to which GE crops are brought to commercialization. Market size, trait value, regulatory costs, environmental concerns, and technology access influence biotechnology firms' decisions to develop and sell GE seeds.

Minor Crops

The market for seeds must be large enough to warrant the investment in commercialization. If markets are too small or are characterized by farmers with low ability to pay for the technology, the benefits to biotech firms are too low to induce them to introduce GE varieties. High costs relative to benefits are one of the reasons that specialty crops have largely been overlooked. For example, Hawaii's papaya industry was on the verge of extinction due to the papaya ringspot virus (PRSV) and private companies had not developed a genetic line to combat the virus. A USDA plant virologist, Dr. Dennis Gonsalves, along with a team of university biologists and horticulturalists began efforts to develop GE papaya that was resistant to PRSV. One PRSV-resistant line was discovered and farmers began planting the transgenic cultivar in 1999, effectively sparing the industry from disaster.

In addition, the number of researchers in these types of crops is considerably smaller and the marketing infrastructure less extensive than for soybean, corn, and cotton. That lack of resources, the diversity of species, the relatively short marketing season, and the small number of planted acres combine to deter private sector investment in agricultural biotechnology for specialty or minor crops (Bradford and Alston 2004). To collect sufficient returns, biotech firms instead invest in widely grown crops that have long storage life and that have year-round marketing potential. That generally means that farmers growing such crops have access to biotechnology, whereas the option is not available to farmers growing minor crops or crops that are not widely grown in the United States.

Regulatory Costs

The cost of regulatory compliance to ensure that GE crops do not pose unacceptable food safety and environmental risks has become an important component of the overall cost of new biotechnologies (Kalaitzandonakes et al. 2007). These costs may have contributed to limiting the development of GE minor crops, as was the case with pesticide development during the 1970–1990 period. As Ollinger and Fernandez-Cornejo (1995) found, "pesticide regulations have encouraged firms to focus their chemical pesticide research on pesticides for larger crop markets and abandon pesticide development for smaller crop markets." Obtaining regulatory clearance of GE crops in the United States is a long process, and the cost per crop can be very high. Furthermore, for crops with wild, weedy relatives (e.g., wheat), the potential for gene flow or migration that can cause weedy relatives to exist in a field raises their environmental risk and expense.

Large private firms have concluded that investment in less widely grown crops does not generate adequate returns to justify the development and regulatory cost of bringing them to market. On average, it takes approximately 15–20 years from the development of the first new GE plant to conduct the field tests, perform the safety studies, submit the data to the appropriate regulatory agency, receive agency approval, and record its first sale–at a cost of approximately $100–150 million.

Intellectual Property Rights

Research and development in genetic-engineering technology have been stimulated by the development of patent protection for GE organisms. Changes in intellectual property rights (IPR) law in the 1970s and 1980s are largely responsible for creating a profitable environment for biotechnology research. However, that protection may also create constraints on the development of GE varieties of more crops. Companies that control the patents may be unwilling to provide licenses or offer licenses at affordable prices to public sector researchers or other companies that would like to develop seeds for smaller markets. A similar restriction may occur when university scientists patent genetic material that becomes essential for the development of GE crops by other university scientists. Thus, the mechanism that generated the incentives to develop and commercialize biotechnology may limit its applicability to most crops (Alston 2004).

Consumer Acceptance

Marketing decisions are also influenced by perceived consumer acceptance of GE products.

If technology providers have reason to believe that a GE crop will not be purchased by consumers, the technology will not be commercialized regardless of the potential benefits of the technology to producers. Indeed, a product may even be decommercialized if consumer avoidance, or the fear of it, is high enough. For example, consumer concerns and competing pest-control products caused the GE potato to be discontinued. The perceived potential loss of markets has also postponed the commercialization of GE wheat. Consumers appear to be more accepting of products that are further removed from direct consumption. Thus, companies have been more willing to invest in corn and soybean, which are used primarily for animal feed and processed products, and cotton, a fiber crop. Even though wheat and rice are grains (like corn), are widely planted, and have a considerable storage life, their proximity to the consumer in the food supply chain has contributed to additional pressures on the private sector. As an alternative, some consumers do avoid consuming GE products by purchasing organic foods that are prohibited from intentionally using GE crops as discussed below.

Some consumer groups have advocated for special labeling of foods containing GE products. The FDA's evaluation of a GE food focuses on its characteristics, not the method used to develop it. A new GE food that is "substantially equivalent" (meaning it has the same chemical composition and nutritional value to conventional varieties) does not require a special label. FDA's regulations state that requiring the labeling of foods that are indistinguishable from foods produced through traditional methods would mislead consumers by falsely implying differences where none exist.

According to the 2010 Consumer Survey by the International Food Information Council (IFIC), consumer satisfaction with current information on food labels remains high. Only 18 % of consumers supported additional information on food labels, with only 3 % supporting the labeling of GE foods.

Nonadopters of Agricultural Biotechnology

Some producers have chosen not to adopt GE technology regardless of its accessibility and productivity impacts. That attitude is typified by organic production in the United States. As American agricultural practices incorporated greater use of synthetic chemicals in the 1950s and 1960s, organic production gained popularity as an alternative farming system.

By the 1980s, the organic movement was large enough to justify the establishment of national certification standards. The proliferation of standards, inconsistency in labeling, difficulty in marketing, and inability to police violators of standards prompted organic groups to push for passage of the Organic Foods Production Act (OFPA) of 1990. The OFPA authorized a National Organic Program (NOP) in the US Department of Agriculture (USDA) to define organic farming practices and acceptable inputs. The act established an advisory group, the National Organic Standards Board (NOSB), to provide recommendations to USDA on the structure and guidelines of the NOP. The NOSB viewed GE plants as inconsistent with the principles of organic agriculture and recommended their exclusion (Vos 2000). Opponents of GE technology in organic production raised concerns about food safety and environmental effects. They also argued that organic agriculture is based on a set of values that places a high priority on "naturalness", a criterion that in their view biotechnology did not meet (Verhoog et al. 2003).

The proposed rule that was issued in 1997 deemed GE seeds permissible in organic agriculture; subsequently, USDA received a record number of public comments, almost entirely in objection to the proposal. In response to the opposition, USDA rewrote the standards. When the NOP final rule went into effect in 2001, GE plants were not considered to be compliant with standards of organic agriculture and thus excluded (Johnson 2008).

However, the inadvertent presence of GE plants does not violate NOP standards. Organic certification is process based and as long as an organic operation has not used excluded methods and takes reasonable steps to avoid contact with the products of excluded methods as detailed in their approved organic system plan, the unintentional presence of the products of excluded methods will not affect the status of the organic operation (NOP 2000). To date, no organically certified farm has lost its USDA certification due to the presence of unintended GE plant material.

Environmental Impacts

Generally, GE crops have had fewer adverse effects on the environment than non-GE crops produced conventionally. The use of pesticides with toxicity to nontarget organisms or with greater persistence in soil and waterways has typically been lower in GE fields than in non-GE, nonorganic fields. However, farmer practices may be reducing the utility of some GE traits as pest-management tools and increasing the likelihood of a return to more environmentally damaging practices (NRC 2010).

HT Crops

When adopting HT crops, farmers mainly substituted the herbicide glyphosate for more toxic herbicides. However, the predominant reliance on glyphosate is now reducing the effectiveness of this weed-management tool.

Glyphosate kills most plants without substantial adverse effects on animals or on soil and water quality, unlike other classes of herbicides. After the commercialization of HT crops, farmers replaced many other herbicides with glyphosate applications after crops emerged from the soil.

However, the increased reliance on glyphosate after the widespread adoption of HT crops is reducing its effectiveness in some situations. Glyphosate-resistant weeds have evolved where repeated applications of glyphosate have constituted the only weed-management tactic. Nine weed species in the United States have evolved resistance to glyphosate since the introduction of HT crops in 1996 compared with seven that have evolved resistance to glyphosate worldwide in areas not growing GE crops since the herbicide was commercialized in 1974. Furthermore, communities of weeds less susceptible to glyphosate are becoming established in fields planted with HT crops, particularly fields that are treated only with glyphosate (NRC 2004).

The adoption of HT crops complements conservation tillage practices, which reduce the adverse effects of tillage on soil and water quality. Farmers have traditionally used tillage to control weeds in their fields, interrupting weed lifecyc1es before they can produce seeds for the following year.

However, using tillage to help manage weeds reduces soil quality and increases soil loss from erosion. Tilled soil forms a crust, which reduces the ability of water to infiltrate the surface and leads to runoff that can pollute surface water with sediments and chemicals. Conservation tillage, which leaves at least 30 % of the previous crop's residue on the field, improves soil quality and water infiltration and reduces erosion because more organic matter is left on the soil surface, thereby decreasing disruption of the soil (NRC 2010).

Weed problems in fields of HT crops will become more common as weeds evolve resistance to glyphosate or weed communities less susceptible to glyphosate become established in areas treated exclusively with that herbicide. Though problems of evolved resistance are not unique to HT crops, their occurrence diminishes the effectiveness of a weed-control practice that has minimal environmental impacts. The situation may cause growers to return to tillage as a weed-management tool and to the use of potentially more toxic herbicides.

A number of new HT cultivars are currently in development and may provide growers with other weed-management options when commercialized. However, the sustainability of the new cultivars will also be a function of how the traits are managed. If they are managed in the same manner as the current HT varieties, the same problems of evolved HT resistance may occur. Growers need to incorporate more diverse management practices, such as herbicide rotation, herbicide application sequences, and tank-mixes of more than one herbicide; herbicides with different modes of action, methods of application and persistence; cultural and mechanical control practices; and equipment-cleaning and harvesting practices that minimize the dispersal of HT weeds (NRC 2010).

IR Crops

Targeting specific plant insect pests with Bt corn and cotton has been successful, and the ability to target specific plant pests in corn and cotton continues to expand. Insecticide use has decreased with the adoption of insect-resistant (IR) crops. The emergence of insect resistance to Bt crops has been low so far and of little economic or agronomic consequence; only two pest species have evolved resistance to Bt crops in the United States (NRC 2010).

Since their introduction in 1996, the use of IR crops has increased rapidly, and they continue to be effective. Data indicate that the abundance of refuges of non-Bt host plants and recessive inheritance of resistance are two key factors influencing the evolution of resistance. The refuge strategies mandated by the Environmental Protection Agency, and the promotion of such strategies by industry, likely contributed to increasing the use of refuges and to delaying the evolution of resistance to Bt in key pests. Nevertheless, some populations of two generalist pests have evolved resistance to Bt crops in the United States, although the agronomic and economic consequences appear to be minor. With the introduction of multiple Bt toxins in new hybrids or varieties, the probability of resistance to Bt crops is further reduced (NRC 2010).

Gene Flow

For the three major GE crops, gene flow or pollen migration to wild or weedy relatives has not been a concern to date because compatible relatives of corn and soybean do not exist in the United States and are only local for cotton. For other GE crops, the situation varies according to species. How that relationship changes will depend on what GE crops are commercialized, whether related species with which they are capable of interbreeding are present, and the consequences of such interbreeding on weed management.

Gene flow of GE traits into non-GE varieties of the same crops (known as adventitious or low level presence) remains a concern for growers whose market access depends on adhering to strict non-GE presence standards. The potential risks presented by gene flow may increase as GE traits are introduced into more crops. Resolving this issue will most likely require the establishment of thresholds for the presence of authorized GE material in non-GE crops, including organic crops that do not impose excessive costs on growers and the marketing system.

Potential Impacts for Food Security

Nobel laureate Norman Borlaug estimated that to meet projected food demands by 2025, average cereal yield must increase by 80 % over the 1990 average (Borlaug 2000). Making this formidable task even more difficult is that, to ensure that food production is coupled with both poverty reduction and environmental conservation, it will be essential that this increase occur in the complex smallholder farming systems of the poorest countries. That requires policies and actions to promote agriculture and rural development, an enabling regulatory framework, fair trade, flexible and responsive institutions, increased investments in health and education and access to credit, roads, marketing, and extension The transformation will require access to and ability to apply technological advances, since future growth in food production will have to come largely from agricultural intensification on existing land. Most land suited to agriculture is already in use (Serageldin 1999).

Because land and water for agriculture are diminishing resources, there is no option but to produce more food and other agricultural commodities from less arable land and irrigation water. Thus, the need for more food has to be met through higher yields per units of land, water, energy, and time.

Biotechnology may help achieve the productivity gains needed to feed a growing global population, introduce resistance to pests and diseases without costly purchased inputs, heighten crops' tolerance to adverse weather and soil conditions, improve the nutritional value of some foods, and enhance the durability of products during harvesting or shipping. New crop varieties and biocontrol agents may reduce reliance on pesticides, thereby reducing farmers' crop protection costs and benefiting both the environment and public health. Biotechnology based agriculture combines elements of ecological agriculture with crop varieties designed to perform well under low-input and stress conditions, uses inorganic inputs very judiciously, and engages farmers themselves in analyzing their needs and adapting new varieties and agronomic practices to their own conditions. Greater commitments and new partnerships are needed to sustain and expand this revolution in agriculture to small-scale farming families across all developing countries (Conway and Toenniessen 2003).

Biotechnology research could aid the development of drought-tolerant and insect-resistant crops, to the benefit of small farmers and poor consumers. Research on genetic modification to achieve appropriate weed control can increase farm incomes and reduce the time farmers spend weeding, allowing more time for the child care that is essential for good nutrition. This technology may also offer cost-effective solutions to micronutrient malnutrition, such as vitamin A- and iron-rich crops (Pinstrup-Andersen and Cohen, 2000).

Dietary micronutrient deficiencies, such as the lack of vitamin A, iodine, iron, or zinc, are a major source of morbidity and mortality worldwide. These deficiencies affect particularly children, impairing their immune systems and normal development, causing disease and ultimately death. For example, according to the World Health Organization, dietary vitamin A deficiency (VAD) causes some 250,000 to 500,000 children to go blind each year. Blindness and cornel afflictions are but indicators of more severe underlying health problems: more than half the children who lose sight die within a year of becoming blind. The best way to avoid these micronutrient deficiencies is by way of a varied diet, rich in vegetables, fruits, and animal products.

One of the best sources of beta-carotene (provitamin A) is rice. However, rice plants produce beta-carotene in green tissues but not in the endosperm—the edible part of the seed. Even though all required genes to produce provitamin A are present in the grain, some of them are turned off during development. In a new GE rice variety called *Golden Rice*, two genes were inserted into the rice genome via genetic engineering, to account for the turned-off genes. The intervention led in turn to the production and accumulation of beta-carotene in the grains. Since a prototype *Golden Rice* was developed in 1999, new lines with higher beta-carotene content have been generated. The goal is to be capable of providing the recommended daily allowance of vitamin A—in the form of beta-carotene—in 100–200 g of rice, which corresponds to the daily rice consumption of children in rice-based societies, such as India, Vietnam, or Bangladesh.

Regulatory Policy and Programs (Status Quo)

Domestic

Coordinated Framework for Regulation of Biotechnology

The basic federal guidance for regulating biotechnology products is the Coordinated Framework for Regulation of Biotechnology (51 *Fed. Reg.* 23302) published in 1986 by the White House Office of Science and Technology Policy (OSTP). A key regulatory principle is that biotechnology products should continue to be regulated according to their characteristics and unique features, not their production method, that is, regardless of whether they were created through the use of genetic engineering techniques. The framework provides a regulatory approach intended to ensure the safety of biotechnology research and products, using existing statutory authority and previous agency experience with traditional breeding techniques (OSTP 1986). The three lead biotech regulatory agencies are USDA's Animal and Plant Health Inspection Service (APHIS), the Food and Drug Administration (FDA) at the Department of Health and Human Services, and the Environmental Protection Agency (EPA).

Animal and Plant Health Inspection Service

APHIS regulates the importation, interstate movement, and field testing of GE plants and organisms that are or might be plant pests under the Plant Protection Act (PPA). Specifically, GE plants that are or might be plant pests are considered "regulated articles" under APHIS regulations (7 CFR 340). APHIS authorization is mandatory prior to import, interstate movement, or environmental release, including field testing.

More specifically, a "regulated" plant cannot be introduced into the environment, or even field-tested, unless its developer obtains APHIS authorization through either the (1) permit process or (2) notification process. Notification can be used in lieu of permitting when the plant species is not considered a noxious weed and other APHIS standards are met. These authorizations impose restrictions on movement and planting to prevent escape of plant material that may cause a pest risk. Sponsors follow APHIS guidance on testing and movements to ensure that the plant will not damage agriculture, human health, or the environment. However, most GE crops have been developed under the more expedient notification process.

Regardless of the process employed, after testing is completed, a developer next seeks "nonregulated status" from APHIS, the typical route to full commercialization and no further formal oversight. The developer must provide APHIS with extensive information on plant biology and genetics, and potential environmental and plant pest impacts that may result from the modification. APHIS conducts a formal environmental assessment, a pest risk assessment, and has public comment periods before deciding whether to approve the developer's request for "nonregulated status."

Food and Drug Administration (FDA)

FDA regulates food, animal feed additives, and human and animal drugs, including those derived from the use biotechnology, primarily to ensure that they pose no human health risks, mainly under the Federal Food, Drug and Cosmetic Act (FFDCA). Under the FFDCA, all food and feed manufacturers must ensure that the domestic and imported products they market are safe and properly labeled. All domestic and imported foods and feeds, whether or not they are derived from GE crops, must meet the same standards. Any food additive, including any introduced through biotechnology, cannot be marketed before it receives FDA approval. However, additives that have been determined to be "generally recognized as safe" (GRAS) do not need such preapproval.

To help sponsors of foods and feeds derived from GE crops comply, FDA encourages them to participate in its voluntary consultation process. All GE-derived products now on the US market have undergone this process. With one exception, none of these foods and feeds was considered to contain a food additive, so they did not require formal approval prior to marketing. However, a May 1992 FDA policy statement noted that GE foods must undergo a special review under certain conditions, such as if the gene transfer produces unexpected genetic effects, changes nutrients or toxicant levels from the food's traditional variety, might contain an allergen from another crop, or would be used to host an industrial or pharmaceutical substance, for example.

In June 2006, FDA published new guidance under which developers of new plant varieties intended for food use—including those that are derived through biotechnology—can provide FDA with any information about new proteins they are using in the early stages of crop development. This voluntary consultation is to occur prior to the stage of development where the new proteins might inadvertently enter the food supply. FDA believes that any potential risk from the low level or adventitious presence of such material in the food supply would be limited to the remote possibility of it containing or consisting of a new protein that might be an allergen or toxin.

Environmental Protection Agency (EPA)

EPA must approve the use of all pesticides, including those genetically engineered into plants, which it terms “plant-incorporated protectants” (PIPs). EPA essentially determines a Pip’s environmental safety through its authority under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). Also, under the FFDCA, the EPA establishes tolerances (i.e., safe levels) for pesticides in foods. Pre-commercial regulation is through a system of notifications for small-scale field tests or experimental use permits for larger field tests. As for any pesticide, EPA requires the manufacturer of a PIP to obtain a registration through a regulatory process intended to ensure its safe use environmentally.

As part of the registration process, EPA requires technology developers to establish refuges of non-Bt crops near Bt crops. It is the primary strategy in the field for delaying insect resistance. This strategy is based on the idea that insects feeding on plants in the refuge are not selected for resistance, because those plants do not make Bt toxins.

In practice, all three agencies have more detailed procedures than described here for monitoring and for approving the development and commercialization of GE crops and foods, particularly if they are for new uses. The process takes approximately 2–3 years to complete depending on the complexity of the product. The fundamental guiding policy assumption since 1986 has been that the biotechnology process poses no unique or special risks; therefore it demands no new laws beyond those that already govern the health, safety, efficacy, and environmental impacts of more traditional production methods.

Coordinated Framework Issues

Although the coordinated framework is a very useful concept in the management of regulatory policy and programs for biotechnology, it has resulted in inconsistent policy and at times hindered the evolution of regulatory policy. For example, as discussed above, APHIS policy that applicants apply for a permit to conduct confined field trials is mandatory. However, FDA policy that applicants provide food and feed safety data prior to product commercialization is voluntary. In addition, policy at times has been uncoordinated among the agencies. For example, the adventitious or low level presence issue received high priority at FDA and the issuance of a policy in 2006. However, the issue at APHIS is still under consideration.

International

The Biosafety Protocol

The Cartagena Biosafety Protocol, an outgrowth of the 1992 Convention on Biological Diversity (CBD), was adopted in January 2000 and took effect in 2003. The United States is not a party to the 1992 CBD, and therefore cannot be a party to the protocol. However, because its shipments to ratifying countries are affected, it has actively participated in the negotiations over the protocol text and in countries' preparations for implementation. The protocol, which 134 other nations had ratified as of August 2006, permits a country to require formal prior notifications from countries exporting biotech seeds and living modified organisms (LMOs) intended for introduction into the environment. The protocol requires that shipments of products that may contain LMOs, such as bulk grains, be appropriately labeled and documented, and provides for an international clearinghouse for the exchange of LMO information, among other provisions. The protocol further establishes a process for considering more detailed identification and documentation of LMO commodities in international trade.

Codex Alimentarius Commission

The Codex Alimentarius is a collection of internationally recognized standards, codes of practice, guidelines and other recommendations relating to foods, food production and food safety. Its texts are developed and maintained by the Codex Alimentarius Commission, a body that was established in 1963 by the Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO). The Commission's main objectives are to protect the health of consumers and ensure fair practices in the international food trade. The Codex Alimentarius is recognized by the World Trade Organization as an international reference point for the resolution of disputes concerning food safety and consumer protection. It has developed guidelines for the safety assessments of foods derived from biotechnology or traits introduced into foods by biotechnology on the basis of scientific evidence and risk analysis. US food safety regulatory policy is very consistent with these international guidelines.

The Structure of the Seed Industry

The global agribusiness sector has been undergoing consolidation and concentration for many years. Through divestitures, mergers, and acquisitions, a few major integrated corporations currently dominate much of the agricultural input sector, (e.g., agricultural chemicals, seeds, and biotechnology traits). With the emergence of innovations in biotechnology in the early 1980s, an upsurge of takeovers and mergers began within the seed industry. Chemical and pharmaceutical industries were the major purchasers of independent seed companies. By 2005, according to Phillips McDougall, a UK agribusiness consulting firm, the top 10 companies were estimated to comprise 51 % of the world's commercial seed sales (Phillips McDougall 2005). This figure is based on a 2005 global seed market of $19.0 billion. A smaller group of transnational firms—Monsanto, DuPont/Pioneer, Syngenta—are the industry leaders today. Between 2004 and 2005, there was an increase in seed industry acquisitions. Monsanto, through its acquisition of Seminis in 2005, displaced Dupont/Pioneer as the world's largest seed corporation (ETC Group 2008).

Determining whether concentration and consolidation in the seed industry have reached a point where anticompetitive behavior becomes a concern requires accurate data on market share of individual firms and the total market value of the industry. However, estimates for the size of the global seed market are not precise. According to one estimate, the 2006 global value of the commercial seed market was $22.9 billion. The International Service for the Acquisition of Agri-Biotech Applications (ISAAA) estimated the 2005 global market at $30 billion. In 2005, the International Seed Federation estimated the size of the market of seed and "other planting material" in 56 countries at $25.2 billion. The ETC Group estimated the total to be $21 billion. Assuming a global seed market value of $21 billion, the top 10 firms dominated approximately 49 % of the market in 2004–2005 (ETC Group 2005).

While Monsanto, the largest seed company, has approximately 14% of the global seed market, it has greater dominance in particular seed categories. Monsanto's Roundup Ready cotton, soybeans, and canola, for example, dominate the world's GE crops, which have become an increasing share of global crop production. In 2004, Monsanto's GE seed and/or its patented trait technology accounted for 175.7 million acres, approximately 88% of the total global GE crop area. Monsanto has 41% of the global GE corn seed and 25% of global GE soybean seed sales (ETC Group 2008).

In 2006, Monsanto announced its intention to buy Delta and Pine Land (D&PL), the world's largest seed cotton company with subsidiaries in 13 countries, including such major cotton producers as China, India, and Brazil. Together, D&PL and Monsanto account for 57% of the United States cotton seed industry. This proposed merger is under scrutiny by the Antitrust Division of the US Department of Justice. Bayer Crop Science, also a top ten seed company, accounted for approximately 25% of the US cotton seed market.

Anticompetitive Behavior

Anticompetitive practices that prevent or reduce competition in particular markets may include the creation of barriers to entry for firms, dumping of products on markets below their cost of production, price fixing, linking products together to limit consumer choice, government-granted monopolies, and other business actions.

Anticompetitive practices are argued to have negative effects on markets and, by extension, on whole economies, through the creation of monopoly profits.

The assumption is that a free and efficiently functioning market economy arises when many enterprises, each with limited market power, are permitted to buy and sell. Such markets are then assumed to produce lower prices to consumers as well as on a wider range of products.

Some licensing practices and conditions pertaining to intellectual property rights may also restrain competition, have adverse effects on trade and impede the transfer and dissemination of technology. Licensing practices or conditions that in particular cases constitute an abuse of intellectual property rights can have an adverse effect on competition in the relevant market.

Governments enact competition laws to prevent these and other anticompetitive practices. The realities of modern competitive markets, however, are arguably sometimes more complex than simple theories of open market competition would suggest. Oligopolistic or quasi-monopolistic firms, for example, can achieve scale economies in production or marketing that would be difficult or impossible for smaller firms to accomplish. In these production sectors (e.g., airlines), the levels of capital investment are very high, and the firms' evolution into quasi-monopolies can be an effective strategy from the standpoint of a competitive economy.

Lawsuits have been filed against Monsanto over its US dominance of glyphosate herbicide. In September 2006, a class-action suit involving 100,000 farmers was filed against Monsanto in the US District Court in Wilmington, DE (Pullen Seeds 2006). Plaintiffs alleged that Monsanto, through its control of 80% of the US market for glyphosate, had an effective monopoly. In their suit, the plaintiffs alleged that Monsanto retained product exclusivity "by acquiring seed companies that were developing modified seed technology, eliminating those products that could have led to the development of genetically modified seeds that could be used with non-glyphosate herbicide." They went on to argue that these efforts to block the development of competing GE seeds had a direct effect on Monsanto's glyphosate herbicide monopoly because had competing seeds been developed, farmers would have had a choice not only to buy competing seeds, but also to use different types of herbicides instead of glyphosate. Monsanto defeated the plaintiffs' motion for class certification in July 2007; the case was dismissed without prejudice, and was filed subsequently in the Missouri courts.

In 2009, the US Department of Justice and USDA decided to hold joint public workshops to explore competition and regulatory issues in the agricultural industry. The workshops, announced by Attorney General Eric Holder and Secretary of Agriculture Tom Vilsack, were the first joint USDA/Department of Justice workshops that had ever been held to explore competition and regulatory issues in agriculture. A total of five workshops were scheduled throughout the country in 2010.[1] Seed industry concentration was the main topic of the first workshop. At the conclusion of

[1]The five workshops were (1) seed technology, vertical integration, market transparency, and buyer power, March 12, (2) poultry industry, May 21, (3) dairy industry, June 25, (4) livestock industry, August 27 and (5) margins, December 8.

the workshop series, the agencies were to determine if there would be any follow-on activities. See Chap. 4 on market structure and competition policy for further discussion of these workshops and their conclusions.

Private Sector Programs Interface with Current Policies and Regulatory Programs

The issue of adventitious presence (AP) or low level presence of either approved or yet to be approved varieties is a serious issue for the biotechnology industry. Since in most cases a zero tolerance for AP exists—especially in other countries, the industry has put forth a number of initiatives in the form of guidelines to assist biotechnology companies, universities, government agencies, and other organizations in minimizing the occurrence of AP or "matter out of place." They are a series of stewardship guidelines for (1) maintaining plant product integrity, (2) launching a new product, and (3) discontinuing a product at the end of its life cycle.

Maintaining Plant Product Integrity

This program provides detailed guidance on how to develop and implement a stewardship program and quality-management system that will assist product developers in maintaining plant product integrity from product development through commercialization and post-market activities. The program has been developed as a series of extensive and informative educational modules that can be adapted to the specific activities pertinent to the user's own operations, including incorporation into existing quality-management systems. Common to all of the modules is an emphasis on the importance of product identification and traceback as well as documentation and data governance.

The program addresses quality-management systems for the full life cycle of plant products to address GE traits that could be present in food or feed. It is applicable to all stages of the plant product life cycle from gene construct development through commercialization and post-market activities.

Product Launch

Organizations that develop and market GE plant products should implement policies for product launch stewardship as well as appropriate processes and plans that manage the commercialization activities. When carefully thought out, those steps will help an organization initiate actions that promote the responsible introduction of new products, minimize trade disruptions, and facilitate the availability of crops and products with the appropriate function and composition for intended uses.

The results of the planning will facilitate continued global adoption of plant GE products, and bring additional benefits and value to the marketplace.

The program provides guidance to an organization in its development and implementation of the policy and related activities recommended for biotechnology-derived plant products, including commodity and specialty crops and, where applicable, consideration of their derivative products and by-products. For example, an organization may choose to implement product launch stewardship activities that are designed to direct GE plant products and crops either to or away from specific markets in other countries.

Depending on the complexity of the organization, the product launch stewardship policy and related activities may be "stand-alone" elements or may be incorporated into an organization's broader product-stewardship program.

Product Discontinuation

For purposes of this program, "discontinued products" are defined as authorized commercial plant biotechnology seed products that have reached the end of their commercial life cycle and all sales of which have terminated globally. This situation is separate and distinct from that associated with withdrawn or recalled products. The decision to discontinue a product is a strategic business decision that should take into account many factors, including regulatory requirements, market forces, and product replacement. Discontinuation is a normal part of the product life cycle.

The objectives of a global product discontinuation are to eliminate product inventories and prevent new market exposure for the discontinued product; especially if it needs to be re-registered in the United States or another country. Product discontinuation is a process whereby termination of sales of the commercial product is effected and includes the following circumstances:

- Cessation of research and development efforts, if applicable.
- Cessation of commercial seed production, distribution, and sales.
- Elimination of product inventories.
- Termination of licensing agreements.
- Application of appropriate quality-management procedures designed to minimize the presence of the discontinued seed product in other seed products.
- Communication of discontinuation to key stakeholders.
- Varietal de-registration/de-listing, where applicable.

Evaluation of Status Quo Policies

Based on the above discussion, four major issues arise from the current policy. They are (1) overlooked minor crops, (2) adventitious presence, (3) regulatory policy, and (4) seed industry concentration. Each of these issues is addressed here, first identifying the elements of the status quo policy and then evaluating its consequences.

Overlooked Minor Crops

Research and development of GE crops is dominated by private sector companies that must produce profits for their shareholders. Therefore, the marketability of a crop plays a determining role in decisions as to which GE crops are brought to commercialization. Market size, trait value, regulatory costs, environmental concerns, and technology access are important factors in biotechnology firms' decisions to develop and sell GE seeds.

The market for seeds must be large enough to warrant the investment in commercialization. If markets are too small or are characterized by farmers with low ability to pay for the technology, the benefits to biotech firms are too low to induce them to introduce GE varieties. That is, at least one of the reasons that minor crops such as papaya, sunflowers, grain sorghum, and fruits and vegetables, in general, have largely been overlooked by the private sector in agricultural biotechnology.

From a technical efficiency standpoint the output of the economic system is not maximized. The system focuses firms to concentrate on large markets to the detriment of small markets. So instead of witnessing the use of biotechnology across the wide spectrum of food and agricultural products, it has instead been skewed to three commodity areas, albeit with very large markets.

Allocative efficiency is also not maximized. Market failure exists due to the lack of appropriate signals to firms, growers, and consumers because of the monopolistic competition in a system that puts in place high barriers to entry, such as regulatory requirements, that skews incentives away from small to large markets to recover these costs.

Adventitious Presence

AP or low level presence gene flow of GE traits into non-GE varieties of the same crops remains a concern for growers whose market access depends on adhering to strict non-GE presence standards. The potential risks presented by gene flow may increase as GE traits are introduced into more crops. There is currently no established tolerance or threshold for the presence of GE material in non-GE crops, including organic crops, that do not impose excessive costs on growers and the marketing system.

Technical, allocative, and dynamic efficiencies are negatively affected by the lack of an AP threshold in the market system. The analogy to grades and standards is appropriate. They establish thresholds of matter that should not exist in grain but in the real world are unavoidable and allow for markets to work in an efficient manner. For example, No. 2 yellow corn has a threshold of 5% damaged kernels and 3% broken corn and foreign material, which includes items such as stones, glass, cockleburs or similar seeds, and other grains. Without such thresholds that are widely accepted, markets are very inefficient and left by default to individual buyers and sellers to establish a tolerance or to reject the sale if any amount of "matter out of place" is detected in a transaction.

Regulatory Policy

The Coordinated Framework for Biotechnology involves three separate federal agencies in the regulation of agricultural biotechnology. The result at times has been an uncoordinated approach to regulatory policy. For example, the AP issue has received high priority at FDA and the subsequent issuance of a policy in 2006. However, the issue at APHIS is still under consideration.[2]

In applying the performance criteria, technical efficiency clearly suffers. Three agencies, each with their own regulations that are loosely coordinated to provide regulatory policy and programs for biotechnology products are challenged in providing a coordinated and efficient implementation of policy and programs.

Seed Industry Concentration

Anticompetitive practices could exist in the seed industry. Such practices are argued to have negative effects on markets and, by extension, whole economies, through the creation of monopoly profits. The assumption is that a free and efficiently functioning market economy arises when many enterprises, each with limited market power, are permitted to buy and sell. Such markets are then assumed to produce lower prices as well as a wider range of products.

In addition, some licensing practices and conditions pertaining to intellectual property rights may restrain competition resulting in higher prices, have adverse effects on trade, and impede the transfer and dissemination of technology. Licensing practices or conditions that in particular cases constitute an abuse of intellectual property rights can have an adverse effect on competition in the markets. Governments enact competition laws to prevent these and other anticompetitive practices.

From a performance criteria viewpoint, a trade-off between technical and allocative efficiency exists. By providing intellectual property rights to innovators, technological advance has dramatically moved forward by providing new agricultural biotechnology crops—reflecting improved dynamic efficiency. These crops have increased yield per acre, decreased input costs and enhanced the environment. It is doubtful that these advances would have taken place without such patent protection; at least not in the timeframe that GE crops have been available.

[2]APHIS released a statement in 2007 on how it would respond to low-levels of regulated GE plant materials which may occur in commercial seeds or grain. In 2007, APHIS also initiated a process to amend its biotechnology regulations under 7CFR part 340. As a part of that process, APHIS stated that it will consider establishing new criteria to determine whether low levels of regulated materials would be acceptable in commercial seeds and grain based on risks to plant health, public health and the environment. In 2012, the amendments to the biotechnology regulations have not been published.

However, allocative efficiency has not fared as well. The seed industry has become more concentrated with a small number of firms controlling large shares of the market and higher prices to growers for GE seed. It is also very difficult for new seed firms to enter the market, offer competing products, and be sustainable.

Policy Options and Consequences

The above discussion suggests some possible policy options to address the challenges with the status quo policies. These policy options are presented below, along with analysis of their likely consequences.

Establish GE Development Incentives for Minor Crops

To provide GE incentives for increased research and development (R&D) and the commercialization of minor crops, a policy similar to the one enacted in the Food Quality Protection Act (FQPA) for minor crops could be established. FQPA mandated that pesticides developed for minor crops receive priority for registration at EPA and a streamlined registration process was developed. A similar system could be established for GE minor crops to assist their pathway through the regulatory process. Providing such assistance for GE minor crops could be a greater incentive to technology providers in both the public and private sectors to focus more of their R&D and commercialization efforts on these crops.

With the use of biotechnology in additional crops that can result in more and higher quality food produced with less of an environmental footprint, the potential for enhanced efficiencies in the marketing system exist. Technical efficiency would increase because more crops using the best technology would be available in the marketing system. Dynamic and allocative efficiencies could both increase with additional research and development focused on minor crops, especially if conducted by small firms and universities. There would be little, if any, change to nonmarket effects, unless this research was conducted by small firms and universities.

Establish a Minimum Tolerance for Adventitious Presence

The establishment of a minimum AP tolerance would greatly enhance the technical and allocative market efficiencies, as well as nonmarket effects. However, reaching an agreement on the tolerance level will be a challenge. The government is not likely to be involved because, when the government determines that a GE product is safe, it is safe at any level.

The most likely scenario is the participants in the market setting the tolerance. There are signs that this is beginning to happen. The grain industry has routinely established tolerance levels with buyers who have customers that want non-GE grains. Even some in the organic community are beginning to advocate a tolerance or action threshold. The Non-GMO Project, a nonprofit organization created by leaders representing all sectors of the organic products industry in the United States and Canada, issued a Working Standard for its Non-GMO Product Verification Program in the Spring, 2010. This working standard sets "action thresholds" for the amount of biotech content permitted in "non-GMO" products. Participants are to establish quality-management systems to assure that biotech content stays within the applicable standard. The Non-GMO Project's adoption of non-zero-tolerance standards for biotech content in crops indicates that the organic industry recognizes the impracticality of a zero-tolerance threshold for biotech content.

The establishment of a tolerance or action threshold for AP clearly enhances the technical efficiency of the marketing system. More certainty exists with an action threshold in the market and resources can be maximized to improve allocative efficiency. Nonmarket beneficial outcomes are also enhanced with an action threshold which helps create and sustain alternative markets such as organic markets to help meet consumers' needs.

Establish a Single Biotechnology Safety Agency

To alleviate the inefficiencies in implementing regulatory policy by three federal agencies for agricultural biotechnology products, a single biotechnology safety agency could be established. It would most likely involve pulling the biotechnology safety components from each of the three agencies, USDA, FDA, and EPA, and placing them in one agency. If such an agency were to be formed, it should report directly to the White House to help ensure that all facets of regulatory activities are meeting their respective mandates. And the new agency should have active oversight by the US Congress.

Technical efficiency would most likely be enhanced across the food safety and environmental safety components in implementing regulatory policy. For example, it should be possible to implement an AP policy for both food and environmental safety at the same time instead of the current system where an AP policy is in effect for food safety but not environmental safety. There would be little, if any, effect on allocative and dynamic efficiency, or on nonmarket effects.

Establish More Competition in the Seed Industry

Intellectual property rights and certain licensing agreements have contributed to a more concentrated seed industry resulting in higher prices to growers for GE seeds.

Table 17.2 Trade-offs in marketing performance criteria by policy option

Policy	Marketing performance criteria			
	Technical efficiency	Allocative efficiency	Dynamic efficiency	Nonmarket benefits
Minor crops				
Status Quo	–	–		
Establish GE incentives	+	+	+	
AP				
Status Quo	–	–	–	
Establish a minimum tolerance	+	+		+
Regulatory policy				
Status Quo	–			
Establish biotechnology agency	+			
Seed industry concentration				
Status Quo	+	–	+	
Establish more competition	–	+	–	

+ Positive effect; – negative effect; *blank* no effect/neutral

The government has a number of tools at its disposal to correct such situations. One method that has been discussed is to reduce the length of time that an innovator can protect its patent. Present law allows patent protection for 17 years. The US Congress could reduce patent protection to 10 or 12 years. By doing so it would allow generic seed that offered the same benefits as the patented product to enter the market much earlier and at substantially reduced prices to growers.

The impact of reducing patent protection would have opposing directional impacts on the marketing system. Allocative efficiency would increase because growers would not be subjected to higher prices for as long a period of time. On the other hand, both technical and dynamic efficiency could suffer because seed companies may reduce their research and development since the incentive (patent protection) is not as great as it once was. The result could be less GE products in the market. There would be little, if any, impact on nonmarket benefits.

To summarize the policies by marketing performance criteria, Table 17.2 provides the trade-offs for each policy scenario.

Information and Research Gaps

There are some information and research gaps related to environmental, as well as to economic and social implications of biotechnology crops.

Nonpoint pollution is a major cause of water-quality impairments in the United States. Agriculture remains the largest source of nonpoint pollution, with much of it coming from cropland. The predominant contaminants are sediment from land erosion and nutrient and pesticide residues not used or retained for growing crops.

Evidence is beginning to emerge that GE crops are often associated with changes in cropping practices that should lead to improvements in the nation's water quality. The changes include shifts to conservation tillage or no-till techniques that leave more residues on the cropland surface and thereby reduce water runoff that contains sediment, nutrient, and pesticide contaminants. They also include the use of pesticides, such as glyphosate, that are less toxic and more quickly degrading than conventional crop herbicides and insecticides. However, as mentioned earlier, weed problems in fields of HT crops will become more common as weeds evolve resistance to glyphosate. The situation may cause growers to return to tillage as a weed-management tool and to the use of potentially more toxic herbicides.

Because monitoring and research resources have been inadequate, those potential water-quality impacts on GE crops have not been documented. Monitoring changes associated with the adoption of GE crops is important given the rapid, widespread adoption of these crops and the potential large impacts they could have on water quality by changing agricultural practices. Such information could influence the design of future environmental and agricultural policies (NRC 2010).

The quantity of research on the social processes and effects associated with the development and use of agricultural biotechnology has been inadequate and has not matched the amount of research previously in agricultural mechanization. For example, empirical research into the effects of changing market conditions and farmer practices has not kept pace. In addition, little work has been conducted regarding the effects on livestock producers, and non-adopters of GE crops. Issues in need of further investigation include (1) the costs and benefits of shifts in pest-management practices for non-GE growers due to the adoption of GE crops; (2) the value of market opportunities afforded organic growers by defining their products as non-GE crops; (3) the economic impacts of GE-crop adoption on livestock producers; and (4) the costs to growers, processors, and marketers of the presence of approved or unapproved GE traits and crops in products intended for restricted markets (NRC 2010). As more GE crops are made available, understanding the impacts on all components of the system will become more important in ensuring that agricultural biotechnology is used in a way that facilitates its sustainability in agriculture.

Opportunities for Improved Industry–Government Collaboration

The rapid adoption by growers of the first generation of GE corn, cotton and soybean varieties illustrates the speed and scope with which agricultural systems can be improved if appropriate products and systems are available. However, agricultural biotechnology could be used in more crops, in novel ways beyond herbicide tolerance and insect resistance, and for a greater diversity of purposes. With proper management, it could help address food insecurity by reducing yield losses through the introduction into other crops and with the development of other yield protection traits such as drought and heat tolerance. Crop biotechnology could also address public goods issues that will be undersupplied by the market acting alone.

Expanding the effects to additional crops and further improving the technology will require an expansive program of R&D. Private companies are already working to develop additional traits that will improve productivity and sustainability in the United States and worldwide. However, both the public and private sectors must be involved, albeit with different roles, if the full potential of biotechnology is to be realized.

In developing analogous traits in "minor" crops and additional GE traits to meet broader public environmental and economic objectives (e.g., improved water quality, carbon sequestration), the active involvement of universities, government, and nonprofit organizations will be crucial. Developing the most appropriate agenda for such research will require extensive stakeholder involvement, including adopter and non-adopters of GE crops, environmental groups, and industry representatives.

The first generation of biotechnology corn, cotton, and soybean has been economically and environmentally advantageous for growers who have adopted the technologies. The next generation of biotechnology products will enhance those benefits and go beyond them to new traits such as drought and heat tolerance and enhanced fertilizer utilization that may indirectly reduce nutrient runoff, renewable energy, climate change, and nutritional qualities. The public sector must complement industry by developing biotechnologies for crops that have insufficient markets to justify R&D and regulatory expense and to develop socially valuable public goods applications. Universities, government, and nonprofit organizations should lead in the development of traits that deliver public goods, including basic discoveries. The private sector should continue to lead in the commercialization of biotechnology crops for which there are adequate market incentives.

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Chapter 18
Humane Treatment of Farm Animals

David Blandford

Abstract The welfare of farm animals is an increasingly important issue for the U.S. food and agricultural system. Dramatic improvements in productivity have contributed to lower consumer prices for animal products, but critics contend that this has been at the expense of the well-being of farm animals. The food and agricultural industry has responded to concerns by adopting a range of voluntary schemes designed to improve farm animal welfare. However, a range of activist groups, some of whom would like to see the elimination of animal agriculture entirely, have been increasingly successful in pressing for tighter regulation, particularly at the state level. The proliferation of regulations is likely to impose additional costs on producers and could place them at a competitive disadvantage. Despite the likelihood that higher standards will increase production costs, it would be extremely risky for the industry not to take a proactive approach to the animal welfare issue. A combination of strengthened voluntary actions, supported by more stringent penalties for those who fail to follow accepted practices, could satisfy the welfare concerns of the vast majority of Americans who wish to continue to consume animal products.

Animal agriculture in the USA has changed dramatically since World War II. Genetic selection for desired production traits and scientific feed formulation, combined with animal confinement and a shift to larger production units, have resulted in dramatic improvements in productivity, especially for hogs and poultry. As recently as 1992, for example, the average hog farm in the USA had less than 1,000 head. By 2004, the industry was dominated by farms with 5,000 head or more. McDonald and McBride (2009) show that the change in the production locus

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(the size of farm at which half of pork production comes from larger farms and half from smaller farms) has been even more dramatic, reaching over 23,000 head in 2002. Real (inflation-adjusted) production costs per hundredweight of pork fell by almost 5% per year between 1992 and 2004 and this contributed to a 30% reduction in the price of hogs at the farm gate (Key and McBride 2007). While changes in production methods have undoubtedly contributed to lower consumer prices, critics contend that this has been at the expense of the well-being of farm animals.

Ruth Harrison's book *Animal Machines*, published in 1964, focused attention on the welfare of animals in intensive production systems and also raised questions about the safety of eating products from animals kept in such systems. Harrison's book and a subsequent UK government report on farm animal welfare, known as the Brambell Report (Brambell 1965), marked the beginning of an intense debate on the ethics of modern animal agricultural practices, such as the use of battery cages for hens and crates for veal calves and sows. In Europe, the debate resulted in the signing of the European Convention for the Protection of Animals kept for Farming Purposes in 1976 (Appleby 2003). The Convention establishes a series of principles for the treatment of farm animals (Box 18.1).

After the release of the Brambell Report, the issue of farm animal welfare became increasingly prominent in many European countries, for example, Sweden, Switzerland, and the UK. Concerns were expressed about the conditions in which farm animals are kept and some management practices, particularly in systems where animals are kept in confinement for most of their lives. Concerns were also expressed about the way animals are transported and slaughtered. There has been substantial legislative activity in Europe to regulate or prohibit certain practices, for example, the use of conventional ("battery") cages for laying hens. The confinement of hens in battery cages allows hens and their eggs to be separated from feces, thereby decreasing the likelihood of the transmission of soilborne parasites and improving egg cleanliness. Caged systems also allow automation of feeding, watering, and egg collection and improve the ability to control environmental conditions. However, caged systems have been criticized on a number of grounds, particularly the inability of birds to lie down or to stretch their wings due to the limited space provided (Mench et al. 2008).

A recent review of the literature on the implications of alternative layer-housing systems for a range of welfare indicators demonstrates how difficult it can be to reach a definitive conclusion on the "best" production system from a welfare perspective (Lay et al. 2011). Caged systems tend to generate a lower disease risk than environments in which hens are exposed to litter and soil, but by limiting movement they can also contribute to osteoporosis. Noncage systems allow hens to perform a greater repertoire of behaviors but can also generate a higher incidence of bone fractures, as well as deleterious behavior such as cannibalism and smothering through piling, and a higher risk of mortality from predation. Alternative production systems for farm animals are likely to have both advantages and disadvantages with respect to various aspects of animal welfare since as Dawkins (2006 p. 81) observes "there is no single measure of animal welfare (no convenient equivalent of a litmus test)".

In the USA, farm animal welfare has become an increasingly prominent issue in recent years. The level of regulatory activity has been less than in Europe but has been increasing rapidly. Several activist groups, such as the Humane Society of the

Box 18.1 Principles Embodied in the European Convention on the Protection of Animals Kept for Farming Purposes

Article 3

Animals shall be housed and provided with food, water and care in a manner which—having regard to their species and to their degree of development, adaptation and domestication—is appropriate to their physiological and ethological needs in accordance with established experience and scientific knowledge.

Article 4

1. The freedom of movement appropriate to an animal, having regard to its species and in accordance with established experience and scientific knowledge, shall not be restricted in such a manner as to cause it unnecessary suffering or injury.
2. Where an animal is continuously or regularly tethered or confined, it shall be given the space appropriate to its physiological and ethological needs in accordance with established experience and scientific knowledge.

Article 5

The lighting, temperature, humidity, air circulation, ventilation, and other environmental conditions such as gas concentration or noise intensity in the place in which an animal is housed, shall—having regard to its species and to its degree of development, adaptation, and domestication—conform to its physiological and ethological needs in accordance with established experience and scientific knowledge.

Article 6

No animal shall be provided with food or liquid in a manner, nor shall such food or liquid contain any substance, which may cause unnecessary suffering or injury.

Article 7

1. The condition and state of health of animals shall be thoroughly inspected at intervals sufficient to avoid unnecessary suffering and in the case of animals kept in modern intensive stock farming at least once a day.
2. The technical equipment used in modern intensive stock-farming systems shall be thoroughly inspected at least once a day, and any defect discovered shall be remedied with the least possible delay. When a defect cannot be remedied forthwith, all temporary measures necessary to safeguard the welfare of the animals shall be taken immediately.

United States (HSUS—http://www.humanesociety.org) and People for the Ethical Treatment of Animals (PETA—http://www.peta.org), have been successful in publicizing issues associated with the treatment of farm animals, such as the handling of "downer cattle" (cows that cannot walk due to injury or disease) and the confinement of laying hens in battery cages. Animal rights activists associated with PETA and other groups, such as Mercy for Animals (http://www.mercyforanimals.org), have used videos of animal maltreatment in some production units to promote an agenda for the elimination of animal agriculture. Bills have been introduced in a number of states (e.g., Florida, Iowa, and Minnesota) to prohibit undercover filming of farm animals, but at the time of writing none of these has actually become law. If they did, they would probably be challenged on constitutional grounds as an infringement on free speech.

In addition to animal welfare aspects, concerns are expressed about a possible linkage between current production systems and disease risks for humans. Much of the debate centers on the creation of antibiotic-resistant microbes through the use of subtherapeutic doses of antimicrobials in meat and poultry production to increase productivity (Pew Commission 2008). As in Europe, where a series of highly publicized food safety events have intensified concerns about production methods in agriculture, a similar trend has emerged in the United States in recent years.

For those involved in animal agriculture—farmers and ranchers, processors, and distributors—a key issue is whether to respond to public pressures by changing production systems through voluntary action or whether the industry will be forced to do so through legislation. An important question is how such response will affect the economics of animal agriculture—its profitability and product prices.

Defining Animal Welfare and Humane Treatment

To examine the issues, it is necessary to discuss what is meant by animal welfare and the humane treatment of farm animals.

Animal Welfare

As indicated earlier in the brief discussion of housing systems for laying hens, animal welfare is a difficult concept to define. Discussion of the issue can be influenced by the attribution of human characteristics to animals (anthropomorphism), leading to judgments on animal welfare that are based on empathy rather than objectivity. It is sometimes argued that a science-based approach can be used to determine the welfare of farm animals (e.g., American Humane Association 2011; United Egg Producers 2011). While the scientific method has much to offer in this regard, it is extremely difficult to apply an exclusively science-based approach, primarily because the assessment of welfare status involves evaluative concepts of what is considered "good or bad, better or worse, for animals" (Fraser 2008 p. 273). Hence, while few would disagree that if an animal is visibly sick or injured, its welfare must be poor, not all would agree that if animals are growing, their health is good, or they have high productive efficiency, they necessarily have a high level of welfare. Some argue that well-being also requires that an animal be free from fear and pain, and that it be in good psychological or mental health, i.e., it is comfortable and coping well with its environment. In that case, the absence of animal welfare problems might be indicated by "minimum mortality, low morbidity, little or no risk of injury, good body condition (sustaining adequate production and reproduction), the ability to perform species-specific activities (including social interactions, exploration and play), and the absence of abnormal behaviors and physiological signs of stress, including suppression of immune responses" (Halverson 2001 p. 14). Most scientists who study animal welfare go beyond a narrow definition of wellness as the absence of disease to include other behavioral, physiological, and immunological indicators that the health status of an animal may change for better or worse in the future (Fraser 2008).

Three types of questions are often raised when discussing animal welfare (Dawkins 1998):

1. What objective measures (biochemical, physiological, and behavioral) can (should?) be used to evaluate the welfare status of an animal?
2. Are animals that display objectively measurable symptoms consciously experiencing what humans would term "suffering"?
3. Regardless of whether animals suffer, is it ethically appropriate to treat animals in certain ways?

Most scientists who try to assess animal welfare are prepared to address the first of these questions, and many are prepared to try to shed light on the second, but most prefer to avoid the third question—since ethical issues cannot be resolved in an "objective" scientific way. The parallel in economics is that economists typically focus on what determines efficiency in the allocation of resources and some are prepared to assess the distributional implications of a particular allocation, but few are willing to tackle the issue of whether the distribution of economic welfare is "just" or "fair" since economic theory does not provide the necessary tools to make that assessment. One respected professor of animal behavior has argued "mixing ethical questions about how animals ought to be treated is likely to lead to confusion, since humans do not automatically know what conditions are best for the welfare of animals" (Dawkins 1998 p. 306), but other authorities in the field are critical of that approach. Rushden (2003 p. 201), for example, observes: "many of the concepts proposed and used, particularly by scientists, address only a limited subset of the issues that are of deep concern to the public or animal welfare groups." Croney and Millman (2007 p. 558) conclude that "despite advances in behavioral science and neuroscience, arguments persist that some concepts that cannot be measured directly, such as emotions and consciousness, are beyond the scope of scientific enquiry.

Ironically, these are precisely the concepts that the public is grappling with in animal welfare." Unfortunately, a strict distinction between objectivity and subjectivity is about as difficult to maintain in the field of animal welfare as is one between efficiency and distribution in economics—and in both cases this is particularly true when it comes to the question of what, if any, policies should be pursued.

Despite these limitations, several categories of indicators are often used to assess the welfare of farm animals:

1. Productivity, e.g., yield of meat, milk, or eggs per animal.
2. Health, e.g., evidence of normal growth and development, the absence of disease.
3. Physiology, e.g., absence of endocrine measures of stress; normal blood pressure, heart rate, and respiratory rate.
4. Behavior, e.g., appropriate maintenance and reproductive behavior; absence of aberrant behavior.

The first three categories of indicators are relatively straightforward to apply, at least in principle. Yields of animals under various production systems can be compared to determine relative performance, the health of animals can be monitored, and tests can be made to determine whether animals are under stress (for example, by measuring the amount of blood cortisol produced by the adrenal gland). Judgments will have to be made on whether observed indicators are within an acceptable range. As with humans, there can be natural differences among individual animals in terms of health and physiological status. However, the final category of indicators can be particularly difficult to apply, since these depend on the standard adopted for "normal" behavior. Aspects of the observed behavior of humans in large urban centers might be viewed to be unusual if a rural benchmark is used and the same can apply to animals kept for farm purposes compared to those in the wild. Consequently, behavioral indicators typically focus on extreme abnormalities such as self-harm or atypical aggression. Significant scientific advances are being made in the analysis of behavioral markers of pain and stress in animals and in the quantification of abnormal behavior, although existing methodologies are far from perfect (Asher et al. 2009).

A particularly difficult challenge is how to make an overall assessment of the welfare status of an animal, in other words what weights should be attached to individual welfare indicators? This is demonstrated by the review of hen welfare in various housing systems cited earlier (Lay et al. 2011). If hens that are raised in a certain type of housing system score well on most criteria, but lower on a few does this mean that their welfare is below an acceptable standard? Are there some indicators for which an absolute standard should be met? The absence of a dangerous disease is clearly one that would probably qualify, but what about evidence that animals are harming other animals to some degree? Making an assessment of the welfare status of animals is not a simple matter when multiple criteria are involved and judgment must be used to determine their relative importance.

Humane Treatment

The concept of humane treatment, which clearly relates to the welfare status of animals, is even more challenging to define objectively. Various production practices used in animal agriculture can be viewed to be unattractive—castration and animal slaughter being two obvious examples. But many other practices that have been developed by farmers and ranchers to address a variety of issues, such as tail docking or beak trimming designed to prevent aggressive behavior or to control morbidity, could be viewed to be objectionable. As noted earlier, the situation is complicated by the fact that judgments on what constitutes humane treatment for farm animals can be subject to anthropomorphism and based primarily on personal value-based assumptions of how production methods affect welfare. For example, the negative attitude to the confinement of laying hens in cages often seems to be driven by a subjective assessment that this is "unnatural" or "cruel", rather than on specific indicators of welfare in this system. Subjective assessment can easily lead to the conclusion that birds should not be kept in cages. This is not to suggest that current caged systems and their management cannot be improved to provide an enriched environment for hens, and indeed this is what some of those who are involved in the poultry industry are proposing, but it does suggest that major decisions, such as the abolition of caged systems, can be driven largely by value judgments, rather than by objective welfare criteria.

This discussion illustrates that defining and measuring welfare, and to an even greater extent defining what constitutes humane treatment of farm animals, poses a considerable challenge for those involved in animal agriculture and for framing policies in this area.

Perspectives on Animal Welfare

Views of animal welfare vary based on the perspectives of producers, supply chain stakeholders, and other interest groups. Individuals differ in values and beliefs, and, consequently, their expectations for products they purchase often differ. Most consumers expect animal products to be safe, but not all expect them to be produced in a certain way. Most expect that the products they consume will not come from systems that depend on cruelty to animals, but views of what constitutes acceptable treatment can vary. This is reflected in differences of views over the acceptability of production and consumption of such products as duck liver (*foie gras*) and veal. A review of several surveys of consumer attitudes in the USA concluded that the majority of the public believe that farm animals are currently raised without cruel treatment and that any pain and suffering should be minimized, even though animals are eventually going to be slaughtered (Herzog et al. 2001). One study found that consumers tend to associate positive animal welfare attributes with smaller farms (Tonsor et al. 2009a). Another found that the majority of Americans rank farm animal welfare as a low priority relative to other social issues, such as food safety and poverty, and that they rate the financial well-being of U.S. farmers higher than the well-being of farm animals. Nevertheless, consumers also believe that efforts should be made to reduce animal suffering (Lusk et al. 2007). More than 60% of those questioned in one study agreed with the proposition that the government should take an active role in promoting farm animal welfare, while paradoxically also believing that food companies would voluntarily improve animal welfare and advertise their activities if people really wanted higher welfare standards (Lusk and Norwood 2008). It is also interesting to note that 46% of those questioned believed that decisions about farm animal welfare should be based on moral and ethical considerations as opposed to science-based measures of animal well-being. This is suggestive of the difficulty of relying on an "objective" approach to determining animal welfare to satisfy public concerns over the issue. A final study suggests that support for legislation to improve animal welfare is highest among females, those will college degrees, and among households with higher incomes. It is lower among families with more children and those who are larger consumers of animal products (Tonsor and Wolf 2010).

As noted earlier, several pressure groups are seeking to shape public attitudes on animal welfare and to influence public policy. The spectrum of views ranges from those who would like to see changes in production methods to provide more humane treatment for farm animals to those who would like to see the complete elimination of the use of animals by humans. In popular speech, the term "animal rights" is sometimes used interchangeably with animal welfare, but the two concepts are fundamentally different. Advocates of animal rights believe that nonhuman animals should not be treated as property by humans and should not be used as a source of food or for any other purposes, including pharmaceutical testing. In addition, the issue of humane treatment of farm animals is often linked to other issues such as whether modern production methods increase food safety risks or lead to the elimination of "family farms" and the control of agriculture by large business firms (Fraser 1995). In the European Union, for example, animal health and animal welfare are both included under the heading of food safety (see http://ec.europa.eu/food/index-en.htm). Activism on animal welfare and humane treatment often becomes entwined with a broader agenda on the nature, structure, and ownership of agriculture and the food system.

There is little evidence to suggest that most farmers and ranchers and others who work in the food and agricultural industry are any less concerned about the treatment of animals than the public at large. However, those involved in the industry derive their livelihood from animals, so they will inevitably be concerned by how changes in production methods might affect them economically. From the perspective of farmers and ranchers, the first set of welfare criteria identified earlier is particularly important since productivity can affect profitability. Lower productivity rates imply higher per unit costs, and lower returns. Similarly, health criteria are important in as much as poor performance increases the expense of caring for unhealthy animals. Returns can be reduced if users or consumers of animal products are reluctant to purchase because they perceive that there may be a risk to their own health from the way that animals are raised. Behavioral and physiological issues in animal welfare can also be relevant in as much as aberrant behavior or stress result in product losses, for example through premature death, or a deterioration of product quality. Animals that are wounded by other animals may be discounted at slaughter and there is evidence that stress hormones can result in lower meat quality (see, for example, the literature on this subject on the website of Dr. Temple Grandin of Colorado State University at http://www.grandin.com). A study of transport losses from dead and nonambulatory pigs in the United States estimates that these cost the US pork industry approximately $46 million in 2006 (Ritter et al. 2009).

Despite the possibility of economic gains from improvements in the welfare of farm animals, farmers and ranchers will be concerned about any additional costs imposed by new production practices designed to enhance welfare. For example, although critics contend that intensive production methods reduce the well-being of farm animals, confinement can reduce mortality rates due to predators and extreme weather and can also reduce the risk of disease transmission, both of which help to control production costs. There are differing opinions on the extent to which confinement affects overall disease risk in farm animals. Some argue that keeping large numbers of animals in close proximity increases the probability of infection and the spread of disease. Control of disease risk has been a factor underlying the prophylactic use of antibiotics in poultry. On the other hand, nonconfined production systems may expose animals to higher risks of infection from undomesticated animals and airborne contaminants. The potential for infection of unconfined poultry by wild birds has been identified as an issue in the spread of H5N1 Avian influenza. Many of the practices that have been developed in intensive systems have been driven by the assumption that a healthy animal is one of the most important factors that contribute to maximizing productivity and efficiency and minimizing production costs.

Requirements for less intensive production may impose costs on producers that they are unable to pass on to consumers, and consequently earnings and profitability may be reduced. The competitive position of some producers can be undermined if they are required to adopt higher standards while producers in other regions or countries are not required to do so. These issues are examined in more detail below.

The earnings and profitability of processors and others (food distributors) in the supply chain can also be affected to the extent that poor welfare practices tend to lower productivity and quality, and increase processing costs. Profitability can also be affected through welfare requirements on the handling animals for processing, particularly those that increase the costs of transportation and slaughter, although there may be a premium for higher quality carcasses through the grading of meat.

Specialization and economic integration associated with the growth of international trade have stimulated changes in the way animals are raised in the United States. In addition to a substantial increase in specialization and the average size of livestock and poultry farms, there has also been substantial consolidation in parts of the livestock processing industry (McDonald and McBride 2009). In 1980, 36% of the steers and heifers were slaughtered by the top four meatpacking firms; in 2007, the corresponding figure was 80%. The comparable figures for hogs were 34% in 1980 and 65% in 2007 (USDA 2008). As a result of industry consolidation, large numbers of animals can sometimes be transported long distances to slaughter facilities designed to take advantage of economies of scale. A recent study of the hog industry suggested that one of the factors underlying an increase in the number of dead and nonambulatory pigs being delivered to processing plants in the United States is an increase in the size of production operations and the need to transport animals over longer distances (Ritter et al. 2009).

The integration of the livestock industry associated with the North American Free Trade Agreement (NAFTA) has also led to increased movements of feeder cattle and pigs between the United States, Canada, and Mexico (Clemens 2003). Adapting transportation systems, for example, by reducing the amount of time that animals can be transported without a rest period or for watering or feeding, or by changing housing requirements in vehicles can increase transportation costs. Adapting slaughter facilities to reduce the stress to which animals are exposed can require new construction or reduce the rate of throughput, also leading to increased costs. Some of these additional costs might be recouped from the market through payment for higher product quality. Furthermore, they may be part of the price of securing contracts with food firms. But as for producers, it may not be possible for processors and distributors to pass all the additional costs on to consumers and their earnings and profitability may be reduced.

Despite the potential economic implications for those upstream in the supply chain, the principal pressure on animal welfare concerns is often felt by downstream firms that are closest to consumers, i.e., retailers and food service companies, even if they may not actually bear the costs of responding to such pressure. Animal welfare advocacy groups often find it more effective to focus their efforts on the parts of the food system that tend to be more visible to consumers, rather than the less visible or more fragmented parts of the system represented by farmers, ranchers, and processors. The parts of the food system that are closest to consumers are at the greatest risk of consumer reaction to animal welfare concerns through negative publicity, product boycotts, demonstrations, and other actions (Brown and Hollingsworth 2005). In the United States, much of the pressure for improved animal standards has come from food retailers and food service companies rather than regulators, although there has been an increasing emphasis on regulation in recent years, particularly that at the state level.

U.S. Policies and Programs for Farm Animal Welfare

Most of the concerns about the welfare of farm animals relate to husbandry practices. However, there can also be concerns associated with the transportation of farm animals and methods of slaughter. Public policies in these areas are implemented through laws and regulations. There are also numerous, highly developed private sector programs that address welfare issues. Up to the present, programs such as those implemented by food service companies such as McDonald's corporation have tended to be the principal driving force behind changes in practices affecting farm animal welfare in the United States, although legislative activity is increasing.

Federal, State, and Local Laws and Regulations on Farm Animal Welfare

At the Federal level in the United States, there is no anticruelty statute and no statute that regulates the treatment of farm animals per se. The principal law is the *Animal Welfare Act* of 1966 as amended (7 USC, 2131–2156), which regulates the treatment of animals in research, exhibition, transport, and by dealers. The Act defines minimum acceptable standards and is enforced by the U.S. Department of Agriculture through APHIS (Animal and Plant Health Inspection Service). The definition of "animal" in the Act excludes "horses not used for research purposes and other farm animals, such as, but not limited to livestock or poultry, used or intended for use as food or fiber, or livestock or poultry used or intended for improving animal nutrition, breeding, management or production efficiency, or for improving the quality of food or fiber." In recent years, members of Congress have offered various legislative proposals for changes in the treatment of animals on the farm, during transport or at slaughter. Hearings have also been held in the House and Senate Agriculture Committees on various animal welfare issues, but members of Congress have generally shown a preference for voluntary actions in this area (see below for a discussion of private animal welfare initiatives). Animal welfare groups continue to press for tighter legislation at the Federal level, with much of the recent activity focusing on banning the killing of horses for human consumption by prohibiting slaughter in the United States or the transport of horses across US borders to provide horsemeat to countries where this is consumed, such as France, Italy, and Japan (Cowan 2010). Mench (2008) concluded that the prospect of significantly tighter regulations at the Federal level for most farm animals "seems remote at this time" (p. 301), although the situation is evolving rapidly, as discussed further below.

Every state has an anticruelty statute that protects animals from inhumane treatment. However, the legislation does not apply to farm animals in 37 states, and 35 states have specific exemptions for farming or ranching. There are currently 23 states that allow initiatives (proposals for new laws or constitutional amendments) to be placed on the ballot. Several states (Arizona, Florida, and California) have already passed animal confinement laws through ballot initiatives and HSUS has indicated its intent to bring initiatives to other states in order to pass regulations on farm animal welfare (Springsteen 2009).

In 1996, New Jersey became the first and only state (thus far) to enact comprehensive legislation mandating standards for the "humane" treatment of farm animals. A set of regulations developed by the state's Department of Agriculture was adopted in 2004 and modified in 2006. The New Jersey Society for the Prevention of Cruelty to Animals (NJSPCA) was given the responsibility of enforcing the regulations but it, along with several other entities (including HSUS and the American Society for the Prevention of Cruelty to Animals), challenged the standards in court, arguing that they failed to comply with the Legislature's intent of humane treatment. The New Jersey Supreme Court broadly upheld the standards developed by the Department of Agriculture, including approval for the use of crates and tethers for veal calves and swine. However, it rejected the approval for tail docking of dairy cattle and criticized certain other aspects either because they had been based primarily on economic rather than humane treatment criteria, or they lacked objective standards of "knowledge" required to minimize pain (McCarter 2009).

Several states have introduced laws to regulate the confinement of pregnant swine and veal calves through the use of crates. Gestation crates for sows were developed largely to prevent fighting among sows kept in confinement. Veal crates were developed to reduce the likelihood of infection and physical injury among veal calves. However, the restriction that crates place on the movement of animals has been subject to criticism. Florida introduced the earliest law in this area, banning the use of gestation crates for sows through a ballot initiative in 2002. The provisions—including a fine of up to $5,000 and imprisonment—came into force in 2008. Other states have laws banning sow crates that do not specify penalties (Oregon—comes into force in 2012) and for both sow and calve crates (Arizona—comes into force in 2012; Colorado—comes into force for 2012 for calves and for sows in 2018; and Maine). Confinement exceptions for swine are generally allowed for the last 7 days of gestation—largely to prevent piglets from being laid on or stepped on by the sow—and there are typically other exemptions, e.g., for animals used for research or receiving medical treatment.

The California Prevention of Farm Animal Cruelty Act, which was approved through a ballot initiative in 2008, comes into force in 2015. The Act prohibits confinement of farm animals in a manner that does not allow them to turn around freely, lie down, stand up, and fully extend their limbs. It applies to veal calves, pregnant sows, and laying hens plus other poultry including turkeys. Violators are subject to a fine of $1,000 and or a period of imprisonment of up to 180 days. Michigan has a broadly similar law—but without the criminal penalties—whose provisions take effect in 2012 for veal calves and in 2019 for hens and sows. Bills similar to those adopted by California have been under consideration in several other states, including Massachusetts, New York, and Rhode Island.

California had earlier (2004) introduced a regulation into its Health and Safety Code that prohibits the production or sale of *foie gras*—a product made from the liver of force-fed ducks or geese—from 2012. Since there is only one *foie gras* producer in California, the effect of this on agriculture in the State will not be large, but it could have an impact on food retailers and the food service industry.

The Indiana State Board of Animal Health is empowered by statute to adopt rules and to establish standards governing the care of livestock and poultry, taking into account health and husbandry, generally accepted farm management and veterinary practices, and the potential economic impact on farms, the livestock and poultry sector, and consumers. This power has been used to set standards for the treatment of livestock beyond the farm (e.g., in auction markets) and to prohibit the entry of downer cattle into the marketing system. In 2009, voters in Ohio approved the creation of a 13-member Livestock Care Standards Board with similar responsibilities to the Indiana Board. In addition to four farmer representatives, two veterinarians and the dean of the agriculture department of a college or university in the state, the Standards Board has two consumer representatives and one from a county humane society organized under state law. The Board has been focusing on developing standards for the euthanasia of farm animals. Springsteen (2009) argues that the creation of the board was a pre-emptive measure to avoid a threatened proposal to impose animal welfare regulations on farmers. The ballot initiative was approved by a margin of almost two-to-one, which illustrates the degree of public support for farm animal welfare measures in some states.

A 13-member Livestock Care Standards Board was created under Chap. 19 (article 1c) of the legislative code in West Virginia on July 1, 2010. The balance of the membership is similar to that in Ohio. The Board is chaired by the Commissioner of Agriculture or the Commissioner's designee, as well as the Director of the Animal Health division of the Department of Agriculture, who are both nonvoting members. The Standards Board also includes five farmer representatives.

Under its legislative code (title 4, Chap. 3), Utah has created a 14-member Agricultural Advisory Board composed of seven farmer/rancher representatives with the balance primarily being a mix of others involved in the agricultural system (e.g., livestock auctions and food processing). There is one veterinarian and a representative of "a consumer affairs group." The role of the Board is to advise the agricultural commissioner on three issues—food safety, local availability and affordability of food, and acceptable practices for livestock and farm management.

Legislation has been introduced in Oklahoma (House Bill 1306) that would create a Livestock Care Standards Board and bills to establish similar bodies or require agriculture departments to develop standards for the treatment of livestock are under consideration in other states, for example, Kentucky, Louisiana, and Vermont.

In contrast to these initiatives, several states have introduced measures to limit the potential for promulgation of animal welfare standards at the local level. Alabama, Georgia, Oklahoma, and South Carolina have statutes that restrict the ability of local government entities, e.g., towns or counties, to impose rules or regulations on the care and handling of livestock. Similar laws are under consideration in Kentucky and Missouri. In fact, relatively few farm animal welfare measures have been enacted by cities or municipalities. The most notable was the vote of the Chicago City Council in 2006 to ban the sale of *foie gras*. There was considerable negative reaction to the ban and it was repealed in 2008.

Federal regulations governing the slaughter of livestock are contained in the *Humane Methods of Slaughter Act* (7 USC, 1901–1907), which is the 1978 version of an act originally dating back to 1958. It covers livestock, but excludes poultry. Approved methods include the use of a single blow, a gunshot, or an electrical, chemical or other means that is rapid and effective; or by slaughtering in accordance with the ritual requirements of any religious faith, through which an animal suffers loss of consciousness by ischemia of the brain (disruption of the blood supply) caused by simultaneous and instantaneous severance of the carotid arteries with a sharp instrument. The Act provides authority to the Secretary of Agriculture to issue regulations on the treatment, handling, and disposition of nonambulatory livestock by stockyards, market agencies, and dealers. In addition, 21 states have passed humane slaughter laws. The earliest of these was enacted in Arizona in 1956 and the most recent was in Maryland in 2002. The other states involved are California, Colorado, Florida, Iowa, Illinois, Indiana, Kansas, Maine, Michigan, Minnesota, New Hampshire, New Jersey, Ohio, Oregon, Pennsylvania, Rhode Island, Vermont, Washington, and West Virginia.

Federal regulations governing the transportation of farm animals are specified in Section 80502 of Title 49 of the US Code (Transportation) generally referred to as the *Twenty-Eight Hour Law*, which dates back to 1873. This section of the code specifies that animals may not be confined in a vehicle or vessel for more than 28 consecutive hours without unloading for feeding, water, and rest. After that period, they are required to be unloaded in a humane manner into pens equipped for feeding, water, and rest for at least 5 consecutive hours. The 28-h maximum can be extended to 36 h on request. The law does not apply to poultry or to vehicles in which animals have food, water, space, and the ability to rest.

As this brief review demonstrates, the majority of the legislation that pertains to on-farm animal welfare focuses on husbandry practices and has been implemented by individual states, rather than at the Federal or local levels. Legislative activity at the state level has been increasing, as this avenue appears to have become the primary target of animal welfare advocacy groups in the United States (Springsteen 2009). This increased activity has been mirrored by a significant expansion in the coverage of animal issues in U.S. law schools in recent years (Mench 2008). The increasing pressure for regulation at the state level raises the possibility of conflicting sets of standards that could limit interstate commerce. This appears to lie behind a recent decision by the major trade group for eggs—the United Egg Producers (UEP)—to cooperate with one of the leading animal welfare advocacy groups—the Humane Society of the United States (HSUS)—on the adoption of a set of legislated national standards for laying hens that would see the phased introduction of enriched cages (providing a large amount of space per bird and other enhancements). This decision has been criticized by some other producer groups as strengthening the ability of pressure groups to impose a range of welfare regulations on the animal industries in the USA.

Private Sector Programs for Farm Animal Welfare

In the United States to date, the private sector, rather than government, has been the source of most of the currently functioning animal welfare programs. Several prominent food retailers, major food service industry groups, and animal producer groups have developed and put into practice private animal welfare standards. In the case of the programs of retailers and food service companies, compliance by suppliers is mandatory. As noted earlier, agents in the food system closest to consumers have perceived themselves to be risk from negative public reaction to animal welfare and humane treatment issues and are often subject to considerable pressure from interest groups to change the standards they apply. Similarly, some producer groups, such as egg and pork producers, who view themselves to be high risk targets for advocacy groups, such as PETA and the HSUS, have been active in the development and implementation of private welfare and handling standards. Table 18.1 gives a summary of the principal private standard schemes currently in operation in the United States.

Much of the early negative publicity on the treatment of farm animals focused on a limited set of issues—primarily the use of cages for laying hens, and crates for veal calves and pregnant sows. Many observers view such practices to be defensible examples of confinement that restricts the movement of animals and birds but has other benefits—e.g., protection of piglets, reduction of mortality in laying hens. Egg producers in both Europe and the United States have been targets of groups that oppose the use of cages for laying hens. In response, in 1999, the United Egg Producers, a cooperative whose members account for roughly 95% of the laying hens in the United States, established a Scientific Advisory Committee for Animal Welfare. The Committee was headed by an animal scientist and comprised of government officials, academics, scientists, and representatives of humane associations. The Committee initially focused on deriving welfare guidelines for cage production. The guidelines that resulted from their efforts were adopted in October 2000. They prescribed that beginning in 2002, the cage space allowed should be increased gradually from 48–54 square inches per hen (310–348 cm^2) to 67–76 square inches (432–490 cm^2) by 2008, depending on breed. Recommended standards were also established for a range of other industry practices, including air quality, lighting, beak trimming, handling, and on-farm euthanasia. The withdrawal of feed to induce birds to molt in order to increase productivity in subsequent laying seasons was prohibited.

Under the UEP program, independent auditors examine the operations of participating producers annually, and the information may be supplied to customers on request. Failure to meet the minimum space requirement results in automatic audit failure. Companies applying the guidelines in all of their facilities, passing the annual audit, and filing monthly compliance reports can be authorized to sell UEP Certified eggs or egg products. They may not comingle eggs with a noncertified supplier's eggs. Beginning in 2008, the UEP has also applied standards for noncage production systems. UEP certification is advertised through labels on egg packages. This provides consumers with a choice between purchasing certified and noncertified eggs. The element of choice through the development of certification schemes and labeling, rather than a reliance on government intervention via regulation, has been an important feature of private initiatives to improve farm animal welfare in the United States.

Beginning in the late 1990s, McDonalds® became increasingly involved in the development of mandatory animal welfare standards for its animal protein suppliers. The company has stated on its website that "we care about the humane treatment of animals and we're committed to working with suppliers and outside experts to continuously improve our standards and practices both within McDonald's and across the industry" (McDonald's 2010). The company set up an Animal Welfare Council in 2000, composed primarily of academic animal scientists, to develop objectives

Table 18.1 Farm animal welfare schemes in the USA

Institution	Scope	Nature	Reference
American Meat Institute	Livestock slaughter plants	Animal handling guidelines[a] and voluntary audit guides	http://www.meatamii.org
American Humane Association	All animals used to produce eggs, dairy and meat products	Voluntary standards, third party auditing, and certification	http://www.americanhumane.org
American Sheep Industry	Sheep	Sheep care guide	http://www.sheepusa.org
Animal Welfare Institute	All animals used to produce eggs, dairy and meat products	Voluntary guidelines with audits and certification for family farms	http://www.awionline.orth
Certified Humane Raised and Handled	All animals used to produce eggs, dairy and meat products	Standards, on-site inspection and certification	http://www.certifiedhumane.com
National Cattleman's Beef Association, state associations, land grant universities	Beef cattle	Care and handling recommendations[a] with self-assessment	http://www.bqa.org
National Chicken Council	Broilers	Guidelines[a] for breeders and producers, voluntary audit	http://www.nationalchickencouncil.com
National Milk Producers Federation	Dairy cows	Animal care standards[a] with third-party verification	http://www.nationaldairyfarm.com
National Pork Board	Pigs	Standards[a] and voluntary benchmarking	http://www.pork.org
National Turkey Federation	Turkeys	Animal care guidelines	http://www.eatturkey.com
United Egg Producers	Laying hens	Guidelines[a] with certification and auditing	http://www.unitedegg.org
US Department of Agriculture, National Organic Program	Organic food production	Animal husbandry and handling guidelines and standards	http://www.ams.usda.gov

[a]Approved by the Food Marketing Institute/National Council of Chain Restaurants for the development of retail auditing programs

and practices to achieve them. The core of the company's program is a global audit system for beef, poultry, and pork processing plants. The first audits were conducted in 1999. Suppliers that fail audits and do not take necessary corrective action are subject to termination as a supplier to the company. Other food retailers (such as Burger King®, KFC®, and Wendy's®) began to follow McDonald's lead.

In 2000, the leading trade association for supermarkets—the Food Marketing Institute (FMI)—which represents 2,300 food retailers and wholesalers, and the trade association for restaurant chains–National Council of Chain Restaurants–(NCCR), which represents 40 of the largest companies joined together to create a uniform program for animal welfare standards. Standards are developed in collaboration with independent expert advisors and producer/processor groups and the program is designed to promote best practices to ensure animal well-being throughout production and processing. Some of the key goals identified in the initiative are:

1. Consistency across the U.S. retail sector.
2. Implementation of science-based guidelines.
3. Improved communication across the supply chain on animal welfare issues.

The program is voluntary and involves an auditing process, the results of which are confidential. Several other major food companies, such as Wendy's and Yum! Brands (current owner of several food service outlets, including KFC) require certification and auditing of animal welfare standards for their suppliers. The FMI–NCCR committee has worked with a range of producer groups to develop science-based standards (see Table 18.1), and the committee has also assisted in the creation of auditing guidelines to ensure compliance. Voluntary guidelines have been developed for on-farm welfare standards for most categories of livestock and for animal handling by slaughter plants.

Where standards are adopted by producers, the scheme under which the standards are defined is typically noted in some fashion on consumer packaging. Producers, processors, and others involved in animal agriculture view such certifications to be an asset in helping to reassure consumers about the safety and quality of their products. For example, the National Pork Producers Council promotes its Pork Quality Assurance Plus program on the grounds that is assures "consumers that they are purchasing the highest quality, safest product possible while caring for animal well-being" (NPPC 2011).

As noted earlier in contrast to the European Union, the private sector has been the major actor in developing and promoting programs for higher standards of animal welfare in the United States. More food industry examples include Burger King®, which announced in 2007 a series of measures to respond to consumer concerns. The company shifted its supplies of eggs away from caged systems, and its sourcing of pork away from producers who use gestation crates. Smithfield Foods also announced in 2007 that it would phase out the use of gestation crates and replace them with group housing through a program called "free access". Several food companies have announced that they will move away from the purchase of eggs produced in caged systems–examples include the food and beverage manufacturers Kraft and Sara Lee, and the retailers Safeway and Walmart. A range of other businesses, hospitals, and schools have announced changes in sourcing food, primarily to eliminate purchases of eggs from caged systems.

In recent years, several programs have been set up by groups involved in promoting animal welfare to certify that products meet specific animal welfare standards. Such programs have been developed by the American Humane Certified program operated by the American Humane Association (http://www.armericanhumane.org) and the Certified Humane program operated by Humane Farm Animal care (http://www.certifiedhumane.org).

Current animal welfare policies and programs in the United States are a mixture of private sector initiatives and regulations. Many animal welfare activists are critical of private sector approaches since they view the standards adopted to be too lax. Thus, for example, the Humane Society of the United States has a "No Battery Eggs" campaign that is committed to phasing out of the use of eggs from birds confined in cages. Organizations such as United Poultry Concerns (http://www.upc-online.org) oppose the use of so-called "enriched" cages, which provide more space per bird and a number of other enhancements such as litter and perches. These and other animal welfare organizations are working to promote increased regulation to force producers to adopt different production methods. Citizen opposition to a range of animal husbandry practices is growing and there is increasing pressure for regulation. As one observer noted recently "while the actions (to date) are only a small step in addressing welfare issues, they may be the beginning of a significant movement to do more to address human and animal welfare issues" (Centner 2010 p. 469).

International Developments on Farm Animal Welfare

U.S. agriculture and the U.S. food system operate in an increasingly global economic environment. Export markets are increasingly important for the U.S. livestock industry, and parts of the industry are subject to competition from imports. The United States is the world's second largest exporter of broiler meat after Brazil and the world's largest exporter or turkey products. It also exports table eggs, mostly to Canada and Mexico, and egg products to a range of countries. Exports of beef and pork have also been growing rapidly in recent years (Johnson 2011). Developments in other countries and international initiatives on farm animal welfare can be important for the competitive position of the U.S. industry and provide pointers to the way that policies may evolve in this area in the future.

The European Union has approved a detailed set of directives (laws) regulating the rearing, transport, and slaughter of farm animals and specific regulations for laying hens, calves, pigs, and broilers. Each of the member states of the EU has its own legislation that, at a minimum, must conform to EU requirements but in some cases goes beyond these. Several of the Northern European members, including Austria, Denmark, Germany, the Netherlands, Sweden, and the UK, have stricter requirements than other EU countries; Norway and Switzerland, which are not members of the EU, also have strict requirements (Promar International 2009; Veissier et al. 2008). By 2012, for example, all conventional cages for laying hens in the European Union were supposed to be replaced by enriched cages or alternative housing systems. Under previous rules layers kept in conventional cages must have had access to at least 550 cm^2 of space per hen. In an enriched cage, this is increased to 750 cm^2, and the cage must have a perch, nest box, and litter. By way of comparison, certification under the voluntary program operated by the UEP requires a minimum of 430 cm^2 of cage space per hen. European standards are important, because they are increasingly becoming the benchmark for animal welfare standards internationally. However, some observers have expressed doubt that tighter regulations will be enforced uniformly throughout the Union (Allison 2010). The European Commission estimated that at the beginning of 2012 roughly 14% of the hens in the EU were being kept in cages that did not meet the new requirements (Casert 2012). Future developments in the European Union will provide an important indication as to whether restrictive animal welfare legislation will actually be enforced if and when the economic reality of higher costs and loss of international competitiveness becomes apparent to both producers and consumers.

The Paris-based World Organization for Animal Health (OIE), an intergovernmental organization with 177 member countries, proposed a program in 2002 to establish international standards, guidelines, and recommendations on animal welfare. OIE has operated for more than 80 years to minimize the international transmission of animal disease. Its mandate was expanded to the setting of international standards under the Sanitary and Phytosanitary Standards (SPS) agreement, part of the 1994 Uruguay Round Agreement under the General Agreement on Tariffs and Trade (GATT) that established the World Trade Organization (WTO). Even though animal welfare is not covered by the SPS agreement, the issue was placed on the OIE's work agenda by its member countries. Since 2005, a series of standards have been adopted, including those relating to the transport of animals and slaughter for human consumption. There are plans to deal with other related areas, including housing and production methods. Working groups have been established for beef cattle and broilers and there are plans to establish a group for dairy cattle (details of OIE activities are contained under the animal welfare section of the organization's website at http://www.oie.int). Given differences of opinion among the member countries of the OIE on farm animal welfare, it may prove difficult to reach agreement on an international set of standards for production practices for farm animals. It would probably be even more difficult to ensure that such standards were actually enforced. The application of standards in international trade by members of the WTO, which includes the United States, is governed by the Agreement on Technical Barriers to Trade (TBT). The TBT and other agreements limit the ability of countries to apply animal welfare standards to imported products. See Blandford and Fulponi (1999) for a discussion of the issues involved.

Apart from developments in Europe and the OIE, other large exporters of animal products have been active in establishing animal welfare guidelines and standards. Animal proteins (primarily dairy products, beef, and lamb) accounted for roughly 45% of the value of total exports by New Zealand in 2009 (MAF 2010). New Zealand passed a comprehensive animal welfare law (The Animal Welfare Act) in 1999 requiring the development of detailed codes of practice through a public consultation process. Upon completion, codes are issued by the Minister of Agriculture on the recommendation of an advisory committee (the National Animal Welfare Advisory Committee—NAWAC). To encourage industry input, any producer, processor, or other interested party can propose code components for consideration by the Committee. In making a recommendation to the Minister, NAWAC is required to take into account all such submissions, good practice, available technology, and any other relevant matters. Once adopted, codified minimum standards for care and treatment of animals are legally binding, and failure to meet them could result in prosecution. Codes can also contain recommendations for best practices, but these are not legally binding. Exports of live animals are covered by a certification system under the Act to ensure that the welfare of animals is protected/ensured during transportation so that upon arrival at their destination they are in good health. The cost of certification is borne by the exporter.

Livestock products account for roughly 6% of Australia's GDP and more than 80% of the volume of production is exported (Vandegraaff 2009). Although the Australian Constitution assigns the primary role to the States and Territories in formulating and administering animal welfare regulations, the Commonwealth Government has been active in the development and promotion of codes of practice for the welfare of farm animals that include handling, transport, and slaughter. The Australian approach has been to develop minimum outcome-based standards with extensive support by industry that are underpinned by legislation, auditable and applied in a consistent manner across jurisdictions. Several livestock industries in Australia are developing quality assurance programs that incorporate specific animal welfare standards. Minimum standards will be legally enforceable, but auditing will be done privately. The federal government will provide oversight but will only intervene directly if there is evidence of serious noncompliance with the standards.

International developments in the area of farm animal welfare are generally moving in the direction of the introduction of higher standards (Blandford et al. 2002). Export-dependent animal industries in Oceania have perceived that animal welfare is a concern to some foreign customers. Australia and New Zealand have adopted proactive welfare programs in order to safeguard their export markets. As in the United States, a mixture of private and public approaches is being used. It is difficult to predict what the public–private balance will be in the future, but it is clear that public and private activity in the area of animal welfare is likely to become even more important for export-oriented livestock and meat industries in many countries.

Impact of Animal Welfare Standards on the U.S. Livestock Industry

As indicated above, much of the focus on animal welfare standards in the United States and globally has been on husbandry practices, such as confinement in housing systems for livestock. In the past, changes in such practices in the U.S. livestock industry have been driven primarily by efficiency considerations.

The aim has been to produce a unit of livestock product output at the lowest possible cost, thereby maximizing profits. The search for technical efficiency in livestock production has resulted in an increase in production intensity–for example, the number of animals kept in production facilities–as farmers and ranchers have sought to maximize output per unit of input. Van Horne and Achterbosch (2008) note that in Brazil, India, and Ukraine, where no legislation or voluntary actions are in place that affect the welfare of laying hens, birds are kept in cages that provide 300–400 cm^2 of space per bird. They conclude that "farmers choose this density as the economic optimum giving the highest income per cage" (p. 47). They state that a cage space of 350–400 cm^2 per bird yields the highest income for a U.S. farmer.

Allocative efficiency has been achieved in that consumers have been able to secure animal products at prices that they are willing and able to pay. In fact, production efficiencies have enabled the US animal protein industry to supply increasing quantities of animal products at decreasing real costs (Gardner 2003). Increased efficiency in the U.S. food system has meant that consumers spent less than 10% of their disposable income on food (including food away from home) in 2008, compared to 22% in 1946. Over the same period average daily consumption of protein per capita—obtained primarily from animal sources—increased by over 10% (see databases on food expenditures and food availability maintained by the Economic Research Service of USDA at http://www.ers.usda.gov).

Proponents of higher welfare standards for farm animals would likely argue that the economic gains from increased efficiency in livestock production have been achieved at the expense of humane treatment of farm animals. Livestock products might be viewed to be multiattribute goods, in which production methods (how animals are raised, transported, and slaughtered), are unpriced but important characteristics. Some would argue that farm animal welfare is a public good because anyone can experience pleasure from better animal care, even if they do not consume animal products (Norwood and Lusk 2009). A public good is one that is nonrival and nonexcludable. That is, the consumption of the good by one individual does not reduce its availability to others and no one can be effectively excluded from consuming the good. Hence, an insufficient supply of animal welfare can lower the utility (well-being) of individuals even if they choose not to consume animal products. Becker (1974) examines the implications for individual utility when the actions of others (in this case the consumption of animal-welfare-unfriendly products) enter into an individual's utility function. He makes a distinction between money income and "social income", which includes the value of these other characteristics. One implication of Becker's analysis is that measures to reduce the disutility created by the actions of others will be welfare improving for an individual whose utility is affected by those actions. Increasing the welfare-friendliness of animal products consumed by others would meet this requirement.

Bennett (1995) developed a theoretical framework for analyzing the economics of animal welfare that takes into account the potential trade-off between welfare and productive efficiency and demonstrates that there will be an underprovision of animal welfare if public preferences for the supply of welfare are not reflected in prices of livestock products. The logic of this approach is that the resulting "market failure" could be corrected by internalizing the additional costs of increasing the supply of welfare characteristics to satisfy the preferences of the public as a whole, i.e., regardless of whether individuals choose to consume animal products or not. But the market failure argument can only be taken so far in this case, primarily because animal welfare can be viewed as a "moral" attribute, i.e., one whose worth cannot be determined solely by its economic value. Consistent with the criteria for evaluating performance used throughout this book, the impacts of nonmarket, social-value interventions into the market are difficult to evaluate due to the lack of well-defined, measurable goals.

Individuals who have a high level of concern about animal welfare are less likely to adopt the utilitarian perspective that underpins the logic of economic rationality, i.e., the view that measures to prevent undesirable welfare consequences should only be undertaken if their economic benefits exceed their costs. Rather, such individuals are more likely to have a principles-based, rights-based or deontological approach to this type of issue (Spash 1997). If farm animals are considered by certain individuals to have an absolute right to a certain level of welfare, those individuals will have lexicographic preferences under which indifference curves collapse to single points. In that case, it is impossible to consider trading off changes in levels of welfare against the costs of achieving these. If animal welfare is a moral good, it is far more difficult to deal with from an economic perspective than a public good.

If the moral good argument is not generally applicable and some trade-off is acceptable, it would be possible influence the supply of welfare by using the price system—using taxes or subsidies to influence the amount of welfare embodied in a product. For example, if the public at large would be willing to support animal welfare standards higher than those which currently exist, then why not set up a system under which producers could be induced (incentivized) to supply more of it? While this might result in an economically efficient solution, the public at large might also find such an approach to be objectionable, just as they would if it was suggested that parents who are cruel to their children should be paid to change their behavior rather than expecting all parents to meet certain socially acceptable standards of conduct.

Regardless of whether an appeal is made to the market failure argument or to moral imperatives, if husbandry practices change as a result of either the voluntary adoption or imposition of higher standards to satisfy nonmarket social values, production costs are likely to increase unless gains in dynamic efficiency are possible through the development of new and lower cost welfare-friendly production technologies and management techniques. A study by Rahn (2002) provides estimates of changes in costs per dozen eggs associated with increasing the amount of cage space per bird in an existing 1,000 square foot facility. He concludes that the higher standard introduced by the United Egg Producers (an increase from roughly 360 to 430 cm^2) results in an average increase in costs of roughly 11% per dozen eggs. Using data provided in the paper, the standard currently applied in the European Union (550 cm^2) would roughly double that figure to 21%. Rahn's estimates take into account the positive effects of increasing cage space on costs of production in terms of lower mortality rates and a higher yield of eggs per bird. The negative

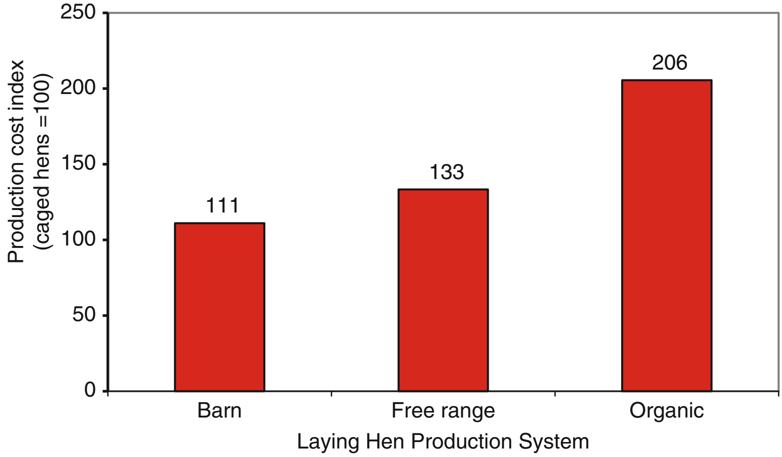

Fig. 18.1 Relative production costs of alternative systems for laying hens in the EU. Source: Agra CAES (2004)

effects are primarily reflected by increased feed intake per bird, higher costs for utilities—primarily due to additional heating requirements, and the reduction in total egg production due to the smaller number of birds housed in an existing facility.

The change in costs becomes more difficult to predict if radical changes in production systems are involved—in particular, changes to alternative cage systems or to noncage systems. A study prepared for the European Commission (Agra CAES 2004) estimated that shifting from a cage to a barn system in the EU (Fig. 18.1) would increase production costs for a dozen eggs by roughly 11%. Hens that produce barn eggs are kept at a maximum density of 9 birds per square meter and have nest boxes, perches, and litter for scratching and dust bathing. If a free range system is used, this is estimated to result in a 33% higher cost than caged eggs. In addition to the requirements for barn eggs, EU rules specify outdoor space requirements and access to this for free range production. Free range organic production is more than double the cost of a caged system. In addition to higher feed use, the principal causes of higher costs for less intensive egg production systems are due to greater labor requirements and larger facilities. Several other studies have estimated even larger cost increases for noncage systems in the U.S. context than in the EU (Promar International 2009). For example, in a study of California egg producers, Sumner et al. (2010) estimate that the average increase in costs of moving from the current caged system to a noncage production system of 41%, but that the increase for the lowest cost producers could be as high as 70%.

The impact of higher production costs generated by changes in husbandry practices depends on whether these costs can be passed on to consumers through higher product prices, or whether they must be largely borne by producers. Figure 18.2 depicts a situation in which higher welfare standards are imposed that result in higher production costs of CS for all producers in an industry. The domestic supply curve shifts back and to the left by CS, the amount of the cost increase. Since there

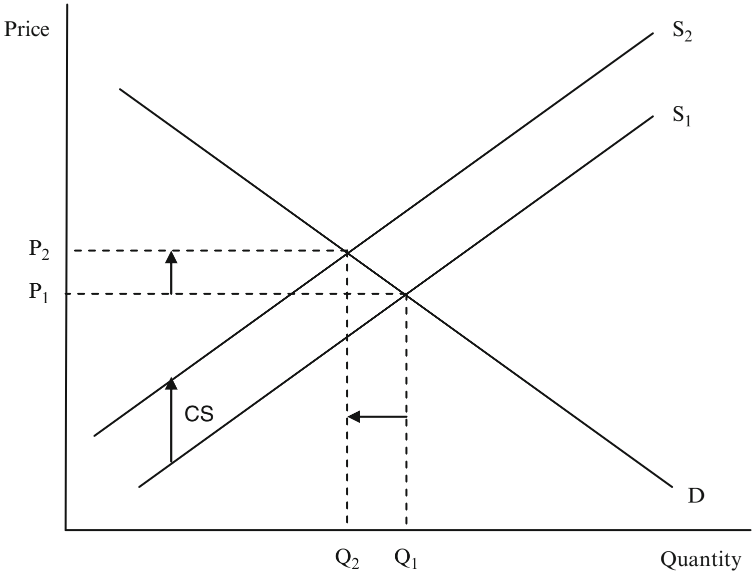

Fig. 18.2 Impact of a universally applied cost-increasing standard

are no other sources of supply, this leads to a reduction in consumer demand from Q_1 to Q_2 and an increase in the market price from P_1 to P_2. In this case, the additional cost of the new standard is borne partly by consumers since they pay higher prices. However, the more elastic the demand curve, the more the cost of the standard is borne by producers since the market price does not increase sufficiently to help compensate for the increase in production costs. For most animal products, the demand curve is likely to be relatively elastic since consumers are able to adjust to higher prices for one type of product by consuming more of another. Thus, if Fig. 18.2 applied to eggs, consumers who are not sensitive to animal welfare concerns would probably respond to higher egg prices by purchasing alternative sources of animal protein or by shifting to competing nonanimal products. The costs of products that incorporate eggs would also be affected to some extent, and those consumers who have a particular preference for eggs would be affected proportionately more. However, only if the imposition of higher standards affected the costs of producing all animal products, not just eggs, would we expect to see a significant pass-through of the costs of the standards to consumers.

Much of the effort to change welfare standards is currently focused on a limited segment of the animal products industry—primarily poultry. Consequently, it is reasonable to expect that the relative price of poultry products could increase if higher standards are adopted (Gardner 2003). This may not necessarily lead to a reduction in consumer welfare, since consumers may voluntarily choose to switch their purchases to higher standard products. For example, a recent study of the demand for eggs in California has concluded that publicity associated with egg production

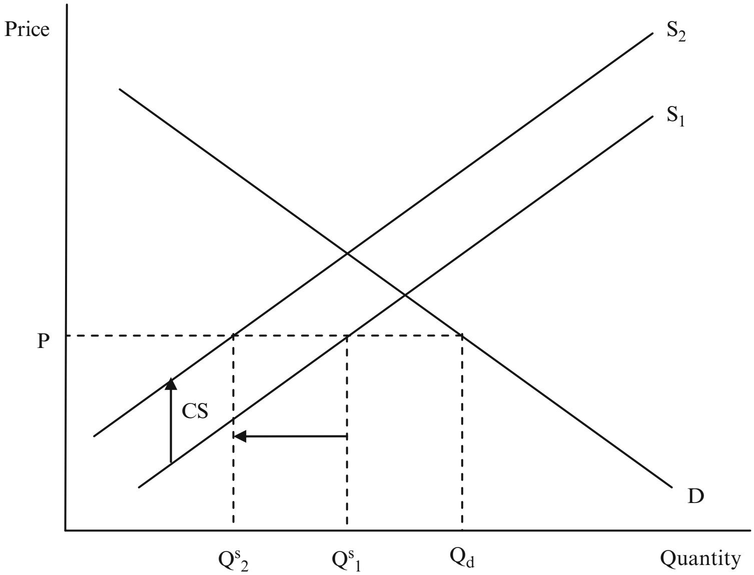

Fig. 18.3 Impact of a cost-increasing standard with nonconforming supplies

practices generated by the campaign over Proposition 2 caused a shift in demand from eggs from caged birds to cage free and organic eggs during the period leading up to the vote (Lusk 2010). It is unclear if this reflects a permanent shift in preferences and increased willingness to pay for eggs produced under more costly systems, but such a possibility cannot be ruled out.

Figure 18.2 assumes that consumers do not have access to any competing supplies of products that are not forced to absorb the increase in production costs created by the higher standard, i.e., that there is a closed market. Figure 18.3 shows the situation when consumers have access to both the conforming product and to a nonconforming product and they are indifferent between these. This situation would apply, for example, to the case in which the standard is applied to eggs in a single U.S. state, such as California, but eggs can be shipped into California from producers in neighboring states who do not have to meet the standard. It would also apply to the case in which a higher standard was adopted for all domestic egg producers in the United States, but not to suppliers of imported eggs or egg products. The imposition of the standard, resulting in an additional cost of CS, shifts the supply curve back and to the left as before, but now there is no impact on prices. Consumers simply reduce their purchases of eggs from conforming suppliers from Q_1^s to Q_2^s and make up this difference by increasing purchases from nonconforming suppliers. In this case, the impact of the standard results in a contraction of the industry that has to meet the higher standard and production tends to relocate to states or countries with lower standards. Van Horne and Achterbosch (2008) argue that the EU directive banning the use of battery cages will have this type of impact on world trade in egg products, especially for egg powder used in food processing.

The situation depicted in Fig. 18.3 is close to that examined by Sumner et al. (2010, 2011) for the imposition of a cage-free production system for eggs in California. They estimate that the shift from conventional cages to barn housing would increase the farm level production costs per dozen eggs by roughly 40% (Sumner et al. 2011). They argue that such an increase in costs would eliminate egg production in the state since California consumers would shift their purchases to eggs imported from other states that continue to use a cage system (Sumner et al. 2010). Because California is a large market for eggs, the supply curve for the nonconforming product is not assumed to be perfectly elastic as depicted in Fig. 18.2, so there is a small impact on consumer prices, although this is not sufficient to compensate California producers for the higher production costs. Nonconforming producers in other states benefit initially from higher prices (these are estimated to increase by 1.3%), but because the elasticity of supply in the rest of the United States is high, the long run price effect is very low (0.66%). It could be even lower if some of the additional supply of shell eggs or egg products to California were met by imports from outside the United States, rather than by suppliers in other states alone. The possibility that consumers would be able to switch from U.S. sourced products to imported products produced under lower animal welfare standards in other countries is a significant concern to those consumers concerned about nonmarket social values, as well as to California producers. International trade agreements through the WTO impose significant constraints on the ability of the United States to limit imports from other countries that are produced under different production systems (see Blandford 2011).

The ability of producers to pass on the costs of higher welfare standards to consumers is increased if product differentiation is possible and if consumers respond positively. As noted earlier, U.S. producers who participate in various animal welfare schemes in the United States typically advertise this on their packaging. It is unclear whether labeling actually allows producers to extract a retail price premium to offset additional production costs, but such labels can provide reassurance to consumers so that they continue to buy the product at a given retail price. In other words, given current attitudes among consumers in the United States for whom price is a key consideration in purchasing decisions, labeling may simply act to maintain or perhaps increase market share, rather than allowing sales to be made at higher prices. Recent U.S. studies of willingness to pay for higher welfare standards for hogs—a ban on the use of gestation crates and a ban on the use of antibiotics in pork production, have generated very high estimates—a premium of roughly 60% in the case of gestation crates (Tonsor et al. 2009b). Tonsor and Wolf (2010) have shown that willingness to vote for tighter regulations on egg production systems is significantly lower when individuals learn that the regulations may involve higher retail prices. Similarly, although a study by Tonsor and Wolf (2011) suggests that a majority of consumers (62%) would be in favor of the mandatory labeling of pork produced on farms using gestation crates and of eggs from caged housing, the number supporting this is reduced substantially (roughly 45%) if they are shown that the elimination of these practices would result in higher product prices. Finally, a recent European study has shown that while consumers often express a high willingness to pay for higher animal welfare standards in egg production, their actual purchasing behavior does not conform to that standard, or as the author of the study concludes "the expressed concern for animal welfare… is to a large extent just cheap talk" (Andersen 2011). While there are no directly comparable studies for the United States, it is probably reasonable to assume that many U.S. consumers would display similar behavior so that regardless of any hypothetical expressions of a willingness to pay higher prices it might be difficult to pass on increased costs resulting from higher standards if cheaper and less "animal-friendly" alternatives are available in stores.

This and other evidence suggests that, when questioned about the issue, U.S. consumers are likely to overstate their willingness to pay for better animal treatment and that they are generally more concerned about higher food prices than the well-being of farm animals (Norwood et al. 2007). However, when presented as an ethical issue, most want conventional egg and pork production methods banned (Norwood 2010). There is, therefore, an inconsistency between economic behavior and emotional judgments regarding the willingness to pay for "higher" welfare standards, reflecting the dichotomy between animal welfare as an economic attribute and a nonmarket moral attribute. Given this dichotomy most of the battle over animal welfare, and the ability of animal welfare "advocates" to secure support for higher standards is taking place outside of a market context—in legislatures and the ballot box.

Future Options for Addressing Farm Animal Welfare Issues

Currently, farm animal welfare is not a major issue among the U.S. public. Although there are some state-level concerns, most notably pertaining to housing for laying hens, there is not currently a strong national groundswell of opinion against existing production practices. Norwood et al. (2007), for example, report that consumers are twice as concerned about the financial well-being of farmers as they are about the well-being of farm animals. However, interest groups, such as PETA and HSUS, have been increasingly successful in raising the profile of farm animal welfare and influencing legislation at the state level. From a producer's perspective, a major difficulty with a state-by-state approach is that the application of differing standards risks creating distortions in the pattern of production and trade of livestock products. The livestock industry in a high standards' state may decline in the face of competition from other states unless consumers can be convinced to pay a premium to cover any increase in local costs. For this reason, a national standard seems to be preferable, but if such a national standard were legislated, U.S. producers run the risk of being undercut by suppliers in nonconforming countries. Labeling can be used to differentiate products, but there is no guarantee that consumers will respond to animal welfare labels by preferring labeled products and be willing to pay a price premium to cover the additional costs of providing these products.

U.S. Options

The U.S. food industry has responded to farm animal welfare concerns through a series of quasi-voluntary initiatives and there has been considerable activity in terms of the development and application of “higher” standards. But the measures adopted do not satisfy the demands of many of the advocacy groups who would like to see the elimination of some current practices, such as the cage system for egg production rather than the provision of improved cages. In addition, there are doubts as to whether voluntary standards that may or may not require auditing, and for which noncompliance does not have clear consequences, will ever be fully effective. A small number of well-publicized cases of poor animal treatment make far more impression on public opinion than evidence that the vast majority of farmers and ranchers do not maltreat their animals. The negative impression is strengthened if a linkage can be established in the public consciousness between poor husbandry practices and human health. Such a link received considerable publicity in the case of an outbreak of salmonella infections traced to an Iowa egg producer during the summer of 2010.

Voluntary standards can be an effective alternative to legislated standards if they are widely applied and providing that noncompliance has consequences—i.e., that the opportunity for free-riding is minimized. The potential loss of status as an approved supplier under some of the current schemes operated in the food industry can provide an incentive to satisfy agreed standards and to make these effective. However, it may be difficult to obtain a voluntary agreement that will cover all those who need to be included and will provide for effective sanctions if any individual does not meet her/his obligations. Federal or state marketing orders have been used in the fruit and vegetable and in the dairy industries to minimize free riding. See Chap. 6 in this book for further discussion of marketing orders, which involve industry agreement through referendum to adopt mandatory requirements.

The existence of legislated standards for animal welfare also does not guarantee compliance, but makes it more likely that cases of noncompliance will be met with legal penalties. In this context, the models being adopted in Australia and New Zealand seem to offer some pointers as to a workable future for the United States that does not rely too heavily on regulation, and one in which there are roles for both industry and government. Based on the approaches used in those countries, a workable model would involve (1) sets of outcome standards for animal welfare developed on the basis of scientific principles for the various categories of livestock, with substantial input from both industry and other interested individuals and groups, supported by recommended codes of practice, both of which would be reviewed on a regular basis and modified in accordance with advances in knowledge; (2) reliance on industry-led implementation of standards and the promotion of good practice; (3) provision for regular auditing or random checks by publicly certified auditors to ensure that standards are being followed; (4) agreement by processors or purchasers of animal products to suspend suppliers from an approved supplier list for a specified period of time if violations are found, with continued suspension until violations are rectified; and (5) establishment of a supporting legal framework to penalize individuals found to be in gross violation of accepted standards and judged to be guilty of cruel treatment of animals.

If this approach were to be adopted, it might be possible to satisfy the concerns of the middle ground of public opinion on animal welfare—those who do not want to eliminate animal agriculture, but to improve its welfare performance. The active and substantial involvement of industry and other stakeholders could generate substantial "buy-in" to the process of developing standards and their implementation, and would bring necessary practical knowledge and experience of animal husbandry to the table. The use of science and technical analysis—including economic analysis—of the implications of proposed standards could help to guide the development of new practices that are both welfare enhancing and economically efficient. The development of an effective and supportive legal framework would increase the effectiveness of the system and help to avoid the current tendency for states to develop separate and possibly conflicting legal requirements, which can pose problems for the industry and create economic distortions.

International Options

At the same time as efforts are made to develop an improved system domestically for animal welfare, attention needs to be directed to international standards for animal products. The work of the OIE could be used to develop practical and agreed international standards for the treatment of farm animals, in the same way that CODEX Alimentarius (http://www.codexalimentarius.org) has been used to develop international standards for food. There is not only a threat that domestic standards for animal welfare will be undermined by nonconforming imports but also a threat that such standards will be used as a protectionist device. As a major exporter of animal products, the United States has an interest in seeing that the international debate on animal welfare standards is conducted on the basis of firm scientific and technical evidence, in order to minimize departures from technical and allocative efficiency while addressing nonmarket social values.

If an attempt is not made to bring those with an interest in animal welfare standards in the United States together to discuss what changes are possible to production practices and to develop a system for the future, it is highly likely that the future will be shaped in legislatures and through the ballot box. The outcome of that process is more likely to be standards and regulations that are less objective and scientifically based, and this could undermine the economic future of U.S. animal agriculture.

Information and Research Gaps

Considerable progress has been made in recent years in the science of animal welfare. Several professional journals are devoted to the subject, and many of these present results of research into the welfare of farm animals and how these are influenced by production practices. Not all the questions have been answered, but the knowledge base has been steadily expanding. In contrast, relatively little research has been conducted into the economic impact of animal welfare regulations and standards in the United States—how these might affect production costs, supply, demand, and prices for animal products, and what the implications might be for international trade. Conducting meaningful research in this area requires substantial contact and collaboration with industry, as well as an interdisciplinary approach. Economic research that combines these elements is bound to be challenging. Nevertheless, if decisions are to be made on future standards and practices, it is important that both their technical and economic dimensions are thoroughly understood so that appropriate choices can be made.

Publicly funded research has made an important contribution historically to increasing the productivity of agriculture and this will continue to be the case, providing that resources are made available to support such research in the future. The welfare of animals used in experiments is addressed through research protocols, but the welfare effects of research outcomes have not figured prominently in the past. Thus, for example, there have been criticisms that the focus on higher productivity in meat animals or dairy cattle has come at the expense of animal health—e.g., lower bone density leading to greater probability of fractures, increased incidence of mastitis. The inclusion of animal welfare-enhancing objectives into future research programs could help to redress this imbalance. Similarly, greater attention could be directed to research, which addresses the development of more "welfare-friendly" production systems that are also more economically efficient—e.g., how to reduce the relatively high death loss in noncage systems for laying hens. Such research relies on a better understanding of animal behavior and disease risks and how facilities design can contribute to reducing mortality. Improved management practices and the development of improved technologies for welfare-friendly production systems will be necessary, if alternative production systems that both address public concerns and are economically efficient are to be developed.

Conclusions

The welfare of farm animals is becoming an increasingly important issue for the U.S. food and agricultural system. Genetic selection for desired production traits and scientific feed formulation, combined with animal confinement and a shift to larger production units have resulted in dramatic improvements in productivity in animal agriculture. While changes in production methods have undoubtedly contributed to lower consumer prices for animal products, critics contend that this has been at the expense of the well-being of farm animals.

The food and agricultural industry has responded to growing public concern by adopting a range of voluntary schemes designed to improve the welfare of farm animals. However, a range of activist groups, some of whom would like to see the elimination of animal agriculture entirely, have been increasingly successful in pressing for tighter regulation of production practices, particularly at the state level. The proliferation of such regulations is likely to impose additional costs on producers and could place them at a competitive disadvantage. Despite the likelihood that higher standards will increase production costs, it would be extremely risky for the industry not to take a proactive approach to the animal welfare issue. A combination of strengthened voluntary actions, supported by more stringent penalties for those who fail to follow accepted practices, may satisfy the concerns of the vast majority of Americans who wish to continue to consume animal products. As one observer has noted "Arguably, general public ignorance about animal agriculture provides an opportunity for (animal) activists to have influence beyond what their numbers would suggest. But one should not underestimate the importance of public expectations…" (Thompson 2005 p. 1325).

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Part VI
Challenges and Opportunities

This part draws a set of cross-cutting conclusions from the content of the previous chapters. It identifies the major challenges and opportunities facing those concerned about and involved with U.S. policies and programs affecting food and agricultural marketing. Key issues that cut across stakeholder interests are identified along with opportunities to improve the performance of the food marketing system.

In Chap. 19, Knutson and Armbruster draw on the findings in the various chapters to review the major forces of change in the marketing system that have been identified as creating market failures and generating the need for adjustments in marketing policies. They present a set of cross-cutting issues which deserve further research and possibly program or policy action to modernize policies affecting food and agricultural marketing.

Chapter 19
Program Challenges and Future Opportunities

Ronald D. Knutson and Walter J. Armbruster

Abstract This chapter summarizes the results of the author's findings and options identified for addressing policy and program changes. It reviews the major forces of change in the marketing system identified as impacting policies and programs affecting food and agricultural marketing. An overview of the major options suggested as areas that deserve further discussion and analysis as a basis for policy and program changes in the future is then presented. Market conditions are generally materially different than those which existed at the time when contemporary policies were established. Some programs have failed to be adequately adjusted to accommodate these changes in market conditions. The evolution of markets to coordinated and managed supply chains; contracts and market structure; technology; and expectations of market performance relative to food safety, consumer information, variety, and nonmarket social values are highlighted as forces leading to policy changes affecting food and agricultural marketing. Finally, the chapter identifies priority areas for attention to address market and legislative failures.

In the previous chapters, economic experts have utilized research results to summarize the impacts of a wide range of contemporary issues affecting food and agricultural marketing. They have reviewed federal policies and programs affecting food and agricultural marketing, and identified options for changes in them to better serve the needs of the markets in the future.

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This chapter summarizes the results of the author's findings and options identified for addressing policy and program changes. Initially this chapter reviews the major forces of change in the marketing system identified as impacting policies and programs affecting food and agricultural marketing. Following this analysis of the forces of change is an overview of the major options identified for policy change. Those options identified are not suggested as solutions or prescriptions. Rather, they are proposed for consideration as areas that deserve further discussion and analysis as a basis for policy and program changes in the future.

Forces Leading to Changes in Policies Affecting Marketing

This section identifies the market changes that may precipitate the need for changes in policies affecting food and agricultural marketing. The economic experts not only identified these market conditions as being materially different than those which existed at the time when contemporary policies were established, but also connected them to specific conditions or consequences that suggest a need for policy or program adjustment. In some cases, these policies or programs may have been established as early as the 1930s or even before. This does not per se make them obsolete. That only happens when the programs have failed to adjust to changes in market conditions. Heifner (Chap. 3) provides a thorough review of the establishment and evolution of the various policies and programs affecting food and agricultural marketing. Often, the authorizing legislation under which these programs were established was sufficiently flexible to allow for adjustment to changing market conditions. In addition, several of the forces for change were identified in more than one of the chapters as necessitating consideration of the need for policy or program adjustment. While economic and policy issues are highlighted by chapter and author in this section, the specific priority policies affecting food and agricultural marketing suggested for further discussion, consideration and evaluation will be examined in the subsequent section.

Market Structure

The evolution of markets to coordinated and managed supply chains was identified in virtually every chapter as an economic factor that requires a reassessment of marketing policies. The starting point appears to have been vertical integration in the poultry industry during the 1950s. The concept of supply chain management was widely developed and adopted by multinational supermarket and foodservice chains who needed to schedule the sourcing and marketing of perishable fruits and vegetables being demanded by consumers on a year-around basis (Kinsey, Chap. 2). The development of vertical market structures and supply chain management led to a disintegration of spot and central wholesale markets, which has had important implications for the availability of reliable price information (Parcell and Tonsor, Chap. 14).

Globalization receives particular emphasis as a force requiring consideration for policy adjustment in chapters that deal with imports, exports, and international markets. The role of USDA, USTR, and the Department of State in expanding trade and in providing food aid appears to be uncertain, confused, and seriously reduced. Supporting evidence includes more attention focused on the utilization of corn for the production of biofuels; the failure of the WTO trade negotiations; adverse rulings against the US export credit and various other farm and export-related subsidies; and the reduced emphasis on regional trade agreements (Henneberry, Chap. 8). Souza-Monteiro and Hooker (Chap. 10) emphasize the importance of increased imports as factors presenting challenges for implementation of the new Food Safety Modernization Act. Nganje's (Chap. 11) analysis indicates that port-of-entry inspection needs to be dramatically increased to provide statistically reliable protection against unsafe food entering the US food system and to prevent intentional bioterrorism, a responsibility that extends beyond USDA. Peck (Chap. 12) indicates that increased trade and international travel challenges the ability of APHIS/USDA and Department of Homeland Security to protect against nonnative pests and pathogens that could jeopardize crop production and livestock production, as well as against zoonotic disease transmission.

Armbruster (Chap. 4) and Kinsey (Chap. 2) both point to the development of national food manufacturers, foodservice companies, and multinational retailers with progressively larger market shares. These developments led Kinsey to the conclusion that smaller companies are rarely economically sustainable. There is ample evidence to support this hypothesis. Economies of size in virtually all aspects of farming, vertical integration, and supply chain managed systems have put the squeeze on smaller farms. However, this phenomenon is being tested by a counterculture of new generation cooperatives and local food outlets. The new generation cooperatives, established under innovative state cooperative laws, have adopted the supply-chain managed systems approach with nonpatron investors contributing equity capital. The local foods concept combines the struggle of smaller farms seeking a marketing formula for their survival with the consumer interest in fresh locally produced food purchased through a shorter supply chain (McFadden, Chap. 16).

Technology

Due to a variety of factors identified by the authors, the United States is not effectively utilizing its technological capabilities to deal with marketing problems or with issues that affect marketing. The primary contributing factor may be a lack of resources to commit to program adjustment in areas such as port inspection and food safety. Also, resistance to technology-induced change is a factor in areas such as biotechnology and animal welfare.

Port Inspection

Nganje (Chap. 11) finds that port inspection procedures have not kept pace with dramatically increased tonnage of imports. In addition to the increases in volumes, risks have increased with the potential for terrorist activities and increased drug trafficking. FDA inspects only about 1% of the imported foods it regulates at the border due to resource limitations, down from an 8% inspection rate in 1992 when import volumes were far less. Even on high-risk commodities, the standard inspection rate is only 2%. Contributing to the lack of progress in the modernization of inspection services is the shared responsibility among several US agencies resulting in overlaps in addressing issues related to food safety, food defense risks, and market failures.

Food Safety and Traceability

Souza-Monteiro and Hooker (Chap. 10) indicate that a common feature of the most recent US-based food safety outbreaks was the lag between the detection of the incident and the full assessment of its origin, cause(s), and spread. Public and private agents have struggled to fully identify and contain problems in a short amount of time. A number of authoritative studies have identified or raised concerns about the apparent inconsistencies and duplication of effort in the way food safety is treated by the different agencies. One of the key features of the recently approved Food Safety Modernization Act regulation is the adoption of HACCP procedures by all operators at all levels of the food chain. However, traceability requirements are limited to one-step forward and one-step back in the food chain, which make timely detection of the origins of a disease difficult or impossible.

Biotechnology

Phillips (Chap. 17) notes that the advent of biotechnology moved agriculture into a new era of crop improvement, and the expectation of equally significant future advancements in animals. US producers have responded rapidly to adopting biotech advances in crops such as corn, soybeans, and cotton, but the market for seeds must be large enough to warrant the investment in commercialization. This is the case because it takes approximately 15–20 years from the development of the first new GE plant to conduct the field tests, perform the safety studies, submit the data to the appropriate regulatory agency, receive agency approval, and record its first sale. The cost incurred over this period was found to be in the range of $100–150 million. Therefore, regulatory cost is a major deterrent to technological advancement, at least in the case of biotechnology.

Animal Welfare

Blandford (Chap. 18) concludes that a primary initial driving force for vertical integration of the poultry and pork industry was cost reduction through the adoption of various forms of confinement production systems. Animal welfare and humane treatment advocates want to restrict the use of these systems as being inhumane. However, the terms animal welfare and humane treatment are difficult to define, with no agreed upon scientific definition. Each concept has varying definitions depending on the advocacy interest group. Arizona, California, and Florida have enacted laws that restrict the use of certain types of confinement systems. Research indicates these laws would result in sufficient cost increases to make commercial production in those states noncompetitive. On threat of boycotts by interest groups, some private sector retail chains have set standards for humane production systems that their suppliers must follow.

Expectations

The expected performance of markets covers an increasingly wide range of criteria as markets become more complex and more highly managed, and as influential segments of consumers have the ability to pay for the cost of realizing those expectations.

Cost/Production Efficiency

Kinsey (Chap. 2) makes the point that large segments of consumers tend to be price driven, in part because of income constraints. The realization of prices that reflect costs is dependent upon the persistent adoption of cost reducing technology, which has characterized agriculture. As producers and firms in the marketing channel strive to reduce costs, consumers realize the benefits through lower prices. The policies identified as having the greatest cost reducing impacts include those that foster the development and adoption of biotechnology products (Phillips, Chap. 17) and the prevention and control of nonnative pests (Peck, Chap. 12). On the other hand, several cost increasing policies were identified. Those most likely to raise costs were regulatory in nature, including food safety and traceability (Souza-Monteiro and Hooker, Chap. 10), biotechnology (Phillips, Chap. 17), labeling (Lusk, Chap. 13), and humane treatment of farm animals (Blandford, Chap. 18).

Competition/Allocative Efficiency

The speed with which lower prices are transmitted to consumers is dependent on competition. Competition and the rapidity of price transmission declines as firms differentiate their products, as markets become more highly concentrated, and as consumers have less sound and accurate information on which to base their decisions. In the process, allocative efficiency declines to the disadvantage of producers and consumers. Armbruster (Chap. 4) identifies increased market concentration as a prime factor that reduces competition in the food industry. He discusses market concentration and anticompetitive conduct as being historically troublesome for policymakers and antitrust regulators in the meat packing, poultry, dairy, and retail market sectors. In addition to antitrust action, Knutson and Cropp (Chap. 5) identify cooperatives as being relied upon by producers as countervailing forces in offsetting concentrations of market power. However, their effectiveness is primarily limited to dairy and to fruit and nut products. Cooperatives have been particularly unsuccessful competing in the meat and poultry subsectors. Legislative actions to support bargaining activities in contract agriculture have been a particularly dismal failure. New generation cooperatives offer some hopeful signs of cooperative resurgence as competitive forces.

Dynamic Efficiency

Technology development and adoption is a main driver of progress in the capitalistic system. Policies and interest group activities that delay, or even deny, progress that yields efficiency gains stifle the dynamism of the market system. Examples include the technology restraining and reversing activities of animal rights activists (Blandford, Chap. 18) and of interest groups opposed to biotechnology (Philips, Chap. 17). Likewise, government agencies that delay adoption of policies and programs having efficiency enhancing effects stifle dynamic market efficiency. Contrast, for example, the progressive adoption of the Leafy Green Marketing Agreement with the resistance to developing a comparable federal produce safety marketing order, and USDA's inclination to wait for farm bills to mandate changes in federal milk marketing order policies (Paggi and Nicholson, Chap. 6).

Convenience, Health, and Consumer Information

Kinsey (Chap. 2) identifies convenience as a driving force in consumer decisions to eat fast foods and manufactured fully prepared foods despite their potential adverse impacts on obesity and health. Lusk (Chap. 13) identifies nutrition labeling and Caswell (Chap. 9) identifies grades and standards as a means of providing consumers with information desired for healthy living decisions. However, Lusk warns of the potential for information overload.

Food Safety

Despite the passage of the Food Safety Modernization Act and its mandate for expanded use of HACCP or HACCP-type methods for ensuring food safety, many issues remain. Central among these are the development and adoption of reliable traceability systems; widespread adoption of farm-level systems for reducing food safety incidents; and improved systems for border inspection (Souza-Monteiro and Hooker, Chap. 10; Paggi and Nicholson, Chap. 6; Nganje, Chap. 11).

Variety Versus Homogeneity

One of the underlying economic tenets for perfectly competitive markets is product homogeneity. When products are homogeneous, prices are comparable and are expected to differ only by the cost of transportation to markets. A number of policies and programs are based on notions of homogeneous products, including generic advertising (Crespi and Sexton, Chap. 7) and marketing orders and agreements (Paggi and Nicholson, Chap. 6). Grades and standards (Caswell, Chap. 9) are designed to segregate products into homogeneous groups of categories, which may facilitate price reporting and ease buyers' product quality decisions. Parcell and Tonsor (Chap. 14) note that price reporting is meaningful only for products or product classes having homogeneous quality.

Nonmarket Social Values

Various advocacy groups are increasingly injecting nonmarket social value expectations that extend beyond market determined forces. These nonmarket proposed remedies often utilize prohibitions or regulations that would impose sufficient costs to make the targeted activity economically infeasible. The economic effect of the advocacy group's position is to impose costs on society, in general, including those segments of the population that do not share their views. The impact of such nonmarket outcomes is similar to externalities which cause market failures that result in reduced allocative efficiency. Policy positions taken against the products of biotechnology (Phillips, Chap. 17) and animal welfare (Blandford, Chap. 18) are excellent examples, although certain types of labeling (Lusk, Chap. 13; Caswell, Chap. 9) also fall into this category.

On the other hand, there are nonmarket social benefits that have positive effects for general society. For example, Peck (Chap. 12) notes the positive merit good health benefits of controlling nonnative pests. Knutson and Cropp (Chap. 5) identify the positive rural development impacts of cooperative activity, particularly new generation cooperatives. McFadden (Chap. 16) sees local foods as having nonmarket social benefits for smaller farmers, rural communities, and for some consumers. Armbruster (Chap. 4) identifies nonmarket social benefits associated with a number of trade practice regulations.

Priority Areas for Consideration, Analysis, and Evaluation

There are a number of major priority areas identified by the marketing expert authors as requiring further consideration, analysis, and evaluation. The areas discussed here are not meant to be prescriptive, but rather to be sufficiently specific as to be meaningful. In addition, there were instances where the authors had problems identifying specific alternative policy or program remedies. There are also areas where other unidentified options may exist for dealing with particular issues. Vigorous pursuit of identifying and evaluating such options is warranted.

Maintaining Market Efficiency and Structural Balance

Maintaining economic/allocative efficiency and structural balance within supply chains demands ongoing attention by the research community, industry leaders, policy makers, and government program administrators.

Establishing Balance in Contract Markets

With ever increasing contract integration at the producer level, the discriminatory conditions that the Agricultural Fair Practices Act of 1967 (AFPA) was designed to rectify are still festering among contract growers. The proposed Producer Protection Act contains key provisions that would (1) require contracts to be in plain language and contain disclosure of material risks; (2) provide producers a 3-day cancellation period to review production contracts and discuss them with advisors; (3) provide producers with a first-priority lien for payments under a contract in the event the contractor goes out of business; (4) protect producers from having contracts terminated capriciously or as a form of retribution; and (5) prohibit tournament contracts (Knutson and Cropp, Chap. 5).

Local Foods

The various outlets for local foods are designed to keep markets open to smaller producers and to enhance their sales (McFadden, Chap. 16). In the short run, assertive efforts to utilize federal food assistance programs may offer the greatest opportunities for expanded local food sales. Other promising strategies include augmentation of programs that support CSA and farmers markets, and provisions that allow food assistance recipients (SNAP, WIC, etc.) to purchase food products from authorized local food outlets. Market information is a priority. Any market assessment to examine enterprise viability needs price, production, and marketing channel data. In addition, process verification programs are a valuable innovation (Lusk, Chap. 13; Caswell, Chap. 9). Expanded federal support for process verification programs would allow smaller producer stakeholders to define the differentiable attributes of their products and their positioning in the market. An important longer-run option involves evaluation of the need to balance farm subsidy support across commodities, including fruits and vegetables.

Restoring USDA Cooperative Support

For decades the USDA maintained an agency that had a specifically designated mission of providing national leadership for cooperative education activities, maintaining cooperative statistics, conducting cooperative research, providing technical assistance to cooperatives upon request, and analyzing cooperative issues for policy makers. These activities have, for all intents and purposes, been dismantled. While state public and private agencies have played an important role in filling the gap left, they lack the resources to address national issues and maintain the cooperative statistical database (Knutson and Cropp, Chap. 5).

Providing Federal Marketing Order Authority for Farm-Level Fresh Produce Safety

The Leafy Green Marketing Agreement has been a major positive innovation in assuring food safety. Efforts by USDA to expand this authority in the form of fruit and vegetable marketing orders have been unsuccessful. Federal fruit and vegetable food safety marketing orders are evaluated as a much superior marketing policy option to pending farm-level federally mandated HACCP-type regulations (Paggi and Nicholson, Chap. 6; Souza-Monteiro and Hooler, Chap. 10).

Consistency of USDA Policies Across Program Areas

One of the functions of high level USDA officials is to maintain consistency across program areas, both within agencies, which is the responsibility of agency administrators, and across agencies. While there are likely others, three instances have been identified where policy inconsistencies are present.

- First, the Secretary has the authority under the 1996 farm bill to authorize generic advertising and promotion for any commodity, which includes both pork and beef. The Secretary is also mandated to implement the Dietary Guidelines for Americans 2010 (DGA 2010), which recommend reduced consumption of red meat. Promoting increased consumption of pork and beef, while recommending reduced consumption under the dietary guidelines, is patently inconsistent (Crespi and Sexton, Chap. 7). The Supreme Court has upheld the constitutionality of these promotion programs on the grounds that they represent government speech. However, it is counterproductive and wastes producers' check-off money to promote consumption of two products that are substitutes for one another.
- Second, federal milk marketing orders set the procedures to be utilized in setting minimum prices to be paid by handlers at the producer level. One of the key factors in pricing producer milk is the butterfat price, with higher prices being paid for milk having higher butterfat content. The DGA 2010 recommends increased consumption of skim and low-fat milk and reduced consumption of

animal fats. The procedures for pricing milk under milk marketing orders are thereby inconsistent with DGA policy.
- Third, farm subsidies favor program crops to the disadvantage of fruits and vegetables, another inconsistency in policy.

Cost–Benefit and Feasibility Analysis Prior to Regulatory Decisions

Increasingly regulatory decisions are being made without the benefit of reliable cost–benefit and feasibility analyses prior to making policy and program decisions. Three situations were identified where the need for cost–benefit analysis is important in maintaining efficiency: First, cost–benefit and feasibility analysis would be useful in setting priorities for pest intervention action (Peck, Chap. 12). Second, labeling requirement decisions would benefit from reliable analysis of benefits vs. costs (Lusk, Chap. 13). Third, animal welfare and humane treatment decisions would benefit from reliable and transparent cost–benefit analysis (Blandford, Chap. 18).

Consistent Distribution of Costs and Benefits

All producers are mandated to contribute to check-off programs established for their commodities on the basis that the products are homogeneous and noncontributing producers would be free riders. Individual producers may seek to differentiate their products through their own promotion programs. Such producers are not free riders, nor are they producing a homogeneous product. Consideration of an individual producer promotional expenditure offset may be warranted.

Traceability and Food Safety

Current biosecurity regulation requires a one-step forward and one-step back trackback. A necessary building block for an effective food safety strategy involves farm gate-to-plate and plate-to-farm gate traceback (Souza-Monteiro and Hooker, Chap. 10). These systems need to be developed utilizing, for example, the experiences of Canada.

Sampling at Ports of Entry

Risk-based regulatory systems are widely utilized in federal programs. Analysis clearly indicates that sampling rates at ports of entry are substantially lower than warranted by statistically reliable risk-based systems. The combination of terrorism threats and food safety incidents suggests an urgent need to develop and evaluate alternative risk-based port-of-entry inspection systems (Nganje, Chap. 11).

Mandatory Reporting

Voluntary price reporting is based on the premise that sellers report in good faith sales volume and price for separate transactions to the AMS, USDA. Primary support for mandatory price reporting is that no transaction goes unreported and the public views price and sales information reported from mandatory collection of data to be unbiased and representative. As market concentration continues to increase, consideration may need to be given to expanding mandatory reporting (Parcell and Tonsor, Chap. 14; Armbruster, Chap. 4).

Streamlining Regulatory Programs Where Multiple Agencies Are Involved

In a time of severe budget pressures and concern about the costs of regulation, there is no excuse for persistent findings of duplicative and overlapping regulations. Five areas were identified as having persistent overlap issues.

- First, repeated studies by the General Accounting Office and the National Academies of Sciences have identified overlaps in food safety regulation. Even if the Food Safety Modernization Act is fully implemented, there will be several different federal agencies involved in delivery of these regulatory services. Options for reducing regulatory overlap and consistency need to be addressed, including the formation of a single food safety agency.
- Second, the three lead biotech regulatory agencies are USDA's Animal and Plant Health Inspection Service (APHIS), the Food and Drug Administration (FDA) at the Department of Health and Human Services, and the Environmental Protection Agency (EPA). Although the Coordinated Framework for Regulation of Biotechnology is a very useful concept in the management of regulatory policy and programs for biotechnology, it has resulted in inconsistent policy and, at times, hindered the evolution of regulatory policy.
- Third, ensuring quality for imports and trade is a shared responsibility among several US agencies including FDA, USDA, and US Customs and Border Protection of the Department of Homeland Security. Within USDA there are multiple agencies with different responsibilities. It is a point of confusion and frustration for international officials and businesses that they may have to communicate with multiple agencies within USDA to address all of the issues with importing agricultural products.
- Fourth, in preventing invasions of nonnative pests USDA's lead agency, the Animal and Plant Health Inspection Service, faces significant coordination challenges not only with trade partners, but within its own borders among the numerous federal agencies (Peck, Chap. 12). For example, the National Invasive Species Council (NISC), created in 1999 to develop a coordinated nonnative pest network among federal agencies, includes Secretaries and Administrators from 13 federal departments.

- Fifth, the lack of clearly defined responsibility between USDA and DOJ for enforcement related to the Capper-Volstead limited antitrust exemption for cooperatives is problematic (Armbruster, Chap. 4).

Public and Private Sector Collaboration

Numerous examples exist of federal agencies working effectively with state counterparts to provide the services and regulatory programs to facilitate efficient marketing of food and agricultural products. Formal collaboration with the private sector may be a productive strategy in dealing with new or existing programs which are becoming more important because of increased globalization of food and agricultural markets, in particular.

Advisory Boards and Committees

The NICS cited above has an Invasive Species Advisory Committee (ISAC). It is one of several examples of such collaboration provided by Peck (Chap. 12) regarding invasive pests. Many programs have successfully incorporated such industry collaboration, including fruit and vegetable marketing orders implemented under direction of the Boards (Paggi and Nicholson, Chap. 6) and generic commodity promotion programs administered under several types of structures involving industry representatives (Crespi and Sexton, Chap. 7).

Certification of Service Providers

AMS has a large number of audit and accreditation services that focus primarily on process attributes to provide market oversight and support. Companies with approved programs can make marketing claims about verified process attributes and market themselves as, and use the shield for, “USDA Process Verified” (Caswell, Chap. 9). These voluntary government and industry collaborations are supported by a fee for service structure. This approach is used in the National Organics Program, a public–private partnership.

An example of another approach is the growing number of certification programs whose development has been led by producer organizations or nongovernmental organizations (NGOs), but of which have sought verified process status with USDA. This is particularly true in the organics arena. Other private sector certification programs provide a range of criteria, such as those related to animal treatment, fair trade, or family farmed. Most of these market segments are too ill-defined to warrant such government verification of private sector certifiers, but this may change over time as more consumers seek food systems aligned with their values which may or may not influence eating or sensory quality (McFadden, Chap. 16). The evolving role of third-party certification and the yet to be defined role of import certifications following the passage of the Food Safety Modernization Act make for a possible interesting dynamic public–private partnership for food safety and traceability (Souza-Monteiro and Hooker, Chap. 10).

Partnering for Risk Management

Government has long provided programs through the farm bill that have essentially mitigated production and price risk for producers, especially for the major commodities. The commodity futures markets also have provided price risk management tools used largely by the marketing sector firms as opposed to producers. As producer scale has increased, they have turned more to the futures markets to help them manage price risk and government subsidized insurance to mitigate production risk impacts. As the complexity of market relationships have evolved, opportunities for public–private partnerships in managing risk continue to change and new risks result from such things as the interconnections between the fuel and feed sectors, or from commodity investors including agricultural commodities in diversified portfolios. The potential of government–industry collaborative solutions should be carefully explored, to be sure that proposed remedies are dealing with documented market failures. Roberts (Chap. 15) identifies some opportunities for such industry–government collaboration.

Market Failure and Legislative Failure

For many economists who have spent decades working in the marketing policy arena, marketing programs were primarily viewed as being established as a service to facilitate efficient marketing. This was consistent with the philosophy of President Lincoln in creating USDA as the "peoples' department." USDA agencies that delivered marketing programs generally had "service" as part of their name. The Agriculture Marketing Service is an example. Even marketing orders were service functions in that producers requested them and voted on their approval. Over time, regulatory policies and programs affecting food and agricultural marketing by mandating particular functions have become increasingly common. Frequently, the new regulatory programs replace or overlap service functions. Worse yet, related regulatory activities were often placed in a different agency within the USDA. This required that an Undersecretary or even the Secretary perform the function of rectifying inconsistencies and coordinating activities between agencies. Perhaps the greatest legislative failure occurs when the same type of regulatory function with the same basic objective is placed in different cabinet departments or independent regulatory agencies. It is in this case that the regulatory burden becomes overwhelming. While this book has been designed to uncover and analyze instances of market failure, the authors have uncovered a number of instances of legislative failure, which may have even more adverse efficiency consequences.

In short, there is a need for continuing reexamination and periodic evaluation of the various policies and programs affecting the marketing of food and agricultural products. Researchers, industry leaders, policymakers, and government agency administrators need to continue to work collaboratively to assure the most efficient marketing system possible to maintain the enviable performance of the US food and agriculture sectors.

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