Chapter 2: The Economics of Price Fixing

This chapter offers a non-technical economic explanation of the causes and effects of price fixing, beginning with a description of how prices are formed in competitive markets and in the presence of a monopoly. These two analytical models of how prices and output evolve in markets are too unrealistic to fit natural markets, yet their contrasting results are useful because they bracket the price/quantity outcomes in real markets. That is, perfect competition and pure monopoly are the extreme points on a continuum of market environments, and the performance of real-world markets tends to be "in between" the two extremes.

These "in between" markets have a small number of sellers or buyers. Small numbers raise the possibility of strategic behavior among sellers, of which price fixing is one type. Price fixing is more than just fixing prices, so an enumeration behaviors that constitute a broader notion of price fixing is provided. This is followed by an explanation of the economic factors that affect the formation and success of cartels. The chapter ends with a brief empirical analysis of the economic harm imposed on market participants by effective cartels and a brief historical survey of global cartels.

Basic Concepts

Pure Competition and Monopoly

Until the 1930s most students of economics were taught only two diametrically opposed abstract models of how markets worked. The perfectly competitive market model describes a world in which there is a large number of buyers and sellers, all of them well informed about prices and product quality and trading perfectly homogeneous goods according to uniform trading rules. Goods are homogeneous when buyers are unwilling to pay more for one seller's product compared to any others. A key assumption in this model is that if the numbers of buyers or sellers become too few, there is nothing preventing more of them from jumping into the market almost immediately to take advantage of trading profits. Similarly, in the face of

negative profits, participants could quickly and costlessly exit the market by selling their assets to large numbers of willing buyers. Another assumption is that trading occurs in a double oral auction in which the participants could observe the price of every transaction. While this ideally competitive market is an abstract construct of economic theorists, some real world markets in agricultural products or stock trading come pretty close to matching its characteristics. Even though few natural markets are perfectly competitive, the model is important because it is a benchmark for comparing the performance of all other markets.

The behavior of sellers in perfectly competitive markets is also rather unrealistic. Firms in perfectly competitive markets lead pretty dull lives because they are pure price-takers. After checking out the market price, a seller sets the firm's output at the profit-maximizing level, which is the same level at which all other identical firms set their output. Individual firms pay no attention to overall market demand.[1] The seller then observes input prices and purchases an optimal mix of labor, capital, and other inputs from markets that are also perfectly competitive; all sellers choose the same mix of inputs because they all have adopted the same low-cost technology of production. All the sellers earn zero economic profits (which will be a positive rate of return on investment, adjusted for market risk, on the company's financial records). Perfectly competitive firms are unconcerned about creating loyal customers because they can always sell all that they can make at the market price.

The other model is pure monopoly. In this case, a single firm supplies the entire market for a well-defined product. The monopolist sets the market price on the assumption that entry into its industry is blockaded, perhaps because the firm has unique access to an essential input or production technology or perhaps because it owns patent or trademark that makes its product inimitable. A monopolized good may be homogeneous in the sense that it is simple or comes in only one grade or variety. On the other hand, the many buyers of the monopolist's product perceive that there are no satisfactory substitutes available for purchase; in this sense the monopolist's product is like a unique brand that has no rivals – it is the most differentiated of products. Like the perfectly competitive market, there are few examples of pure monopolies in natural markets, and the few that exist tend to be publicly regulated.

Behavior by monopolists is quite different from perfectly competitive firms, though it too has an air of unreality about it. The monopolist sees the demand for its product as identical with market demand because

[1] Nor is there a role for a trade association to stimulate market demand or to create product standards in a perfectly competitive market. However, if government intervenes in the market, such associations may have a lobbying role.

buyers believe there is no substitute for the monopolist's product. Market supply equates with the output under the control of the monopolist. There is no market price separate from what the monopolist decides to charge; that is, the monopolist is a price-maker not a price-taker. The profit-maximizing price set by a monopolist will depend only on its costs of production and the shape of the market demand curve. The monopoly price will be positively related to the height of production costs and inversely related to elasticity of demand.[2] The most important implication of the monopoly model concerns its effect on market performance.

Welfare analysis demonstrates that perfect competition results in the greatest quantity of production at the lowest possible price, which is highly beneficial to consumers. Monopoly, on the other hand, restricts output to some level below the competitive level, resulting in a loss in consumption and production. This is termed the dead-weight loss. Moreover, the supra-competitive price charged by a monopoly results in the transfer of income from buyers to the owners of the monopoly. While a loss to consumers who still buy at the elevated price, not all of the transfer is a loss to society.[3] A monopolist may set a single price, but the size of the transfer can be increased if the monopolist is able to divide demand into distinct groups that are then charged distinct prices; such price discrimination may be on the basis of size of purchases, buyers' income, or each group's sensitivity to price.

Oligopoly

Firms in perfectly competitive markets cannot manipulate demand and have no power over price. Perfectly competitive behavior is anonymous. There is no benefit in getting to know one's input suppliers or competing sellers because there is no hope of developing a common strategy that would pay. The free-entry condition alone ensures the unprofitability of collective action.

The possibility of group activity aimed at raising profits through purely private actions is much greater in an *oligopoly,* that is, an industry

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2 If *P* is price, *MC* is the marginal costs of production and distribution, and η is the elasticity of market demand, then the optimal monopoly price is: $P_m = MC/(1- 1/\eta)$. When η is a small negative number, demand is inelastic. Holding costs constant, the smaller η is, the larger is the optimal price. In a perfectly competitive market η is perceived to be infinite; thus P = MC.

3 To the extent that the transfer (monopoly profits) is used by the seller to bolster or maintain its monopoly power, this is also a social loss.

with a few sellers.[4] In essence, when a group of sellers becomes small enough to control a sufficiently large share of sales in the market, the group comes to realize the possibility of collective action that can raise the group's total profits. Similarly, when numbers of sellers are few, they begin to appreciate the fact that their independent decisions over price or output can hurt the profits of their industry rivals.

In the 1930s, progress in cartel theory was aided by the discovery and development of simple, static oligopoly models. Thinking about cartels was also greatly influenced by legal-economic case studies of the tobacco, steel, aluminum, and other industries with well documented cartel prosecutions. The great early industrial-organization economist Edwin Chamberlin (1933) called this "mutual dependence recognized." That is, oligopolists infer that their business actions (price changes, output adjustments, plant investments, and the like) *will* affect the profits of their rivals, and vice-versa.[5] Typically, oligopolists form strategic plans that take into account what their industry rivals will do in response to a notable business action. Strategic thinking of this type is folly in a perfectly competitive industry because the actions of one firm can only have an infinitesimally small impact on industry supply or product price.

Chamberlin (1933) envisioned that monopolistic conduct would spontaneously replace cutthroat competition when the number of firms slipped below some critical threshold. Cartel agreements may involve such sudden shifts toward noncompetitive behavior, though it is more likely to be a shift from conscious parallelism a greater degree of cooperation. Modern oligopoly theory teaches that collusive behavior in general will result in prices significantly lower than pure monopoly prices (Werden 2004). However, dynamic games that best represent cartels also predict prices that are higher than noncooperative conduct.

Economists call the formation of market plans that take into account expected reactions of rivals *conjectures.* Strategic behavior falls into two one of two broad classes, cooperative and noncooperative. *Cooperative* or *overtly collusive* behavior requires a conscious agreement between rivals (established firms already selling into the same market) or between an actual and potential rival. "Conspiracies" in the legal sense are types of strategic behavior that economists class as cooperative. Overtly collusive groups are *cartels* (see box).

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4 "Oligopoly" was coined by Sir Thomas Moore in his book *Utopia* published in Latin in 1516. The term was revived in the first book on the economics of oligopoly, Edwin Chamberlin's *Theory of Monopolistic Competition* (1933). By the 1950s business newspapers began to contain articles using the word *(Oxford English Dictionary).*

5 Formal models of duopoly or oligopoly date back to Cournot (1838) and Bertrand (1883), but like Chamberlin (1929) these presume independent or tacitly collusive behavior.

Noncooperative behavior (also called *tacit collusion* or *conscious parallelism)* involves conjectures that are formed independently by firms. That is, firms develop hypotheses about rivals' strategic behavior without any direct "spoken" communication with those rivals. Typically, noncooperative conjectures are formed by observing a rival's reactions to historical changes in market conditions or to independent actions of the conjecture-making firm. A classic example of tacit collusion is price followership by firms that take note of public price announcements of leading firms. Conscious parallelism can evolve through "unspoken" communication (Werden 2004).

Cartel

A cartel is an association of two or more legally independent firms that explicitly agree to coordinate their prices or output for the purpose of increasing their collective profits. The members of a cartel must knowingly and intentionally conspire to raise (lower) the price of the product that they sell (buy) above (below) the price that natural market forces would cause in the absence of the cartel's actions. Affecting price will cause the quantity of product sold in the market to contract, but some cartels reinforce the price distortion by agreements to reduce output, sales, or industry capacity. Cartels can sign contracts or use various subtle techniques to communicate, monitor, and enforce agreements. Those conspiracies that engage in overt agreements about market price or quantity are called "naked" or hard-core cartels.

The word cartel come into English in the 16th century from the Old Italian word *cartello,* which meant a note or letter of defiance, a preliminary step in the etiquette of dueling. This sense of the word is now obsolete. A second meaning of cartel that slipped into the language a little later (and is still in use) is a written agreement between opposing armies for the exchange of prisoners. This meaning was extended by German writers in the 1880s to describe a government coalition that brought together normally antagonistic political parties. Shortly thereafter the word *kartell* was applied to a combination of two or more business rivals for the purpose of regulating prices or output of an industry. The word cartel was first used in English in this business sense in three British publications in 1902 to refer to what were formerly called "producers syndicates" or "trusts' (*Oxford English Dictionary*).

Cartel Theory

A cartel is organized for the purpose of maximizing the joint profits of its members.[6] If completely effective in meeting this goal, the oligopolists that

6 While there is a general presumption on the goal of profit maximization, there is some evidence that many private cartels operating in the 1930s may have had price stabilization as a principal or additional objective (Suslow 2001). In a sample of 34 cartel episodes, 59% raised prices and 56% stabilized prices; only 9% failed at both.

are parties to the agreement will enjoy collective profits almost equal to those of a monopoly in the same industry. A cartel may be viewed as a temporary and usually partial merger among rival sellers for the purpose of generating monopoly profits. For various reasons -- the costs of colluding, the inability of a cartel to insure uniform compliance with the agreement, and uncertainty about market conditions -- most cartels fall short of generating full monopoly profits.

The "Chicago School" of industrial economies mounted a number of serious challenges to the orthodoxy of the mainstream in the 1970s. However in the area of cartel analysis, there were few substantive differences between the two schools of thought. The principal difference was the importance of government regulations in supporting cartel behavior. The Chicago School tended to give great weight to regulations as an explanation for the formation and duration of private cartels. While the critical role of governments is clear in "public" cartels like OPEC, mainstream economists tend to dismiss the importance of regulatory bodies in maintaining private cartels organized by corporations.

The first formal theory of cartel behavior is that of George Stigler (1964). According to this model, cartels will be formed if the net present discounted value of the economic expected total profits made during the collusive period exceed profits that would have accrued during the same period in the absence of collusion (Friedman 1977, Dick 1998). The collusive profits exclude any added costs of monitoring and enforcing the cartel. Benchmark profits will be zero if the alternative to collusion is perfect competition, but often the but-for scenario is tacit collusion that would generate positive economic profits. Green and Porter (1984) put Stigler's model in the form of game theory.[7]

Osborne (1976) presents an elegant model of private cartels that boils down the decisions facing cartel members to five. First, to *form* a cartel the potential participants must locate the "contract surface;" that is, they must find which mutually satisfactory combinations of company outputs will result in profitable equilibria. Second, they must choose a precise rule for sharing sales. Then, in order to *sustain* the agreement, the cartel has to develop methods to detect cheating and to punish cheating from the quota agreement. If these third and fourth steps are successful, in order to *endure* the cartel must predict the likelihood of entry into the industry and adopt a

[7] McCutcheon (1999) has developed a cartel theory based on the interest group theory of government regulation (see also Bork 1978, Posner 2001). Her model depends on the application of quite small penalties to explain why cartels are formed, yet penalties that are large enough to encourage renegotiation of a cartel agreement after a price war. This model would seem to have been made obsolete by the high price-fixing penalties documented in this book.

strategy to prevent the growth of external competition. When prices rise the threat of entry may come from fringe suppliers or from substitute products.

To elaborate somewhat, the initial formation of a cartel will depend on the predicted collusive profits, predicted costs of managing the cartel, and predicted "but-for profits" (profits in the absence of overt collusion). Because potential cartel participants generally can be expected to ascertain easily their costs of production and distribution, the major items that need to be predicted are the collusive price, the duration of the agreement, the chances of being caught and prosecuted, and the economic costs of future price-fixing penalties.[8] There are likely to be uncertainties and differences of opinion among the potential conspirators on each of these four major factors; the greater the uncertainty and differences, the less likely the cartel will be formed.

The expected collusive price may be one of the easier items upon which agreement can be made. An approximate notion of the elasticity of market demand and knowledge about substitutes at anticipated cartel-enhanced price levels will usually suffice. The fact that most cartels are established by sales or marketing managers probably ensures that the conspirators will have the necessary expertise about customer behavior. If the expected cost of discovery and punishment are low enough, then predictions about durability will have little influence on cartel formation because even the short run collusive profits will be positive and high enough to justify launching a cartel. Prior to the mid-1990s, the size of government fines and civil settlements for price fixing *were* small in the major industrialized countries (see Chapter 3 below, Posner 1976). Now corporate price-fixing penalties are much larger, but *personal* penalties are either completely absent (as in the European Union) or treated under the law as civil misdemeanors in all but a few jurisdictions. Finally, the expected costs of collusion are low because the subjective probability of detection is low, as surveys of antitrust lawyers in the United States and Europe verify (Feinberg 1985).

If a cartel agreement is successful in raising market price, individual firms in the cartel can make even more profit by "cheating," that is, selling some of their output at prices below the agreed-upon price. Cartel members incur costs in monitoring the sales activities of co-conspirators. Moreover, one or more of the participants must be prepared to discipline deviants once they are detected.

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[8] Costs of production and distribution are usually readily knowable because production will contract to levels observed in the recent past. Management costs of collusion are trivial except for price wars and personal and corporate legal penalties. Most cartels appear content to use the pre-cartel prices or profit rates as the but-for scenario.

Modern cartels are usually clandestine. In the absence of reliable reporting of market transactions *within* the cartel, cheaters may be able to hide their chiseling from their co-conspirators.[9] Cartels operate secretly not only to avoid detection from antitrust authorities but also to hide the effects of collusion from their victims (Porter 2005). As a result, cartels will usually attempt to detect cheating indirectly from ambiguous or probabilistic information (Dick 1998). Stigler's model suggests that evidence on cartel cheating can be inferred from the behavior of customers. Evidence of cheating can be inferred from a participant's failure to attract an equal share of first-time buyers, a failure to retain its historical share of loyal customers, and by a decline in the market shares of non-cheaters in the cartel. This last signal would require reliable and frequent reports of members' market shares and a good notion of total market consumption. No cartel can expect to eliminate all cheating.[10]

The basic task of a cartel is to set a uniform market transaction price. Uncertainty about the costs of monitoring and policing the agreement will often imply that a cartel will start with a price well below the monopoly price. As experience, trust, and discipline grow, the price will ratchet up towards the profit-maximizing monopoly price. Thus, a cartel must regularly meet to reset the price, particularly to take into account shifts in demand or supply conditions. If different grades exist, price discounts and premia must be established and perhaps adjusted over time. The cartel must develop policies that discourage its members from expanding their sales through service differentiation. All these tasks will be made more effective if the cartel can agree to set observable market shares for each participant or divide markets by geography, product form, or by customer.

Price Fixing Conduct Defined

Price fixing is the quintessential example of cooperative behavior. The aim of oligopolists that enter into an overt agreement on price is to increase the *pool* of profits available to all sellers in an industry. The agreement on price might benefit some sellers outside the collusive group, but to be effective it must raise the pool of profits for those in the club above that

9 The presence of third-party reporting on transaction prices to sellers will generally facilitate illegal conspiracies. Organized auction markets are unlikely places for collusive price agreements whereas markets that depend on posted prices or bilateral negotiations are fertile grounds for collusion.

10 Cheating will be tolerated up to the point where the marginal costs of policing the agreement equal the profits gained from preventing cheating.

amount available prior to the agreement. Once the pool of additional profits is created, the collusive group must assure its members will share the pool as an incentive to join or remain in the group. This type of cooperative behavior is called joint-profit maximization.

Noncooperative strategies are pursued with the objective of increasing single-firm profits, possibly at the expense of the profits of the firm's rivals. Some types of price-leadership behavior are noncooperative oligopolistic conducts. In most price leadership cases, a single firm may be designated as the first mover in announcing price changes. This works as a collusive device because the leader conjectures that it will be followed under certain conditions and because the followers conjecture that a sufficiently large share of leading firms will follow. If such a form of industry behavior evolved through historical repetitions, it is tacit collusion.[11]

Price fixing has long been recognized as a problem in natural markets. Adam Smith, the founder of neoclassical economics, was a keen observer of the business practices of his day. Perhaps alluding to behavior he had observed in the coffee houses of 18th-century Edinburgh, he wrote in his famous 1776 book *The Wealth of Nations* that

> ". . . people of the same trade seldom meet together, even for merriment and diversion, but the conversation ends in a conspiracy against the public, or in some contrivance to raise prices."

This passage neatly describes *horizontal* price fixing, that is, an explicit arrangement among sellers of the same product. It also points to the fact that a conspiracy may involve a wider array of specific agreements besides price fixing *per se.* Indeed, "price fixing" is really just a popular, short, and convenient phrase for the broader class of activities called "restraint of trade," a term that has a complex meaning in economics and the law.

Setting Prices and Conditions of Sales

A more complete list of collusive restraints is shown in Table 2.1. While raising prices (and thereby profits) is the key or ultimate objective, many other actions may be agreed upon to support that objective. There are six categories of trade restraints covered by the general term "price fixing." The first category covers price agreements proper and terms of sale that can directly affect the prices paid by customers. In

[11] If, however, the leading firms overtly agreed to such a strategy, it could be held illegal.

every case, these decisions by a group of sellers have the effect of reducing the total number of different prices sellers can charge and reducing the discretion of sellers in bargaining over price. By narrowing the array of alternative prices, a cartel reduces the costs of negotiating an initial agreement on prices and the costs of monitoring adherence to an agreement in force.

Most cartels begin by agreeing on *list* prices, that is, the price quoted to potential buyers in a company's catalog, on its web site, or by fax or telephone by its salespersons. The agreed-upon price tends to be an exact rounded number, such as $1.20 per pound (rather than $1.185 per pound) (Lanzillotti 1996). For ordinary consumers, there is no distinction between list price (also called "posted" or "shelf" prices) and the price at which a transaction will occur. However, for industrial products only the smallest or most anxious buyers will pay the full list price. Purchases for immediate delivery are called spot sales.

Many industrial products are sold primarily through annual supply contracts. The purchasing managers or agents for major buyers will expect a discount for the large quantities their company expects to purchase, and they may be willing to sign a long term supply contract to enhance their bargaining position. In some industries, the largest buyers solicit written bids from sellers they believe qualified to serve them. Spot sales, contract sales, and accepted bids result in *transaction* prices, all of which are usually lower than list prices. Over time, list and transaction prices tend to move together.

In many industrial markets, the conditions of sale are well known, customary, or specified by widely accepted uniform contract provisions. Where this is not the case, conspirators often must negotiate a common set of transactional conditions. These may include payment dates (e.g., due within 30 days of delivery), price protection clauses (limits on purchases made after a price increase is announced but before it is effective), price ratios for different quality grades (if any), and transportation charges. Eliminating or limiting discounts or rebates are a form of price fixing. Supply contracts that contain promises to match the price cuts of other sellers ("most-favored-nation" clause) or to "meet-or-release" buyers who find lower prices are frequently used to support collusion (Jacquemin and Slade 1989).

The classical economists of the nineteenth century implicitly assumed that trading occurred in a double oral auction in which the participants could observe the price of every transaction. Modern economic analysis verifies that auctions of several types do result in clearing prices and quantities exchanged that are quite close to these predicted by the model of pure competition (Marion *et al* 1987, Plott 1989). However, monopoly and

oligopoly tend to be associated with other trading and exchange systems: private negotiations, posted prices, formula contracting, administered pricing, and various vertical arrangements. A common characteristic in non-competitive markets is non-transparency of transactions; not all the prices or quantities traded can be observed by market participants.

Where quality grades exist, most conspiracies will focus on the purest or most common product form and rely on conventional discounts or premia to be applied to the modal product form. List prices frequently are quoted on the assumption that the seller will provide delivery of a full truckload or rail car within some conventional delivery

Table 2.1 Collusive Activities in Restraint of Trade

Pricing:	● Agreeing on list or transaction prices ● Agreeing on delivery charges ● Agreeing on discounts, rebates, or premia ● Agreeing on bid prices ● Agreeing on currency exchange rates ● Agreeing on price protection clauses
Shares:	● Setting global sales shares ● Setting global quantities per seller ● Setting regional or national shares ● Allocating specific customers ● Allocating winners on bids
Production:	● Agreeing on global output reduction ● Agreeing to limits on export destinations ● Restricting arbitrage by buyers ● Agreeing to restrict production capacities ● Refraining from production or sales
Monitoring:	● Sharing frequent, detailed sales information ● Agreeing to third-party certification of shares ● On-site inspections of facilities or inventory ● Meeting-the-competition clauses
Enforcement:	● Dominant firm targets deviants ● Periodic compensation mechanism ● Marketing agency for pooling sales ● Pooling and division of profits ● Trigger-price agreements
Cover-up:	● Destroy evidence of travel, meetings, communications, or monitoring ● Create or use existing trade association ● Use code language or ciphers

zone. Smaller loads or more distant deliveries will require price premiums. In some cases customer pick-up discounts will be specified. Unless transportation charges are set by customary industry practice, cartel members must grapple with creating them; otherwise buyers will be able to use them as bargaining points to obtain discounts that are difficult to detect. Geographic price differences may be quite complex in an extensive market like the United States; collusion will be more difficult if production sites are widely scattered and if imports from multiple plants is significant.

Cartel managers must be wary of raising prices too quickly, too high, and in the wrong season. Unless there is some extraordinary surge in demand or supply interruption, buyers will ordinarily be suspicious of radical price changes. With global sourcing so prevalent today, industrial buyers will soon alert antitrust authorities if prices rise in one geographic market but remain unchanged in some more distant region. Ideally cartels are formed around a unique product. However, the higher the prices of most products rise, the greater the number of close substitutes, and the looser becomes the cartel's control of supply. Many cartels have seasonal price fluctuations; raising prices during the conventional trough often helps overcome customer resistance.

Global price fixing is further complicated by the existence of multiple currency regimes whose exchange rates fluctuate. If regional price differences become too pronounced, a price agreement on storable commodities can be undermined by geographic arbitrage by companies outside the cartel (Bush *et al.* 2004). Most of the global cartels covered in this book used the U.S. dollar to maintain nearly uniform regional prices. Cartel managers typically met quarterly to adjust prices in response to exchange-rate movements.

Fixing Market Shares

The more successful a collusive group is in setting transaction prices at or close to the monopoly level, the greater the incentive for individual members to offer secret discounts to customers. Cheating on the price agreement will result in an increase in the quantity share of the deviant firm. The effect is to increase the deviant's profits and lower the pool of joint profits. The ability to detect secret price-cutting is a key feature that explains the effectiveness and longevity of cartels Stigler (1964). To counter such tendencies a cartel may assign volume limits or market shares to each cartel member. Negotiating volume or sales shares for its members is not strictly necessary for a cartel, but share

agreements reinforce cartel cohesion because quantities can be more easily monitored by the group than the prices of transactions. Faithful members of a cartel can use changes in market shares as indicators of cheating more easily than trying to verify allegations of price discounts to particular buyers.

Typically, each member of the agreement is assigned its historical share of whatever market is being cartelized. However, negotiating acceptable shares in a more dynamic setting, particularly where potential members have been gaining shares in the recent past, will be more problematic and may require considerable diplomacy and compromise. The largest members of the cartel may be asked to give up some of their present market share to satisfy newer upstarts. Alternatively, a low cost member of the cartel may demand a quota above its historical share.

In the case of geographically widespread cartels, the level of calculating the shares must be decided. The simplest agreement is one that encompasses global sales. A global share agreement is also likely to be the easiest to monitor if cartel members share production or sales data frequently. The extreme example of a localized approach to setting shares would be a cartel that assigns specific buyers to specific sellers in the cartel. However, in many cartels there is a tendency for members to desire hegemonies in their home markets or others that they have historically dominated. Although assigning territorial or customer shares is appealing in its simplicity and holds the promise of easy monitoring, there are several disadvantages. It may prove difficult to reach an initial agreement that involves many territories or customers, and once in place customer allocations will increase the number of opportunities for bickering among the conspirators. Perhaps most problematic are the suspicions raised by customers that observe refusals to deal by all but one of the cartel participants, suspicions that could lead to complaints to antitrust authorities.

Limiting Production or Sales

Given the "law of demand" (i.e., prices and quantities demanded are inversely related), raising prices and reducing quantity should be in principle perfect substitute conducts. That is, a cartel would appear to have the option of raising price or contracting output but should not need to do both. In practice, cartels frequently make volume-reduction agreements in order to reinforce previously agreed price increases. Volume restrictions can be global in scope and may involve sales or investment plans. Agreements to avoid plant expansions are particularly

appealing ancillary deals because in a growing market the appearance of capacity constraints would in itself raise prices. Moreover, agreements on plant capacities are much easier to monitor than agreements on sales transactions. Failure to expand capacity as quickly as demand insures the cartel of long-term stability because capacity typically takes years to create and full utilization discourages defections from the cartel.

In global cartels, the phenomenon of international trade in the cartelized product may raise vexing problems. Agreements on export restrictions may have to be reached in order to effectuate regional or territorial share agreements. Even if cartel members are disciplined in their observance in volume agreements, their customers may not be. Wholesalers may engage in geographic arbitrage if regional price differences widen during a conspiracy. Large geographic price differences may especially appear if a cartel engages in geographic price discrimination. The usual answer to such a problem is rather unappealing: cartel sellers must intimidate buyers into observing a no-arbitrage rule.

Monitoring the Agreements

Simple price fixing can be monitored by individual cartel members if their customers show a willingness to pay close to the agreed price. Offering price guarantees that require evidence of a lower price is a way of turning customers into price monitors for a cartel. For market-share or volume-reduction agreements, more elaborate information systems may be established by a cartel. One of the most common monitoring systems involves regular reporting of members' sales or production levels to a designated cartel secretary. The secretary in turn totals up the reported sales and prepares "scorecards," running accounts of each participant's market shares or progress toward a volume-reduction goal. Honest reporting that shows movement toward cartel objectives is an indicator of group harmony and discipline.

Misreporting (usually under-reporting) of company sales may spur the cartel to institute a system of third-party verification. International accounting firms are sometimes hired to perform on-site inspections of plant production, sales, and inventory records. The cooperation of an accounting firm is more likely if the client is a trade association.

Enforcement of Agreements

A common feature of cartels is a firm that takes on the role of "the enforcer." Typically a leading or dominant cartel member will threaten ad-

verse actions against potential deviants in the group. The enforcer may poach customers from a suspected cheater or organize a broader boycott against the recalcitrant firm possibly supplemented by rumor mongering, bribes, or other strong-arm tactics. Sometimes the threat, usually an increase in production so large that it causes a precipitous decline in price, is directed at firms that are reluctant to join the cartel in the first place. Thus, the enforcer must have sufficient excess capacity to make the threat a credible one. The wavering candidates for membership must be convinced that the enforcer both has sufficient excess capacity and is willing to employ it as a competitive weapon. Historically, the formation of cartels is frequently preceded by price wars because these are tangible demonstrations of the power of the enforcer over market price. Once formed, the enforcer may continue to threaten the others in the cartel with price wars, or the cartel may adopt a "trigger mechanism," a side agreement among cartel members to increase output by a specified amount should cheating be detected. However, the price war is a terribly blunt instrument redolent of self-flagellation. The problem with price wars is that it punishes all the members of a cartel, the enforcer included. Moreover, after the deviants surrender the details of the cartel agreement must be renegotiated.

An alternative to a designated enforcer is a mechanism that will redistribute the monopoly profits among cartel members. One such technique is periodic compensation. A disciplined cartel controls supply but has little influence on demand and may be faced with substitute products that have uncontrollable prices. The likelihood of substitution increases as the cartel becomes more successful in raising price. Thus, even a well-intentioned market-share agreement may be difficult to maintain with great precision over time. Some cartel members, despite their best efforts, may overshoot or undershoot their target market shares. This problem can be handled by developing a compensation system whereby cartel members with excess sales transfer product at cost to those who undershot; the recipients then resell at the elevated cartel price, recouping lost profits in the next period. In effect, cartel members that sell more than their allotted share are penalized, thus providing deterrence for future violations of the share agreement.

Another mechanism for redistribution of cartel profits requires a high degree of trust among conspirators. It involves the creation of a secret or illegal joint venture. The new subsidiary of the cartel becomes the sole marketing agency for cartel output. In some historical instances the common sales agency actually took title to the product, as would a merchant wholesaler. Quarterly or annually this joint venture would redistribute profits to its "stockholders," the members of the cartel, according to some previously agreed formula. Alternatively, a less formal profit-sharing plan

might be developed by a cartel. Periodically, the members will meet and share its internal profit-and-loss statements, calculate the total profits of their profit centers, and apply the formula for redistribution. In the latter case, the level of trust is extraordinary because each of the participants must reveal their costs of production. However, profit pooling is particularly useful for attracting and holding cartel participants with relatively high costs of production.

Covering Up Cartel Activities

Where cartels are legal, no covers need be implemented. Indeed, cartels may prefer to register their contracts with a national administrative body or court system so that legal authorities will help enforce the cartel's agreements. In the United States, Webb-Pomerene export cartels submit reports of their collusive activities annually to the Federal Trade Commission.

However, when a cartel operates in a jurisdiction with an effective antitrust law, efforts are made to keep its activities clandestine. Evidence that could help possible future prosecutions is destroyed or kept to an absolute minimum. Face-to-face meetings are still the preferred mode of communication of cartels, because they avoid possible future indictments for mail fraud or wire fraud. If the telephone must be used, code names or ciphers are devised. The major problem with face-to-face meetings, especially for global conspiracies, is that they create a paper trail of travel records. To overcome this problem, cartels often hold meetings concurrent with those of an otherwise legitimate trade association. Commodity trade associations operate for nearly every industry with at least a few hundred million dollars in sales; indeed, the formation of such associations is actively encouraged by the European Commission. In some cases, cartels create sham associations with fake agendas as a cover for illegal price discussions.

Conditions Facilitating Collusion

A great contribution to cartel analysis was the explosion of mathematical models of collusion emanating from the relatively new field of game theory.[12] Game theory is well suited to the study of oligopolistic decision making because of the many analogues between games and oligopolies.

12 The field grew out of a seminal book by John von Neumann and Oskar Morgenstern entitled, *Theory of Games and Economic Behavior* (1944). However, analytical difficulties limited progress in the field until the 1970s (Friedman 1977).

Both have a limited number of players, well-defined payoffs (such as profits), and strategies for winning. In a market setting, strategies are rules or decision criteria that are limited by the environment (cost and demand conditions) and formed on a basis of conjectures about the anticipated reactions of rivals. Conjectures may be formed *independently* by merely observing rivals' actual choices through time as market conditions vary or *cooperatively* by an overt agreement or by signaling intent. Collusion is one cooperative strategy available to those firms in an oligopoly game.

Mathematical game theories vary greatly in the degree of realism embodied in the assumptions (Pearce 1992). Early models assumed that the payoffs were fixed and known with certainty; more recent models allow for variable-sum payoffs in which the total profits can rise or fall as the firms choose alternative strategies. In some, players start out with identical endowments, while in others firms may have access to variable cost configurations. In some models, players choose quantity of production (Cournot) in others price (Bertrand). The earliest games were single-period (comparative-static). Others allow for two stages in which different strategic choices are made at each stage, and still others for an infinite sequence of moves and countermoves (so-called supergames).

Infinitely repeated interaction among firms often leads to outcomes that can be described as cooperative behavior (Grout and Sonderegger 2005). Most such models assume that cartel contracts are not legally enforceable. Rather, the contracts made by independent rivals exist only if they can be *self-enforced.* That is, a cartel agreement will persist if and only if members of the cartel implement *credible punishment mechanisms.* Cooperation is rewarded by higher profits, but deviation from monopoly output levels is punished by reverting to non-cooperative conduct (often Cournot equilibria) that will generate lower profits. Recent models have been able to incorporate environmental uncertainty and learning by the players over time.

Game-theory models have some limitations for the study of cartels. They tend to result in ambiguous conclusions about the role of market and firm characteristics; put another way, predictions about market equilibria depend crucially upon often small changes in assumptions or parametric values. Most cartel models tend to focus on the conditions that foster episodic sustainability, ignoring cartel formation and multi-episodic secular duration. Cartel stability is modeled as equilibria in which the losses from long-run price wars outweigh the short term gains from cheating. A major drawback of game theory is that few models explicitly incorporate communication among cartel members. As a result, legal tacit collusion cannot usually be distinguished from illegal conspiracies. Put

another way, the need for overt agreements is greatest when the conditions favoring tacit collusion are weak, and many factors predicted by theory as adverse to collusion can be negated by reliable, frequent communication within the cartel (*ibid.* p. 36).

From formal theorizing and generalizations from empirical studies of collusive behavior, a number of facilitating conditions for cartel formation and stability can be deduced. A facilitating factor is one that increases the probability that a cartel will be formed, stable, or enduring.[13]

High Seller Market Concentration

Assuming that there are barriers to entry, the Stigler model and virtually all others predict that the expected market price under collusion will be positively correlated with the degree of seller market concentration. Generally this result is a continuous one. That is, there is no threshold level for concentration above which collusion first becomes feasible; also, most models do not require a lower limit on the number of firms to obtain a collusive result. An exceptional model is by Selten (1973).[14] As a rule of thumb, Selten predicts that cartels are unlikely to be formed when there are more than five equal-sized firms (Herfindahl index below 2000). Phlips (1995) and Ferris *et al*. (2001) find that six is the critical threshold. Dick (1998) argues that very high levels of concentration are likely to induce tacit rather than overt collusion; moderate seller concentration is more conducive to cartel formation and persistence.

Market concentration and the shares held by a cartel are conceptually distinct, but as most leading firms join cartels the two measures tend to be the same. Among contemporary international cartels, formation and effectiveness seem to require that a cartel control at least 70% of industry supply. Cartels tend to lose their ability to raise prices when an uncooperative fringe of suppliers exceeds 20 or 30% of production; if fringe suppliers choose to engage in umbrella pricing (following the cartel's moves without formally joining the collusive agreement), then sustainability may not require a high degree of cartel control.

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13 The sections that follow are a distillation of conclusions of Scherer and Ross (1990), Carlton and Perloff (2005), Grout and Sonderegger (2005), Jacquemin and Slade (1989), Martin (2002), Grossman (2004), Posner (2001), Levenstein and Suslow (2002), Hovenkamp (1999), Connor (2001), and Porter (2005).

14 A one-period, homogeneous-product Bertrand oligopoly with identical firms predicts zero profits from collusion with three or more firms (Martin 2002). One-shot models are generally less applicable to the study of cartels.

Empirical studies of prosecuted price-fixing conspiracies have confirmed the tendency of cartels to be formed by a small number of firms. Hay and Kelly found that 80% of the U.S. cartels in their sample had ten or fewer members. Fraas and Greer (1977) found that the majority had fewer than eight firms, but there have been successful prosecutions of cartels with up to 30 participants. The median number of firms in a sample of 167 modern international cartels is five (Connor 2003). Price-fixing cartels with relatively large numbers of members often are assisted by trade associations. Bidding rings seem to be compatible with large numbers of sellers; long-running bid-rigging schemes with hundreds of firms called *dangō* are common in the Japanese construction industries (McMillan 1991).

Low Buyer Concentration

Often overlooked is the structure of the direct buyers' market. Cartel formation and sustainability are facilitated by an atomistic structure among buyers. The reasoning is straightforward. To achieve the same level of additional sales, a deviant firm will have to make a larger number of price concessions when there are many buyers compared to a more oligopsonistic structure. A large number of price cuts mean a greater chance of detection, especially when buyers report their transaction prices to other members of the cartel or to third parties. Furthermore, when there are few buyers paired with few sellers, buyers may be more loyal to their suppliers (Stigler 1964). Stability in buyer identities makes it easier to detect cheating indirectly through changes in market shares, as does fewness in the number of distribution channels. Low buyer concentration is not a necessary condition of collusion because sharing reliable information among cartel participates nullifies the ability of buyers to wrest lower prices by making claims about better offers from cartel members.

Buyer concentration is considerably more difficult to measure than seller concentration. Measures of buyer concentration require information on customer lists, and these are typically closely guarded by companies. Perhaps for this reason, little empirical verification can be found among cartel studies that low buyer concentration facilitates cartel behavior. However, the prevalence of direct-purchaser class actions with hundreds of plaintiffs attests to the fact that price-fixing is most compatible with small buyers. The case studies in this book also suggest that, no matter how sophisticated the buyers, it is easier to cartelize minor ingredients than major inputs.

Homogeneity and Standardization

Product homogeneity is often cited as a necessary condition for effective collusion. By definition, a pure monopolist sells a product that is unique: No other brands exist, and there are no substitutes. Cartels may not require pure homogeneity to operate successfully. Certain types of product differentiation will mask price cutting while others will encourage nonprice rivalry. Heterogeneity can originate from several avenues, some of which can be accommodated by a cartel.

First, product differences in tangible or subjective quality can cause heterogeneity. Heterogeneity arising from the first source may be traced to purity, power, durability, or some other gradation in quality that all buyers prefer more of. This type of differentiation (technically, vertical differentiation) can be handled by the development of industry grades or product standards. A cartel can accommodate grade-based price differences, though at some additional costs of negotiation and enforcement (Hackner 1994). However, difficulties in forming a cartel will be presented if vertical differentiation is based upon competing production technologies that are associated with variable costs of production.

The second type of differentiation arises from a taste for variety among customers that can be reinforced through brands and image advertising, from space, or from time.[15] This "horizontal" differentiation is most likely to be incompatible with pricing coordination. Carried to its extreme, horizontal differentiation implies that a unique bundle of real or imagined characteristics is sold to each buyer. Cartel contract negotiations are more costly in such markets, and cartel members can cheat on price more easily by appealing to putative quality differences. The prices of strong brands are insulated from each other's price movements, and this implies that separate price agreements must be made for each brand. Custom-made products make for nearly insuperable barriers to price collusion. Thus, collusion on airline services is much more likely than collusion on large commercial aircraft.

A second source of horizontal product heterogeneity is spatial differentiation. Customers will often prefer products that originate from certain locations or sellers that are closer to them. When sellers are located in widely separated regions or countries, transportation costs alone will tend to create geographically localized monopolies. While local cartels may flourish in such markets, the effects of spatial heterogeneity, the phenomenon greatly complicates international price schemes. As a result, collusion

15 Sellers can still exercise market power in such situations, but it is unilateral (single-firm) power not multilateral.

is more common for industries in which production or sales locations are either geographically clustered or markets in which transportation costs are small relative to selling prices.

Third, product designs may change frequently over time. This is true in fashion goods and in industries experiencing rapid technological change. Temporal differentiation frustrates attempts to collude on price because frequent renegotiations of an agreement increase both the costs of operating a cartel and the chances of bickering (Ivaldi *et al.* 2003).

Inelastic market demand at the pre-cartel price is often mentioned as a prerequisite for cartel formation and effectiveness. However, inelastic demand flows from the fact that a market has well defined product and geographic boundaries, in other words markets few or no substitutes. Successful cartelists are skillful at recognizing clear market boundaries and predicting how high prices can go before inviting substitution.

Cost Conditions

Heterogeneity among sellers may be due to differences in production or distribution costs, in capacity utilization, or in rates of process innovation. Variations in costs across firms will make agreement on an optimal cartel price more difficult to reach and to sustain (Rothschild 1999). High cost firms will prefer higher prices, and vice-versa. While such differences do not make arriving at a consensus impossible, it raises the costs of colluding. In addition to lengthening negotiation time, a profit-pooling arrangement may have to be implemented to attract high-cost participants to the cartel. Alternatively, high-cost participants may have to be granted larger market shares from the cartel than their historical market positions would dictate. If the largest firms have the lowest costs, they may have to intimidate the smaller ones into joining the cartel, which does not bode well for stability of the agreement.

The foregoing discussion suggests that cartels are less likely to be formed during the early years of a new industry than an industry's more mature phase. At an industry's formative stage, there are likely to be several potential production technologies vying for supremacy. Later, the less efficient methods of production will be weeded out leaving a more standardized combination of plant size and input-output relationships across firms. Moreover, when an industry reaches a certain threshold in size, it is more likely to have a trade association or cadre of industry analysts that help spread information around about the industry's best technologies. That is, asymmetry of costs and information will decline. Secret cost information is antithetical to unruffled collusion (Athey and Bagwell

2001). Frequent information-sharing among cartel members is an antidote to asymmetry, because collusion can be sustained through side-payments; indeed, market-quota concessions to weak members are one form of side-payment.

Collusion is also facilitated by constant returns to scale at levels of output after collusion begins. That is another way of saying this is that cartels work better in industries with relatively low fixed costs relative to variable costs. As industry output contracts when prices rise, excess capacity will develop for cartel members, and this provides an additional to cheat on price agreements. High excess capacity *per se* has an ambiguous effect on collusion (Abreu *et al.* 1986). While it encourages cheating, it also gives cartels ringleaders the wherewithal to punish deviants. Perhaps the ideal condition for cartel stability is for excess capacity to be concentrated in the hands of the leaders (Compte *et al.* 2000).

Ample empirical evidence exists showing a relationship between cartel operation and cost, product, or technological homogeneity (Dick 1996, Asch and Seneca 1975, Fraas and Greer 1977).

Growth and Demand

There is a large and somewhat contradictory literature on the role of demand changes in collusive decisions. This literature does not apply so much to seasonality or regular cycles in demand as to unforeseen demand shocks. In the cases of regular seasonal demand, both formation and stability are improved by raising prices just before seasonal demand would raise prices anyway.

In general unexpected non-seasonal growth favors the formation of cartels, whereas stable growth helps cartel sustainability (Haltwanger and Harrington 1991). Surges in growth are expected to lead to increases in capacity utilization (decreases in excess capacity). The traditional view is that, like monopolists, collusive arrangements would require a "passive sales" rule; that is, rather than adjust price or volume in the face of demand perturbations, collusive firms would want to absorb the changes by building up inventories or increasing orders backlogs (Scherer and Ross 1990). On the other hand, passive sales behavior increases the likelihood that during unanticipated recessions would be tempted to dump excess stocks, thus setting off a price war. When demand is low and excess capacity high, the threat of entry is reduced making the likelihood of cartel formation (and higher prices) higher. Thus, compared to competitive industries, the conventional view is that collusive behavior results in dampened price flexibility and in countercyclical price change movements (Rotemberg and Saloner 1986, 1989; Schmitt and Weder 1998).

If cartel members cannot reliably observe sales of its members, they will not be able to distinguish demand fluctuations from cheating. Staiger and Wolak (1992) and Goodhue (1998) use somewhat different theoretical approaches to conclude that demand volatility tends to cause more and more severe price wars, but they do not agree with the timing. A model developed by Green and Porter (1984) and generalized by Abreu *et al.* (1986) predicts that cartels would punish deviants with a price war whenever the cartel observes negative demand shocks. That is, cartels would induce procyclical price changes.

Regular sharing of firm-level sales data can nullify the destabilizing effect of demand shocks. Quarterly or monthly monitoring of sales or production is a common feature of private cartels. Alternatively, sales reports can be provided by trusted third parties, such as independent accounting firms, industry trade associations, or government statistical agencies. Albaek *et al.* (1997) provide a concrete case of government transactions data that promoted collusion.

Finally, there are models that predict that long-term duration is enhanced by certain future cyclical growth patterns (Bagwell and Staiger 1997). Longevity is increased if cartel participants expect the future to consist of long booms interspersed by brief recessions.

The evidence on countercyclical price changes in collusive (or high concentration) industries seems to be supported by some studies (Domowitz *et al.* 1986) as does the tendency for cartels to be formed when demand is low or slowing down (Nocke 2000). The regularity of price wars is not well established empirically, partly because it is difficult to disentangle price wars from mere price reductions (Porter 1985). Moreover, there seems to be an untested presumption in this literature that a tendency toward frequent price wars is to be interpreted as supporting collusive behavior.

Conduct, Customs, and History

The sustainability of collusion is assisted by various industry practices, which may have evolved over decades to promote tacit collusion or may be implemented as part of a cartel scheme. These habits include standard contract terms, pricing rules of thumb, certain details of internal cartel management, and a history of collusion. Ephemeral factors like business culture probably are part of the mix.

Industry-wide pricing rules can overcome problems of horizontal and spatial differentiation. Standard price differences for recognized industry grades and basing-point pricing are examples. A pattern of advance notification on price changes is helpful to price coordination. Standardization

of terms of sale helpful to collusion include details about delivery charges, credit terms, quantity discounts, follow-up services, and the treatment of used, rebuilt, or recycled substitutes. Contracts that contain "most-favored-nation" or "meet-or-release" clauses are especially useful in detecting price chiseling.

Rules followed internally by the cartel often facilitate stability. The advantages of market quotas and passive sales rules were already discussed. A pre-arranged trigger strategy may be effective in discouraging defections. Many cartels have agreed on internal fines to be paid by members that exceed their quotas; an alternative tactic is to agree on compensation of under-quota members through the inter-firm sale of product at a competitive price. A very effective technique because of the information and profit-sharing advantages is to establish a common sales agency. Although unusual, cartels can effectively raise prices using *only* agreements on terms of trade and internal rules (Genosove and Mullin 2001).

There is widespread agreement in the literature that a history of collusion eases the establishment or re-establishment of collusion in the next episode (Verboven 1998). A collusive group may recognize the need for merely tweaking a predecessor's operating procedures. Cartel formation and stability are also served by a history of multimarket contact between firms (Bernheim and Whinston 1990). That is one reason that most cartels are populated by highly diversified companies. Paradoxically, regular pauses in collusion may be a positive sign for the long-term duration of cartels. Brief reversions to more competitive pricing conduct can signal a cartel's flexibility in the face of changed market conditions, its willingness to accommodate important new entrants, or the expected implementation of disciplinary triggers.

Entry Barriers

High concentration and product homogeneity are usually sufficient conditions for at least some type of collusion in the short run. Entry barriers foster cartel formation, and the prospect of barriers continuing at higher cartel-induced prices facilitates stability of collusion. A cartel will not be durable unless entry is slow or difficult.

Many models of collusion assume that entry into the industry is blockaded during the period of analysis (Pearce 1992). Actual entry or the threat of entry will complicate the formation and stability of collusive arrangements. Entry will be slow or forestalled by inaccessibility to low cost production methods by would-be entrants, sunk costs of production (which may be signaled by high fixed costs of production),

and customer loyalty (Schmitt and Weder 1998, Scherer and Ross 1990). In addition, the established firms in an industry can pursue strategies that will raise barriers to entry or exit. They may limit prices below the short-run profit-maximizing level or raise rivals' costs (Granitz and Klein 1996). When cartels are successful in raising price, new entry is more likely to be induced but the greater the share of fringe firms, the lower the cartel price will be (Nocke 2000). The ideal mechanism for preventing entry is government sponsorship or regulation of cartels; the power of government can be used to make membership in a cartel compulsory. In the 20th century, cartels were often the favorite tool for governments to "rationalize" industries. Short of sponsorship, government may be induced to use its regulatory powers to slow or prevent entry (Lanzillotti 1996).

Private cartels may have to take steps to slow entry. One method is to reduce the cartel price below the level it considers optimal. The additional stability may generate more profits in the long run than those sacrificed near term by the lower price. Another technique is for the cartel or its leading members develop large excess capacity so as to credibly threaten output increases upon unwelcome entry. Saudi Arabia played this role in the well-known OPEC oil cartel, but in many cartels the designated enforcer may build excess capacity to threaten both would-be deviants and potential entrants. Predatory tactics have been noted in several historical studies of cartels (Scott-Morton 1996, Levenstein 1993).

Other Cartel Factors

Early work is appearing on a host of other possible determinants of collusive behavior. There is a hint in the work of Lambertini (1996) that the shape of the industry demand curve may affect collusion. While most theorists specify linear demand, Lambertini suggests that Cournot behavior is more likely when demand is highly convex, a demand condition associated with differentiated product industries. The attitudes and cultural orientation of cartel managers may affect cartel formation. With long run financial goals uppermost, cost heterogeneity is less likely to inhibit cartels (Scherer and Ross 1990). This hypothesis may explain why cartel formation is more common among firms in Asia, where managers have reputations for focusing on distant profit or market-share goals. Highly localized markets seem more prone to collusion (Dick 1998). This could be a surrogate for high seller concentration, or it may capture a tendency for more uniform business cultures to spawn collusion. If so, both geographic and cultural propinquity will facilitate conspiracies. Even the leadership styles of CEOs are being factored in. Industries that lack innovation may find cartel

formation to be more compatible with an autocratic management style (Rotemberg and Saloner 1991).

Effects of Collusion

Welfare Effects [16]

A successful cartel demonstrates its power by moving the market price. A sellers' cartel will attempt to raise the price paid by its customers, and a cartel of buyers will aim to lower the price it pays to its suppliers. Figure 2.1 illustrates the first case, market power exercised by sellers.

A market consists of two sides, a set of buyers who have different degrees of willingness to pay for a product at different quantities and a set of producers whose technologies of production determine their ability to supply various quantities at different prices. The willingness to buy is summarized in the demand curve shown in Figure 2.1. Demand curves are almost always downward sloping because as the market price falls more customers enter the market and existing customers will be able to afford to buy more. The ability of suppliers to make and sell product is represented by the supply curve which can be either flat or upward sloping. The area on the graph *below* or to the right of the supply curve is an infeasible region because suppliers will not be able to recover their costs.[17] The area *above* and to the right of the demand curve is not a feasible equilibrium zone either. Thus, the point at which the two curves cross represents the maximum quantity (Q_c) that can be sold at price P_c; and at price P_c consumers will purchase all of Q_c placed on the market. The intersection point is the long-run competitive equilibrium point in this market, given the preferences of buyers and the current technology of supply. The price P_c that consumers are willing to pay for quantity Q_c is exactly equal to the full marginal costs of production of supplies M_c.

16 This section focuses on the so-called static welfare effects of monopoly pricing. In addition to price increases, cartels will normally cause posted and exchange prices to become less dispersed compared to prices in non conspiracy periods. Price discrimination may become common (and prices more uniform within target segments). Dynamic effects include price variation disjointed from cost variation, reduced capital investment, and a slowdown in innovation (Posner 1976, Lanzilotti 1996, Scherer and Ross 1990).

17 These are marginal costs of production and distribution including the opportunity cost of capital (i.e., normal profits). In the short run these are roughly equivalent to variable costs; in the long run a producer must cover both variable and fixed costs. We assume long run in this chapter.

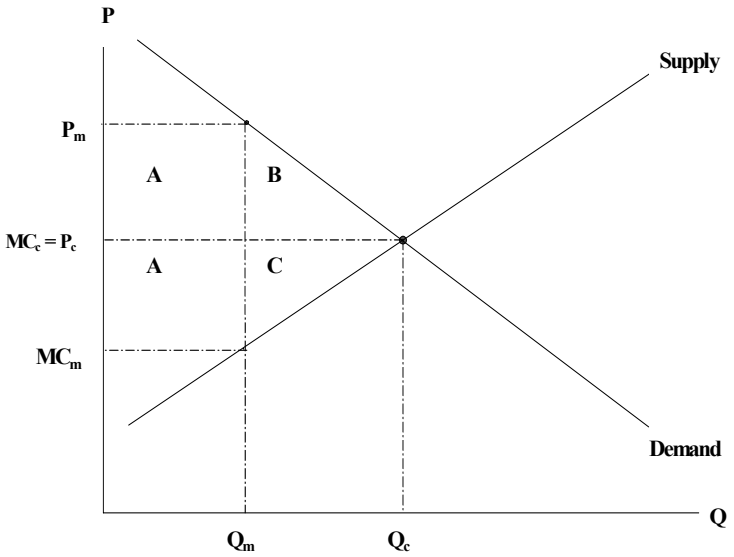

Figure 2.1 Welfare Effects of Collusion.

When a cartel is formed encompassing all suppliers in the industry, it will maximize the profits of all of them by setting the price at P_m, which is what a monopolist would charge in the same market. Given no other changes in this market, when the price jumps from P_c to P_m, consumers pull back on their purchases. The maximum quantity that those who remain in the market is willing to buy at price P_m is Q_m. Suppliers have no power to force consumers to buy more than Q_m, so the cartel must reduce its output to Q_m also. This simple one-period model can be made more elaborate by considering changes in inventories and other dynamic features of markets, but it illustrates the main points as it is.

Price fixing has two distinct effects on the market participants. First, there is a change in total market revenues and costs of production. Before the price was increased, total revenues for producers were $P_c \cdot Q_c$ dollars. When the price rises to P_m, the revenue becomes $P_m \cdot Q_m$. At the same time, as the quantity of industry output shrinks from Q_c to Q_m, the marginal costs of production falls from MC_c to MC_m. The total cost of producing Q_m is always going to be less than producing Q_c.

The upshot of all these changes is that the aggregate profits of sellers will increase from zero when the price was competitive to the rectangle

A when price is P_m.[18] That is, when quantity declines to Q_m, profits will become the difference between total revenues $P_m \cdot Q_m$ and total costs $MC_m \cdot Q_m$. The profit rate will be $(P_m - MC_m)/P_m$, and this is a direct measure of the degree of market power held by the cartel.[19] In actual market situations, a cartel may fail to attract all the suppliers, may fear impending entry, or may miscalculate. If so, the market price will be somewhat below P_m. Similarly, the cartel may incur additional costs in policing its agreement, which would raise its costs above MC_m and cause some reduction in profits. If cartel enforcement costs are too high, it will not be formed. If formed, cartel members must anticipate that its monopoly profits will outweigh the possible costs of discovery and prosecution.

No matter what additional costs of colluding might be, the buyers end up paying all of rectangle A as a sort of monopoly tax on their purchases. This *overcharge* $((P_m-P_c)\cdot Q_m)$ is a monetary measure of the economic harm done to buyers of a cartelized product. Formally, the overcharge is a transfer of income from buyers to the owner of the supplying companies.[20] Because conspiring is never a free good, the size of the overcharge (the injury) is going to be larger than the amount of monopoly profits generated (the gain). Some economists believe that the additional costs of carrying out a conspiracy and industry lobbying for market power should be counted as a loss for both consumers and producers (a social loss).

The second effect of cartel pricing is entirely a social loss. On figure 2.1 it is represented by the two triangles B and C. The upper triangle is a loss to consumers, and the lower triangle is a loss to producers. These losses are incurred because of the cutback in sales and output from Q_m. For consumers, this loss is a result of their withdrawal from the market due to an unacceptably high price; they are forced to give up consumption of the cartelized product and use their spendable income on an inferior substitute

18 The monopoly price P_m is discovered by equating the marginal costs of production (points on the supply curve) with the marginal revenue (not shown, but it passes through the supply curve at the point where $MC_m = Q_m$).

19 Figure 2.1 implicitly assumes diseconomies of scale in production because unit costs rise as Q rises. With constant costs, the supply curve would be flat, but total costs will still decline. Whether revenues increase depends on the elasticity of demand at Q_c. $(P_m-MC_m)/P_m$ is called the Lerner Index of market power. At the monopoly level of profits, $(P_m-MC_m)/P_m = HHI/\eta$, where HHI is the Herfindahl Index of concentration and η is the absolute value of the elasticity of market demand.

20 Note that "supplying companies" includes both cartel members and those non-cartel firms that passively support the cartel by pricing up to P_m. Legally, the cartel is responsible for all the injury caused to the buyers, even non-cartel sales. Free riders gain but are not legally culpable. If some suppliers choose to price competitively, they create no overcharge.

if any exists. For producers, the contraction in industry output means operating at suboptimal levels or exiting the industry. In either case, some labor and plant resources will lie idle. This monopoly loss is called the *dead-weight loss.* Although not apparent in Figure 2.1, the dead-weight loss is typically many times smaller than the overcharge.

Empirical Studies

There are hundreds empirical studies of the price effects of cartels. Connor (2006c) surveys 259 published studies that contain 1,040 quantitative estimates of overcharges of private hard-core cartels. The primary finding is that the *median* long-run price mark-up for all types of cartels over all time periods is 25.0%. The price effects of international cartels were higher, about 31%. Moreover, cartels with multi-continental effects raise prices higher than other types of international cartels.

Price mark-ups vary from zero to 2500%. About 7% of the sampled cartels were unsuccessful in raising prices. Because cartel overcharges are positively skewed the *mean* overcharge for all successful cartels is 43%. Convicted cartels are on average as equally effective at raising prices as unpunished cartels, while bid-rigging conduct displays somewhat lower mark-ups than price-fixing cartels.

Cartels have their defenders. Some governments have mandated "crisis" cartels to address perceived failures by certain national industries to withstand global competition. These are often justified as actions to encourage cost savings through economies of scale. The EU permits cartels to operate if they are organized to promote technological progress and do so for the benefit of consumers. U.S. law allows joint ventures among competitors for research and development. On the whole, it is difficult to find empirical studies that conclude that efficiencies generated by secret cartels are significant.

Although cartels have their apologists, their writings smack of the Elizabethan art of adoxography.

Cartel Histories

Soon after they first appeared in the U.S. economy around the 1870s, there were many popular writings about the "trusts" that were organized in the sugar, railroad, petroleum, tobacco, and many other industries. "Trusts" was the turn-of-the-century term for large economic combinations, often forged by mergers, for creating and sustaining market power. Today these

organizations would be called holding companies, syndicates, pools, joint sales agencies, or simply monopolies.

By 1916 Ripley could differentiate these phenomena using terms in a manner that has endured. Pools or corners were contractual joint-profit-increasing agreements by independent sellers over prices or quantities; today these are called cartels (Ripley 1916: xiv). Ripley cites the U.S. cordage cartel, formed in 1860, as the first documented U.S. pool. Other 19th century cartels include cotton bags, distilling, iron pipes, steel, salt (Jenks 1888), and wire nails (Edgerton 1997). Trusts proper were legal instruments used in the United States from 1882 to 1902 for merging companies. Yet the word "trust" was used loosely and popularly to cover both cartels and mergers intended to increase market power.

The Earliest Cartels

Serious books about cartels began to be published in the late 19th century and continued to about the 1920s. Levy (1968), a careful scholar, cites about 30 books on cartels published before 1927, the great majority in German. His book contains unique information on 18th and 19th century British cartels. Liefmann (1897) published one of the first and most influential economic monographs on cartels in 1897. His book appeared in five editions in German from 1897 to 1929. Liefmann (1932) devised one of the most cited and pithy definitions of cartels: "free [voluntary] associations of producers for the monopolistic control of the market (p. ix)." By this definition he meant to include only arrangements by independent companies linked by formal or informal contractual agreements; compulsory commodity schemes enforced by government decrees or parliamentary statutes are not true cartels by his definition. Liefmann's positions continued to influence German economists for decades to come.

An issue among early writers is when and why cartels first appeared. Sayous (1902) makes a well documented case for the existence of private cartels in the strict sense of the term in 17th century Holland. The Dutch Company of the North was chartered in 1614 to exploit the Greenland whale-oil industry. By 1618 the Company had adopted a supply-restraint objective to keep domestic prices above competitive levels, but its power waned in the 1630s because of entry. Liefmann (1932), also using a modern definition of cartels, believes that the first domestic German cartel was the Neckar Salt Union, an 1829 combination of salt mines in three German states. Five similar private cartels were formed before 1870, but Liefmann and other writers point to the German depression of the mid 1870s as a peak for cartel formation. By 1905 German government

surveys found 385 industrial cartels operating; the number rose to 3000 by 1925.

Seagar and Gulick (1929) trace the earliest of the U.S. pools to the cordage industry, which began making agreements on prices at least as early as 1861; cordage manufacturers formed a formal association in 1878. The Michigan Salt Association, formed in January 1876, may be the first well documented formal U.S. cartel (Jenks 1888). Because of the high costs of transporting salt, an elaborate organizational structure, and the highly inelastic demand for salt, this cartel was successful in dominating the Midwest market for 25 years.

As for *international* cartels, Liefmann (1932) identifies the 1867 merger of the Neckar Salt Union in Germany with the Eastern French Salt Works Syndicate as the first of its kind. By 1897 there were at least 40 international cartels with German companies as members, most of them in chemical or nonmetallic minerals product markets. Andrews (1889) drew upon contemporary business publications to recount what is quite possibly the world's first *global* cartel, the infamously scandalous Paris-based Secrétan copper syndicate of 1887-1889. Edgerton's (1897) paper on the U.S. Wire Nail Association is a superb analysis of the evolution, operation, and price effects of a short-lived but tightly structured, highly effective manufacturers' cartel which was written with the help of insider interviews just a year after the cartel dissolved. This study is notable because the conspiracy is the first U.S. work on a U.S.-based international conspiracy. Notz (1920) stated that there were 114 international cartels in 1912; by 1920 he found 11 international cartels with participation of U.S. companies.

Among the earlier monographs in English by economists are books by Jenks (1900, 1907, 1911), Jenks and Clark (1917, 1929), Hirst (1905), Jones (1914, 1921), Michels (1928), Seagar and Gulick (1929), Domeratsky (1928), Notz (1929), von Beckerath (1930), Piotrowski (1933), and Plummer (1934, 1951). With the exception of Jenks' and Hirst's books, most of these studies describe cartel membership and contracts but contain little or no quantitative data. One European writer who was concerned about the lack of concrete measures of market power is a then young lawyer and economics lecturer, Hirst (1905). Noting that German cartels frequently exported surplus output to other countries at lower prices than their fixed domestic prices, he proposes using the export prices as a yardstick. Although there is some danger of overstating the domestic overcharge if the cartel is dumping product at predatory prices, he applies this method to six German cartels using 1900-1902 prices. This work may be the first to use the now well accepted yardstick method.

Jeremiah W. Jenks was a political science professor at Cornell University in 1900 when the first of his five editions of *The Trust Problem* was published, though he had already been researching pools, trusts, and monopolies for 20 years by that time. Jenk's 1888 study of the Michigan salt cartel seems to be the first economic study of cartels to appear in a peer-reviewed professional journal. His publications display a strong interest in gauging the economic effects of cartels. Unusual among academics of the time, his commitment to the study of trusts seems to have been cemented by his extensive work as an advisor for the U.S. Industrial Commission, which held a series of public hearings in 1898-1899 on conditions in several oligopolistic industries. His books contain carefully constructed series of wholesale prices for refined sugar, whiskey, wire nails, barbed wire, steel, and other products controlled by cartels or dominant firms. Among his analytical advances was the creation of coterminous price series for the principal inputs for the final products (corn for whiskey, steel for nails, etc.). By correcting for changes in product prices due to input prices, he was able to determine more precisely when and how strongly prices were affected by a cartel. This innovation is now called the constant-margin method.

The paucity of journal articles in this period is probably evidence that academic orthodoxy frowned on cartel studies. Stevens' 1912 study of the gunpowder trust is notable for focusing on what was believed to be the longest-running discovered cartel in the Nation's history; Stevens carefully delineated three distinct phases of the cartel, and he drew upon the records of a 1911 antitrust trial to document the final episode. Allen's 1923 account of the 18th century English copper-smelting cartel seems to be the only assessment of cartel effectiveness by a European economist to appear in a peer-reviewed academic journal.

Eliot Jones' (1914) book deals with 1871 to 1914 episodes of cartelization of the U.S. anthracite coal industry. This study is for its time one of the best analyses of the economic history, market structure, collusive conduct, and price effects in any industry. It is one of the first books to combine an empirical interest in industrial concentration with attention to the antitrust laws. In addition to detailed ownership and price data from industry trade sources, Jones had available testimony and exhibits from one of the early U.S. antitrust trials. Scores of later studies would follow this model.

In the United States federal government victories in the courts against price fixing led to the disbanding of most U.S. cartels by World War I. However, many private commodity cartels were re-established during the interwar period in Europe. During the 1920s and 1930s several of the formerly "domestic" cartels (some controlled exports) took on an

international character. For example, the 1933-1939 international steel export cartel managed production and sales among several of the major continental European steel-producing nations (Barbezat 1993). Stocking and Watkins (1946) wrote about several international cartels that were active in the interwar period in the markets for magnesium, aluminum, incandescent electric bulbs, and several chemicals.

Cartels were a concern of the League of Nations, which sponsored a major conference on the subject in 1927. Papers prepared by some of the leading European cartel scholars of the day were published as part of the conference proceedings (e.g., de Rousiers 1927, MacDonald 1927, and Wiedenfeld 1927). The near absence of empirical detail in these reports and other studies by European scholars active in the interwar period provide a striking contrast with the industrial analyses emerging in the United States. The final report of the 1927 conference revealed a deep split between those participants who believed that cartels harmed national economies and international trade and those who believed that cartels stabilized prices, investment, and employment. In the 1930s in Europe and Japan, cartels became instruments of government policies to reduce excess capacities, raise prices for certain raw commodities, or extend the power of authoritarian regimes over labor and industrial production. The League later sponsored cartel studies with more empirical content (Benni *et al*. 1930, Oualid 1938). Some exceptions are studies of the German coal and steel cartels (Weganroth 1964, Peters 1989). Lundqvist (1998) examined the formative period of the Swedish beer cartel in the 1890s, which operated quite harmoniously for 50 years (1906-1956).

The Interwar Cartels

There were relatively few cartel studies in the 1930s, but during and immediately after World War II, a surge in publications examined the roles of cartels active in international trade and in war production. Several books were written about the role that German cartels and the Japanese *zaibatsu* played in the emergence of totalitarian political structures in the Axis countries in the 1920s and 1930s. (Reimann 1942, Hexner 1946). Several more books on the topic were written by three of the most prominent economists of the fledgling field of industrial organization: Edward Mason (1946), Corwin Edwards (1944, 1967), and George Stocking (Stocking and Watkins 1947, 1948). Edwards and Stocking had direct experience with the German and Japanese cartels as advisors to the Allied occupation authorities just after the war. They were directly involved in the imposition of U. S. type antitrust laws and the establishment of

national agencies to enforce the new laws: the Federal Cartel Office in West Germany and the Japan Fair Trade Commission. Edwards (1944) provides many examples of interwar collaboration, some of it unwitting, between U.S. and German companies that ultimately aided the Axis war effort. Edwards relates instances of cooperation that resulted in militarily valuable technology transfers from U.K and U.S. firms to German chemical companies.

Ervin Hexner (1946) produced the most comprehensive economic study of international cartels yet published. Hexner had an insider's knowledge of cartels. He had served as secretary of the Central European group in the international iron and steel cartel (Barjot 1994:65). Louis Marlio (1947), a French economist who wrote a detailed account of the international aluminum cartel, had a similar background in the aluminum industry. Both of these authors found much to admire in the effects of international cartels, whereas post-war works by American authors tended to be distinctly more skeptical, if not hostile concerning the economic and political effects of the interwar cartels (e.g., Berge 1944, Edwards 1946).

Perhaps the first publications to attempt to quantify systematically the price effects of cartels were a pair of books produced by a team of economists that had access to information handed over to investigators of Congressional committees and to prosecutions after grand-jury antitrust investigations (Stocking and Watkins 1946, 1948). These books set a new standard for rigor and detail in the economics literature on cartels. In my estimation, Stocking and Watkins (1946, 1948) represent a new era in the economic literature on cartels, because they were the first to apply rigorous modern concepts of the emerging field of industrial economics and because they were among the first to focus on the market effects of international cartels. Numerous and continuing citations to their books by leading scholars attest to their status as classics in the field.

The negative impacts of the interwar cartels during 1920-1945 began to bring about a reappraisal of cartels among Europeans just after World War II. In Germany there was a healthy parliamentary debate over its cartel laws in 1951-57 (Wells 2002:165-74). The German cartel law would prove to be quite effective in purging most of German industry of cartels. The UK had a common-law tradition that disallowed the enforcement of cartel contracts by the courts, but this law did not discourage price fixing by trade associations. Through the early 1950s, a majority of the UK's manufacturing output was affected by cartels (Symeonidis 2001, Swann 1974). The reconsideration of the benefits of cartels began around 1950 with a series of empirical studies of cartels by the Monopolies Commission. By the late 1950s UK anticartel legislation had been adopted that placed the burden of proof on cartels to prove the economic benefits of

their price fixing and related conduct. Germany was the prime mover behind the adoption of tough anticartel provisions in the Treaty of Rome, which solidified the antitrust tradition in the EU and its Member States.
the EU and its Member States.

The embarrassing role of international cartels in contributing to World War II combined with an active program of prosecutions by the U.S. Department of Justice in the 1940s seems to have caused a hiatus in international cartels for almost 50 years. Until the late 1990s very few legal or economic studies were written about post-war international cartels, perhaps because there were so few of consequence.

The Electrical Equipment Conspiracy

There was a short lived U.S. interest in domestic cartels when the "Great Electrical Equipment Conspiracy" burst onto the Nation's consciousness in 1960-1961. This cartel resulted in the publication of more publications in a few years than any other single historical event since the beginning of cartel literature. The scope of the conspiracies, their duration (up to 40 years), the as yet unsurpassed size of the sales involved ($7 billion per year in the late 1950s), the fame of the leading companies involved, and the U.S. Government's aggressive prosecution of the violators – all these factors lead to a degree of public fascination and publicity about an antitrust action not seen since 1911. More than 1900 private suits offered unusually detailed pictures of the cartel's organization (Herling 1962, Smith 1963, U.S. Congress 1965, Sultan 1974, Sultan 1975, and Bane 1973). In addition to the books, three economic studies were devoted to the cartels (Kuhlman 1967, Finkelstein and Levenbach 1983, and Lean *et al.* 1985). These studies have become staples in textbooks in industrial organization (e.g., Carlton and Perloff 2004).

Recent Cartel Studies

There was brief revival of interest in international cartels after 1973 when the Organization of Petroleum Exporting Countries (OPEC) first used its power to raise crude petroleum prices. Many books and articles were written about the cartel (Eckbo 1976, Griffin 1989). OPEC is one of many international commodity stabilization schemes established by international treaties, and therefore are immune from antitrust prosecution.

Relatively few books were written about cartels from the early 1960s until the revelations about the international lysine, citric acid, and vitamins cartels began in the late 1990s. Four books may be traced to high profile U.S. and EU prosecutions that began in late 1996 (Lieber 2000, Eichenwald 2000, and Connor 2001). Harding and Julian (2003) provide a legal overview of EU cartel enforcement that began in 1969. They note that

the European Commission began publishing book-length decisions in the late 1980s that often contained rich detail on the internal organization and conduct of EU-wide cartels.

However, there has been a strong upward trend in academic papers on cartels since the 1970s. Many are focused on testing new quantitative methods. There is a huge new literature on auctions and bid rigging (Porter 2005). Most recent economic studies are written by North American academics using cartel episodes that affected commerce in the United States or Canada. Some classic studies are: the 1885-1914 bromine cartel (Levenstein 1997); collusion in U.S. railroads that began in the early 1880s (Porter 1983); and the U.S. railroad express cartel lasted for an extraordinary 52 years (Grossman 1996). One reason for the continuing interest in these early cartels is they were entirely legal at the time and there are numerous historical records available.