# Development Strategies and Industrial Policies Amidst the Pervasive Use of Internet

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**Abstract**

This chapter considers the support and viability of government conducting industrial policy in the digital age. The accessibility and pervasive use of the internet by companies and consumers has diminished the power of the government in having an advantage in information and data availability to justify its intervention in economic planning and resource allocation. Nonetheless, the public goods characteristics of information and knowledge together with ICT-enabled networks and platforms for social economic transactions has given rise to a *disruptive innovation.* New business models, new products, and new production and delivery system have provided new scope and justification for new form of government industrial policy. Many scholars have recommended that government to act more like a venture capitalist to place bets rather than picking winners. Network economies and winner-take-all phenomenon necessitate the government to take on "soft" industrial policy, whose goal is "*to enable closer co-ordination between individual economic agents and to allow for experimentation in the economy.*"

**Keywords**

Digital economy • Placing bets • Disruptive technologies • E-commerce • Network effects • Economies of scale • Picking winners • Sustaining innovation

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## Introduction

The early 2000s marked the beginning of a new phase of government involvement in economic development. Such a new approach, which can be characterized as somewhat in-between the traditional interventionist strategy and the *laissez-faire* policies of the 1980s and 1990s. The belief that governments should take up a coordinating role, facilitate innovation rather than targeting specific industries, focus on correcting "systemic failures" instead of market failures started to spread in the Western economies. This systemic approach aims to ensure that the system does not contain any obstacles to firms' growth and industrial development. It recognizes the role of governments in providing supportive institutions and a broad set of horizontal policies conducive to competition, innovation, and industrial change. Some scholars characterize this approach as "soft" industrial policy, whose goal is "*to enable closer co-ordination between individual economic agents and to allow for experimentation in the economy.*" This rationale has been the mainstream thinking until now.

The systemic approach did not, however, prevent governments from bringing financial support to industry but public intervention tended to be more strategic in nature, to move away from support for single firms and to focus more on activities and technologies. This rationale, although still prevailing amidst policy makers, has been slightly altered by the economic and financial crisis.

A new challenge is posed to the government with the advent of information communication technologies and **digitization**. The accessibility and pervasive use of the Internet by companies and consumers has diminished the power of the government in having an advantage in information and data availability to justify its intervention in economic planning and resource allocation. Nonetheless, many analysts hold that fundamental economic principles still prevail but new concepts and methodologies need to be designed and crafted to handle the situation of abundance of information initiated by the Internet.

This essay is organized as follows. Following this introduction an update of the recent views and development in the practice of industrial policy is provided in section "Industrial Policies: An Update of Recent Thinking." In section "Characteristics of the Information Age and Market," the key features and economics concepts in the **Internet** or **digital economy** are traced. In the discussion the challenges posed by the digital economy to government industrial policy are identified. Modification to the scope and practice of industrial policy to cope with new challenges in the digital age is the focus of section "Policy Response Framework in the Digital Age."

The final section, section "Conclusion," summarizes the main arguments and conclude the essay.

## Industrial Policies: An Update of Recent Thinking

When considering improving the standard of living of the community, economic growth matters. An expanding economy creates jobs and opportunities for people and firms to maximize their potential. When labor markets are tight, wages are more likely to increase. When there is insufficient aggregate demand, workers are more likely to see wages erode, particularly lower-skilled, minority, and younger workers. Should the state or government be involved in expanding the economy? The answer to this question is not unequivocal and is even more complex in the information age where Internet usage is pervasive. For better or worse, all governments get involved in the economy and to implement industrial policies using ICT to uplift the standard of living is one of the many reasons.

Many discussion and debates about the scope of industrial policy have focused on the question of whether it should be sectorally specific or horizontally across industries. According to Krugman and Obstfeld (2003), industrial policy is defined as "an attempt by a government to encourage resources to move into particular sectors that the government views as important to future economic growth." This definition is associated with the targeting of specific firms and sectors – frequently referred to as **picking winners** (Owen 2012). This old-style industrial policy, also known as "vertical" industrial policy is most criticized for using subsidies not linked to performance measures, distorting competition, while exposing government to capture by vested interests (Aghion et al. 2011).

In contrast, the dissatisfaction about **picking winners** can be sidestepped by considering the horizontal approaches to industrial policy which emphasize "neutrality" and focus on policy interventions – such as R&D tax credits, training policies, subsidizing private efforts to "discover" new areas of comparative advantage (Hausmann and Rodrik 2003), working with existing industries and clusters to deal directly with the coordination failures that limit their productivity and expansion – that could in principle benefit many firms or industries (Aiginger 2007).

Harrison and Rodriguez-Clare (2010) refer the horizontal approach as **soft industrial policy** in contrast to the traditional **hard industrial policy**. The goal **soft industrial policy** is to develop a process whereby government, industry, and cluster-level private organizations can collaborate on interventions that can directly increase productivity. The idea is to shift the attention from interventions that distort prices to interventions that deal directly with the coordination problems that keep productivity low in existing or raising sectors. As an illustration, policy makers intending foreign capital to jump-start industrialization, can instead of tariffs, export subsidies, and tax breaks for foreign corporations, think of programs and grants to help particular clusters by increasing the supply of skilled workers, encouraging

technology adoption, and improving regulation and infrastructure for upgrading and sustainability.

Comparing with the traditional approach to industrial policy, the soft industrial policy has two additional advantages. First, soft industrial policy reduces the scope for corruption and rent seeking associated with hard industrial policy such as protection or selective production subsidies. Second, soft industrial policy is much more compatible with the multilateral and bilateral trade and investment agreements that many developing economies have implemented over the last decades (Harrison and Rodriguez-Clare 2010).

Such thinking and approaches about formulating policies to stimulate innovation, productivity, and employment are attributable to the conceptual framework arising from research on endogenous economic growth (Aghion et al. 2009). The intellectual foundation can also be traced in other heterodox approaches based on theories of national innovation systems and Schumpeterian models of entrepreneurship. The implications of these theories for industrial policy have been widely discussed in the literature (Jaffe 1986; Navarro 2003; Rodrik 2004; Harrison and Rodríguez-Clare 2010; Wade 2010; Weiss 2011; Aghion 2012; Aghion et al. 2012; Wissema and Djarova 2015).

The cluster concept revived and popularized by management guru, Michael Porter, has gain increasing acceptance by business practitioners and policy makers specializing in economic development. **Cluster-based industrial policy** for development has proliferated in many countries both developing and developed. (There are many excellent discussion and review of the cluster-based approach to development and related industrial policies. See for examples Desrochers (2004), Bogdan (2006), Wolman and Hincapie (2010), Toh (2015), and Yulek (2015a, b)). A recent example is the Smart Specialization Strategy adopted by the European Union is one that "integrate cluster policies into a broader transformation agenda for the entire regional economy, and complement cluster policies with other cross-cutting and technology/knowledge-domain-specific activities" (Dhéret et al. 2014). A cluster-based approach begins with the industries and assets that are already present in the region and regional stakeholders pursue initiatives to make those industries better. It can also be an approach to create an entirely new cluster in the economy supported by measures or programs to improve overall business environment conditions, upgrading skills, access to finance and infrastructure, streamlining government rules and regulations, supporting local demand, and being open to foreign investment and competition.

One can consider clusters as network of economic relationships that create a competitive advantage for the related firms in a particular region. This advantage then becomes an enticement for similar industries and suppliers to those industries to develop or relocate to a region to enjoy what is known as agglomeration economies. A cluster policy provides an organizational framework that, through the notion of linking local businesses to central hubs, improves the embedding of firms in both local and global networks (Young et al. 1994; Nathan and Overman 2013; Bulu and Yalcintas 2015; Toh 2015).

On the analytical and methodological front, the availability of more disaggregated data and sophisticated visualization technology coupled with declining cost of

computing and processing has helped the development of the New Structural Economics and the Growth Identification and Facilitation Framework (NSE-GIFF). This framework is a theory of dynamic comparative advantage. In this framework, structural change follows a diffusion process over a network of products, rather than gradual changes in aggregated input variables (Hidalgo and Hausmann 2008). With the NSE-GIFF as the basis, Lin and Wang (2015) suggest a methodology to identify strategies for countries wishing to catch up. It is a six-step procedure to help low- and middle-income countries identify both the countries to emulate and the possible sectors (with latent comparative advantage) that they could target (For more in depth discussion, see Lin and Wang (2015) as well as Hausmann and Klinger (2007)).

Hughes (2015) declares that after decades in the policy wilderness industrial policy has returned to the fold. In the many countries in the aftermath of the financial crisis and dissatisfaction with the effectiveness of policies advocated in the Washington Consensus, policy makers have resurrected industrial policy pursuit of rebalancing the economy away from financial services. (The "Washington Consensus" approach recommends that governments should reform their policies and, in particular: (a) pursue macroeconomic stability by controlling inflation and reducing fiscal deficits; (b) open their economies to the rest of the world through trade and capital account liberalization; and (c) liberalize domestic product and factor markets through privatization and deregulation). This resurrection implies selective identification of support for specific sectors and increasingly particular technologies. In an earlier article, Aghion et al. (2011) argue for a rethink on industrial policy. They provided three reasons to support the relevance of industrial policy in current global economic environment. The first is to deal with climate change in which government intervention is needed to jump-start massive private investment in clean technologies. Second, laissez-faire complacency by many governments has led to mis-investment in the non-tradable sector at the expense of growth-rich tradable sectors. Third, contrary to outcome predicted by critics – emerging economies like China – which are ardent adopters of growth-enhancing sectoral policies and have achieved remarkable economic performance. Furthermore, the authors provide empirical support for adequately targeted and properly governed industrial policy. Each of the cases considered illustrates the existence of knowledge spillovers that are not properly internalized by private firms and sectors.

Given the microelectronic revolution and the emergence of the **information economy**, many analysts have asked whether the relevance of industrial policy and the role of the government will diminish or enlarge.

## Characteristics of the Information Age and Market

The essential feature in the new economy is a structural shift from the industrial economy toward an **information economy** – an economy characterized by information, intangibles and services, and a parallel change toward new work

organizations and institutional forms. The information economy or digital economy is based more in the form of intangibles, information, innovation, and creativity, in expanding economic potential (Persaud 2001) and is based on the exploitation of ideas rather than material things (Sharma 2005). The key activity of the information or digital economy is creation, trading, and distribution of knowledge, intellectual property, and intangibles, in contrast activities in processing material input into material output in the industrial economy. The interaction between changing production and business processes and information and communication technologies (ICT) is the driving force toward the new, digital economy. A production enterprise in the digital economy is largely a producer of services integrated or embedded in the product. A large part of its service production concerns the use of information and knowledge in some form (UNCTAD 2007). The essential elements of the digital economy are:

- Digitization and intensive use of information and communication technologies (ICT)
- Codification of knowledge
- Transformation of information into commodities
- New ways of organizing work and production

This implies that much of information and many services are available online. A widely distributed access to the networks, the intra- and Internet, and of skills to live and work in the information society is the basis for the digital economy (Sharma 2005).

As the economy shifts more toward information-based production, however, the prevalence of public good type and informational concerns loom larger. Public goods were defined as goods having two critical characteristics: zero marginal cost and non-excludability. In other words, a public good exists if providing the good to another person involves no additional cost (zero marginal cost), and it is impossible to exclude that person from enjoying the benefits of the good (non-excludability). Some economists such as Delong and Summers (2001) argued that the shift toward a digital economy where accessibility to information is easy and inexpensive may attenuate the presumption that private sector activity is necessarily more efficient than public sector activity. However, Stiglitz et al. (2000) reminded readers that information is, in many ways, a public good. Information is also almost always an "experience good," in that consumers must experience it to know its value. Carl Shapiro and Hal Varian of the University of California at Berkeley emphasize that individuals do not know the value of a newspaper, for example, until they have read it. As a result, media producers have invested heavily in branding and reputation (Shapiro and Varian 1999, pages 5–6). They argued that the public good nature of information suggests that individuals will have little incentive to invest in obtaining information (since they earn little return from doing so). However, if no one invests in obtaining the information, information imperfections arise and private markets can become inefficient and incomplete.

## Network Economics

The advent and spectacular growth of the Internet have spawned claims of a digital economy that entails new economic and business concepts. The Internet is a global network. Use of the Internet for commercial purposes, as in e-commerce is therefore subject to significant "network effects" or demand side scale economies. Network effects are not new but they are endemic in the online economy (Shapiro 1999). As Shapiro and Varian (1999, p.173) remark, "the old industrial economy was driven by economies of scale; the new information economy is driven by economies of networks."

The role of the government in managing or guiding the growth of electronic commerce with appropriate policies and programs has assumed new importance when online trade is viewed as a possible new engine of economic growth. Electronic commerce is more than just another way to sustain or enhance existing business practices. Rather, e-commerce is a "disruptive" innovation that brings about a paradigm shift, radically changing the traditional way of doing business. New business models, new goods and services, totally different principles and work rules have evolved in the digital economy in response to new information technologies and innovations. Bower and Christensen (1995) explain the difference between disruptive and sustaining technologies or innovations. Sustaining innovations are those technologies or processes that foster improved product performance or business operations, while disruptive technologies are those that initially tend to destabilize domineering incumbent technologies or innovations, depressing their competitiveness and returns but promise greater long-term potential when adopted pervasively. A recent example of a disruptive technology is the case of Uber and Grab Taxi which uses the smartphone app to provide on-demand service to users. It connects willing passengers to taxi cab drivers and freelance drivers. The speed and pace in which such business get started in so many cities in the world is phenomenal and devastating. This innovation has disrupted the operation of many standard taxi services and has created substantive debate as to whether the state should intervene, and how to intervene if intervention is already been decided (Visionary Analytics 2016). Just as minicomputer and laptops replacing mainframe computers, there are mini-steel foundries that increasingly replace traditional steel mills; network of small and versatile generators taking over the functions usually reserved for large power generators. Miniaturization is much facilitated by digitization.

The traditional economies of scale based on manufacturing are referred as supply-side economies of scale. Such phenomenon often associated with the operation of large firm size has served as an effective entry barrier in the industrial economy. However, e-commerce and virtual value chain has redefined the concepts of economies of scale which allow small companies to achieve low unit costs for products and services in markets dominated by big companies (Rayport and Sviokla 1995). Also in e-commerce, online superstores have the ability to spread fixed costs over a larger customer base and offer a wide selection of goods to frequent visitors. For example, Amazon.com is able to apply the same software written to help organize auction listings to toy-selling teams to rearrange their catalogue by price, age group, and other variables (Anders 1999). Even goods that in low demand or have low sales

volume can collectively make up a profitable market share – this is the "long tail" phenomenon coined by Anderson (2008) – made possible in an e-commerce store that has large distribution channel.

In contrast to the traditional supply-side economies of scale, a product exhibits demand side economies of scale (network effect or positive network externalities) if the more people that use such a product, the more valuable it is to its users. The essence of the 'network economy' is consumers place greater value on large networks than on smaller ones. Unlike the supply-side economies of scale, demand side economies of scale do not dissipate when the market gets larger. Supply-side and demand side economies of scale strengthen each other in the network economy (Shapiro and Varian 1999). The growth on the demand side reduces the unit cost (and price) in the supply side and makes the product more appealing to other users. The result is the acceleration of growth in demand for the products even more. The result is especially strong feedback, causing entire industries to be created or destroyed far more rapidly than during the industrial age.

Network externalities coupled with public goods characteristics of non-exclusivity and zero marginal cost become a potion for a market in which "winner-take-all" can occur, and that undermines a laissez-faire approach in the digital economy. In the digital age, companies such as Facebook or Twitter have strong network effects – the more users they have, the more it pays to become a user. There is a strong tendency to have a few or even only one of such companies in the market. Hence, strong network effects can create **natural monopolies** – industries where competition tends to vanish on its own. The reduction in competition and communication costs associated with the digital economy may thus create such a "superstar" phenomenon in any given field. The evidence for, and ramifications of, a winner-take-all society, in which a few top people in each field enjoy the vast majority of benefits, was examined in a popular book by economists Robert Frank, of Cornell's Johnson Graduate School of Management, and Philip Cook, of Duke University (Frank and Cook 1996). As Professor DeLong has noted, "IT and the Internet amplify brain power in the same way that the technologies of the industrial revolution amplified muscle power" ("Untangling e-conomics," *The Economist*, Survey on the New Economy, September 23, 2000, page 6). This phenomenon can encourage excessive investment in attempts to become the best in a specific field and can also generate substantial income inequality. Furthermore, it can also engender a situation that enterprise and consumers are trapped in using suboptimal technologies, with its continued usage and existence solely because everyone else is perceiving high switching cost in using efficient alternatives. This phenomenon is sometimes referred to as the "QWERTY" effect, after the layout of letters on typewriters and now computer keyboards. Such outcomes are inefficient and socially undesirable.

## Implications for the Role of Government

The shift toward an economy in which information is central rather than peripheral may have fundamental implications for the appropriate role of government. Market failure and government failure may be even more prevalent in the information-laden

markets than in traditional bricks-and-mortar markets. In particular, the public good nature of production, along with the presence of network externalities and winner-take-all markets, may remove the automatic preference for private rather than public production. In addition, the high fixed costs and low marginal costs of producing information and the impact of network externalities are both associated with significant dangers of limited competition.

A related perspective on potential government failure in the digital economy is innovation. And public sector entities often face weak incentives to innovate. This may lead to the biased view that private production is more efficient than government production. In reality there are some aspects of research and knowledge that public sector involvement and support is necessary for the private sector to begin to innovate and flourish. Many governments in the world have invested in establishing their national innovation system comprising of the research organizations in the institution of higher learnings as well as R&D centers set up by the private enterprises and public sector. Just as a discovery may lead on to a new discovery, innovations can breed further innovations.

## Challenges

The digital revolution posed two major challenges to policy makers. First, information technologically reduced the costs associated with conducting international business as a result of the globalization (DESA 2000). Enterprises take advantage of the information technology to expand geographically, and this has in turn limited the efforts of government in managing their economies. Capital has become ever more footloose to locate to more hospitable institutional environments, forcing governments around the globe to refrain from stringent domestic regulations, but engage in a race to the bottom in economic intervention (Tonnelson 2000). The autonomy of the state fell victim in the information age to firm mobility.

Businesses choose the different stages of production in their value chain to be located where it is competitively advantageous to do so. This has led to fragmentation of production process – a general trend toward the move of manufacturing and fabrication activities away from relatively high-cost high-wage cost economies such as the EU and the United States to China, India, and elsewhere. Moreover, this has been associated with a very rapid growth in what may be called "vertically specialized trade" in which the import content of exports has increased. This makes outcomes of sectoral policy in terms of, say improving the trade, balance more complex to predict since exports increasingly suck in imports.

Vertically specialized trade is associated with a so-called "second unbundling" of vertically linked stages in production (Baldwin 2006). The rising importance of such trade is attributed to rapidly falling communications costs and the pervasiveness of information communication technology solutions to dispersing production stages that previously had to be performed in close proximity. This contrasts with the first unbundling based essentially on falling transport costs linked to steamships railways and the telegraph. The ability, for example, in the second unbundling to digitally

transmit designs for production to a separate location has increased the extent to which the whole production process from R&D and design through manufacturing/fabrication, and the marketing of the final product can be diced and sliced across different national boundaries. Identifying sectors for industrial policy support is now less important than focusing on the different stages in the overall production process in which an economy can have or develop a comparative advantage.

The nature of industrial policy, as a consequence of the above developments has changed (Baldwin and Evenett 2012). First, with regard to selective industrial policies, it may be necessary to rethink the notion of giving support to particular manufacturing sectors and think instead in terms of interventions targeted at stages of production in a value chain. Second, the increased mobility of some factors of production means that it may be important not only to consider externalities, but how far these will be internalized to the local economy. This means "high spillover, low mobility" factors should be more favored for subsidy and support – for example, horizontal policies should emphasize human capital rather than transferable technology. Third, corporate taxation has to be designed to take into account international tax competition. This would typically implies lower marginal tax rates than in a closed economy setting.

Globalization also undermines industrial policy. Trade openness and WTO rules and EU competition policy forbid government in using subsidies to help infant industries. Also given that companies are outsourcing production the world over, aid to industry, like Keynesian demand stimulus may leak out of the domestic market, providing manufacturing jobs for workers in China or India rather than in developed industrial economies (Levy 2006).

The second major challenge concerns legislation and governance. Government may have legislations and governance tools that are inflexible and unable to cope with the demand of decentralized, nonhierarchical character of information networks. The new global information architecture promulgated by the Internet makes it difficult to design and implement effective regulations through top-down, government-by-government approaches (Haufler 2001). The governance problems raised by information technologies threatened to further erode state autonomy, as non-state actors and nongovernment organizations were empowered to resolve major societal disputes. Many countries including the United States took a wait and see attitude and relied on the private sector to navigate the early years of the information/digital revolution.

Nonetheless, when the Internet was transferred to the commercial world, it soon realized that the legal structure in the operation of the network became more evident and more urgent, and regulation and legislation become quint-essential. The questions of an operating marketplace had to be addressed; appropriate rules had to be defined for domains from privacy to taxation. Governments have to play an instrumental role in shaping the character of the emerging information societies. Like all markets, cyber markets require definitions of property, exchange, and competitive market structure. Industrial policies have to evolve in tandem with policies to develop efficient governance and organizational structures in the economy.

## Policy Response Framework in the Digital Age

In response to the challenges alluded above, government policy must be based on a sophisticated understanding of these **global value chains.** It includes in particular the identification of those sectors where a regular and steady flow of information and feedback between, for example, research and development, product design, and manufacturing is enhanced by close proximity. These connections may be particularly important where there is rapid innovation in the processes by which new products are developed and productivity evolves. Thus, for example, in biotech drugs, super-miniaturized assemblies or advanced semiconductors, where processes are changing rapidly, there is a significant advantage in integrating R&D and manufacturing. The physical separation of these may be a hindrance to rapid progress. Identifying which sectors and technologies gain competitive advantage from national, regional, or locally clustered activity is an important task in developing an effective industrial and technology policy.

Deep engagement with the local and foreign industrial players through dialogue, partnership in feasibility study projects, and foresight exercises linked to particular technologies or sectors have proven to be effective ways to gather feedback and relevant information to be incorporated into policy for sustainable development. It has helped to envision future potential developments and **practical policy steps** to resolve them. It also addresses the ways in which new organizational forms may be developed to bridge the gap between potential players in the development of technologies toward different industrial uses. Dedicated institution or agencies may be required to foster to bridge the gap. For instance, the government agency known as A*STAR in Singapore provides the necessary platform for such activities; Catapult program in the UK is set up to encourage partnership, learning and adoption of intermediate technology by key players.

## Placing Bets Instead of Picking Winners

The increasingly uncertain and risky nature of strategies based on emerging technologies and their potential application in particular sectors and elements in the value chain or across many sectors means that policy for sustainable development must also acknowledge that failures will and do occur. There will be many "honorable dead ends" (Hughes 2015). Policy should be seen to clearly incorporate the cessation of support when these dead ends are reached. It is advocated that government policy should be more like the approach of a venture capitalist (but with a longer-term perspective than that typically implies). The venture capital element is the requirement to see policy not as "picking winners," but as "placing bets" on new technologies or "choosing technological races" to enter. Initial support gives an option to place further bets on those technologies that emerge as successful and stop backing the losers. This technological perspective needs to be married to an approach that seeks to identify sectoral value chain pull through of emerging technologies. This will include the public sector as a potential purchaser of goods and services,

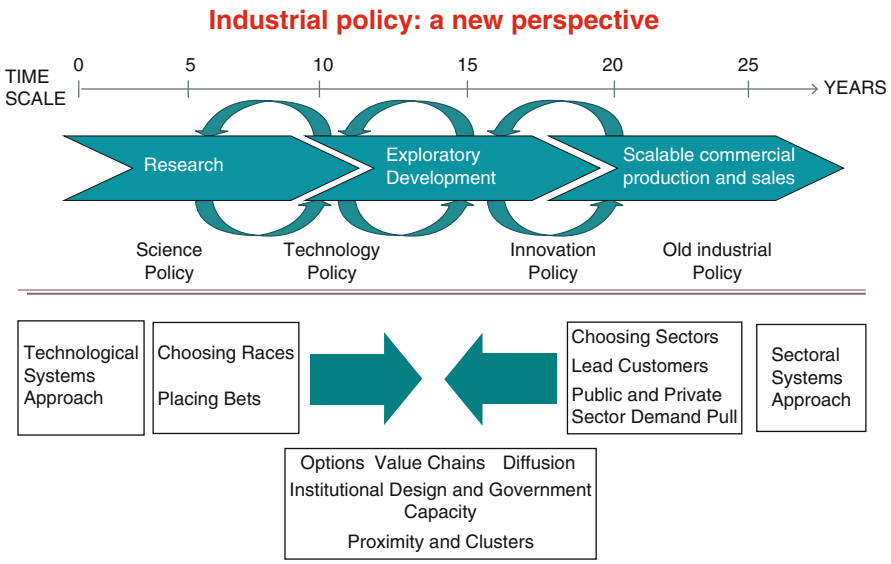
including technological services from the science base enterprises, and the private sector.

In the digital age, many governments have played pivotal role in the construction of the information economy through policies of deregulation, market making, and reregulation. Generally, governments have acted simultaneously to subsidize infrastructure development (e.g., broadband networks), extract themselves from direct market control, and forge new rules to promote competition and positive economic spillovers to all sectors in the economy. It is important to recognize government legislation has helped to shape the way that information technology has interacted with production patterns, influencing the success of emerging business models and modes of industrial organization. Government legislation is critical to embed new markets in social norms and to moderate the "brute" forces unleashed by the information revolution. Industrial policy become *sine qua non* with intervention to shape the digital transformation such that positive benefits are engendered. The new formulation or interventions often require conceptual innovation and political entrepreneurship and may redistribute power and benefits significantly.

In addition to the change in philosophy and mindset about industrial policy formulation, Zysman and Newman (2007) identify three strategies to cope with the challenges of the digital age. Firstly, governments intervene to ensure fair ground rules for the contests between dominant market players and new entrants. These rules emphasize equal market access, level regulatory playing fields, and transparency. For instance, universal service requirements mandate that telecommunication companies and internet service providers guarantee access to underserved communities, a cost not faced by the cabled companies looking to compete in broadband markets.

Second, governments intervene to ensure intellectual property and copyrights are respected in the advent of information technology. Digital innovations have the potential to upset existing business dynamics, threatening the survival of some industries especially those in the entertainment and software production sectors. Encryption programs are used to hide the underlying software code so as to have control over use, replication, and distribution. Notable example of this strategy is the Digital Millennium Copyright Act (DMCA) of 1998 in the United States. The DMCA criminalized the development and use of devices that may be used to break encryption systems.

Third, governments adopt measure to shape the characteristics of emerging digital markets and recast the balance of power in favor of public interests. More in alignment with views of consumer advocates, this strategy attempts to protect public interest more broadly and to prevent digital innovations from further concentrating power in the hands of economic and government elites. Often this strategy is also motivated by the emphasis on state safeguards that protect and assure citizens. For instance, the European Union data privacy directives and Singapore government do-not-call (DNC) registry provide practical examples (The DNC regime under the Personal Data Protection Commission (PDPA) prohibits organizations from sending such messages to Singapore telephone numbers, including mobile, fixed-line, residential and business numbers, registered with the registry).




Source: Adapted from Crafts and Hughes (2013), Exhibit 6, page 24.

**Fig. 1** Policy development framework

Worthy of note is the policy framework suggest by Crafts and Hughes (2013). It captures much of the thinking and spirit of implementing industrial policy in the digital age. Diagrammatically, the framework is illustrated in Fig. 1. They emphasize the need for a patient long-term approach to take a new idea emerging from research to find its way into final production. It also shows the extent to which a "holistic policy" to support this process encompasses science policy, technology policy, innovation policy, as well as what was previously thought of as "old" industrial focusing primarily on industrial sectors.

Figure 1 takes the view that the term "industrial policy" is best conceived as one that make up of several components or programs beginning with a flow of ideas from the public and private sector research base toward commercialization. The direction of flow implies linearity, but there are multiple nonlinear feedback loops in the process. This is captured by the loops in the top bar. The conventional breakdown of policy into science policy, technology policy, and innovation policy is shown beneath the development arrow bar. Industrial policy is shown as primarily focusing on policy support for the sectors in which the new products and processes are commercially developed, implemented, and sustained.

The bottom of the diagram represents a schematic overview of a systems approach to policy. A sectoral systems approach looking backwards to technologies from sectors is shown on the right side of the diagram. On the left side of the diagram, the technological systems approach is represented. It represents the selection of technologies based on the approach identified as choosing races and placing

bets rather than picking winners. Under the heading of industrial strategy, policy implications relating to value chains, technology diffusion, and options.

Far from being debilitated by technological progress, many governments have played a fundamental role in the emergence and development of the Internet age (Zysman and Newman 2007). Governments have created and build infrastructure to accommodate the information economy, and through a series of deregulation, market making, and reregulation initiatives, public policy has constructed the rules for the new market, contributed to environmental protection, and managed conflicts that threatened to derail the information revolution.

As an operational tool for industry selection, **indirect industrial policy** is widely used in advanced economies. This is a strategy for indirectly selecting and supporting industries through private financial markets. Instead of picking specific industries or firms to support with direct assistance, the government broadly defines its favored industries and announces incentives for the private sector to participate in industrial policy (Felipe 2015, page 37). With indirect industrial policy, private financial institutions (PFIs) – not government – interact directly with firms. The PFIs can, if necessary, withdraw their support without causing political backlash or giving the impression that the "government is taking away the umbrella when it rains." As an example, if the European Commission wants to promote SMEs in the biotechnology industry, it assigns a budget to the European Investment Fund to provide partial credit guarantees for bank loans extended to the SMEs. Singapore has similar schemes to help and encourage SMEs to expand into new industries; however, the funds are managed by the government investment agencies rather than by private banks.

## Conclusion

The focus and form of industrial policy have undergone changes with the arrival of the digital age. In the digital era, the role of government hinges on how the emerging digital tools and networks change firms' strategies to capture values, accumulate capabilities, and seize market share. There is a growing emphasis on "nonselective" horizontal policies affecting broad classes of businesses such as the promotion of competition, support for entrepreneurship and small firms, and a new interest in technology and innovation policy. This was increasingly marked by an emphasis on the potential role that the publicly funded science base could and should play in the promotion of productivity and output growth. To conclude, this chapter makes six basic points:

1. As governments rediscover industrial strategy, policy designers need to pay careful attention to new characteristics and business models in the digital economy in the deliberation of industrial policy interventions. **Industrial policy remains useful in a digital economy, but its form and implementation philosophy needs to change to adapt to the new econ-techno environment.** It is suggested that government policy should be more like the approach of a venture

capitalist, which is to see policy not as "picking winners," but as "placing bets" on new technologies or "choosing technological races" to enter. The trick for the government is not to pick winners, but to know when it has losers and stop backing them.

2. Risk of corruption and rent seeking in industrial policy can be minimized or eliminated with the adoption of soft industrial policy. The goal of soft industrial policy is to develop a process whereby government, industry, and cluster-level private organizations can collaborate on interventions that can directly increase productivity. This idea will shift the attention from interventions that distort prices to interventions that directly deal with coordination problems. Instead of imposing tariffs, export subsidies, and tax breaks for foreign corporations, these policies will help particular clusters by increasing the supply of skilled workers, providing incentives for technology adoption, streamlining regulations, and upgrading infrastructure for innovation and sustainability.
   Furthermore, the use of indirect industrial policy prevalent in developed economies is worth serious consideration. As alluded in earlier section, in indirect industrial policy, selection of industries to be supported is done through private financial markets. Risks can be shared between public and private sectors and government can leverage on the knowledge and expertise of the private sector in choosing potential winners. It has the advantage of keeping the private sector at arm length, avoiding exposure of government captured by vested interest groups
3. Cluster-based approach has its virtue despite some reservation and criticism. It can be a basis for better-targeted horizontal interventions and a focus for boosting agglomeration economies to deliver greater results. The planning and implementing of cluster policy is an exercise of system thinking that provides policy makers a better understanding of the opportunities as well as constraints faced in attaining successful and sustainable outcome in industrial policy.
4. The economy is better off if government to embrace globalization as a catalyzing factor for economic growth. The globalization of trade and communications enhanced the efficiency with which assets are allocated in markets (Yi 2003). This means that policy must be based on a sophisticated understanding of the global value chains, for example, identifying those sectors where a regular and steady flow of information and feedback between R&D and manufacturing. In addition, the informational content required to understand the policy challenge and respond to it requires a deep engagement with the industrial players and effective ways of incorporating that knowledge into policy development (Hughes 2015). This could be regarded as a foresight exercise or learning-by-doing process for policy makers in the information age.
5. **E-commerce is here to stay**. The pervasive use of internet in the world has contributed significantly to the growth and transformation of trade and retailing business. E-commerce, which is commonly associated with online shopping, has effectively made use of the Internet to create virtual networks to be used as platform for market transaction in goods and services. Statistics on e-commerce

confirm the rapid expansion of this industry. Worldwide B2C e-commerce sales have grown by 20% to reach US$1.7 trillion in 2015.

Studies have shown that e-commerce has a big boost to national productivity (Humphrey et al. 2003). This impact is found to be significant in developed economies and contribute to widening the gap between the developed and the developing economies. Less developed economies will find themselves in even more dire state if they don't address this broader insufficiency gap and their delays to up their game technologically.

6. Recognize that governments play a legitimate and crucial role in shaping the innovation capabilities of national economies. As between corporations, it's a competition; and, as with companies, the ones that develop the best strategies and skills at fostering, developing, and delivering innovation are the ones most likely to win (Ezell 2010).

   There are appropriate and inappropriate roles for governments to play in this competition. Supporting education, removing barriers to competition, supporting free and fair global trade, opening countries to high-skill immigration, and targeting strategic R&D investments toward the technologies and industries of the future are appropriate roles for governments to play in this competition. Other government policies, such as mercantilist ones which deny foreign countries' corporations access to domestic markets, pilfer intellectual property by stealing it outright or making it a condition of market access, creating indigenous or proprietary IT standards, failing to adhere to trade agreements, or directly subsidizing domestic companies or their exports, are illegitimate forms of global economic competition (Ezell 2010).

The development of the Internet, in particular, has optimized on a global scale (and with limited investment) access to and elaboration of information needed for trade, investments, entertainment, and education. At the same time, the global as well as national social economic environment has become volatile, uncertain, complex, and ambiguous (VUCA). Such environment requires leadership which is resilient and adaptable (Johansen 2007; Wolf 2007). The role of policy makers are no less important than that of the chief executives of private corporations. It would a boon to the country to have policy makers equipped with the capacity of VUCA leadership and well-developed mindset for gauging the technical, social, political, market, and economic realities of the environment in which people work.

This is not to deny that the private sector has the principal role in generating wealth and quality employment and in raising standard of living. Nonetheless, the public sector has the responsibility to help by providing the conducive business environment and economic foundations that will support sustainable economic growth. R&D grants, education and job training programs, and innovation policies are the major tools of states' public policies for raising the living standards of their citizens. Intervention in the economic environment via industrial policy in its modern and enlightened form remains to be an important and worthwhile activity for government in the digital age.

## Cross-References

- ▶ Industrial Policy and Sustainable Development
- ▶ Industrial Policy for a Sustainable Growth Path in Ukraine
- ▶ Information and Communication Technology Based Microfinance Model and Catch-Up Strategy: Latin America
- ▶ Regulatory Reform in Selected Network Industries: Lessons from Turkey
- ▶ Sustainability Challenges Shaping Competitive Advantages in Technology and Innovation

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