

The Role of Innovation and Intellectual Property in Economic Competition¹

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Among both advanced economies and developing nations, innovations and the intellectual property embodied in them play central roles in economic competition. The development and effective application of innovations can determine the outcome of the competition between domestic companies within an economy and between one nation's domestic firms and its foreign rivals in both domestic and third-country markets. The pace at which valuable innovations are developed, and then how quickly and broadly those innovations are adopted and applied across an economy, also greatly influence how much a country's GDP, productivity and incomes increase, absolutely and compared to other nations.

The competition between firms is echoed to some degree by an implicit competition between nations to be the home base for the intellectual property rights associated with the development and application of innovations. Numerous factors affect where firms decide to locate their operations. These factors include, beyond where the major markets for its innovative goods and services are located, the quality of its colleges, universities and scientific institutions, the strength of its intellectual property protections and their enforcement, the regulatory treatment of the firms and institutions that develop intellectual property, and the tax treatment of the profits derived from intellectual property. A nation can benefit greatly from attracting the intellectual-property-generating activities of foreign-based as well as domestic firms. In this context, one can say that nations around the world may well be engaged in a competition around innovation which policy analysts should monitor closely.

The critical importance of innovation and the underlying intellectual property reflects basic features of markets. Analyses of how markets operate usually begin with labor and capital, both physical and financial. However, the economic value of labor and physical capital also depend ultimately on ideas. Equipment or buildings embody ideas of how to construct them, while the value of most labor depends on the worker's education and skills. Moreover, the economic importance of innovation lies not only in the stock of economically-valuable ideas, but in a continuing process of generating new ideas that can be embodied in new innovations.

Innovations generate economic value only when they are adopted and applied. All nations therefore have an interest in promoting openness to innovations, wherever they were originally developed, because most of the economic benefits of innovation are enjoyed by those who use them. There is little doubt that the benefits to workers and corporations from using the Windows operating system far exceed Microsoft's profits, or that cancer medications provide greater benefits to those who use them and their societies, in productive lives prolonged or saved, than the profits earned by the pharmaceutical makers that develop and patent them. And both the development and application of economically-powerful innovations depend on legal and

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regulatory arrangements that protect the intellectual-property rights of those who develop and transfer them, thereby enabling them to profit from doing so.

As Paul Romer, a leading theorist of the sources of economic growth, has written,

The knowledge needed to provide citizens of the poorest countries with a vastly improved standard of living already exists in the advanced countries. If a poor nation invests in education and does not destroy the incentives for its citizens to acquire ideas from the rest of the world, it can rapidly take advantage of the publicly available part of the worldwide stock of knowledge. If, in addition, it offers incentives for privately held-ideas to be put to use within its borders (for example, by protecting foreign patents, copyrights and licenses, and by permitting direct investment by foreign firms), its citizens can soon work in state-of-the-art productive activities.²

In most cases, therefore, a society's openness to innovation is more important, in determining how fast it develops and grows, than its natural resources.³ From 1960 to 2000, for example, economic output and *per capita* incomes grew more than three times faster in South Korea, with relatively few natural resources, than in Brazil, a country with abundant natural resources.⁴ Much of the difference can be traced to Korea's relative openness to technological and other innovations developed elsewhere and imported to Korea through foreign direct investment or licensing agreements, as well as to Korea's greater commitment to broad-based public education that prepared its future workers to adapt to new technologies and ways of doing business.⁵

Over the last half-century, economists have documented the role that innovation and intellectual property play in the economic growth and progress of the United States, the world's most successful advanced economy. Since the 1950s, researchers starting with Robert Solow have established that the development and adoption of economic innovation has been the single most powerful factor determining America's underlying rate of growth and productivity in the 20th century. Solow, who was awarded the Nobel Prize for this work, as well as Edward Denison and others, have estimated that 30 percent to 40 percent of the gains in productivity and growth achieved by the United States from 1900 to the 1980s can be traced to economic innovation in its various forms.⁶ These innovations encompass the development of not only new technologies, but also new materials and processes, new ways of financing, marketing and distributing goods and services, and new ways of managing a workplace and organizing a business.

² Paul Romer, "Economic Growth" in the *Fortune Encyclopedia of Economics*, David R. Henderson, ed., Warner Books, 1993.

³ This discussion is adapted from Robert J. Shapiro and Kevin A. Hassett, "The Economic Value of Intellectual Property," 2005, <http://www.sonecon.com/docs/studies/IntellectualPropertyReport-October2005.pdf>.

⁴ World Bank, *World Development Indicators*, Washington, DC: World Bank, 2005.

⁵ Shapiro and Hassett (2005), *op. cit.*

⁶ Robert M. Solow, "A Contribution to the Theory of Economic Growth," *Quarterly Journal of Economics*, Vol. 70, 1956; Robert M. Solow, "Technological Change and the Aggregate Production Function," *Review of Economics and Statistics*, Vol. 39, No. 3, 1957; Edward F. Denison, "The Sources of Economic Growth in the United States and the Alternatives Before Us," Committee for Economic Development, Supplementary Paper Number 13, 1962.

The dominant role of new ideas in economic life also has been documented in a recent study from the Federal Reserve System.⁷ Its authors analyzed the various ways that companies use ideas by examining several categories of business spending on so-called “intangibles,” including spending on software programs and databases; expenditures for scientific and non-scientific R&D, new-product development costs by service firms; spending on advertising and market research to create brands; resources devoted to developing new business models and corporate cultures; and expenditures on firm-specific training. By classifying these outlays as capital investments intended to increase future earnings, rather than spending on current output, the authors found that U.S. businesses invest as much in these idea-related intangibles – about \$1 trillion a year in the early years of this decade – as they do in plant, equipment and other traditional, tangible forms of investment.

The Federal Reserve study further established that in the 1990s, U.S. business spending on long-lasting, knowledge capital grew faster than any other type of business or personal spending. Finally, they traced more than four-fifths of the gains in U.S. productivity in the latter 1990s to the development and application of new ideas, especially involving new information technologies: Over the years 1995-2001, the development of new information technologies accounted for 28 percent of those gains, capital investment in those technologies accounted for another 34 percent, research and development accounted for 10 percent, and changes in the organization of firms and worker training in response to innovations accounted for another 10 percent.⁸ By applying this approach to data for 2001-2003, other researchers have estimated that nearly 90 percent of U.S. economic growth during that more recent period can be attributed to increases in the stock of intangible assets.⁹

Another recent study affirmed these results by reexamining the impact of innovation on U.S. growth during the last quarter of the 20th century.¹⁰ The authors applied a version of Solow’s growth accounting to two periods – 1973 to 1995, and 1995 to 2003– and found that the impact of innovation on growth increased significantly from the first period to the second. They found that the contributions to growth from improvements in labor quality (skills and education) and traditional capital investment in plant and non-IT equipment fell from 30 percent in the first period to 19 percent in the more recent period. The impact on growth of investments in IT capital remained stable – 18 percent in the first period and 19 percent in more recent years –as did the contribution of intangibles. However, the contribution of “multifactor productivity,” largely a proxy for the development and application of innovations, increased from 25 percent to 35 percent.

Recent research also has explored why most economically-powerful innovations originate in advanced economies: Innovation thrives in places where commitments to research and development are strong, the political and economic environments are stable, barriers to starting new businesses are relatively low, and intellectual property rights are respected and

⁷ Carol Corrado, Charles Hulten, Daniel Sichel, “Measuring Capital and Technology: An Expanded Framework,” Federal Reserve Board, *Finance and Economics Discussion Series*, No. 2004-65, August 2004.

⁸ *Ibid.*, Table 3.

⁹ Robert J. Shapiro and Kevin A. Hassett, “The Economic Value of Intellectual Property,” 2005, <http://www.sonecon.com/docs/studies/IntellectualPropertyReport-October2005.pdf>.

¹⁰ Bart van Ark et al., “Innovation and U.S. Competitiveness: Reevaluating the Contributors to Growth,” Research Report 1441, The Conference Board. 2009.

enforced. Similarly, the most successful developing economies are those that promote the specific economic and political conditions that support the importation of innovations, usually through foreign direct investment, and their adoption. In the words of two leading analysts of economic development, “most of income above subsistence is made possible by international diffusion of knowledge.”¹¹

In this regard, the World Bank reports that since 1980, the world’s greatest economic gains have been achieved by developing nations that aggressively opened their economies to foreign technologies and business methods, and then protected the intellectual property rights of their developers.¹² From 1980 to 2002, the developing East Asian economies achieved growth averaging more than 7.4 percent per year, and the developing South Asian economies grew by an average of more than 5.4 percent annually. By contrast, Latin American economies with more restrictive foreign-direct-investment policies and lax intellectual property protections grew by less than 2.5 percent per year over the same period. More generally, another World Bank study of patenting and growth in 92 countries over the period 1960 to 2000 found that a 20 percent increase in the annual number of patents granted, wherever the technologies originated, was associated with an increase of 3.8 percent in output.¹³

The role of legal protections for the intellectual property embodied in innovation also has been examined in a recent study of China.¹⁴ Researchers looked at high-tech firms in China across a number of provinces, controlling for local factors such as government corruption and banking and legal system development. They found that high-tech firms in provinces that enforced intellectual property rights were more successful in securing external debt and equity financing, invested more in R&D, and participated in more joint ventures than their counterparts in provinces that failed to strictly enforce intellectual property rights.

It may seem obvious that rates of innovation fall sharply when intellectual property rights are weak or absent, since the innovations developed by one person or company could then be copied and reproduced without compensation by any other company in any country. Yet, some analysts have raised questions about the ultimate utility of traditional intellectual-property rights for developing countries, including appeals to the World Intellectual Property Organization (WIPO) arguing that those rights actually impair economic progress in many of those nations.¹⁵

In fact, the relationship between innovation and intellectual-property rights is well-established in modern economics. To be sure, invention for its own sake does not always depend on those rights. Recent research based on data from the catalogues of inventions displayed at three 19th century world fairs, for example, found that inventors remained active in Denmark and Switzerland during periods in the 19th century when those nations lacked intellectual-property

¹¹ Peter J. Klenow and Andres Rodriguez-Clare, “Externalities and Growth,” National Bureau of Economic Research Working Paper No.11009, December 2004.

¹² World Bank, *World Development Indicators*, *op. cit.*

¹³ Derek H.C. Chen and Carl Dahlman, “Knowledge and Development: A Cross-Section Approach,” World Bank Policy Research Working Paper No. 3366, November 2004.

¹⁴ James S. Ang, *et al.*, “Does Enforcement of Intellectual Property Rights Matter in China? Evidence from Financing and Investment Choices in High Tech Industry,” AFA 2011 Denver Meetings Paper, 2009.

¹⁵ Group of Friends of Development, “Proposal to Establish a Development Agenda for the World Intellectual Property Organization (WIPO): An Elaboration of Issues Raised In Document Wo/Ga/31/11,” *Submission to the World Intellectual Property Organization*, April 6, 2005, www.ipjustice.org/WIPO/elaborationDA.

protections.¹⁶ However, the researcher also found that the inventions developed in places without strong patent protections mainly involved products in which the inventor could preserve secrecy without a patent, such as new food stuffs with “secret recipes.” The vast majority of the inventions which ultimately hastened economic development and lifted living standards – especially new technologies and manufacturing processes – were developed in societies with strong intellectual-property protections in the 19th century, most notably the United States and Germany.

Part of the explanation lies in how people normally respond to economic incentives. While a few souls are genuine altruists, most innovators expend the effort to develop something that provides economic benefits to others only if doing so also benefits themselves. Moreover, as corporations have come to dominate the development of innovations, the prospect of future gains as an essential incentive to innovate has become conclusive. The development of most modern economic innovations, especially in technology areas, requires highly-skilled people and sophisticated equipment and business organizations; and the use of all that labor and capital is costly. The reason that certain businesses are willing to bear those costs and forgo more immediate and certain returns from using their labor and capital in other ways is a prospect of larger returns in the future, protected by patents or copyrights.

The rest of the explanation lies in the essential, economic nature of ideas. The ideas that animate economic innovations are what economists call “non-rival goods.” Unlike such “rival goods” as a piece of equipment or real estate, an idea can be used by more than one person at a time and is easily duplicated. Because an idea cannot be physically possessed like land or equipment, its use by those who develop it does not preclude others using it at the same time.¹⁷ As a result, the returns from innovations cannot be secure without legal protections for the new ideas that animate them. This dynamic is evident in the results of a survey of American R&D executives in the pharmaceutical sector, who reported that without patent protections, at least 60 percent of the projects which ultimately produced new discoveries would never have been undertaken.¹⁸

Nations which are attractive places for innovation benefit from being so, and the actions of other countries can affect how much domestic innovation-related activity occurs in a nation. In this regard, some nations are involved in a complex game of moves and countermoves. For example, the Organization for Economic Development (OECD) estimates that counterfeiting and piracy, especially in foreign markets, cost companies as much as \$200 billion in 2005, and notes that the methodology used to derive this estimate may have undercounted those costs by hundreds of billions of dollars.¹⁹ These losses undercut the willingness of firms to invest large

¹⁶ Petra Moser, “How Do Patent Laws Influence Innovation? Evidence from Nineteen-Century World Fairs,” National Bureau of Economic Research Working Paper No. 9909, August 2003.

¹⁷ In economic terms, ideas are also considered to be “partially non-excludable goods”: An innovator acting as a private agent cannot prevent others from using his idea, as compared to someone who owns a piece of land or a factory who can prevent others from using it by hiring security guards.

¹⁸ Edwin Mansfield, “Patents and Innovation: An Empirical Study,” *Management Science*, Vol. 32, No. 1, 1986. For a literature review of the connections between innovation and intellectual property protections, see Sunil Kanwar and Robert Evenson, “Does Intellectual Property Protection Spur technological Change?” Yale University, Economic Growth Center Discussion Paper No. 831, June 2001.

¹⁹ “The Economic Impact of Counterfeiting and Piracy,” OECD, 2007, <http://www.oecd.org/dataoecd/13/12/38707619.pdf>.

sums to develop new goods and services, since a substantial share of the foreign market will be lost to intellectual-property counterfeiters and pirates. These dynamics also operate in the opposite direction: Researchers have found that strong intellectual property protections in developing nations directly stimulate the pace of innovation in advanced economies.²⁰

Innovating firms clearly benefit when they can extract more rents from their intellectual property – that is, claim greater revenues and profits -- by extending into new markets. But they also have to weigh the prospect of those gains against the increased risks of counterfeiting and piracy. Moreover, there is overwhelming evidence that developing nations benefit from cracking down on piracy and counterfeiting. Researchers have established that technology transfers to developing nations increase as those nations adopt and enforce strict patent protections, especially when the domestic companies in those nations compete with foreign innovators. Studies have also shown that increasing patent protections in a developing nation lead to significantly increases in overall U.S. investment into that country.²¹

While intellectual property protections promote the development of innovations, their impact on a nation's overall productivity, and thus its competitiveness, depends on the extent to which a country's businesses and households adopt them and how effectively they use them. Broad adoption of innovations, however, often takes many years.²² Jet engine travel, for example, spread slowly, because travel on the early jetliners was very expensive and offered travelers only modest advantages compared to prop airplane travel. Moreover, the adoption of an innovation always involves significant costs, which may include new training and organizational changes as well as the price of a new technology. Decades after the development of supersonic jet travel, for example, the high price of the technology continues to block its general adoption for commercial use.

However, broad adoption also can occur fairly rapidly, especially in the area of digital technologies. The reason is that these technologies often produce what economists call “network effects” that encourage their diffusion, because the usefulness of a new technology or business method based on it increases as more people or businesses adopt it. The value of a computer operating system such as Windows, for example, increases as more people adopt it and use it to share or exchange information. Such network effects, in turn, tend to take hold as the utility of an innovation increases – for example, as more applications are written for the Windows system – and as its cost declines. Of course, the same basic factors of utility and cost also drive the broad adoption of innovations without network effects. The personal computer achieved broad acceptance only after widely-useful applications were developed and prices fell sharply.

Some innovations also produce a type of cascade dynamic, in which their introduction and adoption are followed by subsequent innovations which build or depend on the initial technology, and which may have comparable or even greater impact on a nation's productivity and competitiveness than the initial innovation. The most prominent example in recent years is the personal computer and Internet, although electrification and early 20th-century mass

²⁰ Ishac Diwan and Dani Rodrik, “Patents, Appropriate Technology and North-South Trade,” *Journal of International Economics*, Vol. 29, No. 1, 1991.

²¹ Keith Maskus, “The International Regulation of Intellectual Property, *Weltwirtschaftliches Archiv*, 1994; and M. Scott Taylor, “Trips, Trade and Growth,” *International Economic Review*, Vol 35, 2004.

²² See, for example, Bronwyn H. Hall, “Innovation and Diffusion,” NBER Working Paper, National Bureau of Economic Research, 2004.

production also exhibit features of this dynamic. The spread of the Internet depended first on the previous broad adoption of personal computers, and later on the innovative development of “killer applications,” starting with e-mail. The Internet, like the personal computer, also produced cascading tiers of additional innovation, especially in the development of Internet-based businesses and the unique services which they can provide.

A more common type of cascading effect involves incremental improvements or enhancements of an existing innovation, which extend its usefulness to more industries or activities. This process may occur through changes in the product or through improvements in the production process which reduce the price and thereby promote its adoption for more purposes and industries. Both processes are apparent in innovations such as cellular telephony and personal computing devices, which gained a broad range of new capacities in a fairly brief time.

However, these dynamics and the factors that drive them do not explain why it can take many years for some innovations to achieve broad acceptance and even longer to produce the productivity and consequent competitiveness benefits ultimately associated with them. The most important recent instance is computerization, about which Robert Solow famously said in 1987, “we can see the computer age everywhere but in the productivity statistics.”²³

These delays involve lags between the development of an innovation and its broad adoption, and lags between its adoption and the time when its benefits are realized.²⁴ Many factors affect the rates at which an innovation is adopted and its benefits realized, including price, knowledge, the extent of investment in the existing goods or services displaced by the innovation, and the organizational changes and disruptions associated with its adoption. The adoption of DNA sequencing, for example, requires extensive additional education or training by those using it. Similarly, the adoption of alternative fuels has been slowed by the potential costs associated with writing down or writing off (for tax purposes) the value of plant and equipment that current forms of energy and then replacing them. And the adoption of information technologies was delayed by the extensive changes in business organization required for their productive use. As these dynamics suggest, product innovations generally are adopted more quickly than process innovations.²⁵ The primary reason is that the successful adoption of process innovations, such as mass production or information technologies, depends on major changes in organizational structure and administrative systems.

While many forces affect the broad adoption of many innovations in advanced countries, the principal underlying factor is usually the strength of competition. A recent study from the Federal Reserve Bank of New York analyzed a natural experiment to measure the impact of competition on the adoption of new technologies: The researchers compared the pace and extent to which various PC manufacturers, competing with each other, adopt new technologies and capacities in their machines, compared to Apple which maintains an effective monopoly on its form of the personal computer.²⁶ They found that competition drove the PC makers to introduce

²³ *New York Review of Books*, July 12, 1987.

²⁴ Richard Barras, “Towards a Theory of Innovation in Services,” *Research Policy* 15, pp.161-173, 1986.

²⁵ Fariborz Damanpour and Shanthi Gopalakrishnan, “The Dynamics of the Adoption of Product and Process Innovations in Organizations,” *Journal of Management Studies*, 38:1, 2001.

²⁶ Adam Copeland and Adam H. Shapiro, “The Impact of Competition on Technology Adoption: An Apples-to-PCs Analysis,” Staff Report No. 462, Federal Reserve Bank of New York, 2010.

significantly more new products, with shorter life spans and faster-falling prices, than Apple. Competition has been especially powerful in driving innovation in the PC market, because the introduction of a new model sharply drives down the price of earlier models. By contrast, Apple has at least partially shielded itself from this dynamic, which in turn has meant that the company has introduced fewer new models incorporating new capacities, maintains longer product cycles, and offers slower price reductions.

Competition also drives the spread of new technologies from businesses in one country to business in other places, especially in the case of the advanced economies. The rapid adoption of innovations by companies in developing nations, however, depends on other factors as well, including the nation's wealth, the educational level of its workforce, its openness to trade, and whether it has adopted predecessor innovations.²⁷ One broad analysis of how innovations diffuse from one economy to another found that between 49 percent and 87 percent of the differences in the rates of adoption across countries can be explained by five factors, the most important being the relative advantage they confer in competition, their compatibility with existing technologies and organizational arrangements, and their overall complexity.²⁸

Researchers also have found that the perception or understanding of an innovation is a critical factor in its adoption both within an economy and across economies. For example, the relative advantage conferred by an innovation depends on how much the innovation is seen to be superior to the existing alternatives. Thus, for example, the use of seatbelts accelerated once it was perceived clearly that the new technology saved lives. The compatibility of an innovation with existing arrangements can also have large effects, so that farmers in developing nations were slow to adopt techniques of soil conservation, because those techniques were seen initially as conflicting with the traditional value of increasing farm production. The importance of complexity is evident in the adoption of computers, which began with small numbers of early adopters and then spread across the American economy and eventually to developing economies once their apparent complexity was reduced by incremental changes that made computers much more user-friendly.

Certain factors also can impede the spread of innovations to some countries, especially legal and regulatory arrangements which dampen competition and otherwise impede the normal process by which innovations are widely adopted. For example, barriers to the formation of new businesses can dampen the competitive pressures to innovate. The reason is that new firms are more likely to seize on innovations, in order to create market niches for themselves; and if they succeed in claiming a share of the market, their success will produce new competitive pressures for others to adopt the same innovations. These barriers are most evident in instances of state-sanctioned monopolies or oligopolies, where new business formation is precluded by law. However, less drastic barriers to new business creation, such as extensive regulatory requirements or limited access to start-up capital, can have similar effects on the spread of innovations.

²⁷ Diego Comin and Bart Hobjin, "Cross Country Technology Adoption: Making the Theories Face the Facts," Staff Report No. 169, Federal Reserve Bank of New York, 2003.

²⁸ Everett Rogers, *Diffusion of Innovations*, Free Press, 2003. The other two factors are "trialability," or the extent to which the innovation can be experimented with on a limited basis, and "observability," the degree to which the results of an innovation are visible to others.

Product price regulations can also dampen these critical competitive pressures, by slowing or stopping the normal scientific and economic process by which the price of many innovations declines over time, which in turn helps to drive their broader adoption. Similarly, trade protections not only can impede the flow of new ideas from one economy to another; they also can directly shield firms from competition from innovative companies in other countries. Finally, labor regulation can slow the spread of many innovations from other countries by preventing companies from undertaking the organizational changes required to make effective use of certain innovations, especially new technologies. For example, French labor law has broadly prohibited the firing or reassignment of workers without sufficient cause, and reorganizing a business in order to take better advantage of new information technologies has not been considered sufficient cause.

Competition: Efficiency versus Innovation

The role that innovation plays in the competitiveness of companies and countries also has important implications for the common understanding of how markets operate. It is generally said that companies compete on the basis of price or quality, with innovation often taken to represent the essential element of quality.²⁹ In practice, this simple, either-or distinction makes sense only when the innovation involves an improvement on an existing product which enables the innovator to gain market share and charge a higher price than its competitors whose products lack the new feature or capacity. This is most common when the innovation is considered especially vital to some consumers and is protected by patents or copyrights, such as a new pharmaceutical or software program, which produce a monopoly rent. In many other cases, however, an innovation may enable the innovator to compete on the basis of both price and quality. For example, some innovators will choose to not raise their prices in order to increase market share. In other cases, the innovation involves some aspect of the business process – production, marketing, financing, distribution, after-purchases services – and produces a price advantage for the product affected by the innovation.

In a period of rapid technological advance, such as our current period, competition itself often centers on innovation. Cellular telephony provides an example of innovation-based competition, in which U.S. companies such as Apple (i-Phone) and Google (Android) have vastly expanded the U.S. share of the global market for a product which European and Japanese firms initially dominated. In such periods, economies like the United States that foster the development and adoption of innovations can secure a significant competitive advantage even when factors such as the cost of labor and capital produce competitive disadvantages.

Furthermore, globalization creates opportunities for companies in advanced economies to combine the advantages derived from the conditions that foster innovation with those derived from low factor costs. American companies have been particularly successful in this use of globalization, developing new products in the United States while using foreign-direct investment in low-cost countries for much of the production and assembly. In 2005, 27 percent of the total stock of U.S. foreign direct investment was located in low-cost developing nations, compared to less than 10 percent for Germany, France and Britain.³⁰ This economically

²⁹ See, for example, Christine Greenhalgh and Mark Rogers, *Innovation, Intellectual Property and Economic Growth*, Princeton University Press, 2010.

³⁰ Robert Shapiro, *Futurecast*, St. Martin's Press, 2008.

powerful combination helps explain why the global market share of U.S.-based high-tech companies increased from 24 percent in 1990 to 41 percent in 2005.³¹ Over the same years, the market share for high-tech companies based in the big three European economies fell from 26 percent to 18 percent, and from 24 percent to 16 percent for high-tech firms based in Japan.³² Moreover, the competitive advantages secured through this use of globalization by innovating companies also depend on the effective use of IT and Internet-based innovations to build and manage efficient global networks.

The likelihood of innovation-based competition depends on the same factors that drive innovation itself, including the ease or difficulty of forming new businesses, the ability of new businesses to secure the talent and financing they need to survive, and the existence or absence of subsidies or other regulatory protections for existing businesses. It also usually depends on the intensity of price-based competition, the condition which often drives existing firms to innovate or adopt the innovations of their rivals. These findings challenge the view of Joseph Schumpeter, who believed that innovation was most likely to occur in large firms in concentrated industries, especially monopolies and oligopolies, because they could use their monopoly or oligopoly rents to finance the innovation process. But as Nobel Laureate Kenneth Arrow and others observed, when intellectual property rights are enforced strictly, producers in competitive industries have greater incentives to innovate than monopoly or oligopoly firms, which can rely on their special legal status to maintain their market shares.

One question that remains unsettled, however, is whether large or small firms are more likely to innovate: Large firms are more likely to conduct R&D, but smaller firms that carry out R&D are more R&D intensive on average than big firms.³³ The answer, at least in the American case, probably lies in the successful combination of large and small firms. In innovation-based industries such as software and biotechnology, for example, the prevailing model for innovation has become one in which small firms develop something new and then are bought by large firms which complete the development and then commercialize and market the innovation.

Michael Porter approaches the distinction between innovation-based and price-based competition in a different way. He argues that innovation-based competition generally characterizes economies at a different stage of economic development than price or efficiency-based competition.³⁴ Emerging economies just beginning to harness global technologies and business methods for local production, usually relying on foreign direct investments and joint ventures with companies from more advanced economies, generally focus on the manufacture of commodity-like goods, and therefore almost always compete on the basis of price or efficiency. By contrast, advanced economies are characterized by “innovation-driven economic development.” It is noteworthy, however, that both stages of development depend on strict intellectual property protections – to enforce the rights and protect the profits of those

³¹ National Science Board, Science and Engineering Indicators, 2006.

³² *Ibid.*

³³ Christine Greenhalgh and Mark Rogers, *Innovation, Intellectual Property and Economic Growth*, Princeton University Press, 2010.

³⁴ Michael E. Porter, “Competitiveness and Stages of Economic Development,” Executive Summary of the *Global Competitiveness Report 2001-2002*, World Economic Forum, 2001.

transferring advanced technologies to developing countries, and to protect the incentives to develop those technologies in more advanced economies.³⁵

In practice, as noted earlier, many of the apparent distinctions between competition based on relative prices or efficiency, versus competition based on innovation, eventually break down. In broad terms, a company's competitiveness depends on how effectively it adopts best practices in production, technology, and business or management methods; and all of these capacities involve innovation as well as considerations of efficiency.³⁶ Moreover, many innovations are designed to enhance the efficiency of an existing process and thus drive down costs and prices, rather than provide a new element or capacity to an existing product or process.

The question remains of how to assess the impact of innovation on economies invested and engaged in innovation-based competition; and one answer can be derived from measures of the intellectual property embodied in innovations. As expected, the American economy is fairly dominated by intellectual-property-intensive industries. One recent study, for example, focused on "IP [-dependent] industries" in the United States, defined as those industries that depend on copyright and/or patent protections in or for a digital environment (semiconductors, software publishers, motion pictures, advertising, and so on), those industries that depend on patent rights to improve their products and improve their efficiency (the automotive, aerospace, biotech/pharmaceutical and chemical industries), and those which support the transportation and distribution of IP products (retail and whole merchandisers and transportation industries).³⁷ This research found that in 2003, IP-dependent industries accounted for 20 percent of all private sector GDP, but 40 percent of the growth of all private industry, attesting to the impact of innovations and the intellectual property embodied in them on U.S. productivity.

These IP-dependent industries also accounted for 40 percent of all exportable high-value-added goods and services and nearly 60 percent of the growth of exportable high-value-added goods and services, attesting to the disproportionate impact of innovation on international competitiveness. In a similar vein, another recent study found that the announcement of a new product has both a significant positive impact on an innovator's stock price and a significant negative effect on its' rivals' share price.³⁸ All together, these data suggest that U.S. industries organized around the development and adoption of innovation are in critical ways relatively more competitive than other U.S. industries.

America's recent capacity to extract greater productivity gains from IT innovations, compared to Europe or Japan, has spurred a number of studies comparing conditions across the various economies. Research by the Commerce Department's Economic and Statistics Administration in the late 1990s points to more stringent labor regulation in the large European economies, as hindering European businesses from reorganizing their operations to take best advantage of the new technologies and so forcing their firms to focus more on price-based

³⁵ See the literature review in Robert Shapiro and Kevin Hassett, "The Economic Value of Intellectual Property," *Sonecon*, 2005.

³⁶ See, for example, Michael E. Porter, "Location, Competition and Economic Development: Local Clusters in a Global Economy," *Economic Development Quarterly*, February 2000.

³⁷ Stephen E. Siwek, "Engines of Growth: Economic Contributions of the US Intellectual Property Industries," *Economicist Incorporated*, 2005.

³⁸ Aigbe Akhigbe, "New Product Innovations, Information Signaling and Industry Competition," *Applied Financial Economics*, 15, pp. 371-378, 2002.

competition. Similarly, a long line of research pointing to intense competition as a critical factor in the diffusion of new technologies and associated business methods suggests that the relatively stricter overall regulatory environment in Europe and Japan reinforces their focus on price-based rather than innovation-based competition.

Another recent study examined more systematically the role of the so-called “knowledge economy” in explaining why, from 1995 to 2004, productivity gains accelerated in the United States while they were slowing down in the EU-15.³⁹ Over this period, the EU-15 grew an average of 2.2 percent per-year while the United States expanded an average of 3.7 percent annually, producing widening gaps across a number of key economic measures. By 2004, Europe’s GDP *per capita* was only 74 percent that of the United States, the hours worked *per capita* by Europeans were 82 percent that of Americans, and GDP and capital input, per-hour worked, across the EU-15 were both only 90 percent of the levels in the United States. The researchers applied growth accounting to analyze why these gaps have widened. They found, first, that the traditional factors of economic production – labor and capital investment – could not explain these growing differences. Rather, they traced these differences almost entirely to three factors which together, they argue, comprise the “knowledge economy” – investments in information technologies, the increased use of highly-skilled workers, and multifactor productivity encompassing both organizational and technological innovations.

The study also disaggregated these growth and productivity differences across sectors. They found that the productivity of European and American non-IT manufacturing firms was generally equivalent over this period, while the contribution to national productivity of U.S. IT producers was nearly twice that of their European competitors. Moreover, U.S. service industries adopted IT more broadly over this period than their European counterparts, and the contribution to productivity by service industries was more than three times greater in America than in the EU-15.

Other research comparing the recent economic performance in America and Europe points to additional ways in which innovation may have bolstered U.S. competitiveness, such as by generating larger spillover benefits. The authors of that study document how U.S. firms are more likely to involve their suppliers in their new product development process than European firms, and how those suppliers then can apply the new inputs to other products.⁴⁰ However, the spill-over process also can have adverse effects on innovation, when it effectively reduces intellectual property rights. A recent study comparing the United States and Japan, for example, found that Japan’s patent system promotes greater diffusion of information across an industry than seen in the United States, but in ways which lower the return to innovators and thus reduce the incidence of innovation.⁴¹

³⁹ Bart van Ark et al., “The Productivity Gap Between Europe and the United States: Trends and Causes,” *Journal of Economic Perspectives*, Vol. 22, No.1, pp. 25-44, 2008.

⁴⁰ Laura M. Birou and Stanley E. Fawcett, “Supplier involvement in Integrated Product Development: A Comparison of US and European Practices,” *International Journal of Physical Distribution and Logistics Management*, Vol 24, No. 5, pp. 4-14, 1994.

⁴¹ Wesley M. Cohen et al., “R&D Spillovers, Patents and the Incentives to Innovate in Japan and the United States,” *Research Policy* 31, pp. 1349-1367, 2002.

The hierarchical and insular character of many Japanese industries also may limit their success in innovation-based global competition, compared to their U.S. counterparts.⁴² For example, researchers have traced the relatively small numbers and limited success of Japanese software firms to the strict focus by Japan's dominant computer and electronics manufacturers on developing hardware and then locking in their customers by supplying the software customized for their hardware.⁴³ In other, more highly-innovative sectors of the Japanese economy, such as anime and mobile telephony, industry leaders have focused almost exclusively on domestic sales, limiting the success of their innovations in foreign markets. Much as in the case of the large European economies, Japan's capacity to grow through innovation and succeed in innovation-based competition is hampered by a number of factors, including weak antitrust enforcement, high barriers to foreign direct investment, and a badly-underdeveloped venture capital sector.

All told, these studies suggest that among advanced economies, those that nurture and promote the conditions for innovation and its broad adoption, and thus become more focused on innovation-based competition, have a competitive advantage over those more focused on price or efficiency-based competition.

Conclusion

For a half century, economic research has shown that the single largest factor driving gains in productivity and growth in a modern economy is innovation. That body of research and this analysis approach the subject broadly, encompassing not only the development and application of new technologies, materials and production processes, but also new ways of financing, marketing and distributing goods and services, and new ways of organizing a workplace and managing an enterprise. Especially in a period of rapid technological and organizational changes, like the present one, the competitiveness of firms and nations depends significantly on how effectively they apply and use economically-powerful innovations from information technologies to online business networks.

These results are apparent not only in the strong productivity and income gains achieved by the United States over the last generation, compared to Japan and the major European economies, and in the growing global market share of American-based high technology companies, compared to their counterparts in Europe and Japan. The impact of innovation is equally apparent in the enormous economic progress achieved by developing nations such as Taiwan and Korea, and China more recently, which encourage foreign direct investment of advanced technologies and business organizations.

Inventive and commercial genius are qualities that know no borders, and no society has a monopoly on such talents. But certain nations are homes to disproportionate numbers of companies capable of developing and adopting the powerful and often disruptive innovations which help drive economic progress and competitiveness. These nations share certain economic and political conditions which promote their development and application, starting with strong intellectual property protections for the new ideas that animate innovations. Every advanced

⁴² Robert Dujarric and Andrei Hagiu, "Capitalizing on Innovation: The Case of Japan," Working Paper 09-114, Harvard Business School, 2009.

⁴³ This approach is similar to that of the U.S. computer firm Apple, which maintains only a modest share of the U.S. PC market.

economy today has reasonably strict IP rights and protections – a major change from the 19th century, for example. Among developing nations – and with the special exception of China – those which have achieved the greatest economic progress respect the IP rights of foreign companies, establishing a critical incentive for foreign direct investments of advanced technologies.

The sustained development and broad application of innovations depends on other social, economic and political conditions as well. An entrepreneurial economic culture and low barriers to the formation of new businesses play significant roles, because new and young businesses are major sources of innovations and more likely than established firms to quickly adopt innovations from others. Strong government support for basic research and development is important, especially in advanced economies, since the incentives for private firms to undertake basic R&D are notoriously weak. Similarly, sustained public investments in education and training are also critical, for both advanced and developing economies, to ensure a sufficient supply of workers who can operate new technologies or at least perform effectively in workplaces dense with those technologies.

Moving beyond these basic conditions, it is clear that numerous factors have induced many American firms to locate more of their intellectual property abroad; and if this trend persists, it could undermine or reduce some of the historical advantages of the United States. Recent research suggests, for example, that firms shift around, from country to country, large amounts of income; and much of that shifting involves income derived from intellectual property.⁴⁴ Further, recent data suggest that firm decisions regarding where to locate the company's intangible assets are quite sensitive to tax rates and tax burdens. One study, for example, estimated that a 1 percent reduction in a nation's corporate tax rate increases by 1.7 percent the stock of intangible assets held there by multinational companies.⁴⁵ Moreover, certain other factors that are likely to have comparably powerful effects, such as the enforcement of patent provisions, vary less now across nations. In any case, there is strong evidence of extensive cross-border patenting activity. The World Intellectual Property Organization reports that non-resident patent filings grew at an average annual rate of 7.3 percent from 1994 to 2006. Moreover, U.S. firms have been especially active in this way. Foreign patent applications by U.S.-based companies increased by approximately 50 percent from 2000 to 2006, growing significantly faster than the growth of U.S. domestic patent applications.⁴⁶

A strong competitive environment is the most important economic condition for promoting the broad development and application of innovations capable of enhancing the competitiveness of a nation's firms. Competitive pressures can provide powerful incentives to both develop new technologies, products and ways of doing businesses, and to adopt the effective technologies and business methods developed by others. These pressures often come from young businesses trying to create their own market niches; and when they succeed, they exert new competitive pressures on more mature businesses to follow suit. Therefore, the

⁴⁴ Harry Grubert, "Intangible Income, Intercompany Transactions, Income Shifting, and the Choice of Location," *National Tax Journal*, Vol. 56, No. 1, Part 2, March 2003.

⁴⁵ Matthias Dischinger and Nadine Riedel, "Corporate Taxes and the Location of Intangible Assets Within Multinational Firms," *Journal of Public Economics* Vol. 95 pp. 691-707, 2011.

⁴⁶ "World Patent Report, A Statistical Review," World Intellectual Property Organization, 2008, http://www.wipo.int/ipstats/en/statistics/patents/wipo_pub_931.html#b11

various conditions which tend to reduce strong competitive pressures – for example, trade protections, product or industry regulations that insulate dominant businesses from competition, special spending and tax subsidies for established businesses, and many labor regulations that can restrict a firm’s ability to hire, reassign or discharge employees – tend to slow or reduce the development and especially the adoption of innovations.

When these conditions are fulfilled, competition itself often centers on innovation or quality, rather than efficiency and price – especially in a time of rapid technological and organizational changes, like the current one. At such times, firms in countries whose culture and legal and economic arrangements promote such changes may establish significant competitive advantages. These effects have been evident in the generally superior economic performance of the United States over the last generation, compared to Japan and the large European economies. Moreover, they are having transformative effects on the U.S. economy, producing the world’s first, genuine idea-based economy. Industries dominated by their intellectual property account for a growing share of America’s GDP and an even larger share of the growth of that GDP. In addition, for the first time on record, American business since the mid-1990s have been investing less in traditional physical assets than in new intangible assets, including not only intellectual property and the R&D that produce it, but also software, databases, training, organizational changes and so on. Moreover, markets now value firms mainly on the basis of those intangible assets: In 1984, the book value of large U.S. public companies – what their physical assets could be sold for, on the open market – accounted for three-quarters of their market capitalization.⁴⁷ By 2005, the book value of large U.S. public corporations accounted for just 36 percent of their market caps, so that nearly two-thirds of the value of American businesses is now based on their intangible assets.⁴⁸

The competitive advantages of an idea-based economy are available to any society prepared to actively and aggressively promote the development of new ideas and the broad application of the most effective ones, wherever they were developed originally - across the city or across the world. The competitive advantages conferred in recent years on many American companies by our economic, political and cultural arrangements, moreover, may not be sustained if those arrangements change in basic ways. Some societies will find it difficult to adopt comparable arrangements. For example, while China has been open and quite successful in adopting many technological innovations developed in the United States and other advanced economies, the broad freedom implicit in the arrangements required to spur such development domestically could well exceed the political tolerance of its current leadership. Nevertheless, the competitive advantages conferred by actively promoting an innovation-based economy will produce strong incentives for its spread in China and many other places. The competitive landscape for American companies and the United States, therefore, will be even more challenging in the years ahead.

⁴⁷ Lowell L. Bryan and Michelle Zanini, “Strategy in an era of global giants,” *McKinsey Quarterly*, No. 4, 2005.

⁴⁸ *Ibid.*