CHAPTER 6

Innovation and the Information Economy

Innovation is a primary engine of economic growth. Many commonplace features of modern life, such as personal computers, the Internet, e-mail, and e-commerce, have developed and diffused throughout the economy within a short span of years. Our Nation's growing prosperity depends on fostering an environment in which innovation will flourish.

The innovative process involves the invention, commercialization, and diffusion of new ideas. At each of these stages, people are spurred to action by the prospect of reaping rewards from their investment. In a free market, innovators vie to lower the cost of goods and services, to improve their quality and usefulness, and—most importantly—to develop new goods and services that promise benefits to customers. An innovation will succeed if it passes the market test by profitably delivering greater value to customers. Successful innovations blossom, attracting capital and diffusing rapidly through the market, while unsuccessful innovations can wither just as quickly. In this way, markets allow capital to flow to its highest-valued uses.

This engine of growth can falter, however, if government policies distort the market signals that guide innovative activity. Well-meaning policies to promote the diffusion of a service or foster entry into new markets can have unintended consequences. A policy to subsidize an existing service so that more people will consume it can deter development of innovative new services that people might otherwise prefer. In addition, pioneering investors forced to share the fruits of their investment with new entrants would find it less profitable to invest in the first place, and a new market may never be developed. When government regulation, instead of a competitive process, "picks the winners," people tend to lose.

This chapter provides an overview of recent developments in one especially innovative sector of the economy: information technology. The main points in this chapter are:

- Information technology is a key contributor to economic growth and productivity, and its importance to the economy is growing.
- Competition drives the broad diffusion of innovative low-cost, high-quality information services. This has held true in markets for mobile wireless telephones, satellite television, and dial-up and broadband Internet services.
- As circumstances change and industries evolve, existing government regulations may need rethinking. In particular, economic regulations

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aimed at correcting an absence of competition may lose their rationale when competition from new technologies emerges.

- People are motivated to invest by the prospect of earning returns on their investment. Government thus has an important role to play in defining and protecting property rights in intellectual and physical capital so that entrepreneurs will be spurred to innovate.

Growth of the Information Economy

Information technology (IT) has made enormous contributions to recent economic growth. IT comprises four categories of industry: (1) hardware (such as semiconductors and computers), (2) software/services (such as prepackaged software and data processing), (3) communications equipment (such as household audio and video equipment), and (4) communications services (such as telephone services and cable and other pay television services).

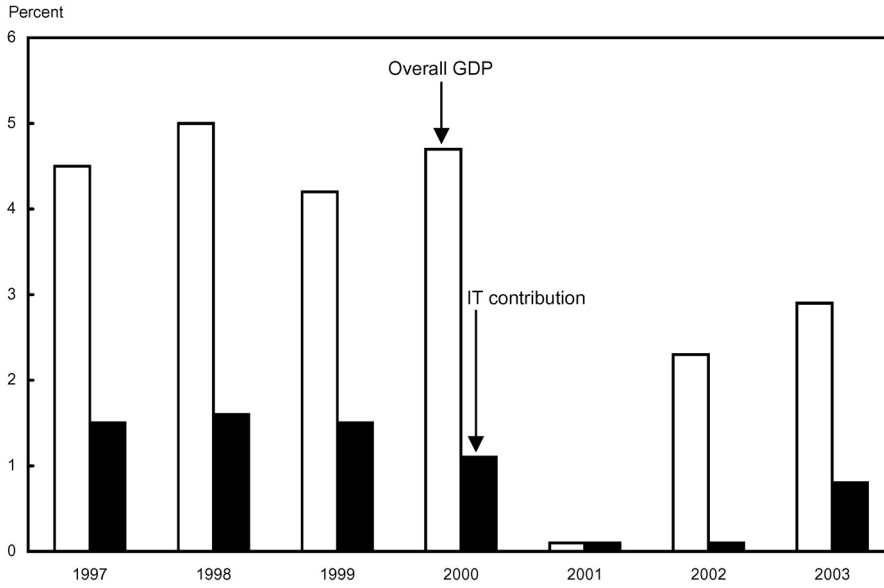
IT has made many workplace tasks easier, boosting people's productivity. One recent study finds that labor productivity in the nonfarm business sector grew at an annual rate of 2.4 percent from 1996 through 2001, and attributes nearly three-quarters of this growth to the accumulation of IT capital together with improvements in how people use this capital. IT has likewise contributed significantly to growth in our prosperity. Real gross domestic product (GDP) grew 2.9 percent in 2003, of which 0.8 percentage point was attributable to IT (Chart 6-1).

Growth in Computer and Internet Use

A key part of the growing information economy is that more people are using computers and communicating over the Internet. At the time of an October 1997 survey, 37 percent of households owned a computer. The corresponding figure for an October 2003 survey was 62 percent. Internet use from home nearly tripled over these six years from 19 percent of households in 1997 to 55 percent in 2003. In the workplace, recent growth in Internet and e-mail usage has also been dramatic. A survey found that in August 2000, 26 percent of employed persons aged 25 and over used the Internet and e-mail at work, while an October 2003 survey found the figure to reach 45 percent.

Explosive growth in Internet use has been a nationwide phenomenon. In 2001, only one state had more than 70 percent of its population using the Internet from any location. In 2003, five more states had reached the 70 percent level, and only one state fell below the 50 percent mark. At 57.2 percent, Internet use in 2003 among people living in rural areas was virtually on a par with the national average of 58.7 percent. Demographically, Internet use increases with both income and educational attainment.

Chart 6-1 **Growth in Gross Domestic Product Due to the Information Technology Sector**
Information technology contributes substantially to overall economic growth.



Source: Department of Commerce, *Digital Economy 2003.*

E-mail is the most common online activity, with more than 87 percent of Internet users aged 15 and over sending and receiving e-mail in 2003. The next most popular online activity, at more than 76 percent of Internet users in 2003, is searching for information about products and services. Two-thirds of Internet users obtained news, weather, and sports information online, and more than half made purchases online in 2003.

E-Commerce Tops $1 Trillion

Transactions conducted online—e-commerce—exceeded $1.1 trillion in 2002. Business-to-consumer e-commerce, reckoned as the sum of transactions in retail trade and in selected service industries (such as publishing, broadcasting, and telecommunications), reached $85 billion in 2002 (Chart 6-2). Retail trade e-commerce alone amounted to $44 billion in 2002, with nonstore retailers—those selling primarily through "clicks" rather than "bricks"—accounting for nearly three-quarters of this total. Online retail sales have continued to grow rapidly. In the third quarter of 2004, retail trade e-commerce was more than 21 percent higher than in the third quarter of 2003.

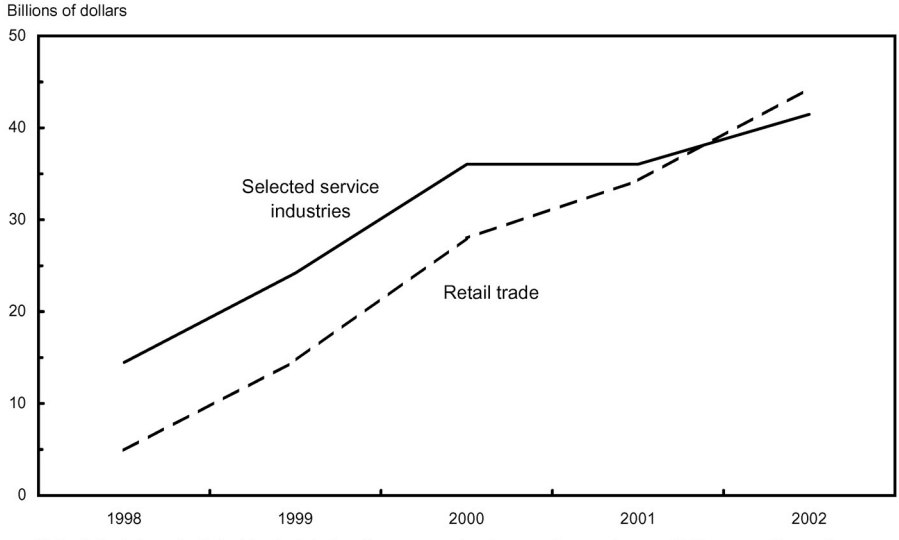
Consumers have gained from shopping online in at least two ways. First, comparison shopping has become quicker and easier online. A consumer can visit a succession of retail Web sites at virtually zero cost. Collecting a similar amount of information by visiting brick-and-mortar retail stores would be far

more time-consuming and costly. A consumer need not even canvass retail Web sites individually; "shopbot" sites can gather such information on the consumer's behalf. As the cost of comparison shopping has fallen, price competition has intensified, both among Internet retailers and between Internet retailers and brick-and-mortar stores.

A number of recent studies have attempted to gauge the consumer benefits from such intensified competition. Studies of the markets for books, automobiles, and life insurance have generally found that comparison shopping online helps consumers obtain significantly lower prices, resulting in savings estimated to be in the many hundreds of millions of dollars per year. Intensified competition between online retailers and brick-and-mortar retailers means that even consumers who do not shop online may be reaping rewards from the spread of e-commerce.

A second way in which consumers have benefited from e-commerce is in the greater variety of goods available online. For example, the number of book titles available at one major online bookseller is 23 times greater than the number of titles stocked in a major chain retail superstore. Greater variety means that consumers can match purchases more closely to their individual tastes. A recent study of book sales suggests that the consumer gains from greater variety online are even larger than the gains from intensified price competition.

Chart 6-2 **Business-to-Consumer E-Commerce**
Online commerce by consumers is growing rapidly.



Note: Selected service industries include travel arrangement and reservation services, publishing, securities and commodity contract intermediation and brokerage, computer systems design and related services, and others.

Source: Department of Commerce (Bureau of the Census).

Changed circumstances, such as new retailing methods, can pose challenges to existing regulatory frameworks, or even undermine the original rationale for regulation. As the Internet changes how we live and work, government should be attuned to these changes and adapt. The Internet is having an impact on regulation given the growth of e-commerce, as illustrated in Box 6-1, and the growth of broadband voice and data services, as discussed in a later section.

Although business-to-consumer online sales have captured much popular attention, these are dwarfed by business-to-business e-commerce, which in 2002 accounted for more than 90 percent of all online transaction volume. Manufacturing shipments transacted online were $752 billion in 2002, a 3.8 percent increase over 2001 (Chart 6-3). Online merchant wholesale trade increased by 11.7 percent from the 2001 level, to reach $320 billion in 2002.

Box 6-1: Airline Computer Reservation Systems

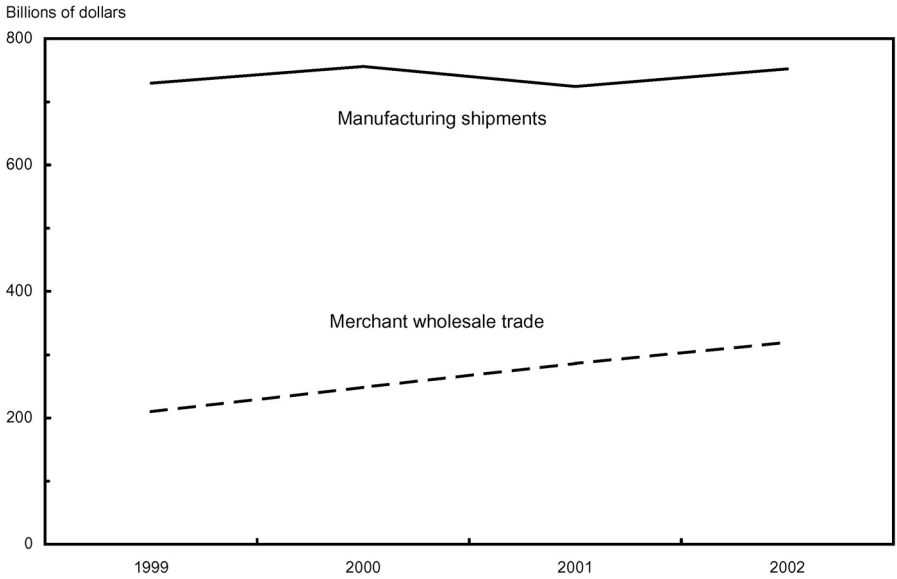
In the first half of 2004, the Administration deregulated airline computer reservation systems (CRS), which travel agents have used to book airline flights for travelers. Regulatory restrictions imposed in the 1980s became obsolete as people gained new information sources over the Internet. CRS centralize flight information across carriers and provide easy booking capabilities to travel agents. Following airline deregulation in the late 1970s, travel agents came to depend on CRS for the latest schedule and fare information. At the time, CRS were largely owned by individual airlines. This ownership raised concerns that CRS-owning airlines might put rival airlines at a disadvantage in the system so that travel agents would book a greater share of flights with the CRS-owning airline. CRS suppliers might also lock travel agents in by requiring long-term contracts and by structuring the programs to raise switching costs. To address these issues, the Civil Aeronautics Board instituted a series of regulations in 1984, which prevented a CRS-owning airline from setting up its systems in a way that disadvantaged other airlines or other CRS.

While the CRS rules may have been beneficial two decades ago, subsequent industry changes have made the regulations largely anachronistic through ownership changes and the development of travel search engines on the Internet. The airlines have completely divested the CRS, so concerns about discrimination against unaffiliated airlines are no longer warranted. Equally important, the advent of the Internet has provided carriers with an alternative avenue for disseminating their fare and schedule information to consumers. The growth of the travel search engines has also enabled consumers to quickly compare rates across airlines. The development of these direct-to-consumer channels has reduced the need for travel agencies and has

Box 6-1 — *continued*

reduced travel agencies' need for CRS, because they too can use the Internet. These changes work to place greater competitive pressure on the CRS vendors, which reduces the concern about their market power. In light of these changes, the Administration acted to deregulate the CRS market in the first half of 2004. Deregulation already appears to be having a positive effect—industry news reports indicate that CRS prices have fallen and are expected to continue to fall as old contracts expire and new ones are negotiated.

Chart 6-3 **Business-to-Business E-Commerce**
Online commerce between businesses exceeds $1 trillion.



Source: Department of Commerce (Bureau of the Census).

In 2002 online transactions among businesses were larger than business-to-consumer e-commerce not only in absolute terms, but also as a fraction of total value. Only 1.4 percent of retail trade revenues were transacted online in 2002. By contrast, 11.7 percent of all merchant wholesale trade and nearly one-fifth of all manufacturing shipments were transacted online in 2002.

Illegal Acts on the Internet

The Internet provides tremendous opportunities to improve the way we communicate, learn, entertain ourselves, and buy and sell goods and services. Unfortunately, theft, vandalism, and fraud are also moving online. From an economic perspective, these activities are costly because they violate the property rights of people, reducing their incentives to create new goods and diverting resources from productive uses as people spend time trying to undo the damage caused by computer viruses and Internet worms. More fundamentally, the growth in such activity could threaten public confidence in using the Internet for productive purposes. As in the offline world, where locks and inventory control tags deter property right violations, private sector responses can make cybercrime more difficult. Government must also act to protect property rights and ensure that the Internet and other new technologies are safe venues for commerce.

Cybersecurity

The growing reliance on the Internet means that computer users are exposed to new threats. Viruses and Internet worms impair computers and prevent authorized users from gaining timely, reliable access to data or a system. Attacks in cyberspace can maliciously modify, alter, or destroy data or a computer system. Attackers access computers without authorization to view or copy proprietary or private information, such as a credit card numbers or trade secrets. At a deeper level, concerns have grown about how unauthorized control over large numbers of systems by those with malicious intent can pose threats to the security of sensitive information or to the functioning of critical infrastructures. In terms of prevention, the private sector is best equipped to take steps against evolving cyber threats. The private sector owns most of the computer systems and networks and can, in many cases, capture the benefits from investments in improved security. Private sector surveys suggest that organizations are spending increasing amounts on IT security. The President's *National Strategy to Secure Cyberspace* also makes clear the Federal government's important role in promoting cybersecurity.

Fraudulent Spam and Spyware

Scams to defraud people are another type of property rights violation. The Federal Trade Commission (FTC) has found that *spam* (unwanted, typically commercial e-mail), in addition to being a nuisance, is mostly deceptive and fraudulent. Of 1,000 pieces of spam examined by the Commission, 84.5 percent were deceptive on their face or advertised an illegitimate product or service. As in the offline world, consumer awareness online is the first line of defense in combating fraud. The anonymity and scope of the Internet can make

it difficult for law enforcement agencies to track down sources of fraudulent spam and *spyware* (which collects information from the victim's computer). Such activity is growing quickly and posing significant costs to victims and companies. The President signed into law the Controlling the Assault of Non-Solicited Pornography and Marketing Act of 2003 (CAN-SPAM Act), which establishes a framework of administrative, civil, and criminal tools to help America's consumers, businesses, and families combat unsolicited commercial e-mail. The problems associated with spam cannot be solved by Federal legislation alone, but will require market responses in the development and adoption of new technologies. The Federal government has also stepped up the pursuit of purveyors of fraudulent spam and spyware. For example, in a joint law enforcement initiative, the FTC and the Department of Justice (DOJ) have brought actions to shut down operations that hijacked logos from online businesses to con hundreds of consumers into providing credit card and bank account numbers. December 2004 saw the formation of a new public-private consortium that includes financial services firms, Internet service providers, IT vendors, and law enforcement to fight Internet-based fraud.

Copyright Infringement

Copyrights encourage the development of goods such as books, songs, and videos that are much costlier to produce initially than to replicate. Digital technologies and the Internet have made possible high-quality reproduction of music and video at nearly zero cost, and facilitated extensive unauthorized use through mechanisms such as file-sharing networks. Industry is exploring technological remedies to combat theft, but the Federal government is also playing a role. The Attorney General has made enforcement of intellectual property laws a high priority of the DOJ. The DOJ has expanded its Computer Crime and Intellectual Property Section and created the Cyber Division of the Federal Bureau of Investigation. In 2004, the DOJ launched Operation Digital Gridlock, the first Federal enforcement action ever taken against criminal copyright theft on *peer-to-peer networks* (that allow groups of computer users with the same networking program to interconnect and directly access files from one another's hard drives).

Competition Versus Economic Regulation

An overly high price or low quality by a supplier opens the door to profit opportunities for the supplier's rivals. Rivals can expand their sales by undercutting price or offering superior quality or service. In this way, competition drives suppliers to provide customers the greatest possible value consistent with covering costs. Pursuit of profit opportunities also draws firms to enter

or develop new markets, which can lead to quantum leaps in consumer welfare. A pioneering firm that develops a new service, for example, may for a time reap high returns on its investment. But the high returns tend to draw other firms to enter and thus intensify competition in the new market. As competition drives down the innovative service's price, the service will become more broadly adopted by consumers. This pattern has unfolded time and again in diverse sectors of the economy.

The promise of competition might not be fulfilled, however, if scale economies in an industry are so great that only a single firm can supply the market cost-effectively. A firm operates under *economies of scale* when its average cost of supplying a good falls as the firm expands its scale of operations. Economies of scale can arise, for example, if the up-front costs of setting up a business are large. Once the groundwork of the business has been laid, the incremental cost of the good—the cost of supplying each additional unit—may be low. Examples of industries in which suppliers compete in the midst of scale economies include automobiles, software, and pharmaceuticals. Prices in such markets can fall over time, as firms enter the market and competition drives prices down toward the good's incremental cost. But a firm will only enter a market if it expects to earn enough of a margin above its incremental cost on enough sales to cover its ongoing overhead costs and recover its up-front costs of entry. In rare cases, up-front costs may be so large, and competition after entry so intense, that no entrant could profitably challenge the incumbent supplier's monopoly. Such industries are called *natural monopolies*.

Natural monopolies are a rare exception to the competition that to a greater or lesser degree characterizes most markets. Industries commonly given the natural monopoly label have tended to have a highly capital-intensive infrastructure, such as the telephone system, cable television, railroads, and the electricity distribution grid. A rationale for the economic regulation of these industries has been that competition and its benefits would not naturally arise. A monopolist has an incentive to restrict output and raise price above the competitive level. In the absence of competition, regulation may offer the prospect of a substitute, although a poor one, for the competitive process. Ideally, the aim of economic regulation would be an industry outcome of low prices and high quality that approaches what competition would have accomplished, had competition been possible.

However, natural monopoly does not necessarily mean economic regulation is needed to protect consumers from monopoly prices. While natural monopoly means that competition *in the field* is unlikely to arise, there could still be vigorous competition *for the field*—that is, competition among firms to attain the position of monopolist. Municipalities can and do exploit competition for the field, for example, by auctioning a monopoly franchise, to extract concessions from the winning monopoly provider.

Traditional, Rate-of-Return Regulation

Under traditional, rate-of-return regulation, the regulator estimates the firm's capital base and incremental cost. This approach allows the firm to charge prices just high enough to yield a rate of return that would have attracted capital to the industry, had the industry been open to competitive entry.

The traditional approach to regulation presents several difficulties. First, measuring a firm's capital base and incremental cost involves substantial auditing effort and uncertainty for the regulator. Judging the appropriate rate of return is also difficult, as it involves gauging the riskiness of capital investments in the industry. An especially problematic aspect of traditional regulation, though, is its effect on incentives. A firm in a competitive industry, and even an unregulated monopolist, has an incentive to trim its costs to a minimum so that it can capture the highest possible profit. A firm subject to rate-of-return regulation has no comparable incentive to keep costs down. The higher the firm's incremental costs, the higher the prices the regulator will generally allow the firm to charge to cover those costs. A key problem is that the firm has an incentive to choose overly capital-intensive technologies, because this increases the capital base to which the regulator applies the firm's allowable rate of return.

Price-Cap Regulation

Many Federal and state regulators have turned from traditional regulation to price-cap regulation of industries considered to be natural monopolies. Prior to 1984, all states regulated telephone service on a rate-of-return basis. By September 2004, 37 states had switched to some form of price-cap regulation. Under *price-cap regulation*, the regulator sets an initial price or basket of prices that the firm can charge for its goods. The price caps are then updated over time, by a positive factor to account for inflation and a negative offset to account for the firm's perceived ability to trim its costs through productivity improvements. If the regulated firm succeeds in trimming costs by more than than the productivity offset in the price cap, its profits will increase. The hope is that price-cap regulation may avoid some of the perverse incentive effects of traditional regulation, by de-linking the regulated firm's returns from its costs. Several recent studies have found that, in comparison with rate-of-return regulation, price-cap regulation is associated with improvements in the technical efficiency of telecommunications providers, as well as greater investment in modernizing switches and deploying fiber-optic cable.

Price-cap regulation is far from ideal, however, and in fact faces problems similar to those of traditional regulation. In setting the initial price cap, the regulator must measure the firm's capital base and incremental costs, as well as determine a rate of return that the capped prices should yield. This is identical to the process in traditional rate-of-return regulation. In setting an

inflation factor for the price cap's growth, the regulator must assess both the rate at which the firm's input costs are likely to grow and the rate of productivity growth the firm is capable of achieving. Given difficulties in gauging these rates, the regulator must make periodic adjustments to the price-cap mechanism in light of industry outcomes. But if the regulated firm underperforms, is it because the regulator miscalculated, or because the firm failed to pursue productivity improvements diligently?

Both rate-of-return and price-cap regulation suffer to some degree from information problems. A regulator cannot know with precision all of the economic factors relevant to setting prices. In practice, these types of regulation can lead to shortages, high costs, slowed innovation, or a combination of all of these shortcomings. Where vigorous competition is feasible, market forces can guide firms to deploy their resources in ways that benefit customers far more effectively than could a price-setting regulator.

Advancing technology is providing competitive inroads to a number of industries once considered natural monopolies. Satellite television offers a competitive alternative to cable television service (Box 6-2), and wireless telecommunications are competing with wireline telephone services. Such technology-induced competition can be expected to increase as cable companies begin to offer voice communications and telephone companies roll out video services.

Box 6-2: Satellite Television

Virtually all cable system operators hold franchise monopolies over cable television service within their local service territories. Only a few communities have issued multiple franchises, allowing for "overbuild" competition between cable system operators in the local market. A number of studies have found that cable rates in the 1980s were roughly 20 percent lower in markets with cable overbuild competition than in comparable markets served by cable franchise monopolists.

The rise of satellite TV services since the mid-1990s has also put competitive pressure on cable system operators. A study of thousands of cable systems across the United States finds that, controlling for a variety of other factors, a cable system's penetration rate (cable subscribers as a ratio of homes passed by cable) tends to be lower in areas where satellite reception is better. This is consistent with satellite TV providing more competition to cable TV where a larger fraction of households has access to satellite reception. While satellite TV has taken market share away from cable TV, the overall penetration of pay TV services among U.S. households has grown as satellite TV services have grown. As of June 1998, 78 percent of households with televisions subscribed to pay TV service.

Box 6-2 — *continued*

By June 2003, this had grown to 88 percent. A recent study indicates that the introduction of satellite TV led to substantial gains for consumers. However, ongoing antitrust oversight of the pay TV industry remains important. In 2002, both the FCC and the DOJ acted to block the merger of the two primary satellite TV providers to prevent a loss of competition in pay TV services.

Telephone Service: A Natural Monopoly?

Natural monopoly arguments have traditionally offered a rationale for economic regulation of telephone service. It can be costly for entrants to reproduce the incumbent local networks of copper wires or "loops" that connect nearly every U.S. household to telephone service. Over the past two decades, however, the wireline (land line) telephone monopoly has yielded to encroaching competition from the entry of alternative suppliers of long-distance service in the 1980s, the explosive growth in mobile wireless telephone service over the past decade, and the recent introduction of voice communications over the Internet. Such proliferating competition has posed challenges to the economic regulation of telephone services.

Long-Distance Services

Prior to 1984, both local and long-distance telephone service in the United States was supplied primarily by a single firm, AT&T. As part of a 1982 antitrust settlement with the DOJ, AT&T was broken up in 1984 into a number of regional exchanges providing local service and one long-distance provider that retained the AT&T name. The breakup separated local telephone service, which remained rate-regulated because of its natural monopoly characteristics or for jurisdictional reasons, from long-distance service and equipment manufacturing—businesses viewed as potentially competitive. Thereafter, competition in long-distance service progressed with the entry and expansion of alternative providers.

Between 1984 and 2002, per-minute long-distance prices fell by more than 80 percent after adjusting for inflation. This resulted in part from the FCC lowering per-minute access charges on long-distance calls, savings that were passed through to long-distance customers as a result of the emerging competition among long-distance providers. At the same time, the proportion of

U.S. households connecting to local telephone service grew from 91.4 percent in 1984 to 93.3 percent in 1990. A study of telephone demand over this period found that much of this increased penetration in telephone service could be explained by the drop in long-distance prices. This reflects the fact that consumers value connecting to the local telephone network for the ability to place long-distance calls as well as local calls.

Goods tend to be supplied efficiently when prices reflect costs. If a price is higher than the true cost of supplying an additional unit of a good, too little of the good will be consumed relative to what would yield the greatest net benefits to consumers and producers. Telephone charges pegged to the volume of call traffic tend to discourage call volume. This can lead to less than efficient utilization of the telephone network, if price exceeds the network costs of putting through an additional call or minute of calling. By the same token, price reductions toward unit cost encourage more efficient utilization of the network and increase the value consumers derive from connecting to the network.

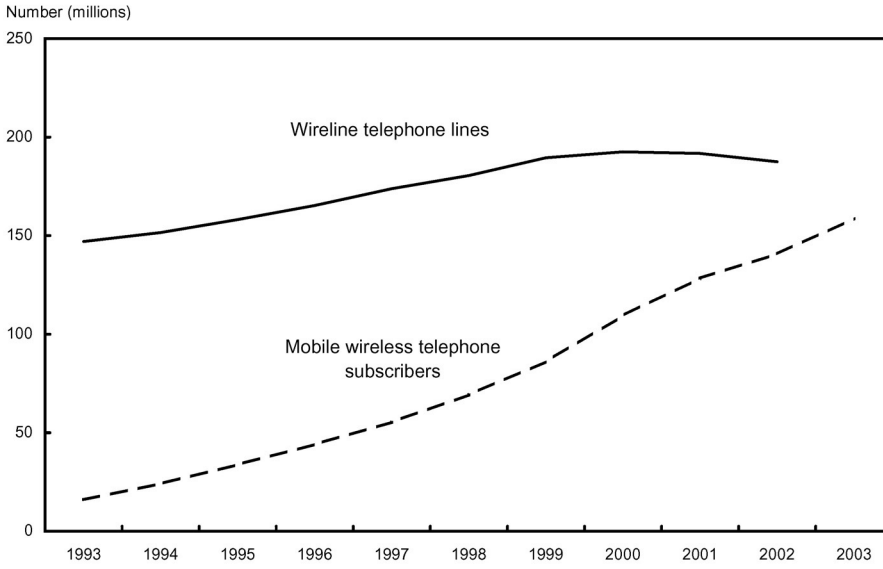
Mobile Wireless Telephone Services

Whatever the prospects for competition in telephone service may have been in decades past, substantial competition has emerged in recent years, and more is on the way. Mobile wireless telephone service has grown by nearly 26 percent annually, from 16 million subscribers in the United States in 1993 to more than 158 million in 2003 (Chart 6-4). Nationwide, 54 percent of the population subscribed to wireless service at the close of 2003. In contrast, nationwide wireline telephone penetration was nearly 95 percent in 2003, but the number of wireline telephone lines peaked in 2000, at 192.5 million lines, and fell by about 5 million lines over the next two years. Some of this decline likely reflects consumers choosing to switch from wireline to mobile wireless telephone service.

Compared to wireline service, wireless service offers the convenience of mobility and accessibility. Growing wireless penetration has been driven by a rapid drop in wireless prices. The average price per minute of mobile wireless telephone service fell from 47 cents in 1994 to about 11 cents in 2002 (Chart 6-5). Sharpening competition has helped drive the falling average price per minute of mobile wireless telephone service over the past decade.

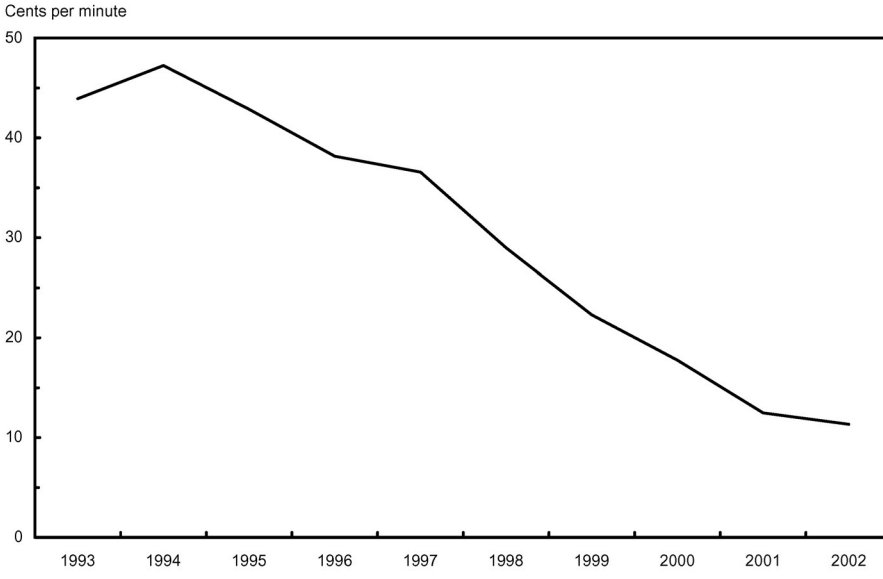
Wireless telephone services are carried over radio spectrum. *Spectrum* generally refers to a broad range of frequencies of electromagnetic radiation, which encompasses visible light. Frequencies higher than those of visible light include ultraviolet light and x-rays, while lower frequencies include first infrared light and then, as wavelengths grow longer, radio waves. *Radio spectrum* refers to the lower range of frequencies, which carry broadcasting and mobile communications services. If two transmitters at the same geographic location were to use the same frequency at the same time, they would *interfere* with each other,

Chart 6-4 **U.S. Wireline and Mobile Wireless Telephone Service**
As wireless telephone service has grown rapidly, the number of traditional telephone lines has begun to decline.



Source: Federal Communications Commission.

Chart 6-5 **Average Price Per Minute of Mobile Wireless Telephone Service**
The price of wireless service has fallen rapidly.



Sources: Federal Communications Commission and Council of Economic Advisers.

garbling their transmissions. To limit such interference problems, the Federal government licenses rights to use specified bands of spectrum at specified locations. Federal government users of spectrum are licensed through the National Telecommunications and Information Administration (NTIA). All other spectrum users are licensed through the FCC.

In the early 1990s, government-issued spectrum licenses for wireless telephone service were limited to just two cellular providers in each cellular market area. A series of FCC-run auctions beginning in 1995 provided additional spectrum for digital personal communications services (PCS), enough to support as many as eight wireless providers. By the end of 1999, 88 percent of the Nation's population could choose from three or more wireless providers and 35 percent could choose from at least six. By the end of 2003, these figures were up to 97 percent and 76 percent, respectively.

Talking on the Internet: Voice over Internet Protocol

Local exchange telephone networks are facing growing competition from Internet-based telephone services. Unlike traditional circuit-switched telephone calls, communications using Voice over Internet Protocol (VoIP) break the call stream into data packets sent over the Internet, turning your computer into an alternative to traditional telephone service. Much of the current volume of VoIP calls originates and terminates on public switched telephone networks, by callers using digital subscriber line (DSL) broadband services. But VoIP services are spreading to other network facilities, such as those of cable television systems. According to news reports, several of the country's largest cable system operators plan to roll out VoIP services within their service territories, which would make them available to millions of households. News reports indicate that Wireless Fidelity (Wi-Fi) broadband service providers are also exploring VoIP services. Looking ahead, electric utilities that develop broadband over power lines service could also provide VoIP services. All of these recent developments, together with the rapid growth in mobile wireless telephone service, suggest that the monopoly access to household voice communications that local telephone exchanges have had for nearly a century is yielding to intensifying competition.

The prospect of growing VoIP traffic has raised concerns in some quarters that this emerging competition may undermine the current structure of regulating telephone services. A basic rationale for the economic regulation of telephone service has been the natural monopoly argument, that is, that competition for telephone service was unlikely to arise. Economic regulation then offered the prospect of an alternative way, although a problematic one, of achieving some of the benefits of competition that customers have enjoyed in most other markets. But with competition now emerging, the natural

monopoly rationale for the economic regulation of telephone service is beginning to fall away. Squelching competition as a threat to the existing regulatory framework would turn matters on their head. Regulation should adapt to changing market realities in ways that allow innovation to flourish and consumers to choose among alternatives, while ensuring national security, homeland security, law enforcement and public safety.

Realizing the Promise of Broadband

Broadband services offer download speeds much faster than dial-up Internet access, enabling innovative features such as streaming video and VoIP. For example, fiber-optic cable to the home can provide speeds of more than 100 megabits per second. Broadband services have quickly been embraced by the public, growing from 2.8 million *high-speed lines* (defined as connection speeds over 200 kilobits per second in at least one direction) in December 1999 to more than 32.4 million lines in June 2004. This represents an annual growth rate of 72 percent. In the first few years after inception, broadband penetration among U.S. households has outpaced the earlier diffusion of dial-up Internet, mobile wireless telephones, personal computers, videocassette recorders, and color television.

Universal, Affordable Access to Broadband

Last March, the President announced a national goal of universal, affordable access to broadband services by 2007. The Administration's ongoing efforts to achieve this goal reflect a belief in the powers of competition and private sector innovation to bring the benefits of broadband to consumers. As experience in the telephone industry has shown, competition offers the most robust and reliable means of broadly diffusing important technologies. The Administration has taken steps to unleash the power of free markets to deliver broadband services by removing disincentives to invest, strengthening property rights, and allowing consumers rather than the government to choose the technologies that best meet their needs.

Removing Disincentives to Invest

Competition in broadband service is growing. Already, many communities have two providers of broadband service. In 1999, 33.7 percent of the zip codes in the United States had at least two high-speed Internet access providers. By the middle of 2004, the fraction had risen to 80.5 percent. So far, competition in broadband has primarily been between DSL services provided by telephone companies and cable modem services provided by cable television system operators. Cable's share in high-speed lines has grown

from 51.3 percent in December 1999 to 57.3 percent in June 2004. One avenue by which telephone companies could compete more effectively in broadband service is through investment in fiber-optic cable, which offers faster connection speeds than can generally be achieved over the copper wires of the traditional telephone network. According to news reports, fiber-optics will allow telephone companies to offer television in addition to very high-speed broadband services, similar to the current offerings of many cable television operators.

While fiber-optic high-speed lines have more than doubled between December 1999 and June 2004, other forms of broadband delivery have grown at an even faster pace, so that fiber's share in high-speed lines has fallen. Part of the reason may be that regulatory uncertainty has impeded fiber-optic investment. The Telecommunications Act of 1996 requires telephone companies to provide portions of their network facilities for sale or lease at regulated rates to competing local exchange companies. This process is known as "unbundling" network elements. Until recently, it remained unclear whether the Act's unbundling requirements would extend beyond copper loops to also cover fiber-optic cable. People are motivated to invest by the prospect of reaping returns. In residential neighborhoods, an unbundling requirement that would force investors to share the fruits of their investment in fiber-optic cable with competitors could blunt incentives to invest in fiber-optics. The result might not be more competition, but rather less innovation. The Administration supported the FCC's decisions in 2003 and 2004 to exempt fiber-optic loops from unbundling requirements when this technology is deployed to residential neighborhoods, including fiber-to-the-home, fiber-to-the-curb, and fiber-to-multi-dwelling-units. According to news reports in the wake of these rulings, a number of major telephone companies have announced plans to invest several billion dollars in deploying fiber-optic cable to reach more than 20 million households within three years.

Setting Interference Standards

The Administration has also helped to lower barriers to the development of new competition in broadband service. Broadband over power lines (BPL) holds the promise of adding a "third wire" into the home to compete with cable modem and DSL services. However, BPL generates radio waves that can interfere with the operation of wireless systems. The Administration has helped the FCC develop policies to address BPL interference issues. Beginning in 2003, the Commerce Department's NTIA undertook a detailed technical examination of interference risks posed by BPL, by conducting millions of measurements on test equipment. The NTIA submitted a report and set of specifications to the FCC, which adopted final rules on BPL technical requirements in October 2004. Setting appropriate interference

standards prevents those who deploy BPL technology from significantly infringing on the spectrum rights of others, while allowing the technology to enhance the broadband service options available to homes and businesses.

Strengthening Spectrum Rights

Another potential source of competition in the provision of broadband service is third generation, or "3G," wireless technologies. Wireless technology may revolutionize broadband competition by eliminating reliance on wires and cables. The technology may hold particular value for areas with sparse customers, where wire- and cable-based communications networks may be particularly expensive to deploy.

The rising demand for wireless services may at some point strain the limits of available spectrum. Aspects of the Federal government's system of allocating spectrum licenses can make it difficult for promising new technologies to displace lower-valued uses of spectrum. In May 2003, the President established the *Spectrum Policy Initiative* to reform spectrum management for the twenty-first century. In June 2004, the Department of Commerce provided two reports including policy recommendations to the President, and in November the President directed Federal agencies to implement the reports' recommendations. In particular, the President directed the Secretary of Commerce, in coordination with other Federal agencies, to develop a plan within one year for identifying and implementing incentives to promote more efficient and effective use of spectrum, while protecting national and homeland security, critical infrastructure, and government services.

One of many issues is the extent to which spectrum currently in government hands could be released for commercial use. In July 2002, the Department of Commerce produced a plan in concert with the FCC and Department of Defense to release for commercial use a broad swath of radio spectrum, while accommodating critically important spectrum requirements for national security. In December 2004, the President signed into law a piece of legislation to establish a spectrum relocation fund that will compensate government agencies for putting spectrum they have used up for auction. This will facilitate making Federal spectrum available when there are higher-valued private sector uses and provide a better mechanism for relocating Federal spectrum-dependent systems, with less uncertainty for both Federal users and industry.

Making more spectrum available for private use is not the only way to promote the development of promising new wireless technologies that provide high-speed Internet and other services. Spectrum policy could also enable spectrum used by the private sector to become available for higher-valued uses without making incumbent users worse off. As discussed in Chapter 5, *Expanding Individual Choice and Control*, assigning tradable property rights allows providers of the higher-valued uses to compensate incumbent holders

for their property rights. The Administration has encouraged the FCC to allow greater use of secondary markets, through which licensees could sublease their spectrum. The FCC adopted spectrum leasing rules in October 2003.

Simplifying Federal Rules

To promote widespread deployment of broadband networks, the Administration has worked to ensure that broadband providers have timely and cost-effective access to *rights-of-way*—the legal right to pass through property controlled by another—including access to conduits, corridors, trenches, tower sites, and undersea routes. Such passageways often cross large areas of land owned or controlled by the Federal government. The Administration has established a Federal Right-of-Way Working Group under the Department of Commerce to explore ways to simplify the tangle of Federal agency regulations broadband providers must navigate in seeking rights-of-way over Federal lands. The Working Group issued a report with a set of recommendations. In April 2004, the President instructed Federal government agencies to implement these recommendations.

Conclusion

The information technology sector has been a vibrant part of our economy and there is every indication that it will continue to be. The continued strength of this sector depends on fostering an environment in which innovation will flourish. In a free market, innovators compete to lower the cost of goods, improve their quality and usefulness, and develop entirely new goods that promise quantum leaps in consumer welfare. People are motivated to invest in developing new ideas and the infrastructure to enter new markets by the prospect of earning returns on their investment. Government thus has an important role to play in defining property rights in intellectual and physical capital so that people will be spurred to invest and innovate, as well as ensuring the development of an environment in which public safety and national security are protected. Government efforts to hasten the spread of innovative technologies should focus on lowering regulatory barriers that impede market provision. But government should avoid "picking winners" among emerging services. Doing so could entrench services that may become outdated as the marketplace evolves and hinder people from choosing the services they truly prefer. At this time, it is hard to predict the range of technologies that will emerge to deliver high-speed data services, or even what the scope of these services will be. As people vote with their dollars, the market winners that emerge will be those technologies and services that deliver customers the greatest value.