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13 *The Benefits of Broadband and the Effect of Regulation*

Economists are now beginning to recognize that the so-called new economy could have a pronounced effect on economic growth. There is still great debate, however, about how large this effect will be and what form it will take. Dale Jorgenson finds that, between 1995 and 2000, information technology accounted for about 30 percent of the growth of gross domestic product, largely as a result of the dramatic decline in computer prices.[1]

This chapter has two objectives: to provide estimates of the potential economic effects of broadband and to further an understanding of the way the regulatory environment can affect the diffusion of a new technology like broadband. It focuses on the potential value of the widespread deployment of broadband connectivity: that is, high-speed access to the Internet.[2]

The authors would like to thank Mary Beth Muething, Elizabeth Kinter, and Paul Brandon. We would also like to thank James Alleman and Thomas Hazlett for their comments. Some of the results described in this chapter are based on work Timothy Tardiff performed in collaboration with Alfred Kahn.

1. Jorgenson (2001) defines the information technology sector as comprising computers, communications equipment, and software.

2. Broadband technology is referred to as advanced telecommunications capability. This is a network with infrastructure capable of delivering a speed in excess of 200 kilobits a second in the last mile, both upstream (customer to provider) and downstream (provider to customer). When services are only capable of delivering transmission speeds in excess of 200 kps in at least one direction, they are referred to as "high speed." Advanced telecommunications capability and services are a subset of the larger category "high-speed." A service may have asymmetrical upstream and downstream transmission paths

Broadband Internet access is a relatively new service and is provided principally by cable modems and digital subscriber lines (DSL). As of December 2001 only about 13 million subscribers were connected to these services, with cable modems accounting for nearly two-thirds of these connections.[3] However, broadband is likely to provide new ways for consumers to acquire information, enjoy audio and video entertainment, monitor remote locations, receive medical care, and engage in business transactions. In addition, broadband could provide businesses with new opportunities to reduce their costs and to reach consumers with products and services. These benefits to households and businesses are likely to be large, as broadband spreads across the nation's households. Some research suggests potential annual economic benefits in the hundreds of billions of dollars.[4]

Broadband services have only recently been deployed to residential and small business customers. At the end of 1998 the Federal Communications Commission (FCC) counted fewer than 400,000 broadband subscribers—a penetration rate well under 1 percent—some 350,000 of them using cable modems and only 25,000 connecting with digital subscriber lines.[5] In the next three years, residential and small business subscribership grew rapidly, rising to 5.2 million by December 2000 and to 11.0 million by December 2001.[6] Cable modems maintained a two-to-one lead over digital subscriber lines, and wireless-satellite systems accounted for about 195,000 subscribers. Some analysts project that by 2004 subscribers will total more than 30 million, with cable modems maintaining or expanding their lead in market share.[7] If the market is unregulated, there is likely to be a competitive free-for-all among suppliers and technologies, but at this early juncture no one can predict what technology will be ultimately victorious. Consumers, however, should be clear winners.

Although the pace of broadband deployment may have been slowed by the regulation of digital subscriber lines, the diffusion of broadband has

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and still be considered advanced telecommunications capability, as long as both paths are capable of an excess of 200 kilobits a second to the network demarcation point at the subscriber's premises. FCC (2000a). See Charles Jackson, this volume.

3. FCC (2002c).

4. See, for example, Litan and Rivlin (2001); Crandall and Jackson (2001) (www.criterioneconomics.com).

5. FCC (2000a).

6. FCC (2002c).

7. See, for example, Belotti, Swinburne, and Lynch (2002).

been relatively rapid by historic standards. If current projections are vindicated, the growth pattern for broadband services will strongly resemble that of wireless a decade earlier: Wireless subscribers numbered 2 million in 1988 (approximately equal to broadband's position at the end of 1999) and reached 24 million in 1994 (somewhat fewer than the number of subscribers analysts expect by 2004).[8]

There is no guarantee that the full potential of broadband services will be realized. The success of this new service depends on whether firms that must make huge investments to upgrade or develop the requisite networks have the opportunity to earn returns commensurate with risks. Unfortunately, firms making such investments operate in the highly regulated communications sector. Telephone and cable companies have been subject to regulation by federal, state, and even local authorities for decades. The degree and type of regulation for the delivery of new broadband services will play an important role in determining whether these firms can earn adequate returns on the investments required to deliver these services.

Information Technology, Broadband, and the Economy

Although economists estimate that information technology has had a significant effect on the rate of growth of the economy, broadband was not a large part of the information technology revolution in the period 1995–2000, and the Internet was only beginning to emerge as a major force.[9] Robert Litan and Alice Rivlin find that the Internet has the potential to reduce business costs by $100 billion to $250 billion annually.[10] Significantly, these researchers also conclude that the likelihood that this potential will be realized and the speed with which it is realized depend on a number of factors, including access to the Internet: "The penetration rate of Internet access, *especially broadband,* will affect the extent to which firms face intense competitive pressure to change existing management methods, among other practices."[11]

8. FCC (2001a, table 12.2). Even though wireless services were already providing massive consumer benefits by 1994, that market exploded afterward.

9. Among them, Oliner and Sichel (2000); Jorgenson and Stiroh (2000); Jorgenson (2001). The latter defines the information technology sector as comprising computers, communications equipment, and software and claims that the growth in this sector was largely a result of the decline in computer prices.

10. Litan and Rivlin (2001, pp. 313–17).

11. Litan and Rivlin (2001, p. 316).

A critical factor not considered in either Dale Jorgenson's macroeconomic analysis or Robert Litan and Alice Rivlin's detailed study of cost savings is the large potential benefits that new or improved products and services could bring to consumers. "It is vital not to overlook the variety of benefits to end users of the Internet, including added convenience, wider choice, and customization that do not and probably never will show up in the productivity statistics."[12] Not only are the consumer benefits of new products and services left out of many economic analyses, but also the specific innovations that provide these benefits, as well as the timing of their introduction and growth, are literally impossible to know beforehand. Indeed, this is an important reason for relying on markets rather than central planning.[13] Some of these innovations, such as the dynamo and the computer, can have profound impacts on how business is transacted and the manner in which society organizes itself.[14] But these effects cannot be known in advance.

The Benefits of Broadband to Consumers and Producers

Robert Crandall and Charles Jackson estimate the potential value of widespread diffusion of broadband to provide Internet access.[15] They use two approaches to estimate the likely benefit of widespread diffusion of broadband. The first approach assumes a linear demand curve with a specific demand elasticity. The authors assume that the advancing deployment of broadband results in a parallel outward shift of that demand curve. They also estimate the auxiliary benefits that consumers would receive from having a higher quality network and better computing equipment to use with their high-speed Internet access. Using this approach, the authors find that universal broadband deployment could result in annual benefits of between $297 billion and $460 billion.[16]

As a check on these estimates, Crandall and Jackson use a second, bottom-up, approach, which adds up the likely benefits from specific

12. Litan and Rivlin (2001, p. 316); see also Brynjolfsson and Hitt (2000).

13. Hayek (1945).

14. David (1990). The introduction of the computer and that of electrical technology (the dynamo) show similar characteristics. Both computers and dynamos give rise to network externality effects, which make compatibility standardization important. Gordon (2000), however, takes a contrarian position: that computers are not dynamos and that, rather than benefiting the entire economy, information technology has affected only that sector.

15. Crandall and Jackson (2001).

16. Crandall and Jackson (2001, p. 64). The universal broadband deployment is 94 percent of households, which is the current level of telephone service.

sources, such as shopping, home entertainment, and remote monitoring. From this approach, they find that annual benefits could range from $272 billion to more than $520 billion. They conclude from these two approaches that consumer benefits from universal deployment could easily be $300 billion a year. These benefits may never be achieved, however, if broadband is not fully deployed: 50 percent deployment would yield benefits of about $100 billion annually (benefits increase nonlinearly because of network effects).[17]

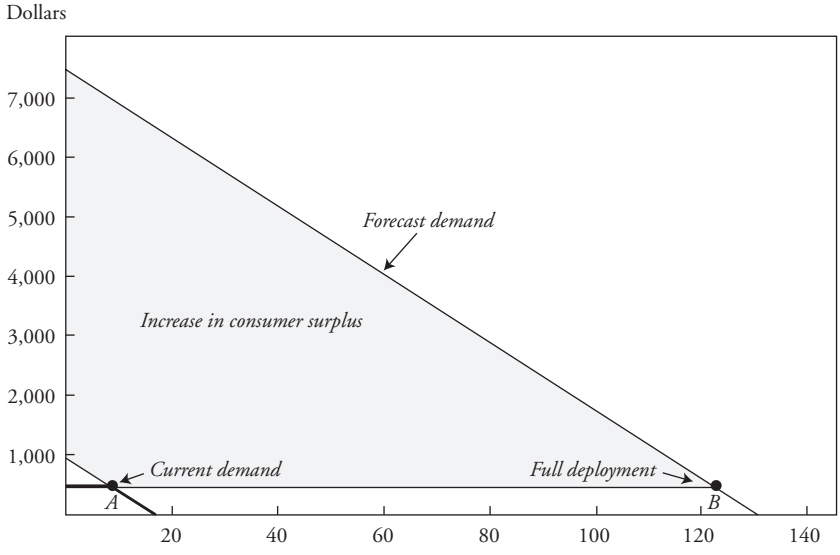
Crandall and Jackson also estimate the potential benefits to producers. These include the producers' surplus from increased spending on computer equipment and household entertainment. In addition, they estimate the benefits from shopping, commuting, telephone services, and telemedicine and conclude that such spending could easily result in annual benefits of $100 billion if broadband were fully deployed. Adding the $100 billion of producer gain to the $300 billion of consumer gain, broadband could yield more than $400 billion in annual benefits when fully deployed. These potential consumer and producer benefits of nearly ubiquitous broadband obviously require that households recognize the need for high-speed Internet connections.[18]

One of the scenarios for full deployment of broadband that Crandall and Jackson use is shown in figure 13-1. The price of broadband is assumed to be $40 a month, or $480 a year. Current demand is noted by point *A* in the figure, and full deployment is given by point *B*. The linear demand curve through point *A* is constructed so that the elasticity at point *A* equals –1. The demand curve shifts in a parallel fashion and is constructed so that it goes through point *B* (the quantity demanded with universal penetration). The change in surplus is given by the shaded trapezoid, which is large relative to the initial region. In addition, the intercept price at which demand is zero (generally known as the choke price) goes from $80 a month in the initial scenario to more than $600 a month.

Using this framework, it can be shown that the consumer welfare increases with the square of the quantity demanded. For example, Crandall and Jackson show that if the broadband demand elasticity is –1 at the current quantity of 8 million subscribers, annual benefits would be about $2 billion. When the same slope of the linear demand curve is maintained and demand for broadband increases from 8 million to 122 million subscribers with universal penetration, consumer surplus would increase to

17. Crandall and Jackson (2001, pp. iii–iv).
18. Crandall and Jackson (2001, pp. 2, 54).

Figure 13-1. *Yearly Price of Broadband Access, Assuming Linear Demand*[a]



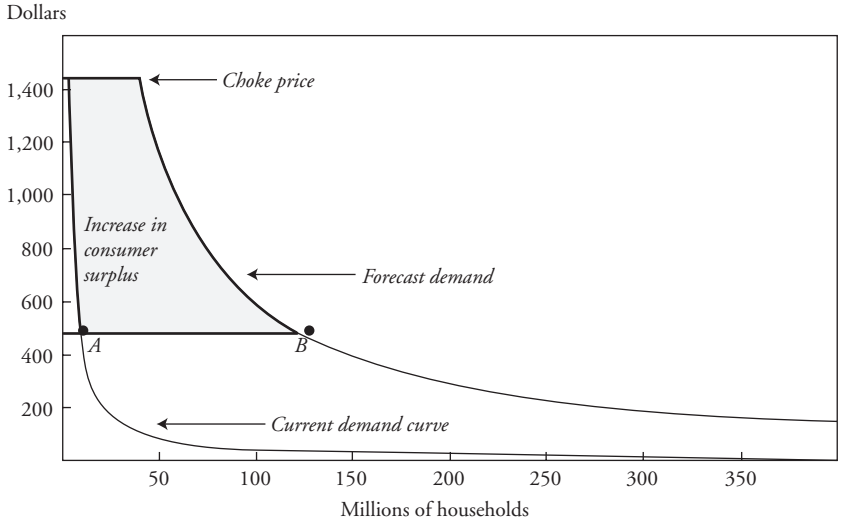
a. Assumptions are that elasticity = −1 at the current price and demand; that the current price of broadband access is $40 a month; and that the current demand for broadband is 8 percent of 105 million households.

$427 billion annually (that is, a 15-fold increase in demand produces a 225-fold increase in consumer benefits).

Absent a fundamental change in the essential nature of a product or service, the assumption of linearity may overstate consumer surplus at the high end. That is, because the assumption of a constant slope implies that elasticity decreases as the demand curve shifts outward, the large consumer surplus estimates could be viewed as a mathematical artifact.[19] An alternative functional form assumes a constant elasticity formula with a choke price (a price above which consumers are not willing to pay to receive the service). An example that is similar to the case considered above is shown in figure 13-2; points *A* and *B* are the same as in figure 13-1. The difference is clearly in the consumer surplus (the shaded area in the figure). Using this framework, it can be shown that, if the price stays the same and the choke price is a constant multiple of the price, the change in consumer welfare is proportional to the change in the quantity demanded. In this

19. In particular, when the price remains constant as the demand curve shifts, $1/e$ will increase linearly with quantity demanded.

Figure 13-2. *Yearly Price of Broadband Access, Assuming Constant Elasticity*[a]



a. Assumptions are that elasticity = −1 at the current price and demand; that the current price of broadband access is $40 a month; and that the current demand for broadband is 8 percent of 105 million households.

example, with a unit elasticity at points *A* and *B* and a choke price of $120 a month, the consumer surplus moves from $4.4 billion with 8 million subscribers to $64 billion with 122 million subscribers.

Table 13-1 compares the assumptions of Crandall and Jackson with the constant elasticity approach for demand elasticities of –1.0 and –1.5.[20] For the parameters used here, the constant elasticity estimation gives a larger consumer surplus at point *A* and a lower consumer surplus at point *B* than the linear estimation. This implies that the increase in consumer surplus is much lower. Clearly, the assumption about the shape of the curve has a substantial effect on the calculation of consumer benefits. The increase in consumer surplus under universal deployment is roughly $300 billion using the assumption of linear demand curves and $50 billion for the case of constant elasticity curves with a choke price.

Since we do not know the shape of the demand curve, this area deserves more research. We can pose the question, however, of whether the

20. Elasticities of –1.0 are from Crandall and Jackson (2001, p. 20); elasticities of –1.5 are from Kridel, Rappoport, and Taylor (2000) and Rappoport and others (2003).

Table 13-1. *Estimated Increases in Consumer Surplus, Two Assumptions about the Shape of the Demand Curve*[a]

Billions of dollars

Elasticity	*–1.0*	*–1.5*
Linear demand curve[b]		
Current consumer surplus	2	1
Forecasted consumer surplus	427	284
Increase in consumer surplus	425	283
Demand curve with constant elasticity and choke price		
Current consumer surplus	4	3
Forecasted consumer surplus	64	50
Increase in consumer surplus	60	46

a. Numbers are rounded to nearest billion. Numbers may not add due to rounding.
b. Elasticity is at the current price; demand is before the curve is shifted outward.

Crandall and Jackson assumption that elasticity declines with increasing penetration is plausible.[21] To the extent that widespread penetration implies that broadband services have become more essential to consumers, the pattern is reasonable. The ubiquitous penetration assumed by Crandall and Jackson approximates that of ordinary telephone service today: The price elasticity is low, even lower than what Crandall and Jackson's approach produces for broadband.

Another check on Crandall and Jackson is provided by Jerry Hausman's results for other services.[22] Hausman's measure of voice messaging demand is approximately the same level as today's broadband demand and approximately a third of wireless demand. Perhaps coincidentally, Hausman's elasticity for voice messaging is about three times that of wireless elasticity, a result that is consistent with the parallel shift of a linear demand curve.[23]

21. This result is consistent with the evolution of price elasticity estimates in Rappoport, Kridel, and Taylor, this volume.

22. Hausman (1997).

23. Of course, this comparison is only suggestive, because the elasticities for different products can differ for reasons other than the differences in quantity demanded of those products.

The Effect of the Speed of Broadband Adoption

Having estimated the annual benefits that full penetration of broadband service would produce, Crandall and Jackson ask the question, How will the speed of rollout affect the benefits to producers and consumers? The answer is that faster rollout of broadband, perhaps as the result of more enlightened regulation, could yield benefits on the order of $500 billion.[24] In this section, we review these estimates and consider alternative scenarios for how regulation could influence the speed of development.

Crandall and Jackson's bottom line is based on comparing two scenarios. Both start at current broadband demand of 8 percent of households; both end with an almost ubiquitous penetration by 2025. But they differ in how fast they get to the end state. The more pessimistic scenario assumes that it will be 2011 before roughly half the population uses broadband, while the more optimistic scenario has this midpoint occurring two years earlier. The authors represent these scenarios as S-shaped curves that differ in the rate of penetration. For each scenario, the authors calculate the present value of the benefits over the 2001–25 period, using a discount rate of 10 percent. The difference in these values turns out to be 1.4 times the annual benefit at full penetration. The authors estimate that increasing the rate of penetration from the relatively pessimistic to the more optimistic scenario would result in about $420 billion for consumers and $80 billion for producers, or a total value of about $0.5 trillion.[25]

Although a bottom line of a half trillion dollars might appear unusually optimistic, we believe it is in the right ballpark. First, although the magnitude of the benefits at full penetration is sensitive to the shape of the demand curve, projecting no change in elasticity is unduly pessimistic. Widespread use of broadband services will most likely mean that they would become increasingly essential to consumers and businesses. Although the speed with which consumer surplus increases with demand may differ from what the linear model predicts, the ultimate size of these benefits would still be large.[26] These large projected benefits also imply that the costs of delay could be substantial.

24. Crandall and Jackson (2001, pp. 54, 64–65).

25. Crandall and Jackson (2001, pp. 52–54).

26. When a logit demand curve—the functional form used in the elasticity study that Crandall and Jackson cite—is used in place of Crandall and Jackson's linear curve, the difference in present values between their optimistic and pessimistic scenarios is about 25 percent of what the linear model produces; for example, when a linear model produces $500 billion, the logit model will produce about

Second, to the extent that Crandall and Jackson's optimistic and pessimistic scenarios represent the bounds of enlightened versus misguided regulatory policies, the overall effect seems modest relative to the historic examples. Rather than delay the introduction and subsequent deployment of the product by many years or perhaps kill a possibly good idea altogether, Crandall and Jackson's scenarios view progress as inevitable, with regulation being a fairly modest impediment (at least by historic standards).[27] In other words, history suggests scenarios that are much more pessimistic than those of Crandall and Jackson's. However, if regulation were sufficiently stringent to keep broadband penetration from rising above 50 percent, the difference in benefits between the optimistic and the modified pessimistic scenarios would be almost twice as large as that estimated by Crandall and Jackson; that is, the faster rollout scenario would be worth about a trillion dollars to consumers.[28]

Economists can only provide conjectures about the types of service that might develop, because many of these services do not exist today. Without new services, it is unlikely that broadband will become ubiquitous. Nor will service providers be induced to roll broadband out widely or to promote it heavily if such services do not develop. But who will develop these services in a marketplace in which only 10 percent of households are connected? The service providers themselves (cable companies, telephone companies, and satellite systems) have the greatest incentives to develop the requisite content. Unfortunately, regulation or potential regulation could dissuade them from harvesting these network externalities.

Regulating Broadband

Current discussions of public policy toward broadband often focus on the need to regulate the carriers who undertake the risky investment in

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$125 billion. With the logit model, the ratio of consumer surplus to revenue increases with quantity, but not as rapidly as with the linear demand curve.

27. Some of the case studies considered below suggest delays considerably longer than Crandall and Jackson's two-year difference in reaching 50 percent penetration.

28. Alternatively, if the effect of regulation shifts the attainment of 50 percent penetration by six years (similar to the effect considered by Hausman [1997] for voice messaging), the alternative regulatory regimes will produce 50 percent penetration in 2007, rather than 2013. This impact is about 2.25 times as large as Crandall and Jackson's; that is, the benefit of good regulation would be on the order of $1.1 trillion.

broadband facilities and content. Much of this discussion involves curbing potential monopoly power even before there is evidence that any such power will develop from the competitive and technological struggle to deploy broadband services widely. But current regulation and the threat of new regulatory programs may be dulling the incentive to invest in facilities and content at the dawn of the broadband revolution.

The effect of regulation on the realization of potential benefits from new services can take several forms. Certain types of regulation can increase the cost or reduce the quality of services. A cost increase usually results in a price increase, which lowers consumer welfare and economic welfare. Similarly, if the quality of services is lowered while costs do not change, there is a corresponding loss in consumer and economic welfare.

A much larger loss in economic welfare can occur when the availability of the service is artificially constrained by regulation, either through a delay in the introduction of a new service or a delay in the rate at which a new service is introduced. In such cases, the economic costs to consumers can be high, particularly when the demand for these services is inelastic. With inelastic demand, losses resulting from delay can be a large multiple of forgone revenues.[29] When the price elasticity of demand is high, consumers will be willing to pay little more than the current price for the service. However, as the demand for a service becomes less price elastic, willingness to pay increases accordingly.

Telephone Companies

For the most part, Congress and the FCC have articulated a hands-off-the-Internet policy. Broadband is an important exception to this policy. Incumbent local exchange carriers face a number of restrictions that have carried over from their legacy as the dominant providers of ordinary telephone services.

Under the 1996 Telecommunications Act, incumbent carriers are required to unbundle their networks and to make the unbundled elements available to competitors at regulated wholesale rates.[30] Specifically, when the FCC decides that certain elements of the incumbents' networks are "necessary" for competition and that the inability to obtain these elements would "impair" the ability of competitive local exchange carriers to offer services, such elements must be made available to competitors at regulated

29. For an overview of the theory for calculating the impact of delay, see Hausman (1997).

30. Section 251 of the Telecommunications Act.

rates.[31] In addition, these incumbents, principally the Bell companies, have agreed to offer their broadband services from separate subsidiaries for a period of time as a condition to obtaining merger approval or the authority to offer inter-LATA (local area transport and access) long-distance service.

There is a growing perception that telecommunications regulations have impeded the growth of the incumbent carriers' digital subscriber line services. For example, some analysts have downgraded their estimate of how fast the incumbent carriers will be able to roll out broadband services. "While regulatory developments continue to favor cable [operators], the constraints on regional Bell operating companies are increasing. Line sharing with other competitive local exchange carriers has been required for the Bells, resulting in increased competition for them. Moreover, the establishment of separate subsidiaries for digital subscriber line operations has been required. As a result, some Bells are holding back on their aggressive rollouts, such as SBC in Illinois."[32]

Over the past few years the FCC has made a series of decisions on unbundling that are likely to dampen the incentives of the incumbents to upgrade their networks, extend broadband services to more customers, and provide enhanced services.[33] These decisions effectively allow competitive

31. Section 252 of the Telecommunications Act. The FCC has interpreted that section to require total-element, long-run, incremental cost methodology. This methodology is based on a hypothetical firm that is constrained only by the incumbent carriers' existing switch locations and that is able to serve the incumbents' entire demand with a new network. For an overview and critique, see Kahn (2001). See also Alleman and Noam (1999), and the chapters by Jerry Hausman, this volume.

32. Gupta, Grubman, and Swenson (2001).

33. In particular, the FCC has declined to order that packet switching and digital subscriber line access multiplexers be unbundled when customers are served by copper loops, because the electronics necessary to provide broadband capability over copper loops are widely available and easy for competitive local carriers to deploy (FCC [1999b, paras. 306–17]). Even in this case, the commission's action could be viewed as tentative in that it qualified its action with the phrase "at this time" (para. 306), strongly suggesting that it reserved the right to unbundle in the future. However, it has required mandatory sharing of other components used to provide high-speed services. First, shortly after refraining from mandatory unbundling of the electronic equipment that provides digital services, the FCC *did* require the incumbent carriers to unbundle the high-frequency part of a loop and offer it at low regulated prices to competitive carriers wishing to offer digital lines—thereby sharing that line with the incumbent carrier providing ordinary voice service (FCC [1999a]). Second, in the event that incumbents offer digital services over loops that are part copper (distribution) and part fiber (feeder) and they are not able to offer collocation space in their remote terminals, they must unbundle their digital subscriber line access multiplexers and packet switches (FCC [1999b, para. 313]). At the time of the order, the most current ARMIS data (1998) showed that about 27 percent of the working lines in Verizon's (pre-GTE merger) territory had a fiber feeder. Since then, such lines have accounted for a large majority of the growth in total working lines. Because collocation space in remote terminals tends to be limited, as incumbent carriers increase the amount of fiber in their networks, the frequency with which

carriers to share in the rewards from the new investments while paying total-element, long-run, incremental cost prices for that privilege. At the same time, they impose the costs of accommodating the competitive carriers only on the incumbent carriers and not on other facilities-based competitors, such as cable operators.[34] Therefore, the current regulatory framework finds the incumbents facing the real possibility that they could upgrade or change their networks at considerable expense and risk and be required to share these improvements at forward-looking, short-term, incremental cost rates. Such regulation is obviously not conducive to investment by incumbents.[35]

The FCC and the states also require that the prices that incumbent carriers charge their end-use customers and Internet service providers be "just and reasonable," while other providers are free to set prices as market conditions permit or dictate.[36] Moreover, the incumbents must offer any services that they sell directly to end users to competitors at prescribed resale discounts. These requirements are unique to *incumbent* telephone companies; they do not apply to new entrants or to cable television systems.

Cable Modem Services

The 1996 Telecommunications Act largely deregulated cable television service prices, and it did not impose new regulatory requirements on

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they would be required to unbundle packet switching and digital subscriber line access multiplexers and offer them at regulated prices would increase.

34. An example of the burden on the incumbent carriers is the costs of increasingly sophisticated operations support systems.

35. To obtain more detailed information on how these regulatory requirements have increased costs and inhibited faster rollout of digital services, we informally interviewed several product specialists at a large incumbent digital provider in September 2001. They report that the regulatory requirements have, in fact, increased the costs of offering digital subscriber lines over all copper loops, put further expansion of such services at risk, and have made the business case for offering digital service over loops with fiber feeder problematic. With respect to deployment of digital service on copper loops, which accounts for 80 percent of that provider's loops, specialists report that the regulatory requirements have approximately doubled the cost for each line of digital service. With respect to loops with fiber feeder, which account for the bulk of that company's new loops, the requirements of sharing space with other carriers in remote terminals (or alternatively, being required to offer unbundled digital subscriber lines at the low prices prescribed by regulation) have evidently made the business prospects for offering such lines uneconomical.

36. FCC (1998, para. 32); FCC (1999c, para. 21). Indeed, while incumbent carriers are required to provide services to Internet service providers at regulated prices, the FCC has not required that cable television providers allow access to Internet service providers at *any* price.

cable providers' Internet services, including cable modem services. As cable companies began to develop their cable modem broadband services, they designed their services to be funneled through their own proprietary Internet service providers, principally @Home and Roadrunner. As a result, independent Internet service providers began to petition municipal franchising authorities and regulators to require open access for all Internet service providers.

After a series of court challenges, the issue of requiring open access on cable systems was referred to the FCC, and cable modem service has been ruled to be a "telecommunications" service, not a cable television service. The FCC has yet to rule on this issue; hence cable modem service remains essentially unregulated, in contrast to the detailed regulation facing incumbent carriers for their digital-line services. This situation is generally referred to as asymmetric regulation.[37]

One way to remedy the asymmetric treatment of broadband services is to impose parallel restrictions on cable modem services. While such restrictions may increase the incumbents' market share, they would do so by increasing the costs of broadband services across the board; that is, the overall market would shrink, and costs to consumers would increase. To date, only one of the special requirements that the incumbent carriers face—the open-access requirement that digital services be available to multiple Internet service providers—has received any serious attention as being applicable to cable operators. Although this single obligation falls far short of the multiple obligations that apparently have increased incumbents' costs and slowed down their rollout plans, even the possibility of new obligations may be slowing cable modem deployment. For example, Thomas Hazlett observes that cable operators have devoted only a small fraction of their capacities to broadband access to the Internet.[38]

Vertical Integration and Network Effects

The debate over the regulation of broadband services focuses heavily on infrastructure competition among carriers and Internet service providers. The incumbent telephone companies are alleged to control a

37. For a discussion of asymmetric regulation, see the chapters by Hausman, this volume.

38. Hazlett (2001, pp. 4, 24): "Even while cable systems have benefited from lower regulatory overhead, the threat of access regulation has produced a visible reduction in investment incentives there, as well. Cable operators underallocate spectrum to high-speed access, preferring to save channel space for low-rated cable channels rather than enhancing Internet functionality. Fear of common carrier regulation is the reason." See also Thomas Hazlett, this volume.

last-mile "bottleneck" facility that new competitive carriers need if they are also to offer a digital subscriber line service. Cable companies have a last-mile facility as well, but regulators continue to force network sharing only on the incumbent carriers.[39] Cable companies are not common carriers, and they have not therefore been particularly willing to accommodate multiple Internet service providers. This failure has led to Internet providers' political demand for open access.

In all of this debate, little attention is focused on the network effects in the development of this new communications service. The demand for high-speed connections depends on the availability of services (that is, content) that require high-speed delivery. However, until large numbers of households have broadband connections, the economic rewards for developing content will be limited. What is the solution to this chicken-and-egg problem? In earlier eras, such network externality problems were solved by vertical integration. The telephone service company (AT&T and its forebears) owned the telephone handset manufacturer. Motion picture companies owned theaters and studios. Henry Ford integrated backward into parts development and manufacture and forward into vehicle retailing. Television networks initially produced their own programming. Cable television companies developed their own cable networks to fill a programming void.

In the case of broadband, policymakers are focused on developing infrastructure competition without any concern for creating the complementary products required for this infrastructure to spread. Indeed, rather than encouraging the development of intellectual property through vertical integration, they often attempt to impede vertical integration through open-access requirements, separate subsidiary mandates, and tough merger standards. For instance, when America Online and Time Warner merged, the Federal Trade Commission required that AOL Time Warner cable systems provide access to Internet service providers that were competitors of AOL.[40] Subsequently, the FCC imposed a number of conditions before approving the AOL Time Warner merger. In its order, the FCC identified three alleged problems:

> First, we find that the proposed merger would give AOL Time Warner the ability and incentive to harm consumers in the residential high-speed Internet access services market by blocking unaffiliated ISPs' [Internet service providers'] access to Time Warner

39. Bruce Owen, this volume, discusses the regulatory history that produced this result.
40. FTC (2000).

> cable facilities and by otherwise discriminating against unaffiliated ISPs in the rates, terms, and conditions of access. To remedy this harm, this Order conditions approval of the merger on certain conditions relating to AOL Time Warner's contracts and negotiations with unaffiliated ISPs. Second, we find that the merger would make it more likely that AOL Time Warner would be able to solidify its dominance in the high-speed access market by obtaining preferential carriage rights for AOL on the facilities of other cable operators. We particularly find that the merger would harm the public interest by allowing for greater coordinated action between AOL Time Warner and AT&T in the provision of residential high-speed Internet access services. To remedy these harms, we impose a condition forbidding the merged firm from entering into contracts with AT&T that would give AOL exclusive carriage or preferential terms, conditions, and prices. Third, we find that the proposed merger would enable AOL Time Warner to dominate the next generation of advanced IM-based [instant-messaging-based] applications. To remedy this harm, we impose a condition requiring AOL Time Warner, before it may offer an advanced IM-based application that includes streaming video, to provide interoperability between its NPD-based applications and those of other providers, or to show by clear and convincing evidence that circumstances have changed such that the public interest will no longer be served by an interoperability condition.[41]

In short, both the Federal Trade Commission and the Federal Communications Commission perceived a potential threat from vertical integration in the AOL Time Warner merger, and both imposed conditions designed to limit the potential harm from such integration. Unfortunately, these conditions also limit the benefits from AOL Time Warner's investment in broadband content because it must ensure that other Internet service providers have access to its cable modem customers.

Whether these restrictions on AOL Time Warner and the regulatory requirements placed on the incumbent local exchange carriers yield benefits in excess of their costs cannot be determined at this early stage of broadband's development. However, our review in the next section of earlier antitrust and regulatory precedents does not provide grounds for optimism in this regard.

Regulating New Technology: Case Studies

There are numerous precedents from which proponents of regulating new broadband services could draw important lessons. Inevitably, a new

41. FCC (2001c, para. 18).

technology replaces older technologies and the goods or services produced by them. Technical change may create large consumer gains, but it also is likely to reduce the value of the assets deployed to produce the older goods or services. The owners of these latter assets or of alternative new technologies are often induced to use the political process to suppress new technologies that compete with them.

The 1956 AT&T Decree

In 1949 the Department of Justice filed a Sherman Act antitrust suit against AT&T and its Western Electric manufacturing subsidiary, alleging that AT&T had attempted to monopolize telecommunications equipment and services through its control and licensing of telephone equipment and technology.[42] The DOJ claimed that AT&T and Western Electric impeded competition in local telephone services and telephone equipment through exclusive dealing, refusing to sell AT&T equipment to independent telephone companies, and requiring independents to apply for licenses to AT&T patents.[43]

The complaint also contended that AT&T impeded competition in communications through its aggressive pursuit of patents in "alternative methods of communication."[44] For example, the Department of Justice claimed that AT&T had patents on important technologies that it refused to license to telegraph operators or radio stations. The complaint identified AT&T's innovations and the control of those innovations as the source of AT&T's market power.

While the technological prowess of AT&T's Bell Laboratories might have contributed to Western Electric's dominant position in equipment, decades of regulatory policy also were to blame. Had the Interstate Commerce Commission not approved scores of acquisitions made by AT&T before 1934, the company would not have enjoyed its prominent position in the purchase of telephone equipment. Perhaps local and long-distance services were still a natural monopoly in 1949, but regulators had not yet begun to test this proposition by admitting entry into either type of service. Yet the 1949 complaint did not identify regulation as a cause of

42. *United States* v. *Western Electric Co.,* Complaint, Civil Action 17-49 (DNJ January 14, 1949).

43. *United States* v. *Western Electric Co.,* Complaint, Civil Action 17-49 (DNJ January 14, 1949, para. 74.)

44. *United States* v. *Western Electric Co.,* Complaint, Civil Action 17-49 (DNJ January 14, 1949, paras. 90–99).

AT&T's market power. It merely concluded that "the absence of effective competition has tended to defeat effective public regulation of rates charged subscribers for telephone service."[45]

The government and AT&T settled the 1949 Sherman Act case in 1956, entering into a Final Judgment, which required AT&T to license all current patents on a royalty-free basis and future patents at a reasonable fee.[46] Much more important were the provisions that limited AT&T to the regulated telephone industry. First, Western Electric was forbidden from manufacturing any equipment other than telephone equipment.[47] In addition, AT&T would be confined to the business of furnishing "common carrier communications" services.[48]

The Final Judgment addressed the concern that AT&T (through Bell Labs and Western Electric) would use its technical prowess to extend its monopoly from telecommunications into other industries, thereby insulating its telephony subsidiaries from nontelephony communications. There was little indication at that time of how the technologies developed by Bell Labs could be used in other industries, such as office equipment (later, computers). The decision by the Department of Justice to limit AT&T, Bell Labs, and Western Electric to the regulated confines of telephony was unexpected, and it would prove to be unfortunate.

Banishing AT&T and its manufacturing subsidiary from all markets except regulated telephone services and the equipment required to deliver them had little effect on its telephone monopoly. This monopoly continued until regulators and the courts began to pry open the long-distance market twenty years later. However, the court-imposed quarantine meant that AT&T could not enter the new electronics markets, such as computers or home electronics. Since Bell Labs had invented the transistor and later developed a major software operating system, it was well positioned to invade the computer market as it began to develop. Instead, AT&T licensed its UNIX software on a royalty-free basis and was forced to ignore the computer business altogether.[49] Thus the economy was deprived of the

45. *United States* v. *Western Electric Co.,* Complaint, Civil Action 17-49 (DNJ January 14, 1949, para. 124).

46. Final Judgment, *United States* v. *Western Electric Co.,* Civil Action 17-49 (DNJ, January 24, 1956).

47. Final Judgment, *United States* v. *Western Electric Co.,* Civil Action 17-49 (DNJ, January 24, 1956, para. 4).

48. Final Judgment, *United States* v. *Western Electric Co.,* Civil Action 17-49 (DNJ, January 24, 1956, para. 5).

49. For a discussion of the development of UNIX, see (www.bell-labs.com/history/unix/sharing.html [May 6, 2002]).

potential benefits of any AT&T forward vertical integration from its early technological lead in transistors and software.

No one can be sure if AT&T would have become an important competitor in either computer hardware or software, but it might have. Had it been allowed to develop a successful line of computer equipment, it could have negated any need for the Department of Justice to bring its mammoth and eventually unsuccessful suit against IBM in 1969. In addition, UNIX could have become an important operating system for personal computers, competing with Microsoft in this market. Instead, UNIX developed as an operating system for servers and work stations.[50]

Television Programming

The FCC's regulation of television programming provides one of the earliest and most futile examples of attempting to control a market with network effects as well as significant scale and scope economies.[51] The FCC's spectrum-allocation policy limited the number of television broadcast stations in major metropolitan areas. As a result, there were only three commercial broadcast networks in the United States because a fourth network could not assemble a large enough roster of affiliates to compete.[52] The inevitable result of this market concentration was public concern over the networks' power in several arenas.

In the 1960s, the FCC conducted an inquiry into network program procurement practices that was to result in the promulgation of rules limiting network "ownership" of programming, including participation in the marketing of reruns of their network series, referred to as *syndication*.[53] At about the same time, the Department of Justice launched an inquiry into network programming practices that would eventually result in antitrust cases filed in 1972 against each of the three networks and in three antitrust consent decrees.[54]

Economic production of mass entertainment programming requires national and even international distribution. But because the FCC has traditionally limited the number of local stations that any single entity may own, a national broadcasting company cannot reach its audience solely

50. For a discussion of the role of UNIX, see Ferguson (1999, p. 44).

51. This section is adapted from Crandall (2001).

52. Crandall (1974).

53. FCC (1963, 1965).

54. The cases were *United States* v. *American Broadcasting, United States* v. *Columbia Broadcasting,* and *United States* v. *National Broadcasting*, Civil Complaints (CD Cal. 1972).

through its own stations. It is forced to negotiate affiliation agreements with broadcast stations throughout the country. A network must also develop programming to distribute over these interconnected stations; it cannot simply purchase existing fare on a spot market. Programs are generally developed as continuing series that appear at a regular time period each week. Because these programs are expensive to produce, few are developed without a distribution agreement—that is, a network contract. Networks often provide development funding for pilot productions before committing to a year's output of a given series.

Popular network television series have value in foreign markets and in further exhibition as reruns in domestic markets. As a result, the seller of a program series will not generally recover its full production costs from the network run alone. The talent involved in its production—the actors, producers, directors, and writers—are able to command salaries that reflect their market value in all of these markets. Thus when a network purchases a new network series, its payments for these programs will not fully defray the supplier's costs.

Early in the development of the television industry, networks shared the risk in developing program series with their program suppliers by purchasing the rights to distribute the program to the foreign market, by purchasing the rights to distribute the program as reruns in the domestic market, or by sharing in the profitability of such syndication, or sometimes all three. In the 1960s the major program suppliers, principally the large motion picture companies, argued that this network participation in reruns was being demanded from them at noncompensatory prices and therefore should be forbidden by the FCC.[55]

When the networks began to enter the motion picture business in the late 1960s, the Department of Justice also began to investigate network program "ownership" and the market power of the networks in programming. In 1970 the FCC enacted its financial interest and syndication rules, and the Justice Department's inquiry languished.[56] The FCC rules banished the networks from the rerun market and forbade them from acquiring any interests in the financial returns from the subsequent exhibitions of their programs. The rules did not bar the networks from producing their own programs or syndicating them in foreign markets. The networks could not, however, engage in the *domestic* syndication—that is, the sale of reruns

55. FCC (1980, vol. 2).

56. For details of these rules, see FCC (1980).

to U.S. television stations—of even those programs that they produced themselves.

The Justice Department inexplicably renewed its interest in network programming issues in 1972 and brought suits charging each network with attempting to monopolize the prime-time programming on its own network. Subsequently, each network negotiated a consent decree with the Justice Department, which included the provisions of the FCC's financial interest and syndication rules and further provisions to limit the amount of programming that network could produce for itself.[57] These decrees thus drove a greater wedge between distribution and production, requiring the networks to purchase a minimum amount of their programming from outside companies—mostly the motion picture companies.

The irony of the network cases is that the originator of the theory of network dominance over programming—the FCC—subsequently ruled that the networks must reduce their prime-time programming by a half hour a day on weekdays. This prime-time access rule was promulgated in 1972 to introduce more distributors into national television by the same agency that had limited the number of such distributors through its limitation on the number of broadcast stations it allowed in each market.[58] The FCC now asserted that it wished to increase program diversity by simply changing the identity of the three distributors for this half hour a day. Unfortunately, the prime-time access rule did not create new networks but rather spawned a large number of inexpensive game shows, which typically carried more advertising minutes than the network series they displaced.

Before the FCC rulings, each network had about 6 percent of national program syndication revenues. In 1971, before the FCC rules began to have an effect on syndication markets, the seven major motion picture studios' domestic syndication accounted for just 22.5 percent of the total viewer hours of nationally syndicated programs. In 1981, the year after the consent decree was negotiated, this share had risen to 36.9 percent. By 1989 seven motion picture companies accounted for 41.1 percent of viewer hours from national syndication and 58.5 percent of viewer hours from syndicating network reruns.[59] This increase in concentration was the direct result of banning three of their major competitors from the syndication market.

57. NBC entered into a decree in 1976; CBS and ABC followed in 1980.
58. FCC (1980, pp. 736–41).
59. Data from Crandall (1990, table 5.2).

Equally important was the effect the FCC rulings (and the network decrees that incorporated them) had on risk sharing of new programming development. In the 1969–70 television season, the four largest suppliers of new network programming accounted for 33.5 percent of revenues from network program purchases. By 1988–89 this four-firm share had risen to 47.1 percent because the networks could no longer share in the risk of programming by purchasing syndication interests in these programs.[60] Smaller producers were forced to seek other sources of risk capital, and the large motion picture companies were the obvious alternative.

Because the networks were uniquely positioned to bear program risk, denying them the right to acquire financial interests in the programs they purchased and limiting their ability to produce their own programs changed the composition of their new program series. The risk of innovative new programming had to be borne by others less well positioned to bear it. As a result, the variety in network program ratings declined after 1972, reflecting a program acquisition process that resulted in less daring, and therefore less risky, new program series.[61] Further evidence of this decline in risk taking may be found in the variance among prime-time network shows in the number of years they were kept on the air. Between 1963 and 1972 this variance increased, but after 1972 it decreased steadily, reflecting the fact that network programming was less innovative and thus less subject to early cancellation after the FCC's rules that were incorporated into the antitrust consent decrees were promulgated.[62]

The FCC rules themselves would have had adverse effects on innovation in network television programming, but the consent decrees' limitation on the networks' ability to supply their own programs surely exacerbated this unfortunate result. The networks could not underwrite the risks themselves through self-supply but were, instead, increasingly dependent on the large Hollywood studios for programming. The result was less innovative, less risky programming.

Cable Television

The experience with cable television regulation illustrates some of the problems with regulation of a new service and, subsequently, of rate regu-

60. Crandall (1990, table 5.1).
61. Crandall (1990, p. 31).
62. Owen and Wildman (1992, chapter 5).

lation in general.[63] Cable television began in the 1950s as a complement to off-air broadcasting, but it soon developed into a major potential competitor. As a result, broadcasters successfully pleaded for the regulation of cable to restrain its growth. The 1966 and 1972 FCC cable rules provided for stringent limitations on the types and quantity of programming that cable operators could offer. The FCC was even induced to block the development of premium services such as *Home Box Office* and *Showtime,* which had separate monthly charges. Cable was also subject to state and municipal rate regulation.

In the late 1970s the courts began to overturn the FCC's restrictive cable rules, and by 1979 the commission had eliminated a variety of its rules limiting distant-signal imports. The Cable Communications Policy Act of 1984 ended monopoly franchising by municipal and state authorities and deregulated cable rates. This shift to cable deregulation precipitated a rapid expansion in the diffusion of cable services, as large, national cable operators began to invest in increased channel capacity and the development of new programming services that could be delivered by satellite to fill these channels.

The 1984 act not only created a favorable environment for the expansion of cable services but also allowed cable operators to raise rates for this improved product. These rising rates, in turn, spurred the passage of the Cable Television Act in 1992, which mandated rate reductions in the price of basic cable service and permitted locally imposed rate controls.[64] In 1994 the FCC rescinded or relaxed some of the rules it implemented in 1992, before fully deregulating the industry (again) as mandated by the Telecommunications Act of 1996.[65]

An econometric analysis focused on the period between 1983 and 1992 (before and after the 1984 Cable Act) shows that rate increases in themselves do not necessarily harm consumers, particularly if they reflect increases in service quality. Consumer surplus increased during this deregulatory period, even though the years between 1984 and 1992 were marked by consistent rate increases. Using a multinomial logit analysis,

63. The FCC (2000b) (www.fcc.gov/csb/facts/csgen.html [September 5, 2001]) defines the cable television industry as the provision of "video delivery service provided by a cable operator to subscribers via a coaxial cable or fiber optics."

64. Rate controls were implemented in stages. The FCC initially required in 1993 that rates be rolled back to a benchmark or to the rates in effect in September 1992, reduced by 10 percent. In 1994 it revised its benchmark calculation, requiring another 7 percent rollback of regulated rates.

65. Hazlett and Spitzer (1997, pp. 67–68).

Robert Crandall and Harold Furchtgott-Roth estimate an average compensating variation of $5.47 a month between the cable service of 1983–84 and that of 1992.[66] That is, the average household would have been indifferent to the difference between the cost of 1992 cable services at their 1992 prices and the cost of 1983–84 cable services at their inflation-adjusted prices only if the cable shopper limited to the 1983–84 options was paid an extra $5.47.[67] Using this estimate, the authors estimate that consumers enjoyed a net annual welfare gain of $6.5 billion in the deregulatory period between 1983 and 1992.[68] The deregulation of cable signal carriage and rates thus contributed substantially to consumer welfare even after paying the higher 1992 rates.

The rate controls that accompanied the passage of the Cable Television Act were intended to curb the prices that cable providers were charging for basic cable service after the 1984 deregulation. In a sense, the 1992 act worked. In the two years preceding the 1992 Cable Act, the typical cable subscriber's bill rose 7.4 percent in real terms; in the two years following the act, real rates fell by an average of 2.1 percent.[69]

Under the 1992 rate regulations, however, cable companies not only lowered their rates but also adopted new strategies to mitigate their revenue loss. Several companies substituted cheaper programming for channels like C-SPAN, which does not have commercials and hence brings the cable companies no advertising revenues. The number of channels delivered to the average basic cable subscriber decreased under regulation.[70] Companies responded to consumers' paying less by delivering lower program quality. Operating costs for each subscriber declined in real terms in the regulatory period, and total expenditures by cable companies grew at a slower rate.[71] Finally, cable regulation had a deleterious effect on the financial status of the industry. The uncertainty caused by price controls and the wavering between different regulatory regimes increased the risk premium demanded by investors of cable companies. The spreads between a fund consisting of long-term cable operator bonds and two general debt funds

66. Crandall and Furchtgott-Roth (1996, pp. 57–58). The logit model uses characteristics of a cable system, including price and the availability of premium channels, to estimate the probability that households would subscribe to basic cable, premium cable, or no cable.

67. The compensating variation, $5.47, is expressed in 1992 dollars.

68. This estimate reflects the fact that, in 1992, 100 million households shopped for cable services in the preferable 1992 market. The $6.5 billion figure is in 1992 dollars.

69. Data from Hazlett and Spitzer (1997, p. 107).

70. Hazlett and Spitzer (1997, p. 126).

71. Hazlett and Spitzer (1997, p. 134); Crandall and Furchtgott-Roth (1996, p. 79).

rose by 132 and 281 basis points between the beginning of 1992 and September 1994.[72]

The cable industry's experience with regulation and deregulation demonstrates that deregulation can lead to increases in consumer welfare, even when prices increase, because deregulation induces companies to invest in greater service quality. The 1992 legislation that reregulated rates stunted cable's growth and reduced program quality as cable operators cut back on their development of new program services.[73]

Wireless Services

Commercial wireless services (cellular services, in modern parlance) provide an informative example of the effects of regulation for two reasons. First, the early pattern of subscriber growth for wireless communications mirrors that of broadband to date. Second, there is published research on the consumer benefits of wireless and regulation's role delaying these benefits.[74]

Jerry Hausman estimates the 1994 benefits of wireless services to consumers at between $25 billion and $50 billion in 1994, or between 1.75 and 3.5 times the annual revenues of about $14 billion.[75] Given that regulation delayed the deployment of cellular service by seven to ten years, consumers were likely deprived of such annual benefits for a number of years.

72. Hazlett and Spitzer (1997, p. 164).

73. Hazlett and Spitzer (1997, p. 113).

74. Another noteworthy feature is that wireless competition consists of vertically integrated providers (incumbent wire-line carriers), which compete against other providers that must obtain essential inputs (access to wire-line customers) from the vertically integrated firms. Some (see Tardiff [2000]) observe that this has been one of several services for which competition has succeeded without serious anticompetitive effects, despite the fact that major providers provide both an essential input and the competitive services. This suggests that entry by formerly excluded regional Bell operating companies into inter-LATA long-distance service would not threaten competition in that market but instead bring large consumer benefits by strengthening price competition. Jerry A. Hausman, Gregory K. Leonard, and J. Gregory Sidak, "The Consumer Benefits from Bell Company Entry into Long-Distance Telecommunications: Empirical Evidence from New York and Texas" (papers.ssrn.com/sol3/delivery.cfm/SSRN_ID289851_code011106140.pdf?abstractid=289851 [May 1, 2002]), report that prices in fact fell as a result of entry in New York and Texas, the first two states where the Bells were allowed to enter under Section 271 of the 1996 Telecommunications Act; at the same time new competitors gained market share in local markets, whose opening was a prerequisite for entry by the Bells.

75. Hausman (1997). Similarly, Rohlfs, Jackson, and Kelley (1991) estimate the social cost of the ten-to-fifteen-year regulatory delay in licensing cellular systems at more than $86 billion, or about 2 percent of gross national product in 1983, when cellular service began.

There is more to the story. Because regulators limited the number of cellular services to two in each market and allowed states to regulate these carriers, the costs of regulation were even higher. Cellular subscribers and revenues have exploded since 1994: Subscribers have increased from about 25 million to over 125 million, and revenues have increased from $14 billion to over $60 billion annually.[76] The *growth* in wireless subscribers in 2000 almost equaled the 1994 *level,* which of course represents the growth for the entire ten-year history of cellular service up to then (see figure 13-3). This explosion coincided with two events that substantially relaxed regulatory burdens on wireless providers as a result of the Omnibus Budget Reconciliation Act of 1993: the deregulation of all cellular rates and an instruction to the FCC to increase the number of wireless providers by auctioning "plain" cable service and spectrum frequencies. Applying Hausman's calculations to current levels of demand shows that the annual benefits of wireless grew to a range of $105 billion to $210 billion by 2001.

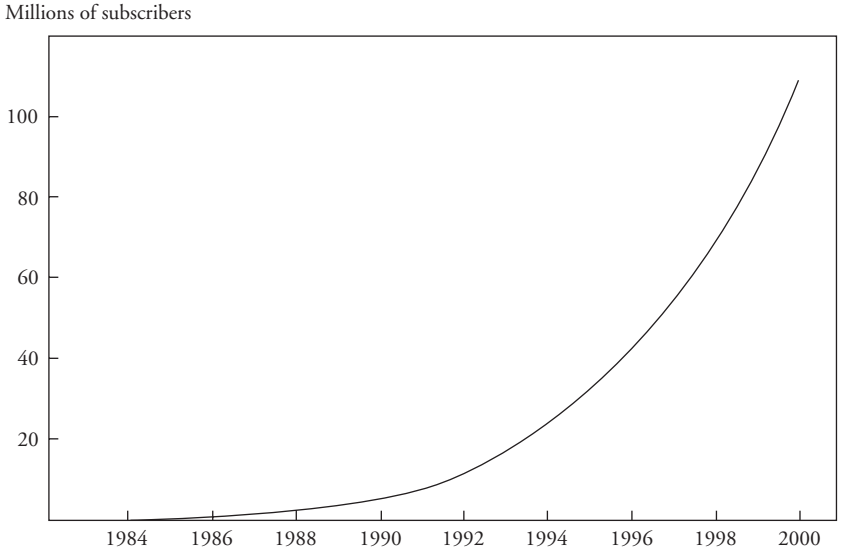
Information Services

In the middle and late 1980s, policymakers began to recognize the economic potential of electronic information services, such as banking, shopping, and travel reservations. In fact Judge Harold Greene, who administered the 1982 AT&T antitrust consent decree, stated that he wanted the regional Bell operating companies to provide users with access to information services, as the telephone companies were doing in other countries in the mid-1980s.[77] Commenting on the Bells' role in information services transmission, Judge Greene said, "In a practical sense, the per-

76. This expansion appears to be the result of both lower prices and competition shifting the demand curve outward by making services available to more consumers, improving the quality of services, and the like. In fact the demand curve shift seems to be at least as powerful as the price reduction. For example, if we treat the 25 percent reduction in revenue for each subscriber as a price decrease and use Hausman's elasticity of 0.5, then over 80 percent of the growth in demand after 1994 can be attributed to the demand curve shift and less than 20 percent to the price reduction. Alternatively, the FCC (see Sugrue [2001]) reports that revenue a minute declined from $0.57 in 1994 to $0.21 in 2000. When this reduction is used as the price decrease, the demand curve shift and the price reduction share equally in explaining the total expansion. Thus a major benefit of the increased competition since 1994, in addition to reducing prices to existing consumers, is the increased reach of these new services to a larger customer base.

77. Opinion of March 7, 1988: *U.S.* v. *Western Company, Inc., et al.,* Civil Action 82-0192, 714 F. Supp. 1, pp. 44–46. The French Minitel system was a frequently cited example.

Figure 13-3. *Number of U.S. Wireless Subscribers, 1984–2000*



Source: Federal Communications Commission, *"Trends in Telephone Service,"* table 12.2 (released August 8, 2001).

vasive services network necessary to create a large and vigorous nationwide market is unlikely to develop without the participation of the Regional Companies."[78] Unfortunately, Judge Greene's expectations were not realized for some time because of the prohibitions the AT&T decree placed on the Bells' provision of information content and inter-LATA services.[79] Under the decree, the Bells were not only prohibited from offering information content but were also required to operate from separate facilities within each local access and transport area.

At the same time, the FCC imposed other regulations that reduced the Bells' incentive to upgrade their networks to handle information content. For example, although Judge Greene allowed the companies to conduct protocol conversions for these services, the FCC classified protocol conversions as an enhanced service, subject to regulation and approval under its regulations.[80] "The FCC spent five years and received over 10,000 pages

78. *U.S.* v. *Western Company, Inc., et al.,* Civil Action 82-0192, 714 F. Supp. 1, p. 45.

79. Services carried across the local transport and access area, which were erected to enforce the long-distance quarantine of the Bell operating companies under the 1982 decree.

80. For Judge Greene's ruling, see March 7, 1988, Opinion, p. 59. Protocol conversion translates message content so that it can be sent as packet signals.

of comments in determining that the Bell operating companies should be permitted to perform asynchronous-to-X.25 protocol conversions."[81] Under FCC rules, the Bells would have had to go through similar proceedings for each additional protocol conversion needed to serve the information service provider market effectively.

In addition, although Judge Greene permitted the Bells to offer e-mail services, "a gateway which provides electronic mail would have to be able to convert individual users' protocols to X.400 protocols, the international standard for electronic mail," that protocol conversion would require yet another FCC approval before the Bells could offer an e-mail service supporting the international standard.[82] Further, since both the Decree Court and the FCC had jurisdiction regarding gateways, the Bells' competitors could shop for a venue that would give them a favorable hearing when they wanted to frustrate the Bell companies' efforts to compete effectively.

All of these restrictions effectively made the Bells' upgrades to their networks for wide-scale and efficient transmission of information services unprofitable. It was not until 1990 that a federal appeals court overturned the information services ban that was written into the AT&T consent decree. However, the requirement that the Bells must have separate facilities in every local exchange and transport area makes the Bells' participation in information service provision less attractive. With the development of digital subscriber line technology, the Bells finally began to revive their interest in information services. The restrictions imposed by the FCC and the AT&T trial court delayed the effective participation of the Bells in the information service provider market for fifteen years.

The Bells did begin to offer at least one information service, voice mail, after the courts reversed the information services ban. In 1994 this service produced revenues of about $1.5 billion and generated estimated consumer benefits of between $0.5 and $1.3 billion.[83] The Bell companies' offering of voice mail services had been delayed by Judge Greene's information service restrictions and an earlier FCC requirement (subsequently rescinded) that information services be offered through a separate subsidiary. In one estimation, these impediments delayed voice messaging services by about five to seven years, suggesting a total loss to consumers of between $2.5 billion and $9.1 billion.[84] This case illustrates once again

81. Ameritech (1987, p. 4).
82. March 7, 1988, Opinion, pp. 59–60.
83. Hausman (1997).
84. Hausman (1997).

how legal and regulatory restrictions employed to restrict purported market power can serve to retard innovation. A number of telecommunications services that shared some of the properties of the Internet could have emerged much sooner except for regulation.

Telephone and Cable Convergence

At its passage, the Telecommunications Act of 1996 was expected to precipitate strong convergence between formerly separated industries. In particular, the act provided for entry by other providers into local exchange services and allowed incumbent local exchange carriers to provide cable television transmission and programming under its open video systems provisions (section 653). While there has been entry into local exchange markets in general—and by cable operators in particular—there has been little entry by incumbent local exchange carriers into cable television services.[85] This outcome falls far short of the great expectations that the act would facilitate significant entry by incumbent local exchange carriers,[86] possibly in the form of the major plans that some of these carriers had announced before the act.[87]

Several provisions of the 1996 act, as well as FCC regulations, may have contributed to the lack of incumbent carrier activity in providing video services with their own networks. In 1998 one analyst observed:

85. The FCC (2002a) reports that competitive carriers provided 17.3 million lines at the end of June 2001, about 9 percent of local telephone lines, with 1.9 million of these lines being provided on coaxial cable facilities. In 2000 these carriers produced about $7.5 billion local service revenue, which implied a market share of about 8 percent. See ALTS (2001). Cable telephony accounted for about $0.33 billion. See Morgan Stanley Dean Witter (2001). AT&T (2000) (www.att.com,/ir/sec [May 30, 2002]) reports more than a half million subscribers.

86. In 1995 James C. Cullen, vice chairman of Bell Atlantic, said, "Our customers want the choice of diversity of voices that only video dial tone can bring them. But we can only operate under the video dial tone model if it makes economic sense for us to do so. . . . While Bell Atlantic remains committed to competing with cable companies, if the FCC imposes burdensome rules, the company may have no choice but to enter the market as a 'me too' cable company." Roy Neal, president of the U.S. Telephone Association, responded: "Such a scenario would be unfortunate. Thousands of customers waiting for fully interactive video dial tone networks could be denied new entertainment sources and the power to work, learn, and shop at home." Neal added that additional regulations would be a serious setback to the deployment of video dial tone. See Bell Atlantic (1995).

87. For example, Pacific Telesis announced in 1993 that it would invest $16 billion to upgrade its core network infrastructure over the following seven years and projected that its fiber-coaxial broadband network would connect more than 1.5 million homes in California by 1996 and more than 5 million by 2000. See AT&T, "Pacific Telesis and AT&T to Test Interactive TV in Milpitas," Press Release, January 19, 1994.

> Congress killed cable-telco competition in the [Telecommunications Act of 1996]. They didn't realize that they were doing it. But the cable industry cleverly and capably got the open-video-system language written in such a way that it is largely prohibitive for telcos to use that method to get into the cable business. . . . In essence, what the open-video-systems language does is to make it too expensive for a telco to pursue that path. They have to build a system three times larger than they would want to in order to reserve two-thirds of the space for a competitor if they came along and wanted to use it.[88]

In addition to the requirement to build and reserve capacity for potential competitors, the FCC developed or considered a number of additional rules for telephone company provision of video services or carried over existing rules that predated the 1996 act. These include pricing rules for the capacity that open video system providers must make available to competitors; a requirement that incumbent carriers allocate costs between open video systems and telephone operations in their regulatory accounting systems; and a requirement for preapproval of new construction.[89] The potential video services from incumbent carriers, which could be viewed as the early 1990s version of today's broadband services, were a suppressed innovation. Although the carriers' plans to offer such services predated the 1996 act, they have essentially abandoned such plans in the wake of the act.

Summary

These six cases illustrate four important points. First, regulation has often served to suppress innovation. Second, the delay in the introduction of new services can be quite costly to consumers. Third, deregulation can result in significant benefits when markets are workably competitive or even when there is arguably market power, as there was in the cable industry. Fourth, vertical integration by even large, dominant firms is often essential to the efficient development of new goods and services.

88. "Forecaster Cleland Skeptical about AT&T-TCI," *Multichannel News*, July 6, 1998.

89. FCC (1996a; 1996b; 1996c). The pricing rules are imposed despite the fact that open video system entrants would not be "dominant" providers; incumbent cable operators would be. The requirement for preapproval was a carryover from the FCC's imposition of section 214 of the 1934 act on incumbent carrier plans such as upgrading the network to provide video systems. The Fifth Circuit Court subsequently vacated the requirement, and the FCC removed the rule at the end of 1999.

Conclusion

This chapter analyzes the possible economic effects of broadband using both a case study approach and a quantitative approach. Our principal findings are that widespread penetration of broadband could have a significant positive effect on the economy and that inappropriate regulation of broadband could have a significant adverse effect on the economy. Estimates of the benefits of broadband and the effects of broadband regulation are sensitive to the assumptions about the shape of the demand curve for broadband service. Unfortunately, relatively little information is available about the demand for broadband services. We thus rely on rough estimates of demand elasticity, assumptions about how demand will grow over time, and conjectures drawn from earlier case studies on the likely impact of regulation.

We believe that there is little economic justification for regulating any broadband services, including those provided by incumbent local exchange carriers. There is no basis for assuming that monopoly power will develop in the delivery of these services, but there is every reason to believe that regulation will reduce the incentive of carriers to invest in infrastructure and broadband content. Symmetrical regulation of the incumbent carriers and cable operators is likely to be much worse than no regulation at all.

The case studies show some of the pitfalls of regulation and the benefits of deregulation. Several case studies indicate that regulation dampened incentives to invest in services that would have been of value to consumers. Regulation can contribute to companies abandoning the development of some services and slowing the rollout of others. Of particular concern is that some incumbent local carriers may slow the deployment of digital subscriber lines as a result of continuing regulations in this market and that content and open-access regulation of cable companies will induce them to devote fewer resources to new broadband services and content.

Appendix A

For the case of linear demand, consumer surplus increases with the square of the quantity demanded. For the case of constant elasticity of demand with a choke price, change in consumer surplus increases in proportion to change in quantity demanded. Both cases assume no income elasticity effects.

Linear Demand

The linear demand curve is

$$q = A - b \cdot p,$$

and consumer surplus is *CS*. For any given $q \geq 0$, it can be shown that

$$CS = q^2 / (2b).$$

Choose any point q^* and p^*. The shaded triangle of figure 13A-1 can be written as

$$\begin{aligned} CS &= 1/2 \cdot (q^*) \cdot [(A/b) - p^*) \\ &= 1/2 \cdot (q^*) \cdot (1/b) \cdot [A - (b \cdot p^*)] \\ &= 1/2 \cdot (q^*) \cdot (1/b) \cdot (q^*) \\ &= 1/2 \cdot (q^*)^2 \cdot (1/b) \\ &= (q^{*2})/2b. \end{aligned}$$

Constant Elasticity of Demand with a Choke Price

Consumer surplus increases linearly with demand if one assumes constant elasticity in the demand curves and if the choke price is a constant multiple of the current price. Under the assumption of constant elasticity and a choke price, $p_{\max,}$

$$\text{consumer surplus / revenue} = [1 - (p_{max} / p_1)^{-(e-1)}] / (e - 1).^{90}$$

Assume that

$$p_{max} = c \cdot p_1.$$

Then

$$\text{consumer surplus / revenue} = (1 - c^{-(e-1)}) / (e - 1).$$

Current consumer surplus, CS_1, is given by

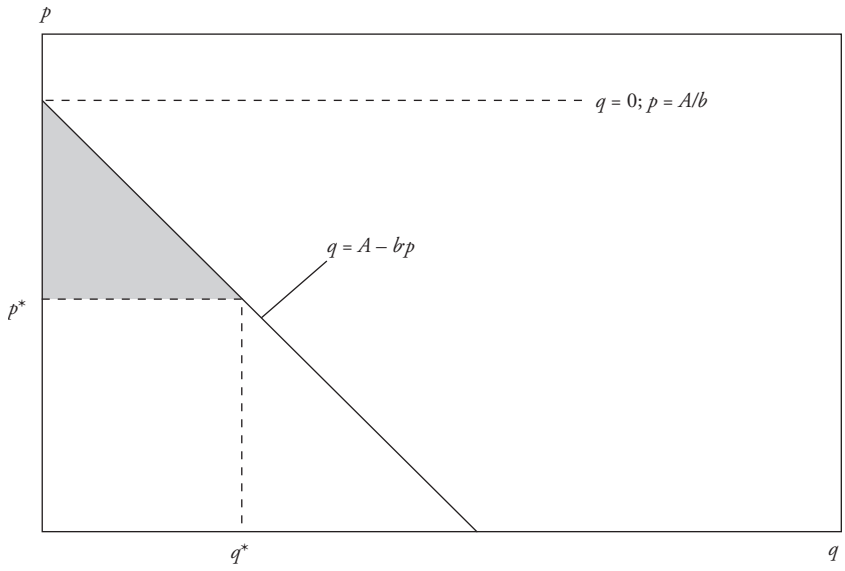
$$CS_1 = \text{revenue}_1 \cdot [(1 - c^{-(e-1)}) / (e - 1)] = (p_1 \cdot q_1) \cdot [(1 - c^{-(e-1)}) / (e - 1)].$$

Future consumer surplus, CS_2, is given by

$$CS_2 = (p_1 \cdot q_2) \cdot [(1 - c^{-(e-1)}) / (e - 1)].$$

90. This formula is a simplification of a formula presented by Hausman (1997), in which there are no income effects. When the price elasticity is one, the formula for *CS* / revenue becomes $\ln(p_{\max} / p_1)$.

Figure 13A-1. *Linear Demand*



The ratio of the consumer surplus,[91] which corresponds to an increase in demand from q_1 to q_2, is given by

$$\begin{aligned} CS_2 / CS_1 &= \{(p_1 \cdot q_2) \cdot [(1 - c^{-(e-1)}) / (e-1)]\} / \{(p_1 \cdot q_1) \\ &\quad \cdot [(1 - c^{-(e-1)}) / (e-1)]\} \\ &= q_2 / q_1. \end{aligned}$$

The change in consumer surplus, $CS_2 - CS_1$, is proportional to the change in the quantity demanded. From the fact that

$$CS_2 / CS_1 = q_2 / q_1,$$

it follows that

$$(CS_2 / CS_1) - 1 = (q_2 / q_1) - 1.$$

Simplification yields

$$(CS_2 - CS_1) / CS_1 = (q_2 - q_1) / q_1.$$

91. When the elasticity is one and $p_{max} = c \cdot p_1$, then CS_i / Revenue$_i$ = ln(c). Therefore, when the demand curve shifts outward, the ratio of initial to new consumer surplus at the same price equals the ratio of the quantities demanded, as in the general case.

Multiplying by CS_1,

$$(CS_2 - CS_1) = (q_2 - q_1) \cdot (CS_1 / q_1).$$

Because CS_1 and q_1 are constant,

$$\text{let } k = (CS_1 / q_1),$$

which yields the desired result:

$$(CS_2 - CS_1) = k \cdot (q_2 - q_1).$$

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