Creating Broad Access to New Communications Technologies:

Build-Out Requirements versus Market Competition and Technological Progress

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Executive Summary

The introduction of new technologies, especially those with the capacity to change the way people work and live, raises important public policy issues about how to ensure broad access to those innovations. The heart of the issue is what approach can best accelerate the spread of valuable technologies? This question is being raised today in Congress and some states as they debate proposals to reform cable franchise rules and open the video marketplace to Internet Protocol Television (IPTV), a potential breakthrough technology that could not only deliver entertainment in new ways, but also significantly expand broadband Internet access and information-sharing.

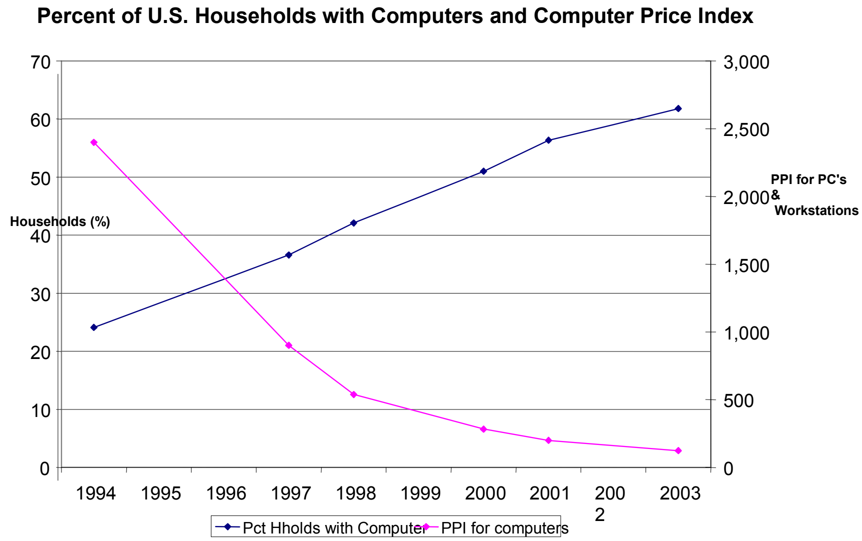
Policymakers need to know whether the application of "build-out" requirements often associated with cable franchise rules to new IPTV competitors will increase or impede broad access to the new service for Americans of every income level, living in urban, suburban and rural communities. Stated plainly, would the absence of build-out rules deny access on the basis of people's income or geographical location, race or education?

To explore these questions, this study, "Creating Broad Access to New Communications Technologies" examines and analyzes public data from the U.S. Commerce Department, Census Bureau and Federal Communications Commission regarding the growth and spread of the two most important breakthrough technologies, home computers and Internet access, along income and geographical lines. The study also applies regression analysis to further test its analysis. The findings are clear: Broad social access to these technologies has been achieved not by build-out requirements, but by sharply-declining prices driven by both fierce competition and the normal and rapid process of technological advance in these areas. Moreover, numerous economic studies have found that applying requirements such as build-out rules to new competitors will only reduce investment and competition, ultimately producing higher prices and more limited and restricted access.

The data show that competition and technological advance, not build-out rules, provide the most efficient and effective route to the broad spread of new technologies. When a valuable, new technology is first introduced, early-adopters take it up quickly. But when the technology has proven to be broadly useful and valuable, many competing providers enter the market; and that competition, combined with the technical advances that characterize the telecommunications market and information technology sector,

[1] The author gratefully acknowledges the helpful comments and insights of Dr. Kevin Hassett of the American Enterprise Institute. This analysis was prepared with support from AT&T.

sharply drives prices down to create broad access. These dynamics can be represented clearly by graphing computer prices and computer ownership rates over time:



Further analysis of the data establishes that this broad access to critical technologies extends increasingly across the economic spectrum. For at least a decade now, computer ownership and Internet access have consistently increased at higher rates among low-income households and those living in rural and central city areas, than among higher-income households and those living in metropolitan areas. For example:

- From 1994 to 2003, Americans with incomes of less than $20,000 increased their computer ownership at an average annual rate of 18.1 percent, more than twice the 8.3 percent average annual rate of those earning over $50,000.
- In the most recent period for which data are available, 2001 to 2003, those with incomes under $20,000 increased their computer ownership rates by 21.9 percent, compared to 6.2 percent for those with incomes over $50,000.
- From 1994 to 2003, Americans with incomes under $20,000 increased their rates of Internet access at an average annual rate of 27.6 percent, or two-thirds higher than the 16.5 percent annual rate for those earning over $50,000
- In the 2001 to 2003 period, Americans with incomes of less than $20,000 increased their rates of Internet access by 14.6 percent, compared to 6.3 percent of those with incomes of more than $50,000.

Regardless of the social or economic group that first adopts a valuable new technology, others across the economic spectrum will increasingly adopt it too, so long as build-out requirements or other comparable regulatory burdens do not dampen the competition and investments that make that process possible.

The question remains, whether advanced video services such as IPTV will follow this pattern. The available evidence suggests that the answer is "yes."

Build-out requirements are based on the view that those providing competitive telecommunications services will systematically bypass areas that include large numbers of households with relatively low incomes. The economic literature and economic logic, as well as the data on the spread of computers and Internet access, all argue otherwise.

In addition to the basic process by which Internet access and computer ownership spread increasingly across all economic and geographic boundaries, certain features of these services and their likely market create compelling economic incentives to provide access on as broad a basis as possible. First, the new video services will be offered through fiber optic networks in a bundle with voice and high-speed Internet; and this bundling will promote greater investment by expanding the potential revenues and shortening the payback period on the investment. In addition, businesses go where their customers are, and there is substantial evidence that lower-income households provide a highly attractive market for advanced video services.

Today, low-income households already subscribe to current video services at roughly the same rates as high-income households, providing the basis for deploying fiber for video in low-income areas. In addition, African-American and Hispanic households subscribe to the premium channels of current video services at higher rates than other groups. In the case of advanced video services, lower-income households and minority neighborhoods appear to be very high-value customers that businesses will seek. This view is supported by a recent study which found that a new provider that offered such video services, in a bundle with voice and high-speed Internet, would find it profitable to extend its network to 84 percent of Census blocks with average earnings of under $20,000 -- a higher level than required under build-out requirements.

The data and other evidence show that the soundest course for promoting broad social access to advanced telecommunications and information technology services, including the new video services, is to reject build-out requirements and instead promote competition and continuing technological advance.

Introduction

The policy debate over whether to impose regulatory requirements developed originally for monopoly cable businesses on telecommunications companies that want to compete with cable by offering internet-protocol video services (IPTV) raises important social issues. If broad access to this new technology is socially desirable, would the extension of build-out requirements to new competitors, on the model of those applied at times to cable systems, ultimately increase or impede broad and equal access to the service?

Broad access to new broadband telecommunications services for Americans at every income level and geographical area can be achieved by encouraging competition itself, which drives down the prices of these services and promotes additional technological innovations that further drive down prices. This is precisely how large shares of Americans at every income level, race and education, living in center cities and rural America as well as suburbia, achieved access to home computers and the Internet.

As broadband-based telecommunications services become increasingly important, promoting access that reaches Americans at every income level, from suburban America to center cities and rural areas, becomes a matter of social equality. To help promote broad access to cable television, regulators some times required that monopoly providers build out their networks based on minimum levels of housing density. What works for a monopoly provider, however, will fail under more competitive conditions: A monopolist can recover those costs by raising prices, as cable did during its build-out. But when competition enters that drives down prices, build-out requirements can limit broad access by depressing investment.

These issues have been examined elsewhere with regard to the direct economic costs associated with imposing build-out requirements on new competitors. Numerous researchers have found that imposing the requirements developed for monopoly cable providers on potential new competitors would delay or deter competition by slowing the pace of new investment, which in turn would lead to higher prices, fewer choices and lower-quality services for consumers. The National Telecommunications Information Administration (NTIA) reached this conclusion nearly 20 years ago:

> The franchising process [and the build out requirements that typically accompany it] eliminates or seriously impedes entry by competitors, imposes substantial costs and delays on franchisees, cable subscribers, and the public, which are not offset by countervailing benefits.[2]

The Federal Communications Commission (FCC) similarly concluded in 1994 that this process "is, perhaps, the most important policy-relevant barrier to competitive

[2] Anita Wallgren, "Video Program Distribution and Cable Television: Current Policy Issues and Recommendations," National Telecommunications Information Administration, Report 88-233, June 1988.

entry in local cable markets."[3] The reasoning is hardly complicated economics. Increasing the fixed costs associated with an investment will generally lead to delays, reductions or cancellation of the investment. For much the same reasons, the FCC in 1997 explicitly barred the imposition of state build-out requirements on new competitors in local telephone service.[4]

The economic costs arising from such regulatory burdens can be even greater when the requirements reduce, delay or deter the introduction and extension of not just simple competition for the same service but, as in this case, a powerful new technology. Much of the growth and productivity gains achieved by the American economy in recent years can be traced to investments in the dynamic process by which successive rounds of economic innovations are developed and applied. To the extent that build-out requirements would delay or deter the introduction and spread of next-generation broadband communications services, they could weaken the dynamic process of innovation, creating economic costs beyond those arising more directly from diminishing competition with the incumbent systems.

Beyond the potential economic costs of imposing such regulatory requirements on the provision of new communications services, an important social issue should be addressed. Would the regulations imposing build-out requirements produce broader access to these new services? Stated plainly, would the absence of build-out requirements produce a "digital divide" which would deny access to the new communications services based on income or geographical location, race or education? Data and other evidence all suggest very strongly that the answer is "no."

To the contrary, since the mid-1990s, the Department of Commerce and the FCC have collected extensive data on the rate at which Americans have secured access to other new communications products and services – computers and the Internet– that have spread without any build-out or comparable regulatory requirements. Careful analysis of these data establishes that normal competition and technological advance consistently produce expanding access for all income groups by driving down the price and that build-out requirements do not materially increase access by lower-income groups or those living in central city or rural areas.

As we will see, computer ownership and Internet access have increasingly spread across all income classes and geographical areas by force of competition, not build-out requirements. For at least the last decade, computer ownership and Internet access have consistently grown at *higher* rates among lower-income American households and those living in rural and central city areas than among higher-income households and those living in metropolitan areas. With regard to advanced video services, there are substantial grounds to expect that providers have compelling incentives to extend the

[3] FCC, *In re Implementation of Section 19 of the Cable Television Consumer Protection and Competition Act of 1992, Annual Assessment of the Status of Competition in the Market for Delivery of Video Programming,* 9 FCC Red 7442, Appendix H, 1994.
[4] FCC, *In the Matter of the Public Utility Commission of Texas,* Policy Docket Nos. 96-13, 96-14, 96-16, 96-19, *Memorandum Opinion and Order,* FCC No. 97-346 (October 1, 1997).

fiber optic networks carrying those services broadly to low-income areas. Finally, the extension of those networks for video services, bundled with voice and high-speed Internet service, will further expand access to high-speed Internet for low-income Americans.

Build-out requirements purportedly intended to guarantee broad access to new video services could well produce the opposite result, by reducing competition and the incentive to make the additional technological and competitive progress. The likely consequence of imposing build-out regulation on new telecommunications services would be higher prices and relatively lower quality and capabilities, which in turn would retard its spread to lower-income Americans and those in central city or rural areas.

The Economic Impact of Regulations that Restrict Competition

The economic costs of regulations that discourage investment and thereby impede market competition are well documented. Such regulations generally raise prices for consumers and restrict their choices, lowering the efficiency and productivity of the regulated sector and reducing economic growth on the margin.

Such regulation was long considered appropriate in cases of "natural monopoly" where there is no real prospect of self-sustaining competition. When it is more efficient for a single enterprise to serve an entire market – the basic condition for natural monopoly – regulation has typically been applied to protect consumers from the monopolist's ability to control the market. Under most such regulation, some provision for broad or universal service is applied, and prices are set so that profits are not excessive. The ultimate purpose is to produce the same general effects as market competition – lower prices and enhanced access and service.

Local telephone and cable services were once thought to be such natural monopolies. The view of cable television as a natural monopoly, on the model of local telephone service, was based on the large costs of building an infrastructure network of wired connections extending to tens of millions of individual homes.[5] The regulation of monopoly cable providers, therefore, included build-out requirements to encourage providers to make the service broadly available, commonly a provision requiring that cable franchisees extend their network to any part of a local market where the population density was at least 30 houses per-square-mile.[6] Unlike long-term federal regulation of local telephone service, the regulation of cable video services did not usually include limits on prices.

For some time now, however, the FCC and virtually all economists have recognized that both telephone and cable services are not natural monopolies.[7]

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[5] See Thomas W. Hazlett, "Cable TV Franchises as Barriers to Video Competition," George Mason University Law and Economic Research Paper Series, No. 06-06, March 2006.
[6] *Ibid.*
[7] *See*, for example, Laffont, Jean-Jacques and Jean Tirole (2000), *Competition in Telecommunications*, MIT Press: Cambridge, 2000; Cave, Martin, Sumit Majumdar, and Ingo Vogelsang (eds.) (2002), *Handbook of*

Consequently, regulations that artificially increase the cost of entering their markets can impose large economic costs on consumers. The adverse effects of these requirements have been established in a number of economic studies. One report found that by significantly reducing competitive entry into local markets, the requirements led to higher cable prices for consumers, a conclusion confirmed by subsequent studies.[8] In 2004, the General Accounting Office similarly concluded that,

> [c]ompetition leads to lower cable rates and improved quality … where available [competition from a wire-based company], cable rates arte substantially lower (by 15 percent) than in markets without this competition … In markets where DBS [Direct Broadcast Satellite service} companies provide local broadcast stations, cable operators improve the quality of their service.[9]

When regulation creates barriers to the broad application of new technologies that could compete with existing technologies, the potential costs go beyond savings for consumers and businesses from price competition. In such cases, the regulatory barriers may delay or prevent companies from adopting new technologies that could shape or change the way they conduct business, including their capacity to develop innovative products or services of their own. In instances in which such regulation affects the availability of "general purpose" innovations that are potentially useful across the economy, the regulatory barriers may stall or short-circuit the dynamic process of economic innovation itself. When this happens, the costs in terms of jobs, incomes and wealth creation can be very substantial.

The current landscape of the American economy has been critically shaped by the development and spread of new technologies and new business methods developed to make effective use of those technologies. This process is a dynamic one in which one new development can become a building block for succeeding innovations, and the presence of competition is a critical part of this process.[10] For example, the introduction of Lotus 1-2-3 spreadsheet software not only brought down prices for the then-dominant VisiCalc program, but also introduced new integrated charting, plotting and database capabilities. Lotus 1-2-3's innovative features, owing partly to the preceding innovations of VisiCalc, contributed to advances in bookkeeping, analytic research, financial analysis and other areas, along with new ways of organizing these functions inside firms.

Telecommunication Economics, Volume 1: Structure, Regulation, and Competition, North-Holland: Boston, 2002; or, Vogelsang, Ingo and Bridger Mitchell (2001), *Telecommunications Competition: The Last Ten Miles*, AEI Studies in Telecommunications Deregulation, MIT Press: Cambridge, 1997.

[8] T. W. Hazlett and G.S, Ford, "The Fallacy of Regulatory Symmetry: An Economic Analysis of the Level Playing Field in Cable TV Franchising Statutes," *Business & Politics,* Vol. 3, 2001; G.R. Faulhaber and C. Hogendorn, "The Market Structure of Broadband Communications," Wharton School Research Center, Public Policy and Management department, 1`999, www.knowledge.wharton.upenn.edu/paper/701.pdf.

[9] General Accounting Office, "Subscriber Rates and Competition in the Cable Television Industry," GAO 04-262T, testimony before the Committee on Commerce, Science and Technology, U.S. Senate, www.gao.gov/cgi-bin/getrpt?GAO-04-262T.

[10] For a discussion of some of these issues, see Murat Iyigun, "Technology Life-Cycles and Endogenous Growth," University of Colorado, Department of Economics Working Paper No. 00-7, December 2000.

Moreover, the success of the new technology produced competitive pressures to develop the next round of advances that could compete with and perhaps overtake both the original incumbent and the succeeding innovator. In time, Lotus 1-2-3 too was ultimately overtaken by Excel, with its innovative graphical interface for spreadsheets.

Economists have conducted extensive research on the role that competition plays in driving such developments and the diffusion of technological innovations. As Michael Porter and others have found, firms incur the costs of developing and adopting new technologies when competitive pressures require them to do so – whether the firm is a new entrant innovating to claim part of the market of incumbent firms or an established company innovating to compete with its rivals.[11] When firms compete mainly through prices, most innovators will focus on advances that can reduce costs. In sectors characterized by rapid rates of technological change such as telecommunications, researchers have found that technological or innovation-based competition is more important than price competition.[12]

Researchers also have established that government regulation can materially affect an industry's pace of innovation, as well as its prices. A leading scholar, Clifford Winston of the Brookings Institution, has written,

> Economic regulation of any industry for a long period of time causes that industry to develop a regulatory bequeathed capital structure and a provincial mindset … Inefficient operating practices and a slow rate of technological progress become deeply engrained in the industry as regulation persists. Deregulation therefore cannot be expected to create an efficient and technologically up-to-date industry overnight. However, it can be expected to jump-start the long-term process of dismantling the most costly aspects of regulation. … an industry's adjustment to deregulation is shaped by the increased operating freedoms and intensified competition that force it to become more technologically advanced, adopt more efficient operating practices, and respond more effectively to external shocks.[13]

Other analyses have documented that regulatory restrictions on firms' ability to enter (or exit) an industry reduce competition and thereby slow technological innovation

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[11] Michael Porter, *The Competitive Advantage of Nations*, Macmillan Press, New York: 1990; Philippe Aghion and Peter Howitt, *Endogenous Growth Theory*, MIT Press, Cambridge: 1998.

[12] Stanley M. Besen and Joseph Farrell, "Choosing how to compete: strategies and tactics in standardization," *Journal of Economic Perspectives,* Vol. 8, No. 2, 1994; David Evans and Richard Schmalensee, "Some economic aspects of antitrust analysis in Dynamically competitive industries, *NBER Working Paper Series*, No. 8268, 2001. See Sanghoon Ahn "Competition, Innovation and Productivity Growth: A Review of Theory and Evidence," Organization for Economic Cooperation and Development, *Working Paper* 317, June 2002.

[13] Clifford Winston, "The Success of the Staggers Rail Act of 1980," The Brookings Institution, September 2005.

in the industry, as well as raising its prices.[14] These conclusions are supported by studies of firms and sectors following deregulation. One researcher found that following the divestiture of AT&T, subsequent competition in long-distance service accounted for 17 percent of AT7T's productivity growth.[15] Other researchers have analyzed the impact of the 1980 deregulation of freight railroad operations, including discretion to set rates, abandon unprofitable routes, and consolidate with other carriers.[16] Careful review of the impact 25 years later found that the deregulation had markedly increased railroad companies' incentives to adopt new technologies that could improve their service and reduce their costs.[17]

Researchers also have estimated the costs to U.S. consumers of regulations that have impeded the diffusion of technological innovations. One study estimated that regulatory delays in the introduction of cellular phone service cost Americans some $100 billion – and the final introduction of the service produced consumer benefits of $50 billion a year.[18] Similarly, the introduction of direct broadcast satellite service to compete with cable service produced direct benefits to consumers estimated at $450 million.[19]

How New Technologies Spread Across Income Groups and Geographical Areas

Many factors can influence the rate and degree at which individuals, businesses or industries, communities or entire nations, adopt a new technology. The spread of certain technologies from one country to another, for instance, can depend on prevailing rules of trade, the legal and economic environment for foreign direct investment, and patent regimes.[20] The size and quality of the labor force of a country, a community or a business also can affect whether or not a new technology is adopted.[21]

The actual use of computers and the Internet is not universal anywhere. The public-policy question is whether or not people's ability to afford these valuable goods

[14] Clifford Winston, "Economic deregulation: day of reckoning for microeconomists," *Journal of Economic Literature*, Volume 31, September 1993.
[15] John E. Kwoka, Jr., "The effects of divestiture, privatization and competition on productivity in U.S. and U.K. telecommunications," *Review of Industrial Organization*, Volume 8, No. 1, 1993.
[16] For example, Richard Caves, Lee Christensen, and J.ohn Swanson, "Economic performance in regulated and unregulated environments: A comparison of U.S. and Canadian railroads," *Quarterly Journal of Economics,* Vol. 96, No. 4, 1981; Clifford Winston, Thomas Corsi, Curtis Grimm and Carol Evans, *The Economic Effects of Surface Freight Deregulation* The Brookings Institution, 1990.
[17] Winston, "The Success of the Staggers Rail Act of 1980," *op. cit.*
[18] Jerry Hausman, "Valuing the Effects of Regulation on New Services in Telecommunications," *Brookings Papers on Economic Activity: Microeconomics*, The Brookings Institution, 1997.
[19] Austan Goolsbee and Amil Petrin, "The Consumer Gains from Direct Broadcast Satellites and the Competition with Cable Television," National Bureau of Economic Research, Working Paper No. W8317, June 2001.
[20] Wolfgang Keller, "International Technology Diffusion," National Bureau of Economic Research, Working Paper No. W8573, December 2001; November 2004; Maurice Schiff, Yanling Wang and Marcelo Olarreaga, "Trade-Related Technology Diffusion and the Dynamics of North-South and South-South Integration," World Bank Policy Research Working Paper No. 2861, June 2002; Bin Xu and Eric P. Chiang, "Trade, Patents, and International Technology Diffusion," University of Florida, February 2000.
[21] Martin Falk, "Diffusion of Information Technology, Internet Use and the Demand for Heterogeneous Labor," Center for European Economic Research, Discussion Paper No. 01-48, August 2001.

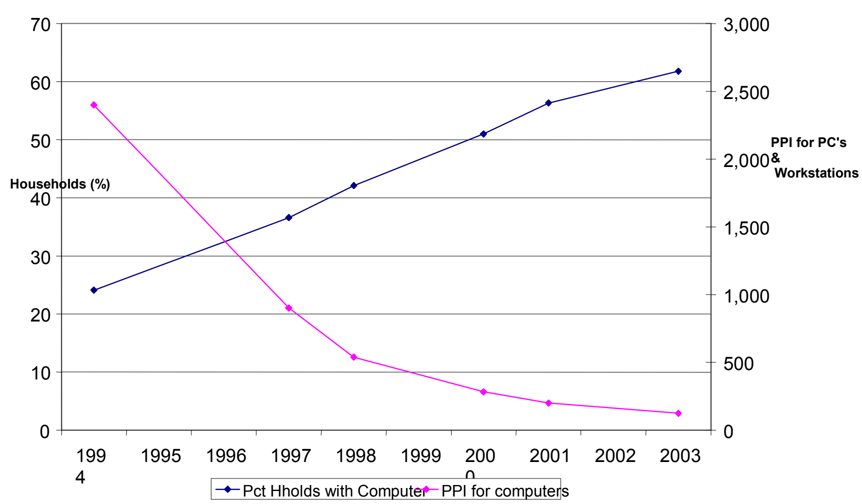
and services is based permanently on how much they earn or where they live, and the conditions that affect the answer. Build-out requirements posit that markets alone would leave access to new telecommunications and video services blocked for most low-income people and those living in center cities and rural communities. Yet, economic research has consistently found that when competition is present, these same requirements reduce rather than encourage investment in the infrastructure required to make those services available to lower-income people and people in those geographical locations.

Two critical social issues remain. How do new technologies normally and efficiently spread across the economy and American society? And in the absence of build-out requirements, will normal competition and the dynamics of technological advance promote expanding social access by steadily reducing their prices?

How Markets Create Broad Access to New Telecommunications Services

It has been long established that within a country or community, the cost of a new technology critically affects the rate at which it spreads.[22] This phenomenon has been closely researched with regard to computers, and it is now well documented that the diffusion of computers across the U.S. economy was driven to a significant degree by the extremely rapid and sharp decline in computer prices over time and the extremely rapid and sharp increase in computer quality over time.[23] The Commerce Department has estimated that real computer prices fell roughly 12 percent a year 1987-1994, followed by 26 percent annual price declines 1995-1999.[24] The following graph tracks the falling price and accompanying increases in the share of U.S. households owning computers.

Graph 1: Percent of U.S. Households with Computers and Computer Price Index



[22] Stephen Davies, *The Diffusion of Process Innovations,* Cambridge University press, 1979; Paul A. David, "A Contribution to the Theory of Diffusion," Research Center in Economic Growth, Memorandum No. 71, Stanford University, June 1969.
[23] Dale Jorgenson, "Information Technology and the U.S. Economy," *American Economic Review*, Vol. 91, No. 1, 2001; Dale Jorgenson and Kevin Stiroh, "Information Technology and Growth, *American Economic Review*, Vol. 89, No. 2, Papers and Proceedings., 1999.
[24] Department of Commerce, *Digital Economy 2000*, Economics and Statistics Administration, June 2000.

When competition is permitted and investment is allowed to proceed without the burden of build-out requirements or other comparably costly regulation, the steadily falling prices that characterize these technologies have consistently created expanded access, measured by rates of increase in their ownership or use, by both income and place of residence, and for both computers and the Internet.

When a new communication or information technology is introduced – whether computers, mobile phones, plasma screens or Internet access – it usually is expensive and taken up first by small numbers of "early adopters." When these technologies have proven to be broadly useful, competing producers or providers have entered the market. That competition for a rapidly expanding market, along with the regular technological advances that characterize these technology sectors, sharply drive down the price – creating broad access that spreads increasingly across the economic spectrum. And since lower-income people may be more price sensitive, they will respond more strongly to falling prices – and therefore their access grows faster as these technology prices drop.

The data show clearly the way that market competition has created this increasingly broad access to these technologies: For at least a decade, computer ownership and Internet access have increased faster among lower-income and non-metropolitan households than other groups. The following table shows that from 1994 to 2003, computer ownership and Internet access increased at much higher average annual rates among households with incomes under $20,000, than among other households, including, compared to those with incomes over $50,000, more than twice as fast for computer ownership and two-thirds faster for Internet access. Computer ownership and Internet access also increased at higher average annual rates among households living in rural (non-metropolitan) areas than metropolitan areas; and within metropolitan areas, access grew most rapidly in central city areas than other parts of metropolitan areas.

Table 1. Average Annual Rate of Increase in Households with Computers and Internet Access, By Income and Geographic Location, 1994-2003[25]

	Computer Ownership	Internet Access
Household Income		
$20,000 or less	18.1%	27.6%
$20,000 - $50,000	14.1%	25.2%
$50,000 or more	8.3%	16.5%
Geography		
Non-Metropolitan	13.4%	24.5%
Metropolitan	10.0%	18.1%
Central City	11.5%	19.3%

[25] "Falling Through the Net: A Survey of the 'Have Nots' in Rural and Urban America," 1995, U.S. Department of Commerce, www.ntia.doc.gov/ntiahome/fallingthru.html; "Falling Through the Net II: New Data on the Digital Divide," 1998, U.S. Department of Commerce," www.ntia.doc.gov/ntiahome/net2 ; "Falling Through the Net: Defining the Digital Divide," 1999, U.S. Department of Commerce, www.ntia.doc.gov/ntiahome/fttn99/; "Falling Through the Net: Toward Digital Inclusion," 2000, U.S. Department of Commerce, www.ntia.doc.gov/pdf/fttn00.pdf; "A Nation Online: Internet Use in America," 2002, U.S. Department of Commerce, www.ntia.doc.gov/opadhome/digitalnation/index_2002.html; "A Nation Online: Entering the Broadband Age," 2004, U.S. Department of Commerce, www.ntia.doc.gov/reports/anol/NationOnlineBroadband04.htm ; public use data from the Current Population Survey, U.S. Census Bureau and Bureau of Labor Statistics..

The data on computer ownership and Internet access are available for seven years – 1989, 1994, 1997, 1998, 2000, 2001, and 2003. Therefore, we also can analyze rates of increase in social access to these vital technologies over six discrete periods: 1989-1994; 1994-1997; 1997-1998; 1998-2000; 2000-2001; and 2001-2003. These data show in great detail that households with lower incomes and those living in rural or central city areas have consistently increased their computer ownership at substantially higher rates than other groups over every period (Table 2). Aggregating some of the data below, we found that from 1994 to 1997, Americans with incomes under $20,000 increased their rates of computer ownership by 85.1 percent – with the greatest gains among those with incomes of $5,000 to $15,000 – compared to 54.1 percent for those with incomes of $20,000 to $50,000 and 41.1 percent for those with incomes of over $50,000. The same pattern of higher rates of increase among lower-income households is evident in every other period examined. In the most recent once, from 2001 to 2003, those with incomes of less than $20,000 increased their computer ownership rates by 21.9 percent, compared to 18.2 percent for those with incomes of $20,000 to $50,000 and 6.2 percent for those with incomes of more than $50,000.

Similarly, in every period for which data are available, computer ownership increased more rapidly among households in rural ("non-metropolitan") areas than in metropolitan areas; and within metropolitan areas, computer ownership grew most rapidly in central city areas in four of the five periods examined.

Table 2. Rate of Increase in the Share of U.S. Households Owning Computers, By Income and Geographical Location[26]

	1994	1997	1998	2000	2001	2003
Household Income						
Under $5,000	44.8%	96.4%	23.6%	37.1%	18.7%	37.6%
$5,000 - $9,999	64.9%	62.3%	24.2%	18.7%	31.0%	40.5%
$10,000 - $14,999	82.2%	57.3%	23.3%	38.4%	16.4%	23.9%
$15,000 - $19,999	46.3%	48.7%	21.8%	34.0%	11.5%	20.7%
$20,000 - $24,999	58.3%	51.3%	11.7%	22.2%	27.6%	14.9%
$25,000 - $34,999	35.6%	60.1%	12.9%	24.6%	11.3%	11.7%
$35,000 - $49,999	46.7%	38.2%	10.1%	16.7$	9.7%	10.7%
$50,000 - $74,999	45.6%	31.7%	9.4%	10.4%	6.1%	5.5%
$75,000 and above	38.7%	24.6%	5.3%	8.0%	3.1%	2.4%
Geography						
Non-Metropolitan	--	64.7%	18.3%	22.6%	15.1%	12.7%
Metropolitan	--	45.6%	13.4%	20.8%	8.9%	8.4%
Central City	--	55.6%	17.2%	19.9%	10.5%	10.5%

The same patterns are evident in the data on Internet access: In every period for which data are available, households with lower incomes and those living in rural or

[26] *Ibid.*.

central city areas have generally increased their Internet access more rapidly than other groups (Table 3). Again, aggregating some of the data presented below, from 1994 to 1997, the number of American households with incomes of less than $20,000 that gained Internet access increased by 100.0 percent, compared to 88.2 percent for those with incomes of $20,000 to $50,000 and 64.9 percent for those with incomes of over $50,000. In the more recent period of 2000 to 2001, Internet access grew at a 35.4 percent rate among households with incomes of less than $20,000, compared to 28.7 percent for those with incomes of $20,000 to $50,000 and 17.5 percent for those with incomes over $50,000. Similarly, in every period for which data are available, Internet access grew more rapidly among households in rural or non-metropolitan areas than in metropolitan areas; and within metropolitan areas, access grew most rapidly in central city areas in three of the five periods examined.

Table 3. Rates of Increase in the Share of U.S. Households with Internet Access, By Income and Geographical Location[27]

	1994	1997	1998	2000	2001	2003
Household Income						
Under $5,000	135.7%	137.5%	23.3%	97.5%	27.8%	31.1%
$5,000 - $9,999	525.0%	59.0%	53.5%	52.5%	54.3%	39.2%
$10,000 - $14,999	342.9%	69.4%	41.0%	91.9%	35.5%	23.0%
$15,000 - $19,999	208.3%	96.5%	34.8%	95.9%	22.4%	25.1%
$20,000 - $24,999	231.3%	82.0%	25.5%	89.3%	38.9%	15.3%
$25,000 - $34,999	165.5%	87.1%	32.5%	78.0%	23.8%	8.3%
$35,000 - $49,999	180.0%	58.9%	32.6%	56.3%	22.3%	11.4%
$50,000 - $74,999	178.8%	51.8%	29.7%	38.7%	17.1%	6.6%
$75,000 and above	132.4%	45.7%	20.3%	28.9%	9.8%	2.9%
Geography						
Non-Metropolitan	--	98.0%	38.0%	83.2%	29.2%	11.4%
Metropolitan	--	69.5%	32.6%	54.3%	19.9%	7.7%
Central City	--	74.0%	40.9%	53.4%	20.7%	7.5%

More Evidence of How Competition Inrceases Access to New Technology Services

The analysis thus far establishes that the data on computer ownership and Internet access are consistent with a process of technological diffusion in which competition and technological advance provide increasingly broad social access to valuable new technologies, across income groups, by driving down their prices. This consistency can be verified statistically through a regression analysis designed to shed light on the process that governs the spread of new technologies.

Using state-level data from the Current Population Survey, this analysis can establish whether the spread of technology to early adopters is followed by the spread of that technology across the income spectrum in the same state. Put differently, the

[27] *Ibid.*

regression analysis shows whether for two states that are identical in every regard except that the early-adopters in one have higher rates of computer ownership or Internet access than the other, the first state will also have higher rates of computer ownership or Internet access among all income groups in the subsequent period. (The complete results of these regressions can be found in the Appendix.).

Our regression analysis first examined whether there is a strong statistical relationship between rates of computer ownership among individuals with incomes of $75,000 and more and those rates for individuals with incomes of $15,000 or less. The results document two strong statistical relationships. First, if more low-income people own a computer in one year in a given state, the number of low-income individuals owning a computer will increase in the subsequent period. Second, if more high-income people have computers today in a given state, more low-income people will own computers in the subsequent period.

We also applied this statistical analysis to the data on Internet access. Here, one might expect even stronger results, because while creating a network for Internet access requires large, initial sunk investments by telecommunications companies, once a critical level of individuals using the Internet has been achieved in a given area, low marginal costs can produce price reductions and diffuse access to all income groups, including the very lowest. Here, too, the regression analysis found very strong evidence that Internet access spreads from early adopters across income categories: There is a strong statistical relationship between Internet access among individuals with incomes of $75,000 and more in one period, and increased access in the next period among people with incomes of less than $15,000.

These regression analyses provide strong, additional support for the conclusion that allowing competition and the technological advances promoted it to proceed is an effective way of ensuring that low-income households secure access to new telecommunications and information technology goods and services.

Access by Lower-Income Americans to Advanced Video Services

There are additional, substantial grounds to expect that without the burden of build-out requirements, advanced video services will rapidly become available to Americans at every income level and in every geographical area. First, these services would be offered through fiber optic networks in a bundle with voice and data (high-speed Internet) service. As noted in economic studies of such combined or bundled services, including all three services together will promote investment by expanding potential revenues, which in turn will shorten the payback period for the investment; and a shorter payback period will reduce the risk of the investment, lowering the cost of capital and thereby producing more network investment.[28] As a recent, important study noted,

[28] George Ford, Thomas Koutsky and Lawrence Spiwak, "The Impact of Video Service Regulation on the Construction of Broadband Networks to Low-Income Households," Phoenix Center for Advanced Legal and Economic Public Policy Studies, Policy Paper Number 23, September 2005.

> "[M]arkets with greater potential revenues can support more facilities-based entry. … [E]ntry is facilitated when new technology permits owners to covert what traditionally were "single-use" networks into "multi-use" networks and leverage their assets to "spill over" into related markets, because such spillovers reduce entry costs. The combination of larger markets and spillovers can produce substantially more entry. [29]

These conditions should promote the rapid creation of a more extensive network than was originally provided, for example, for high-speed Internet access. Moreover, the lower costs and lower prices associated with bundling high-speed Internet and voice services with new video services could further accelerate the extension of low-priced, high-speed Internet to lower-income areas. To examine this question, researchers performed a simulation based on demand for these services in low-income areas, testing whether a new competitor would deploy broadband Internet services more widely in low-income areas if it could bundle fiber-optic video and voice services with the broadband Internet service. The analysis found that by offering all three services together, a new provider would find it profitable to extend its network to 84 percent of Census blocks with average earnings of under $20,000, a higher level than required under existing build-out requirements.[30]

The economic benefits associated with this bundling were also recently addressed in a report by a market research firm, In-Stat.[31] The study estimated that worldwide broadband subscribers would rise from some 200 million this year – of which an estimated 69 percent now use DSL service – to 413 million by the end of 2010. The study found that the bundling of video and telephone service with broadband Internet was an important factor in the projected rapid expansion of broadband subscribers.

In the American case, these findings are reinforced by evidence that lower-income households should provide a highly-attractive market for advanced video services. One recent study found that low-income households subscribe to current video services at roughly the same rates as higher income households,[32] providing a sound financial basis for deploying fiber for video in low-income areas. In addition, recent surveys have found that African-American and Hispanic households subscribe to the premium channels of current video services at higher rates than other groups.[33]

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[29] *Ibid.*; George Ford, Thomas Koutsky and Lawrence Spiwak, "Competition after Unbundling: Entry, Industry Structure and Convergence," Phoenix Center Policy Paper no. 21, July 2005, www.phoenix-center.oirg/pcpp/PCPP21Final.pdf.

[30] Ford, et. al., "The Impact of Video Service Regulation on the Construction of Broadband Networks to Low-Income Households," *ibid.*

[31] In-Stat, "The Broadband Boom Continues: Worldwide Subscribers Pass 200 Million," March 2006

[32] R. Kieschnick and B. D. McCullough, "Why Do People Not Subscribe to Cable Television: A Review of the Evidence," 1998, www.tprc.org/abstracts98/kieschnick.pdf; cited in Ford et al., *ibid.*

[33] Maribel D. Lopez, Forrester Research, Inc. "What Communications Services Are Ethnic Minorities Buying, April 11, 2006

The combination of broadband, voice and advanced video services over the same network will likely promote and accelerate increasingly broad social access to high-speed Internet service among low-income Americans, through both increased competition to drive down the cost and the lower cost of extending the fiber optic networks that can carry the bundle of the three services.

Conclusion

For at least a decade, policymakers and social scientists have struggled with notions of a "Digital Divide" and its attendant concerns that the provision of new telecommunications technologies could exacerbate disparities between America's "have's" and "have not's." These concerns have increased with the rise of the Internet and the prospect that lower-income Americans will be unable to tap into the power of the Web.

The data and evidence confound these concerns and expectations. Our examination has found that competition and technological advance provide increasingly broad access to telecommunications and information technologies by steadily and sharply driving down their prices. Drawing on the U.S. Census Bureau data on computer ownership and Internet access used by the U.S. Commerce Department to originally identify an alleged "divide," our analysis has shown that market competition and the normal process of technological advance have steadily driven down prices to levels that have enabled lower-income households and those living in central city or rural areas to steadily increase their computer ownership and Internet access, over at least the last decade, at consistently higher rates than those of higher-income households. Finally, there are substantial economic grounds to expect that providers of advanced video services will have significant incentives to extend the fiber optic networks carrying those services broadly to low-income areas, and that the extension of those networks for video services will also further expand access to high-speed Internet for low-income Americans.

These data and analyses fairly establish that the soundest course for promoting broad social access to advanced telecommunications and information technology services is to promote competition and continuing technological advance, and not impose build-out requirements on potential competitors.

About the Author

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Appendix: Detailed Analysis of Technology Use by American Consumers

Note on the Data

Every month, the Census Bureau surveys about 50,000 households to collect data for the Current Population Survey (CPS). From this representative sample, the Census Bureau compiles estimates of national labor force characteristics. The monthly survey is periodically supplemented with questions on other topics, and in October of 1994, 1997, 1998, 2000, 2001, and 2003, supplemental questions were asked about computer and Internet use. The 2000, 2001, and 2003 supplements also asked about high-speed Internet access, including the type of high-speed link employed.[34] The National Telecommunications and Information Administration (NTIA) has used these data in a series of reports about computer and Internet use in America, with a particular focus on the differences in use for different demographic groups.[35]

This study brings together the results of the NTIA reports to construct a time series study of the diffusion of these telecommunications technologies. While the NTIA present data on trends over time at irregular intervals, this study reports data for all available years: 1984, 1989, 1994, 1997, 1998, 2000, 2001, and 2003.[36] This study also expands on the NTIA reports by consistently using household-level analysis and by providing the same demographic breakdown of the data in every year. In particular, the NTIA report on the 2003 data focuses on high-speed internet and omits many of the other cross tabulations included here.

Because this study relies on household-level analysis, a caveat is necessary that is not relevant for the individual-level data in some of the NTIA reports. Here, the information on race and educational attainment refers not to the entire household, but to one "reference person" in the household. A reference person is an adult in the household who either owns or rents the residence.

[34] High-speed internet includes DSL, cable, satellite, and wireless connections.
[35] "Falling Through the Net: A Survey of the 'Have Nots' in Rural and Urban America," U.S. Department of Commerce, 1995, www.ntia.doc.gov/ntiahome/fallingthru.html; "Falling Through the Net II: New Data on the Digital Divide," U.S. Department of Commerce,1998, www.ntia.doc.gov/ntiahome/net2; "Falling Through the Net: Defining the Digital Divide," U.S. Department of Commerce, 1999, www.ntia.doc.gov/ntiahome/fttn99; "Falling Through the Net: Toward Digital Inclusion," U.S. Department of Commerce, 2000, www.ntia.doc.gov/pdf/fttn00.pdf; "A Nation Online: Internet Use in America," U.S. Department of Commerce, 2002, www.ntia.doc.gov/opadhome/digitalnation/index_2002.html; "A Nation Online: Entering the Broadband Age," U.S. Department of Commerce, 2004, www.ntia.doc.gov/reports/anol/NationOnlineBroadband04.htm.
[36] Accessed via the U.S. Census Bureau's DataFerrett, www.dataferrett.census.gov/index.html.

.Table 1. Regression Results

Share of households owning computers, income <$15,000
(t-statistics in parentheses; bolded entries are significant at 95% confidence level)

	no FE	state FE
lagged low-income ownership (<$15,000)	**0.754**	0.179
	(10.17)	(1.41)
lagged high-income ownership ($75,000+)	0.080	**0.258**
	(1.76)	(4.45)
Adj R-squared	0.46	0.55
N	250	250

Share of households with internet access, income <$15,000
(t-statistics in parentheses; bolded entries are significant at 95% confidence level)

	no FE	state FE
lagged low-income ownership (<$15,000)	**0.451**	0.127
	(7.64)	(1.92)
lagged high-income ownership ($75,000+)	**0.204**	**0.310**
	(8.16)	(11.71)
Adj R-squared	0.69	0.73
N	249	249

Share of households with high-speed internet access, income <$15,000
(t-statistics in parentheses; bolded entries are significant at 95% confidence level)

	no FE	state FE
lagged low-income ownership (<$15,000)	**0.575**	0.054
	(3.07)	(0.22)
lagged high-income ownership ($75,000+)	**0.266**	**0.434**
	(6.65)	(8.78)
Adj R-squared	0.50	0.59
N	100	100

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