

**A New Analysis of Broadband Adoption Rates
By Minority Households**

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Abstract

This paper examines the link between achieving universal broadband service across minority groups and various approaches to pricing that service. The issue is important because significant gaps in broadband adoption linked to race and income persist.

Based on historic patterns of technology diffusion with respect to personal computers and dial up Internet, simulations show that all groups of Americans might normally achieve universal broadband adoption by 2017 or 2018. In fact, the percentage of Americans with home broadband service climbed by 25 percent during the two years ending in October 2009. But exploding demand for additional bandwidth, associated with the rapid spread of video applications, is disrupting this natural trend by requiring Internet Service Providers (ISPs) to undertake hundreds of billions of dollars in additional network investments. Funding these necessary investments will require additional revenues from subscribers or content providers. The way in which those costs are recovered, however, will significantly affect the pace of broadband adoption, because price is the largest factor determining whether a household subscribes to broadband service.

Our analysis shows that pricing models which recover costs equally, on a per-household basis to all subscribers, will substantially slow adoption. Under this scenario, which would generally follow current pricing practices, broadband adoption by African-Americans would stand at about 83 percent in 2019, and adoption by white Americans would reach 85 percent. However, a more flexible pricing model that recovers a greater share of these additional costs from high-bandwidth consumers or content providers would keep most subscribers' fee low and facilitate broadband adoption by all groups of Americans. Under this model, effective universal adoption should be achieved by all racial and ethnic groups by 2018 or 2019.

Given these findings, we conclude that pricing practices which recover a greater share of the additional investment costs from content providers and/or users who consume large amounts of bandwidth would accelerate the achievement of universal service. This is true even as broadband providers are forced to ramp up their investment expenditures. Government policy should protect the ability of ISPs to employ such flexible pricing strategies and ensure that government does not, even inadvertently, effectively compel pricing practices that would perpetuate differences in broadband adoption by of income, race or ethnicity.

¹ This research was supported by the Georgetown Center for Business and Public Policy in the McDonough School of Business of Georgetown University. It updates and expands the analysis from Kevin Hassett and Robert J. Shapiro, "Towards Universal Broadband: Flexible Broadband Pricing and the Digital Divide," The Georgetown Center for Business and Public Policy, 2009. The authors also would like to acknowledge the extensive assistance of Amy Roden.

I. Introduction

The economic and social value of ensuring easy and affordable adoption of broadband Internet for all Americans is a common theme in current politics. Both candidates for President in 2008 pledged to promote universal broadband service. At that time, Barack Obama declared that “every American should have the highest-speed broadband access – no matter where you live, or how much money you have.”² Moreover, shortly after taking office, he signed the 2009 American Recovery and Reinvestment Act, which committed \$7.2 billion for improving broadband adoption rates and directed the Federal Communications Commission (FCC) to create a national broadband plan. A little more than one year later, on March 16, 2010, the FCC unveiled its roadmap to ensure that at least “100 million U.S. homes . . . have affordable access to actual download speeds of at least 100 megabits per second” by 2020.³ The plan calls the build-out of broadband required to achieve the goal, “*the* great infrastructure challenge of the early 21st century,” and outlines its approach to both expanding that infrastructure across the United States and promoting affordable adoption of it by low-income households.⁴ Broadband use by American households has followed the general pattern of personal computers and dial-up Internet, with market competition and technological advances steadily reducing the cost of adopting it while expanding its utility. However, while access to broadband Internet by minority and lower-income American households has progressed steadily, at least until the recent economic downturn, significant gaps in adoption linked to race and income remain.

As the FCC, Congress, and the White House prepare detailed plans to actually achieve universal broadband adoption, we have reviewed and analyzed the state of the current challenge based on income and race. According to the Pew Center and other sources, in 2009, 68 percent of white households had broadband service, compared to 46 percent of African-American households and 48 percent of Hispanic households (but 68 percent of the subgroup of English-speaking Hispanics).⁵ Based on the earlier patterns of diffusion for personal computers and dialup Internet service across racial and ethnic groups, we could have expected that declining prices and the expanding usefulness of broadband would result in virtually universal adoption by 2017 or 2018. However, the recent evolution of the Internet is disrupting this process: the increasing use of bandwidth-intensive video and audio applications is requiring that Internet Service Providers (ISPs) invest substantial, additional resources in expanding the Internet infrastructure, so they can accommodate this fast-rising bandwidth demand. Experts estimate that these additional investments will total \$300 billion to \$350 billion over the next 20 years, and if those costs are passed along in higher monthly fees for all broadband subscribers, those

² “Remarks of Barack Obama: Renewing American Competitiveness,” Organizing for America, June 16, 2008, http://www.barackobama.com/2008/06/16/remarks_of_senator_barack_obam_79.php.

³ Despite its ambitious infrastructure investment strategy, the plan maintains revenue neutrality, primarily through new revenue generated by broadband spectrum auctions; See Federal Communications Commission, “What is Broadband?” Consumer and Governmental Affairs Bureau, 2010. <http://www.fcc.gov/cgb/broadband.html>; Federal Communications Commission, “Recovery Act Broadband Initiatives,” FCC Recovery, 2010. <http://www.fcc.gov/recovery/broadband/>; Leonard Kruger and Angele Gilroy, “Broadband Internet Access and the Digital Divide: Federal Assistance Programs,” Congressional Research Service, 2009; Federal Communications Commission, “National Broadband Plan: Connecting America,” Broadband.gov, 2010. <http://broadband.gov/plan/executive-summary/>.

⁴ Federal Communications Commission. “National Broadband Plan: Connecting America,” 2010.

⁵ See Table 1, below.

additional costs will sharply slow progress towards universal adoption. If those costs are passed along on an equal, per-household basis to all subscribers, as would occur under the current model of unlimited usage, flat fee pricing, our simulations show that less than 85 percent of white households and less than 83 percent of minority households will have broadband service in 2019. However, as discussed below, our research finds that alternative pricing models that direct a greater share of costs to those who consume the most bandwidth would enable virtually every household to adopt broadband by 2019.

The presence of differences in broadband adoption based on income, race and ethnicity follows a familiar pattern. Although the Internet was seen initially as a way to equalize access to information, early studies of personal computer ownership and dial-up Internet found that minorities and those with lower incomes and/or less education adopted these technologies at a much slower rate.⁶ Differences in adoption rates also were observed across other categories including geography, gender, employment, age, and family structure.⁷ These divisions between information “haves and have-nots,” dubbed the “digital divide” in the 1990s, were first addressed in the Telecommunications Act of 1996. Congress directed the FCC to take steps to help ensure that broadband Internet “is being deployed to all Americans in a reasonable and timely fashion.”⁸ Subsequently, the federal government and private organizations such as One Economy employed a variety of policies to extend Internet service to traditionally disadvantaged groups. For example, President Clinton established the goal of connecting all public classrooms and libraries to the Internet by 2000. The Bush administration also declared universal broadband service as its goal, although it was criticized for failing to take the digital divide seriously.⁹

Now, the need to expand the Internet infrastructure to accommodate rising demand for bandwidth threatens to perpetuate these digital divides. Yet, surveys also show that a small minority of Internet users account for the vast majority of this rising demand, through their extensive use of highly bandwidth-intensive content. Moreover, if ISPs are permitted to employ flexible pricing and network management strategies to focus most of the cost of the additional investment on these high-bandwidth users or on content providers whose content requires disproportionate use of bandwidth, our research finds that the digital divide will disappear: the simulations show that by 2018 or 2019, nearly 99 percent of white and minority households would still achieve broadband adoption if the bulk of the additional investment costs are borne by those who use the most bandwidth. These simulations assume that high-bandwidth users -- heavy users of video, TV online, and online games -- will be relatively insensitive to a higher price for their own broadband service. If those users are more sensitive to higher monthly fees than we assume, and the higher fees threaten to drive offline a significant share of these users, the cost of the additional infrastructure investments could be passed along instead to content providers who use inordinate bandwidth, and those providers in turn could pass along their additional costs in higher ad rates or website membership charges to the users of their services.

⁶ Susan Losh, “Generation versus Aging, and Education, Occupation, Gender and Ethnicity Effects in the US Digital Divides,” *Proceedings, Atlanta Conference on Science and Innovation Policy*, 2009; Hiroshi Ono and M. Zavodny, “Immigrants, English Ability and the Digital Divide,” *HeinOnline Social Forces*, Vol. 86 No. 4, 2008.

⁷ Paul DiMaggio, Eszter Hargittai, Coral Celeste, and Steven Shafer “From Unequal Access to Differentiated Use: A Literature Review and Agenda for Research on Digital Inequality,” Princeton University Center for Arts and Cultural Policy Studies, Working Paper No. 29, 2003.

⁸ Kruger and Gilroy 2009.

⁹ DiMaggio *et al.* 2003.

Government policies to ensure universal broadband adoption by minority as well as white households should work in tandem with the well-established, market-based process seen with personal computers and dial-up Internet, in which declining prices and the expanding usefulness of a new technology gradually narrow and ultimately end differences in adoption rates based on income and race. To promote such universal service even as broadband providers have to ramp up their investment costs – and ensure that disproportionate bandwidth consumption by very high bandwidth users and content providers does not drive up the cost of basic service for everyone else -- government policy should preserve the ability of these ISPs to employ flexible pricing and network management strategies. Policymakers also should ensure that government policy does not require rigid pricing approaches that inadvertently would perpetuate differences in broadband adoption by income, race or ethnicity.

II. The Benefits of Broadband Adoption

As broadband technologies permeate the offices and operations of American business, government and household life more and more, those without broadband often find themselves increasingly isolated from the opportunities and satisfactions enjoyed by the rest of America. A number of studies have catalogued and analyzed the expanding roles and critical uses of Internet technologies, from online government services and healthcare information to educational and job-search services. One recent study, for example, examined how “digital citizenship,” or the capacity to use information technology, “enables individuals to participate more fully in society.”¹⁰ Similarly, another often-cited report notes that, “given that more and more websites make use of bandwidth-intensive technologies such as audio and video files, animated content and interactive applets, broadband connection is becoming increasingly necessary to participate fully in cyberspace, and by extension, society.”¹¹

A growing literature also has identified the important economic role and implications of broadband technologies. The FCC notes, “The ability to share large amounts of information at ever-greater speeds increases productivity, facilitates commerce, and drives innovation. Broadband is changing how we communicate with each other, how and where we work, how we educate our children, and how we entertain ourselves.”¹² Similarly, a 2007 Brookings Institution study estimated that every one percentage-point increase in broadband penetration is accompanied by an increase in employment of 0.2 percent to 0.3 percent per-year, while another study two years later estimates that home broadband service generates consumer benefits of some \$30 billion per-year.¹³ Recent dynamics in U.S. labor markets also suggest how important information-technology-related knowledge and skill can be for an individual’s economic prospects. Three researchers found, for example that computer skills have become a key factor

¹⁰ Karen Mossberger, Caroline Tolbert and Michele Gilbert, “Race, Place and Information Technology,” *Urban Affairs Review* 41: 583, 2006.

¹¹ Wei-Min Hu, and James Prieger, “The Broadband Digital Divide and the Nexus of Race, Competition and Quality,” *Information Economics and Policy* 20.2: 150-167, 2008

¹² Federal Communications Commission, “Strategic Goals: Broadband,” <http://www.fcc.gov/broadband>

¹³ Robert Crandall, William Lehr, and Robert Litan, “The Effects of Broadband Deployment on Output and Employment: A Cross-sectional Analysis of U.S. Data,” *Issues in Economic Policy*, The Brookings Institution, 2007; Mark Dutz, Jonathan Orszag and Robert Willig, “The Substantial Consumer Benefits of Broadband Connectivity for U.S. Households,” The Internet Innovation Alliance, 2009.

in securing jobs, beyond the strong demand for additional workers in the burgeoning information technology industry itself.¹⁴ The FCC's National Broadband Plan also highlights the increasing demand for Internet-related skills, noting that "the share of Americans using high-speed Internet at work grew by 50 percent between 2003 and 2007, and the number of jobs in information and communications technology is growing 50 percent faster than in other sectors."¹⁵

Americans perceive broadband as increasingly important in other areas. One 2009 survey of broadband users, found that 65 percent believe that broadband is somewhat or very important for "communicating with health care or medical providers," and 68 percent agreed that broadband is important for "finding out what is going on in your community." They also find that 57 to 58 percent of respondents believe that broadband universality is somewhat or very important for communicating with government officials about issues and "sharing your views with others about key issues," while 62 percent of respondents believe that it is somewhat or very important "to economic growth in your community."¹⁶

The Internet's capacity to provide audio and video products and services is growing rapidly. That growth, coupled with the recent boom of mobile broadband devices such as Blackberrys and iPhones, extend the technology's impact to many other aspects of people's lives. It is not surprising that surveys also find that broadband subscribers use the Internet in greater and more varied ways than dial-up subscribers. Horrigan and Smith, for example, report that 79 percent of broadband users use the Internet to get news, compared to 61 percent of those with home dialup service. They also found that household broadband users are more likely to upload their own content, conduct job-related research, blog, and gather information about hobbies or interests, than dial-up users.¹⁷ All of this research suggests that the social benefits of enabling universal broadband are likely to be large, along with the cost of policies that impede that progress.

In this paper, we utilize findings from the FCC's National Broadband Plan to update our previous analysis (Hassett and Shapiro, 2009) and to examine the link between universal broadband service across minority groups and various approaches for pricing that service.¹⁸ In the earlier study, we considered the impact on the digital divide of a range of pricing strategies that could cover the cost of the large, additional investments that broadband providers (ISPs) expect to undertake, in order to accommodate the fast-rising demand for bandwidth associated with the spread of video and audio applications. We find, again, that flexible pricing models which allow ISPs to shift a substantial portion of these additional costs to the heavy users who place the greatest demands on the networks could substantially reduce the adverse effects on adoption by lower-income households. By contrast, a pricing system that passes along the costs

¹⁴ David H. Autor, Lawrence F. Katz, and Melissa S. Kearney, "The Polarization of the U.S. Labor Market," NBER Working Paper 11986, 2006; Robert W. Fairlie, "Race and the Digital Divide," *Contribution to Economic Analysis and Policy*, 3(2), 2004.

¹⁵ Federal Communications Commission. "National Broadband Plan: Connecting America," 2010.

¹⁶ John Horrigan, "Home Broadband Adoption 2009," Pew Internet and American Life Project, 2009.

¹⁷ John Horrigan, and Aaron Smith, "Data Memo: Home Broadband Adoption 2007," Pew Internet and American Life Project, 2007; John Horrigan, "Home Broadband Adoption, 2006," Pew Internet and American Life Project, 2006.

¹⁸ Kevin Hassett and Robert J. Shapiro, "Towards Universal Broadband: Flexible Broadband Pricing and the Digital Divide," The Georgetown Center for Business and Public Policy, 2009.

of their additional investments on an equal, per-household basis across subscribers, through higher monthly fees for all consumers or all content providers, could significantly slow broadband adoption by lower-income and minority households. In addition, we evaluate current data on broadband adoption by racial groups and explain how our earlier results help explain the new results on race and income-based differences in broadband adoption.

III. Recent Trends in Broadband Adoption Rates, by Race and Ethnicity

The data show that African-American and Hispanic households have trailed white households in their adoption of dial-up Internet and broadband for some time, a pattern that was also seen with personal computers. In 2000, the Pew Foundation reported that 36 percent of African-American households and 44 percent of English-speaking Hispanic households were connected to the Internet, compared to 50 percent of whites.¹⁹ The U.S. Commerce Department's 2004 report, "A Nation Online," painted an encouraging picture of the digital divide with regard to race and ethnicity, suggesting that these divides might soon close. The report noted that "Internet use has increased across all races and groups, and growth in Internet use rates was faster for Blacks and Hispanics than for Whites and Asian American and Pacific Islanders."²⁰ Similarly, Pew found that from 2005 to 2007, broadband adoption by African-American households nearly tripled, and the gap between whites and English-speaking Hispanics nearly closed.

More recent data suggest that the severe downturn of 2008-2009 should heighten concerns about the digital divide in broadband service, especially for racial and ethnic minorities. While overall home broadband adoption rose 15 percent between 2008 and 2009, adoption by African-Americans showed no significant growth and the gap between African-Americans and whites widened in both 2008 and 2009. (See Table 1, below) Furthermore, despite the gains by English-speaking Hispanics found in the earlier Pew data, surveys that also include non-English speaking Hispanics found far lower rates of broadband adoption by all Hispanics.²¹ A January 2010 study by the Joint Center for Political and Economic Studies found that while 47 percent of Hispanic respondents had broadband at home, only 21 percent of Spanish-speaking Hispanics had the service.²² Finally, the Current Population Survey's 2009 Internet Use Supplement, a periodic survey of approximately 54,000 households, found that African-Americans trailed whites in home broadband adoption by nearly twenty percentage points (65 versus 45 percent), and Hispanic subscribers lagged even further behind at just under 40 percent.²³

¹⁹ Amanda Lenhart, "Who is Not Online: 57% of Those Without Internet Access Say They Do Not Plan to Log On," Pew Internet and American Life Project, 2000.

²⁰ US Department of Commerce, "A Nation Online: How Americans are Expanding Their Use of the Internet," Economics and Statistics Administration, National Telecommunications and Information Administration, 2002.

²¹ US Department of Commerce, "Table 1118: Household Internet Usage in and Outside of the Home by Selected Characteristics, 2007," National Telecommunications and Information Administration, 2008; Horrigan 2009.

²² Jon P. Gant, Nicole E. Turner-Lee, Ying Li, and Joseph S. Miller, "National Minority Broadband Adoption: Comparative Trends in Adoption, Acceptance and Use," Joint Center for Political and Economic Studies, 2010.

²³ US Department of Commerce, "Current Population Survey, CPS Internet Use 2009," National Telecommunications and Information Administration, Table 1, 2009.

http://www.ntia.doc.gov/data/CPSTables/t11_11st.txt.

Racial divides are apparent in both dialup and broadband use. In 2008, the American population was 65.6 percent non-Hispanic white, 12.8 percent African-American, and 15.4 percent Hispanic.²⁴ In 2009, 65 percent of dialup users were white, 17 percent were African-American, and 12 percent were Hispanic. Similarly, in 2009, 73 percent of broadband users were white, eight percent were African-American, and 13 percent were Hispanic.²⁵ Using the Pew and other sources of data, to distinguish English-speaking Hispanic and all Hispanics, we calculate that in 2009, broadband service was present in 65 percent of white households, 46 percent of African-American households, 68 percent of English-speaking Hispanic households, but only 48 percent of all Hispanic households. Again, as the following table makes clear, these gaps widened significantly from 2007 to 2009.

Table 1. Broadband Adoption by Race and Ethnicity, 2005-2009²⁶

Race	2005	2006	2007	2008	2009
White	31%	42%	48%	57%	65%
African-American	14%	31%	40%	43%	46%
Hispanic - English-speaking ²⁷	28%	41%	47%	56%	68%
Hispanic- All ²⁸	20%	29%	33%	40%	48%

These developments unfolded even as the total number of households using high-speed Internet continued to increase at robust rates. From October 2007 to October 2009, the total number of American households with broadband service grew by 25 percent. Yet, as noted in the table above and National Broadband Plan, this substantial growth in the number of adopters obscures important, persistent disparities.²⁹ Even if broadband reaches saturation in coming years, the aggregate adoption number may mask troubling differences along socioeconomic and racial and ethnic lines.

IV. Perceptions of Internet Use by Race and Ethnicity

Strikingly, research shows that despite the lower rates of adoption of and skills with information technologies among African Americans and Hispanics, they view computers and the Internet more favorably than whites.³⁰ 78 percent of African Americans and 80 percent of Latinos view the Internet as important for economic opportunity and “keeping up with the times,” compared with 65 percent for whites, according to surveys. Part of the explanation lies in income differential, especially regarding areas of concentrated poverty. One well-known

²⁴ U.S. Census Bureau, “State and County QuickFacts,” 2010. <http://quickfacts.census.gov/qfd/states/00000.html>.

²⁵ Horrigan 2009.

²⁶ Sample included only English-speaking Hispanics.

²⁷ Pew data are available for years shown, but only include English-speakers. We adjust the pew data based on our limited observations for non-English speakers from an alternative survey.

²⁸ The rate of Hispanic home broadband subscriptions (including English and non-English speakers) is extrapolated using shares of English and non-English-speaking Hispanic broadband subscribers in the Joint Center’s January, 2010 poll. It is difficult to speculate about the trend for each year, however, we assume the difference in the most recent year is constant for all years. This calculation likely understates the true rate of increase among non-English speakers in earlier years, thus overstating the subscription rates for this group during the same years.

²⁹ Federal Communications Commission, “National Broadband Plan: Connecting America,” 2010.

³⁰ Karen Mossberger, Caroline Tolbert and Mary Stansbury. “Virtual Inequality: Beyond the Digital Divide,” Washington D.C.: Georgetown University Press, 2003.

study found that after controlling for concentrated poverty and low-socioeconomic status, African Americans, whites and Asians had similar adoption rates for home computers.³¹ However, this explanation could not account for the Hispanic adoption rate.

Among minorities, income affects the particular use they make of the Internet. One study concluded that higher-income minorities are more likely than whites overall to use the Internet to search for health or medical information, visit government websites for information, and use social networking sites.³² Minorities at all income levels also are more likely to use the Internet for job searches, to find ideas about starting on-line businesses and to access religious or spiritual information. Similarly, lower-income African Americans and Hispanics are reportedly more likely to use the internet to apply for public or government benefits.³³

Despite the well documented digital divide, African Americans exceed the national average in use of mobile Internet. According to one recent study, African-American use of the mobile Internet outpaces the national average by 9 percentage points, despite an at-home broadband adoption rate that trails the national average by 8 percent.³⁴ Data is too limited for definitive explanations on this topic, but some observers believe that the greater use of wireless services is a reflection of the wide range of pricing options, which include plans that subsidize the cost of wireless devices. Personal lifestyles that emphasize mobility also may contribute to this trend. In any case, the issue merits further study.

V. Causes of the Digital Divide

As noted earlier, income and education have been key factors determining broadband adoption. For example, Horrigan (2010) reports that nearly 90 percent of households with incomes of at least \$50,000 have a broadband connection, compared to 52 percent of households with incomes below that level. Similarly, adults with a college degree are almost twice as likely to have broadband at home as those without a college degree.

However, numerous studies also have found significant gaps in Internet adoption between minorities and whites, even when the researchers control for income and education.³⁵ In 2000, the U.S. Commerce Department estimated that differences in income and education accounted for about half of the gap in Internet usage between whites and Hispanics and African-Americans.³⁶ Similarly, a 2004 report found that income explained about 27 percent of the gap between whites and African Americans with regard to personal computer ownership and 15.4 percent of the difference with regard to Internet service, while education explained another 12.7 percent of the computer-ownership gap and 5.8 percent of the Internet adoption gap.³⁷ This

³¹ Mossberger et al. 2006.

³² Gant et al. 2010.

³³ Gant, et al. 2010.

³⁴ John Horrigan, "Broadband Adoption and Use in America," OBI Working Paper Series No. 1, Federal Communications Commission, 2010. http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-296442A1.pdf

³⁵ Mark Cooper, "Explaining the Digital Divide and Falling Behind on Broadband: Why a Telecommunications Policy of Neglect is not Benign," Consumer Federation of America, 2004; Hu and Prieger 2008.

³⁶ US Department of Commerce, "Falling Through the Net: Toward Digital Inclusion," National Telecommunications and Information Administration, 2000.

³⁷ Fairlie 2004.

research found further that education accounted for about 30 percent of the gap in home computer adoption between whites and the subgroup of Mexican-Americans, whites, while about 25 percent of the gap was due to income differences. Education also explained 19.1 percent of the disparity in Internet adoption between whites and the subgroup of Mexican Americans, while income explained 15.6 percent of the gap.

Other studies have documented that broadband demand is sensitive to a household's ability to speak and understand English, the language that dominates Internet content. A 2002 Commerce Department report noted that differences in English language ability account for part of increase in the gap in IT usage between Hispanics and whites that appeared in the latter 1990s and early 2000s.³⁸ Similarly, academic researchers have found that "linguistically isolated" households that did not speak English as a first language or did not speak English "very well" as a second language were 18.6 percent less likely to adopt a DSL connection.³⁹ These findings were confirmed by a major 2008 study showing that the ability to speak English is an important factor driving IT adoption and use.⁴⁰ The research used Census data from 1997 and 2003 to measure computer ownership and home Internet use by immigrants and U.S. natives: Among native Americans, the ratios were 0.87 for computer ownership and 0.70 for home Internet use, compared to ratios of 0.42 for computer ownership by Spanish-speaking immigrant households – but 0.86 for native Spanish-speaking households compared with other natives. Other studies find that the subgroup of Mexican Americans are half as likely to own a computer and one-third as likely to have home Internet service as whites, and that language barriers play a substantial role in these gaps.⁴¹

Other factors also may play a role, including the speed of a broadband connection. A study of Ameritech DSL subscribers in five Midwestern states found a relationship between DSL demand and the length of DSL line from a central office, since transmission speeds decrease when customers reside farther away (beyond 2.2 miles) from a central office.⁴² The results indicated that increasing a household's distance from the central office from one mile to 1.1 miles lowers the household's probability of subscribing to DSL by 5.7 percentage points. But other research indicates that geography considered more generally cannot explain differences in broadband adoption across race and ethnicity, when income and education are controlled. The FCC found that in 2008, households in 98.9 percent of the nation's 66,287 census tracts theoretically could access broadband through some technology.⁴³ Other studies similarly rule out the availability of broadband as a significant factor.⁴⁴ One study of DSL subscribers found, for example, that "the availability of broadband is less of a determinant of the access gap over

³⁸ Ono and Zavodny 2008.

³⁹ Hu and Preiger 2008.

⁴⁰ Ono and Savodny 2008.

⁴¹ Fairlie 2004.

⁴² Hu and Preiger 2008. The states were IL, IN, MI, OH, and WI.

⁴³ Federal Communications Commission, "High-Speed Services for Internet Access: Status as of December 31, 2008," Table 13, Industry Analysis and Technology Division, Wireline Competition Bureau, 2010.

⁴⁴ James Prieger, "The Supply Side of the Digital Divide: Is There Equal Availability in the Broadband Internet Access Market?" University of California, Davis, 2003; Wei-Min Hu and James Prieger, "The Timing of Broadband Provision: the Role of Competition and Demographics," AEI-Brookings Joint Center for Regulatory Studies. Working Paper, 2007; Federal Communications Commission, "High-Speed Services for Internet Access: Status as of June 30, 2008," Industry Analysis and Technology Division, Wireline Competition Bureau, 2009.

time, as broadband access has now diffused over much of the U.S.”⁴⁵

Taken together, these various findings suggest that digital differences in broadband adoption based on race and ethnicity, like those based on income, will pose difficult challenges for policymakers. However, as we see below, the research also establishes that pricing and other economic factors can play a significant role in reducing and ultimately eliminating these differences.

VI. The Price of Broadband and Its Diffusion Across Income Groups

Broadband adoption has increased over the past decade generally in line with a decline in the price of broadband, a pattern seen earlier in the diffusion of personal computers and dialup Internet. As detailed in a 2006 study, information technologies tend to diffuse across income levels as their prices decline and their usefulness increases.⁴⁶ From 2001 to 2009, the share of all American households with broadband service increased from 9.1 percent to 63.9 percent.⁴⁷ There is no doubt about the technology’s expanding usefulness over this period, and respondents to the Pew survey reported that their average bills for residential broadband service fell from \$39 per-month in 2004 to \$34.50 per-month in 2008. Strikingly, overall adoption rates continued to rise in 2009 despite a jump in the cost of service, back to the \$39.00 price from 2004; and respondents to the 2010 FCC survey reported an average monthly price of \$40.68 for their broadband Internet.⁴⁸ To some degree, this development may reflect the willingness by a growing number of Americans to pay more for premium, higher-speed broadband service. According to the Pew survey, the average monthly price of basic service stood at \$37.10 in 2009 while premium subscribers paid an average of \$44.60. In addition, economic studies have also found that households which already have broadband service are far less price sensitive or “price elastic” to increases than prospective subscribers.⁴⁹ Therefore, small price increases for current broadband users, especially middle-income and high-income subscribers, are unlikely to drive them back to dial-up service. However, the higher prices may have a much larger impact on the Internet subscription choices of households currently without service or using dial-up. Moreover, the evidence suggests that lower-income households are particularly sensitive to higher broadband prices. The FCC’s 2010 survey found that non-subscribers who cite cost as the main barrier to adopting broadband said that they would be willing to pay, on average, \$25 per-month for the service.⁵⁰ These and other data suggest that broadband adoption rates would have been even higher in 2009 if the price had not risen. Pew reports that almost one in ten Americans did cancel or cut back their Internet service for financial reasons between April 2008 and April 2009, with 17 percent of those earning \$20,000 or less – more than one in six – giving

⁴⁵ Hu and Prieger 2008.

⁴⁶ Robert J. Shapiro, “Creating Broad Access to New Communications Technologies: Build-Out Requirements Versus Market Competition and Technological Progress,” Sonecon, LLC, 2006.

⁴⁷ US Department of Commerce. “Networked Nation: Broadband in America 2007.” National Telecommunications and Information Administration, 2008. US Department of Commerce, “Digital Nation: 21st Century America’s Progress Toward Universal Broadband Internet Access,” National Telecommunications and Information Administration, 2010.

⁴⁸ Horrigan 2010.

⁴⁹ Kenneth Flamm and Anindya Chaudhuri, “An Analysis of the Determinants of Broadband Access,” *Telecommunications Policy* 31: 312-326, 2007.

⁵⁰ Horrigan 2010.

up or cutting back of their service in this period.

It is clear from the research that price is not the only factor determining broadband adoption rates and trends. Some 22 percent of those without broadband cite digital literacy as the primary reason. Further, roughly 7 percent of Americans who use the Internet rely on dialup connections rather than broadband, with almost one in five of these dialup consumers saying that “nothing would get me to switch” to broadband.⁵¹ Further, among those who use dialup service or are not online at all, about half say that they have no interest in broadband service. However, the success of private-public initiatives such as Connect Kentucky suggests that aggressive outreach efforts and “digital literacy” programs can overcome some of this resistance; and the FCC’s National Broadband Plan proposes an aggressive digital literacy effort that will include a new Digital Literacy Corps to train non-adopters.

Yet, extensive research in addition to our own has found that price is the single-largest determinant of broadband subscription, especially among lower-income households. One very recent study found that 36 percent of those without broadband cite price as the main reason.⁵² This confirms the conclusions of earlier analysis which found, for example, that at \$20 per-month, a 10 percent increase in price reduces demand by 5.3 percent (a price elasticity of demand of - 0.53); and at \$50 per-month, closer to the actual market price, a 10 percent price increase reduces demand by 9.8 percent.⁵³ Another study conducted by Austan Goolsbee, now a member of the President’s Council of Economic Advisors, found that significantly larger shares of affluent people were willing to pay higher prices for broadband than less-affluent people.⁵⁴ Similarly, according to the data, a 10 percent increase in the price of high-speed connections in 2000 reduced demand for those connections by 10.8 percent overall, but by 15.9 percent among those with incomes of less than \$25,000 compared to 8.5 percent to 10 percent for higher income groups.⁵⁵ And the 2009 Pew survey found that lower prices could persuade significant numbers of dial-up users to switch to broadband.⁵⁶

The challenge here is that industry and government experts now expect that broadband bandwidth demand will continue to rise rapidly with the fast-expanding use of video and audio applications, and that consequently broadband providers face an extended period of significantly higher investments to accommodate this growing bandwidth demand. In a widely-cited report, EDUCAUSE, a higher-education technology group, estimated that providing “big-broadband” to every home and business, with sufficient bandwidth to meet demand, would cost an additional \$100 billion over the next three to five years and even larger investments in capacity going forward.⁵⁷ Another estimate cited by David McClure, the head of the U.S. Internet Industry Association, and John Erhardt, Senior Manager of Policy Communications for Cisco Systems,

⁵¹ Horrigan 2009.

⁵² Horrigan 2010.

⁵³ Paul Rappoport, Lestor D. Taylor and Donald J. Kridel, “Willingness to Pay and the Demand for Broadband Service,” mimeo, 2003.

⁵⁴ Austan Goolsbee, “The Value of Broadband and the Deadweight Loss of Taxing New Technology,” Discussion Paper, University of Chicago, 2006.

⁵⁵ Kevin Duffy-Deno, “Demand for High-Speed Access to the Internet Among Internet Households,” ICFC 2000 Seattle, 2000.

⁵⁶ Horrigan 2009.

⁵⁷ John Windhausen, Jr., “A Blueprint for Big Broadband,” EDUCAUSE White Paper, 2008.

projects that the long-term investments required to keep up with rising bandwidth demand could cost providers an additional \$300 billion over 20 years, on top of their trend level investments. Recently, the FCC broadband task force suggested that the additional investment requirements, including wiring every household with fiber, may well reach \$350 billion.⁵⁸

The monthly fees paid by new subscribers could finance some of these projected investments, but demand for bandwidth is growing much faster than increases in uptake rates. Therefore, a significant portion of the additional costs to upgrade the broadband infrastructure will have to be passed on in higher prices to either broadband subscribers or content providers. The challenge for policymakers is to ensure that government does not, even inadvertently, force the broadband ISPs to allocate these price increases in ways that would perpetuate or even exacerbate the existing differences in broadband adoption based on income, race and ethnicity.

In our 2009 study, we estimated the impact of an additional \$300 billion in ISP investment, over the next 20 years, on the price of the service and its adoption rate by income. We found that if federal policy forces ISPs to pass along these costs in higher fixed-monthly fees for all subscribers, the effects on the digital divide would be dramatic. Although the price increases would affect all income groups, lower-income and middle-income families would feel the greatest effects. For example, in our hypothetical “baseline” case, which assumes the patterns of adoption seen in earlier technologies with no additional investment costs factored into prices – what likely would have happened if ISPs did not have to expand the broadband infrastructure -- the rate of broadband adoption among lower-income households increases by more than 34 percentage points from 2009 to 2013. However, when the additional costs are factored equally into everyone’s monthly fee, broadband adoption by lower-income households increases much more slowly: By 2017, almost 20 percent fewer lower-income households would have broadband service, compared to the hypothetical baseline case (79.4 percent with the higher prices compared to 99.0 percent in the baseline case). Similarly, by 2017, more than 13 percent fewer middle-income households would have broadband service if the additional costs are included in higher, uniform monthly fees, compared to the hypothetical baseline (85.7 percent at the higher prices, compared to 99.0 percent without the increases).

For that study, we also simulated broadband adoption rates under a more flexible pricing approach, in which 80 percent of the additional investment costs were borne by very heavy broadband users, assumed to be price-insensitive, while everyone else bore the remaining 20 percent of the costs in higher monthly fees. Using established elasticities for different income groups, this analysis found that the underlying trend towards universal service found in the baseline case would be substantially maintained: By 2017, more than 90 percent of lower-income households and nearly 98 percent of middle-income households would have broadband service. The same narrowing differences in broadband adoption would occur if the 80 percent share of the additional investment is passed along in higher charges to bandwidth-intensive content or applications providers, rather than their customers. Some such approach may well be the most efficient way to ensure that very high bandwidth users do not drive up the costs of basic broadband service for everyone else.

⁵⁸ David McClure, “The Exabyte Internet,” U.S. Internet Industry Association, 2007; Federal Communications Commission, Task Force on the National Broadband Plan, Presentation to the FCC: September Commission Meeting, 2009, http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-293742A1.pdf.

VII. Simulating the Future of Broadband Adoption by Minorities

Here, we extend this analysis by focusing on the impact for minorities of different approaches for financing the additional investments required to avoid online congestion and provide broadband service to all households. As before, we first generate a counter-factual or hypothetical baseline projection of broadband uptake by race, ethnicity, and income, based on rates of adoption of earlier information technologies. Then, we simulate these broadband uptake rates under the higher prices of the different pricing approaches, and calculate the deviations from the hypothetical baseline. In this way, we can see how each pricing approach would affect the national goal of universal broadband adoption, with special reference to race and ethnicity.

We begin with the most recent broadband uptake data by race, ethnicity and income produced by the Joint Center for Political and Economic Studies this year. Next, we note survey evidence that the rate of broadband uptake has slowed considerably as the market has reached a mature phase. Accordingly, we assume that the future diffusion pattern for broadband adoption will be similar to those for dial-up Internet and personal computer ownership in their mature phases. To construct these patterns, we use data on rates of dial-up Internet uptake by income from the U.S. Census Bureau Current Population Survey from 2000 to 2003 to predict the increases in broadband uptake through 2011, and then we use overall computer adoption rates to simulate increases from 2012 through 2017. Further, since many studies show that rates of Internet uptake are income sensitive, we adjust the baseline case to take account of expected income increases in the future for each income group. For this purpose, we use the most recent projections of economic growth from the Congressional Budget Office's (CBO) January, 2010 report, "The Budget and Economic Outlook: Fiscal Years 2010 to 2020," and assume that the income of each bracket grows at the rate that CBO projects for the economy as a whole.

The Baseline Results

In order to perform these simulations, we rely on disaggregated data from the Joint Center for Political and Economic Studies which they have generously provided. These data provide information on broadband uptake by race and income class, and thus enable us to project more precisely the impact of higher broadband prices going forward, because of variations in people's price elasticity by income group.⁵⁹

Our baseline simulation – broadband uptake rates by race and ethnicity for the next decade, if the price of the service did not have to increase to finance additional investment –

⁵⁹ However, this approach also introduces some technical problems, because some of the subgroups by race and income, or "cross tabulation cells," have very few observations which may take on extreme values. Therefore, the uptake or adoption rate estimates that we use to initiate the simulation, which are weighted averages of many different cells using Census Bureau weights for race and income, are different in some cases from the rates reported in Table 1. In particular, it assumes or suggests very rapid increases in adoption by African-Americans and Hispanics from 2009 to 2011. However, these differences do not affect our conclusions concerning the relative impact of different pricing policies on broadband access over time. In fact, this alternative approach reduces somewhat the differences or gaps in broadband adoption across race and ethnicity, which makes the simulations that follow conservative estimates of the effects of the alternative pricing policies.

shows the familiar pattern of steady progress and universal adoption by African-American and Hispanic households by 2019 (Table 2).

Table 2. Baseline Case: Broadband Uptake Rates by Race and Ethnicity, 2011-2020

Households	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Non-Hispanic White	72.5	78.4	82.5	87.1	91.0	94.7	97.7	99.0	99.0	99.0
African American	59.1	65.5	69.9	75.0	80.3	85.6	91.1	96.5	99.0	99.0
All Hispanic	62.7	69.3	74.0	78.9	84.3	89.0	92.5	96.1	98.7	99.0

There may be year-by-year cost savings from Moore’s Law-type advances in electronic circuits. However, only a small part of the necessary network expansion cost consists of electronic equipment, and all installed network equipment have long depreciation lives. Therefore, cost reductions from advances in electronic circuits would provide only modest help in restraining overall cost growth.

It is important to see this simulation as a counter-factual scenario, because universal adoption of broadband cannot occur without very substantial, additional investments by broadband Internet providers – estimated at \$300 billion to \$350 billion -- and those providers cannot undertake those investments without a source of additional revenues. In fact, since these investments will be required to accommodate the fast-expanding use of web-based video and audio applications, broadband uptake rates could even decline without those investments. These baseline projections are necessary, however, in order to appreciate fully the real world effects of the other scenarios.

The Impact of Different Pricing Approaches on the Digital Divide, by Race and Ethnicity

As noted earlier, ISP providers can adopt a variety of pricing strategies to finance these investments. One approach would simply allocate an additional \$300 billion in investment over 20 years through higher fixed, monthly fees for all subscribers, on an equal basis. Table 3, below, examines the impact of this pricing approach on broadband service by minorities. It shows that this approach would both sharply slow broadband adoption by all groups and expand the digital divide for African-American and Hispanic households.

Table 3. Broadband Uptake Rates by Race and Ethnicity, 2011-2020, if Higher, Fixed Monthly Fees Finance \$300 Billion in Additional Investment

Households	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Non-Hispanic White	72.5	73.7	75.1	76.9	79.0	81.2	83.2	84.8	84.9	84.7
African American	59.1	61.3	63.6	66.2	69.2	72.1	75.5	79.5	81.8	82.0
Hispanic	62.7	65.0	67.4	70.0	72.9	76.0	78.9	81.6	83.2	83.2

The simulations show that the effects of the large increases in monthly fees required to finance the additional investment would be apparent almost immediately: From 2011 to 2012, gains in broadband uptake rates by whites slow from six percentage points (72.5 percent to 78.4 percent) to just 1.2 percentage points (72.5 percent to 73.7 percent). Similarly, under this pricing

scenario, the gains by African-American households from 2011 to 2012 slow from 6.4 to 2.2 percentage points, and the progress by Hispanic households slows from 6.6 to 2.3 percentage points. By 2016, broadband service is 13.5 percentage points lower than the hypothetical baseline case for white households, 13.5 percentage points below the hypothetical baseline for African-American households, and 13 percentage points lower for Hispanic households. The impact is greater several years later: In the hypothetical baseline case, the rates of broadband adoption among African-Americans and Hispanics increase by more than 36 percentage points by 2020, compared to a 23 percentage point increase for African-Americans and a 21 percentage point increase for Hispanics under the higher, fixed monthly fees. Policies that have the effect of forcing broadband providers to pass along their additional investment costs in these higher, flat monthly fees would dramatically slow universal adoption of broadband.

The results are very different if broadband providers are allowed to adopt flexible pricing strategies which would focus most of the additional costs on the minority of consumers or content providers that consume very large amounts of bandwidth. We cannot say precisely what form this flexible pricing would take, so we cannot say how the additional costs would be precisely recovered among different groups of consumers. For analytical purposes, therefore, we test two scenarios in which price increases are allocated roughly by bandwidth usage.

The first flexible-pricing scenario uses survey findings that a small share of all broadband users – from 5 percent to 20 percent -- account for most of the increases in bandwidth demand.⁶⁰ Based on this survey evidence, we construct a pricing approach that allocates 20 percent of the cost of the additional investment in higher monthly fees to the 80 percent of average bandwidth users, and the remaining 80 percent of the cost to the 20 percent of heavy bandwidth users. We further assume that these heavy bandwidth users are relatively price insensitive. As a result, the broadband subscription rates of these high-intensity bandwidth users – many of them likely are interactive game players and those who use the web to watch television, movies and other video content -- should remain unaffected by price increases. To the extent that the high bandwidth users are more sensitive to higher prices than we assume, broadband providers could choose between spreading more of the cost to lower bandwidth users or increasing prices for high-bandwidth content providers, who then could pass along their additional costs in higher advertising rates or membership fees for their sites. Our simulations can inform such decisions.

Under a pricing scenario with 80 percent of the additional costs allocated to the top 20 percent of bandwidth users, the burden of building out the Internet infrastructure has only modest effects on the spread of broadband by race or ethnicity. For example, the share of African-American households with broadband rises to 74.9 percent in 2014 and 98.6 percent in 2020, compared to the hypothetical baseline levels of 75.0 percent in 2014 and 99.0 percent in 2020. The results are also significantly better than the adoption rates projected under equal, flat monthly fee pricing, which we found would slow African-American uptake of broadband to 66.2 percent in 2014 and 82.0 percent in 2020. These differences are also apparent for Hispanic households (Table 4, below).

⁶⁰ James J. Martin and James W. Westall, “Assessing the Impact of BitTorrent on DOCSIS Networks,” *Proceedings of IEEE BROADNETS 2007, Fourth International Conference on Broadband Communications, Networks, and Systems*, September 2007. <http://people.clemson.edu/%7Ejmarty/papers/bittorrentBroadnets.pdf>

Table 4. Broadband Uptake Rates by Race and Ethnicity, 2011-2020, if the 20 percent of Heavy Bandwidth Users Finance 80 percent of the Additional Investment.

Households	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Non-Hispanic White	72.5	78.4	82.4	87.0	90.8	94.5	97.4	98.7	98.6	98.6
African American	59.1	65.5	69.8	74.9	80.1	85.3	90.8	96.1	98.6	98.6
Hispanic	62.7	69.3	73.9	78.8	84.1	88.7	92.2	95.7	98.3	98.6

Finally, we estimate the impact on the digital divide of a pricing approach in which the price-insensitive, high bandwidth users bear half of the costs of the additional investments and the other half of the cost is distributed across all other consumers through higher, flat monthly fees. In this scenario, all households – white, African-American and Hispanic -- adopt broadband service at a slower pace than they would when heavy-bandwidth users bear 80 percent of the cost. African-American households increase their rates of broadband service from 59.1 percent in 2011 to 72.4 percent in 2014 and 90.5 percent in 2018, compared to 74.9 in 2014 and 96.1 percent in 2018 when they bear only 20 percent of the additional cost. Similarly, Hispanic households increase their rates of broadband service to only 76.2 percent in 2014 and 92.3 percent in 2019, compared with 78.8 percent in 2014 and 98.3 percent in 2019 under the 80-20 pricing approach.

Table 5. Broadband Uptake Rates by Race and Ethnicity, 2011-2020, If the Cost of \$300 Billion in Additional Investment Is Divided 50-50 Between Heavy Bandwidth Users and All Other Broadband Subscribers

Households	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Non-Hispanic White	72.5	77.5	80.6	84.3	87.4	90.4	92.7	93.5	93.1	92.9
African American	59.1	64.6	68.2	72.4	76.8	81.3	86.0	90.5	92.5	92.2
Hispanic	62.7	68.4	72.2	76.2	80.7	84.6	87.4	90.3	92.3	92.3

Once again, the share of the costs borne by heavy bandwidth users could also be recovered from websites that provide very high bandwidth content, and those content providers could pass along those additional costs to their advertisers or users through subscription fees. This approach could reduce the incidence of heavy bandwidth users, who we assume here are price insensitive, to giving up their broadband service.

VIII. Conclusion

As most American public and private institutions, corporations and civic groups have incorporated broadband technologies into their operations, the importance for all Americans of being connected to the broadband Internet has increased sharply. Great progress has been achieved in this regard; and in the last decade, more than two-thirds of all households today have subscribed to broadband service. This progress has followed the pattern of diffusion seen earlier with personal computers and dialup Internet service, in which adoption rates increase rapidly as a technology’s price declines and its usefulness increases. Nevertheless, critical gaps remain based on people’s incomes, education, language, race and ethnicity, and a significantly larger share of

minority households remain without broadband service. Moreover, the nation's recent economic difficulties have slowed progress in eliminating these digital differences, with the consequence of increasing the policy urgency of addressing this critical matter.

The concerns are amplified by the certain prospect that broadband providers will have to increase their planned investments in the Internet infrastructure by an estimated \$300 billion to \$350 billion over the next 20 years, to accommodate very fast-rising demands for bandwidth arising from the expanding use of bandwidth-intensive video and voice applications. ISPs will have to recover these additional costs in the form of higher prices; and data show that lower-income households, including a disproportionate share of African American and Hispanic households, are more sensitive to such price increases than higher-income households. This prospect threatens to maintain substantial digital differences in the adoption of broadband throughout the next decade.

Given the importance of declining prices in the diffusion of these services to all Americans, the pricing strategies adopted by ISPs to finance the needed additional investment will have direct effects on the prospects of achieving the national goal of universal adoption of broadband. Surveys have found, however, that a small minority of Internet users -- 5 percent to 20 percent -- account for most of the sharply-rising demand for bandwidth. Our analysis shows that if policymakers force the ISPs to pass along their additional costs through pricing mechanisms that reduce variation across Internet users on an equal basis, it will significantly impede future progress towards universal adoption. As a matter of national social policy, average users should not be required to subsidize high-bandwidth consumers and content providers in this way. Instead, ISPs should retain the right to create more flexible pricing strategies in order to focus most of the additional costs on those users or content providers driving most of the expanding demand for bandwidth. Our simulations show that with such flexible pricing approaches, the nation can end the digital divide and achieve universal adoption of broadband by 2019 or 2020.

In its efforts to advance universal adoption, the FCC should preserve the ability of ISPs to adopt such flexible pricing and network management strategies.

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