WORKING PAPER

New Inequality Frontier: Broadband Internet Access

Caroline J. Tolbert
Karen Mossberger

January 2006

EPI Working Paper No. 275

Economic Policy Institute

NEW INEQUALITY FRONTIER: BROADBAND INTERNET ACCESS

Economic Policy Institute Working Paper No. 275
http://www.epi.org/

Caroline J. Tolbert
Associate Professor, Department of Political Science
Kent State University
330.672.0904
ctolber1@kent.edu

Karen Mossberger
Associate Professor, Department of Political Science
Kent State University
330.672.8942
kmossber@kent.edu

New Inequality Frontier: Broadband Internet Access

Executive Summary

The potential economic impact of broadband is substantial (Dataquest, Inc. 2000; Crandall and Jackson 2001; Yankee Group 2001; Ferguson 2004, 6-7), and broadband's faster and more convenient access to the Internet creates social benefits including high-speed interactive uses in the K-12 classroom, distance learning, medicine, telecommuting, and adaptive technology for individuals with disabilities. This report finds that broadband use may encourage skill development and the migration of daily tasks online. Although broadband access has now become more widespread, there are marked disparities in rural areas, where the need for fast connections that can compensate for geographic isolation is perhaps the greatest. Other gaps in broadband access and use are clearly related to social factors (income, education, age, race/ethnicity and gender) rather than infrastructure, as they largely mirror the dimensions of inequalities in computer and Internet access more generally.

Findings

This report compares broadband access in 2001 using the data from Mossberger, Tolbert and Stansbury (2003) with more recent data from a Pew survey conducted in 2003. These disparities are evident after controlling for various demographic factors that affect access, including Internet use at work that is not included in many previous studies on the digital divide.

- Gender matters for broadband access (although the gender divide has disappeared in Internet access generally).
- Other factors commonly associated with the digital divide are replicated in the broadband divide, including disparities based on income, education, age and race/ethnicity.

- Inequities have not diminished over time. The analysis based on multinomial logistic regression reveals similar disparities in broadband access in 2001 and in 2003, despite a growing population of Americans with high-speed home access.
- Analysis of the 2003 Pew survey finds that those least likely to have broadband Internet access at home are the poor, older, less educated, Latinos and African Americans (compared to whites), females (compared to males), residents of rural areas (compared to urban and suburban areas) and those respondents with less exposure to the Internet at work, *ceteris paribus*. The disparities in home broadband access are the largest based on age, followed by income, work exposure, education, race/ethnicity, geography and finally a small access gap based on gender. Interestingly, females are more likely to have dial-up home Internet access than males, but males more likely to have home broadband access.
- Rural residents are less likely to have broadband access, although broadband has the potential to diminish spatial and economic isolation.
- Analysis of the 2001 national survey data that included an over-sample of high-poverty census tracts reveals that those least likely to have broadband Internet access at home are the poor, older Americans, the less educated, African Americans (compared to whites), females (compared to males) and individuals with less exposure to the Internet at work.
- Broadband access at home is associated with more "digital experience," including engagement in political and economic activities online. A strong argument can be made that expanding broadband access is related to increased skill acquisition in conducting activities online.

We found a significant association between broadband and experience conducting a greater number of activities using the Internet. These included locating information online, searching for political information on the web, searching for government information online, viewing a campaign ad on the Internet, searching for or applying for a job online, and taking a class online. These findings support reports from Pew (2004) and the U.S. Department of Commerce (2004) that broadband facilitates the migration of activities online and more intensive use of the technology. Our analysis has greater reliability, however, using multivariate models that introduce a number of controls, including demographic factors such as education and age and broadband use at work.

Recommendations

In order to expand broadband access and the benefits that it offers in terms of skill acquisition and applications, public policymakers should take steps to:

- Improve affordability. The higher cost of broadband has limited its diffusion, and low-income individuals are among those who could reap the greatest social benefit from broadband connectivity.
- Encourage the extension of access in rural areas. Broadband access may be particularly critical for rural residents, who are distant from educational institutions and health care services. Distance education and telemedicine are among the applications that are significantly improved by broadband use.
- Encourage extension of access in African-American and Latino neighborhoods in cities where they are underserved.
- Devise creative partnerships to encourage broadband access for low-income households. Public-private partnerships have subsidized broadband, equipment, training, and

websites for public and other low-income housing. Other possibilities include low-cost wireless services being considered by municipalities such as Philadelphia.

- Promote effective use of broadband at public access sites and within schools. Educational uses such as videoconferencing can open the world to students everywhere, including those in rural areas and inner-city neighborhoods. Public access sites such as libraries and community technology centers can provide high-speed connections to those who are not able to currently afford them.

INEQUALITY IN BROADBAND INTERNET ACCESS

Recent reports show that high-speed, or broadband Internet access is proliferating in the United States, and that it is associated with more frequent and sophisticated use of the Internet (Horrigan 2004; U.S. Department of Commerce 2004). Broadband Internet service, which is most commonly available for home use through cable modems or digital subscriber lines (DSL), is technically defined by the Federal Communications Commission in terms of its speed, of at least 200 kilobits per second in one direction. But, broadband's significance goes beyond transmission speed, as it is also "higher-capacity, always-on, and interactive" (Alliance for Public Technology and Benton Foundation, 2003). Broadband "fundamentally changes the way people use the Internet" (European Commission 2004, 1). Rather than merely providing a faster and better technological tool, broadband access may facilitate the migration of tasks and information online, improving digital skills that are important for economic opportunity and political participation. Despite the overall expansion of broadband access, growth is uneven across demographic groups and geographic areas. Systematic inequalities are apparent, and merit attention as a public policy issue.

This report provides more detailed information than recent studies on the causes of broadband inequality, comparing them to disparities in dial-up Internet access. Using multinomial logistic regression, we investigate a number of possible explanations for differences in Internet access (broadband vs. dial-up access), including individual-level demographic variables and contextual or place-based variables. While broadband access reflects many of the same gaps that are apparent in computer or Internet disparities, there are some notable differences both for individuals and geographic areas. Using survey data from 2001 and 2003, we compare patterns of inequalities over this recent period of growth, to assess whether or not these broadband gaps are closing, and find that they have not changed during the two-year period. Because there are some differences in the questions asked in the 2001 and 2003 surveys, we are able to explore different dimensions of inequalities – for example rural and regional patterns of access in the 2003 survey. Together, these offer evidence that place matters for broadband access, as well as individual attributes. First, we situate broadband in the broader context of information technology disparities in the U.S., showing how this fits into the larger picture of continued inequality in computer and Internet use and skill.

DEFINING TECHNOLOGY INEQUALITY AS A POLICY ISSUE

The issue of the "digital divide" first gained prominence after reports issued by the National Telecommunications and Information Administration (NTIA) depicted systematic inequities in home access to computers (U.S. Department of Commerce 1995).[1] By the fifth NTIA report (2002), *A Nation Online,* there remained persistent gaps in Internet use based on age, income, education, race, ethnicity and dual/single parent households (US Department of Commerce 2002). The findings in the NTIA report, however, don't use statistical controls to untangle the significance of overlapping factors such as race, education and income. Recent studies using more rigorous statistical methods have confirmed the existence of the digital divide: Individuals least likely to have technology access (a home computer, home Internet access, or an email address) are poorer, less educated, older, Latino or African American (Mossberger, Tolbert and Stansbury 2003, Chapter 2; Lenhart 2003).[2]

[1] The data reported by the NTIA are drawn from survey questions from the US Census Bureau's Current Population Survey (CPS), administered to a large sample of 50,000-60,000 households.
[2] Both the Mossberger, Tolbert and Stansbury 2003 and Lenhart 2003 studies used multivariate statistical analysis (regression) to control for multiple causation ; the former also had a unique national random-sample telephone survey of low-income respondents that produced a representative sample similar to that of the much larger U.S. Department of Commerce/Bureau of the Census survey.

This definition of technology disparities – gaps in access, particularly home access – has set the terms for policy debate and much of the research.[3] Access is undeniably important, but this narrow framing of the issue has tended to emphasize connectivity rather than the development of technology skills or what Warschauer (2003) has called inclusion in socially important uses of the Internet.

In previous research, we argued for a broader understanding of virtual inequalities, as composed of multiple divides, including an access divide, a skills divide, an economic opportunity divide, and a democratic divide (Mossberger, Tolbert and Stansbury 2003). Technology inequality is a public policy issue rather than simply an individual concern or private misfortune because information technology has implications for economic opportunity and political participation, fostering benefits that accrue beyond the individual.

It is the *combination* of access and skill that enables individuals to take advantage of technology's potential. T.H. Marshall argues citizenship hinges on access to civil, political and social rights. We suggest citizenship in an information age requires both technology access and skill, which are necessary for social rights. That is, individuals don't have full citizenship unless they have access to technology and the skills to use it. Denial of social rights equates with denial of full citizenship.

The ability to take advantage of technology's potential is limited for some Americans, because of a parallel skill divide that mirrors the better-known access divide. Two dimensions of technology skill are important: technical competence, or the ability to use hardware and software; and information literacy, or the ability to search for, use, and evaluate information on

[3] The studies cited above are both among the most recent and also the few that have used multivariate statistical controls. There are, however, a number of descriptive reports from both the NTIA/U.S. Department of Commerce and the Pew Internet and American Life project that show the persistence of these same inequities since the mid-1990s. Only the gender gap has disappeared over time.

the Internet. Educational skills, such as the ability to read, to solve problems, and to think critically, are important components of information literacy. Given that nearly a quarter of Americans lack basic literacy or reading skills (Kaestle et al. 2001), increasing technology skills is an educational issue for some as well as a matter of technical training or exposure to technology. As a recent Pew study (Lenhart 2003) has demonstrated, there are many individuals who are not currently online who have used the Internet at some time, and there is a continuum of use and skill. Approximately 22 percent of Americans, however, report needing help to use a mouse or keyboard. This suggests a complete lack of familiarity with computers. The 37 percent who say they need help navigating the Internet may include some who can use the computer, but have difficulties searching for information. (Mossberger, Tolbert and Stansbury 2003, 45).

The results of the 2001 national survey discussed above also show that the poor, less-educated, older individuals, African-Americans, and Latinos are significantly less likely to report having technical competence to use hardware or software, or to be able to find information on the Internet (Mossberger, Tolbert and Stansbury 2003, Chapter 3). These same inequities define the better-known access divide (Mossberger, Tolbert and Stansbury 2003, Chapter 2; Lenhart 2003), and it is worth reflecting here on the relationship between access (including broadband access) and technology skills.

While access to computers or the Internet is insufficient if individuals lack the skills to use them, we know that frequent use occurs at home or work rather than in other locations, such as libraries or the homes of friends (Mossberger, Tolbert and Stansbury 2003, 26). The ability to practice and become familiar with software programs and the Internet most likely facilitates skill development, especially technical skills and some information literacy skills such as familiarity with search engines. Home Internet access and a home computer are also statistically significant predictors of engaging in a wider range of activities online, such as locating information on the web, searching for political information, looking up government information online, searching for a job online, applying for a job online, and taking a class online, among others (Mossberger, Tolbert and Stansbury 2003, 125-26). Controlling for other factors, only home Internet access and education are significant predictors for engaging in a broader range of digital experiences; individuals with home access and higher educational attainment are more likely to use the Internet for a range of political and economic tasks. Race, ethnicity, and income do not have any independent effect on the breadth of digital experience once home Internet access and education are taken into account. In summary, both access and skills are necessary for technology use. It may be, however, that faster more convenient home Internet access (such as broadband) may facilitate the development of technology skills.

WHY BROADBAND ACCESS MATTERS?

Broadband can be justified as a public policy issue if there are market failures that produce underinvestment and inhibit society's potential to capture the full benefits of the technology. International organizations such as the Organization for Economic Cooperation and Development (OECD) and the European Commission of the European Union have promoted increased broadband access among member states. One of the primary reasons for this is the potential economic benefits (positive externalities) of broadband for cost savings and increased productivity. A recent study conducted by the Brookings Institution, the University of California at Berkeley and the Momentum research group estimated that 61 percent of U.S. businesses have used the Internet and have accumulated a cost savings of $155.2 billion (NetImpact 2002). Some studies have estimated the potential impact of *broadband* on the American economy at $500 billion per year in gross domestic product (GDP) over at least the next ten years, and others have projected employment increases at 1.2 million jobs (Dataquest, Inc. 2002; Crandall and Jackson 2001; New Millennium Council 2002).[4] These are among the most optimistic forecasts, but others predict substantial economic benefits from broadband as well (Yankee Group 2001; Ferguson 2004, 6-7). Public benefits from broadband include innovative uses in schools and in government agencies (Alliance for Public Technology and the Benton Foundation 2003; Telecommunications Industry Association 2003).

There are other advantages that broadband offers for individual users, as well as businesses, schools and governments. These are most relevant for this report, because of the focus on home broadband access. Some of the most promising applications for broadband are in telemedicine, distance learning, and Internet accessibility for people with disabilities. The improved resolution of broadband permits more accurate diagnosis over the Internet, and the high quality of broadband transmission also facilitates video sign language interpretation. The "always-on" character of broadband opens new possibilities for remote monitoring of patients in their homes. This could increase the feasibility of independent living for the elderly and others (National Academy of Sciences 2002, 117). Broadband is useful for protocol conversion for adaptive technologies for the visually impaired (for computer speech recognition or speech synthesis) (Bowe 2002 cf. Telecommunications Industry Association 2003). Distance learning can be made more interactive through real-time video conferencing and video streaming. As more adult students have broadband in their homes, it becomes easier for distance educators to

[4] The study produced by Dataquest, Inc. (a subsidiary of Gartner, Inc.) estimates $500 billion growth in GDP per year for each of the next 10 years if "true" broadband with a minimum of 10 Mbps is available, and this is significantly faster than broadband today. Crandall and Jackson (2001) have a more optimistic estimate of $500 billion per year within 15 to 25 years if broadband becomes nationally available. The New Millennium Council (2002) estimates a possible increase of 1.2 million jobs.

make fuller use of interactive technology (Alliance for Public Technology and the Benton Foundation 2003). Telecommuting is another application for broadband, and this could have special significance for residents of remote areas or workers who are constrained by child care or elder care needs (National Academy of Sciences 2002, 117).

More generally, accessing the Internet through broadband rather than narrow-band technology enhances information search, use of e-government sites, and virtually any activity on the web. The convenience and quality of broadband may lead to more frequent use of computers and the Internet and increased levels of technical or information skills.

Broadband, or high-speed Internet services provide users with faster and improved access to the Internet, making it easier to download graphics and information as well as open web pages without long waiting periods. Ease of use is also enhanced because broadband services are "always on" and don't require dialing to make the connection. A 2002 Pew Internet and American Life survey found that "connection speed" was the most important feature for 76 percent of home broadband users, compared to 18 percent who said "always-on access" was the most important (Pew 2002).

Using broadband is not conceptually different than using other modes of access to the Internet, in terms of the skills or knowledge required. Yet, broadband may facilitate skill acquisition and experience in navigating the Internet. While high-speed Internet access alone does not address inequalities in basic literacy and information literacy, new data (Horrigan 2004; U.S. Department of Commerce 2004) suggests broadband access is systematically associated with more frequent and sophisticated online use. Another study has found that broadband users, on average, visit 90 percent more websites than dial-up users, although they spend 23 percent less time at each site (Rappoport, Kridel and Taylor 2002). Higher-speed connections facilitate more intensive use of the Internet. These findings echo our earlier conclusions about the relationship between home Internet access and the range of digital experience (Mossberger, Tolbert and Stansbury 2003, Chapter 5).

Public policy has a stake in fostering higher levels of computer and Internet skill. While individuals may use these skills in their homes for a variety of private purposes, including entertainment and socializing, there are public benefits connected to the skills they acquire. Information technology use and skills are "public goods," because, like education and libraries, they are capable of providing positive externalities that promote economic growth and democratic governance. Just as widespread education raises the level of human capital in the economy, so do critical technology skills. The growth of e-government on all levels in the U.S. and the explosion of political information online mean that the Internet has become an important resource for civic and political information. Both the economic and political significance of technology are likely to increase in the future, with more interactive uses of e-government and experiments in Internet voting, as well as further integration of technology across industries in the American economy (Coglianese 2004; West 2003; Larsen and Rainie 2002; Mishel, Bernstein and Schmitt 2001, 19-20).

Given the benefits of broadband, what do we know about home access to broadband service?

EVIDENCE FROM THE MOST RECENT (2004) PEW STUDY

The latest report of the Pew Internet and American Life Project (Horrigan 2004) indicates that 34 percent of Americans (or 55 percent of adult Internet users) have high-speed Internet access at home or work. Similarly, 24 percent of Americans (or 39 percent of adult Internet users) have high-speed access at home. Thus roughly a third of Americans have high-speed Internet access at work or home, and one quarter of Americans have high-speed access at home. These figures compare to 63 percent of respondents or nearly two-thirds of Americans who are Internet users. The estimates are based on a February-March 2004 national survey of 2,204 Americans conducted by Pew. The report found broadband adoption has increased 60 percent in one year since 2003, with digital subscriber lines (DSL) accounting for the majority of the growth in broadband at home. While connections via cable modems still dominate among home broadband users (with a market share of 54 percent), DSL now accounts for 42 percent of the broadband market, up from 28 percent in March 2003.

The report indicates, however, that there remain significant inequalities based on income and education. Pew also found that residents of rural areas continue to lag behind in broadband adoption because of limited infrastructure availability. Ten percent of rural Americans go online from home with high-speed Internet connections, which is about one-third the rate for non-rural Americans (Horrigan 2004).

Monthly service rates are approximately double for high-speed access compared to a dial-up modem connection, so income may be another factor in broadband access. The Pew report found that broadband users (as of February 2004) report an average monthly bill of $39, compared to an average monthly bill of less than $20 for a dial-up modem connection.

Faster Internet connections have implications for the scope and intensity of online activities, according to the Pew data. Home broadband users are more likely to go online everyday (69 percent) compared to dial-up users (51 percent) – a fifteen percentage point difference. Across a range of activities, high-speed connections foster a migration of tasks to the Internet, such as work-related research and reading the news. These tasks can have implications for economic opportunity, political information and participation. For example, 40 percent of broadband users get their news online, compared to 22 percent of dial-up users. Twenty-six percent of broadband users use the Internet for work-related research on the average day, compared to only 14 percent of dial-up users. Similarly, 24 percent of broadband users research a product online compared to 11 percent of dial-up users. The Pew Internet and American Life Project's 2004 survey asked Internet users about 18 different activities they had pursued online, from checking the news to participation in an online auction. The average dial-up user has tried 7 of the 18 activities, compared to a home broadband user who has tried 9. This suggests that the quality of Internet access is important in predicting the frequency of online activity and the depth of experience using information online (Horrigan 2004). Other recent studies have shown that broadband users visit more websites overall (Rappoport, Kridel, and Taylor 2002).

Finally, many Americans are interested in obtaining broadband access in the future, suggesting that for those with financial means, market mechanisms will be effective in diffusing use of the new technology. A Pew 2002 survey found 38 percent of current dial-up Internet users would "like to have a faster, broadband connection."

APPROACH OF THIS STUDY

While the Pew and Department of Commerce reports focus on growing broadband connectivity among the population, less attention has been given to inequalities in access and use. This report builds on an August 2003 survey conducted by the Pew Internet and American Life Project and a 2001 survey reported in *Virtual Inequality: Beyond the Digital Divide,* Georgetown University Press (Mossberger, Tolbert and Stansbury 2003) to compare changes over time. We focus on one question (or dependent variable) in both surveys, whether the respondent has Internet access at home, comparing three groups: individuals with 1) high-speed access, 2) dial-up access and 3) no-access. While the 2001 survey is older, it is drawn from a unique sample that includes a high proportion of low-income respondents.

The U.S. Department of Commerce study released in September 2004 demonstrates that broadband use had doubled from 9.1 percent in September 2001 to 19.9 percent in October 2003. But, both the Department of Commerce and Pew reports on broadband connectivity are based on simple frequencies (percents) and cannot account for overlapping demographic explanations for technology access. All data reported in the rest of this study are analyzed using multivariate regression to sort out what factors "matter" or are statistically significant causes, but the results are reported using probabilities that resemble percentages and are easy for the lay reader to understand. Despite the growth of broadband access between 2001 and 2003, there are persistent patterns of inequality, which are consistent across both the 2001 and 2003 surveys. These disparities largely follow the contours of the "digital divide" in general Internet access and skill, but there are some differences for broadband, including a persistent gender gap. Place of residence matters – individuals who live in rural communities are disadvantaged, and the geography of disadvantage varies by region (with some rural areas ahead of others).

DETAILED METHODOLOGY FOR ANALYSIS OF 2003 and 2001 SURVEYS

We compare the results from two surveys: an August 2003 Pew Internet and American Life survey and a unique 2001 survey conducted at Kent State University. Data from two years are used to compare changes in Internet access (broadband and dial-up) in the United States during a period of rapid growth in connectivity. The 2003 data is a national random digit-dialed telephone survey of 2,924 Americans age 18 and over conducted by Princeton Survey Research

Associates, with a sampling error of plus or minus 2 percentage points. The 2001 data is a national random digit-dialed telephone survey of Americans over age 18 conducted in August by Kent State University's Computer Assisted Telephone Interviewing (CATI) lab. This national telephone survey included 1,837 respondents, with an oversample drawn from all high-poverty census tracts in the 48 states, excluding Alaska and Hawaii. High poverty census tracts were defined as those with 50 percent of more of the households living at or below 150 percent of the federal poverty level. With multiple call-backs, the average response rate was 90 percent.[5] The telephone survey included 50 items and averaged 8.5 minutes to complete (See Mossberger, Tolbert and Stansbury 2003, 7-8).

Because the 2001 survey targeted high poverty areas, the sample included a relatively large proportion of racial and ethnic minorities, compared to standard surveys. Of the 1,837 respondents, 70 percent were white non-Hispanic, 19 percent were African-American, 9 percent Latino and 1.5 percent Asian American. Thus, Latinos and Blacks comprised 28 percent of the sample population, compared to 25 percent of the U.S. population in the 2000 census. Thirty-eight percent of the sample had household incomes below $30,000, allowing accurate inferences to minority and low-income populations as a whole. The survey generated data that were comparable to large-sample studies. Sixty-one percent of our respondents reported having access to a home computer, and 54 percent reported having home Internet access. This closely tracks the figures in the U.S. Census Current Population survey conducted in September of 2001 (US Department of Commerce 2002).

[5]Telephone numbers were dialed daily through the months of July (37 days in the field) by trained interviewers. Up to 524 callbacks were attempted to contact potential respondents for the general population sample and 371 for the poverty sample. Answering machines were treated as "no answer" and called back on a regular no answer rotation, a minimum of three hours later. After securing cooperation, interviewers used Computer-Assisted Telephone Interviewing systems to administer questions and record responses. Federal data show that telephone service now reaches 94 percent of the population (US Department of Commerce 1995), so telephone surveys are a reasonable methodology for obtaining sample data even in low-income communities.

In both the 2001 and 2003 surveys, the dependent variable is nominal, coded 1 for no home Internet access, 2 for dial-up home Internet access and 3 for broadband home Internet access. In the 2001 survey, the dependent variable is measured with the question “How do you access the Internet or an online service from home?” with “DSL” and “Broadband or cable modem” responses coded 3, “Telephone line and modem” coded 2 and “None” coded 1 (see Mossberger, Tolbert and Stansbury 2003, 159). Question wording for the 2003 survey was “Does the modem you use at home connect through a standard telephone line, or do you have some other type of connection?” Responses for “DSL-enabled phone line”, “cable modem”, “wireless connection”, and “T-1 or fiber optic connection” were coded 3, “standard telephone line” coded 2, and no access coded 1.

Since the dependent variable is nominal, measured in three mutually exclusive categories, multinomial logistic regression coefficients are reported (See appendix Tables 1 and 2).[6] A multinomial logistic model allows us to assess the effects that independent variables have on the risk of individuals falling into one of three mutually exclusive nominal outcomes. Covariate effects are interpreted in comparison to a reference category (no access), where a unit change in *x* affects the log-odds of access (either dial-up or broadband) versus a reference category (Aldrich and Nelson 1984; Long 1997).

The coefficients from the model can be used to calculate predicted probabilities for each outcome. Some methodologist argue it is preferable to use the chi-square to determine the overall fit of the variable rather than relying upon the significance of each coefficients, as this provides a stronger test of significance and allows comparison of the effects of a given variable across all possible outcomes (Long and Freese 2001). We thus calculate predicted probabilities for all

[6] Multinomial logistic regression is a method that is useful in cases where there can be more than two possible nominal outcomes. The statistical method assumes that no other possible alternative nominal outcome exists that are statistically correlated with those in the dependent variable (Long 1997).

outcomes if a variable is statistically significant for one outcome. These probabilities are reported in master tables in the appendix. To correct for problems of heteroskedasticity, or non-constant error, all statistical models are estimated using robust standard errors.[7] The robust estimates provide a more conservative estimate of statistical significant that would be obtained otherwise.

Explanatory or independent variables measure individual-level demographic and attitudinal factors, as well as geographical characteristics of the respondent's community. Variables were included to measure income, education, race, ethnicity, gender, age, partisanship, geographical region and suburban/rural or urban resident. Dummy variables measure gender, race, ethnicity, partisanship, and income. This means that they are coded as categories, with female, African-American, Latino, Asian-American, Democrat, Republican and those with an annual income less than $30,000 coded 1, and 0 otherwise. For race, whites were the reference group, while for ethnicity, non-Hispanics were the reference group. For partisanship, those without strong partisan identification – independents – were the reference group. In the 2003 survey, income was measured on an 8-point scale by total family income from all sources, before taxes, ranging from 1=annual income less than $10,000 to 8= $100,000 or more. Also in the 2003 survey, education was measured on 7-point scale from 1 = none, or grade 1-8 to 7= post-graduate training/professional school after college. In the 2001 survey, education was measured on a 5-point scale with responses ranging from 1= less than a high school degree to 5= postgraduate work. In both surveys, age was recorded in years. In the 2003 Pew survey two additional variables were added to measure geographic region and rural areas. Census region was coded with variables for respondents residing in Midwest, West and Northeast, with Southern

[7] Coefficients are specified using the Huber/White/Sandwich estimator of variance.

states as the reference group. Dummy variables for rural and suburban areas were coded 1, with rural residents as the reference group.

WHO HAS HIGH-SPEED HOME INTERNET ACCESS IN 2003?

The 2004 Pew report found that 34 percent of Americans have high-speed (broadband) Internet access at home or work and 24 percent of Americans have broadband access at home. Given this expansion of broadband, do consistent patterns of inequalities in Internet access persist as reported in earlier research?

Appendix Table 1 reports the results of a multinomial logistic regression model based on the 2003 Pew survey data.[8] The discussion below is based on the fully specified model that includes demographic factors, partisanship, region, and the control variable for Internet use at work. Previous research indicates that use of the Internet at work is a strong predictor of home Internet access (U.S. Department of Commerce 2002).[9]

Broadband replicates patterns of Internet access and skill more generally; frequent use at work is also related to broadband access. Despite the growth of broadband, the findings from the 2003 survey parallel those based on previous research on the divide, showing systematic inequalities in access to technology. Many of the statistically significant factors associated with high-speed Internet access at home follow the contours of the "digital divide" for computer and Internet access more generally (Mossberger, Tolbert and Stansbury 2003; Norris 2001). We find the poor, older respondents, the less-educated, females, Latinos and African

[8] The coefficients can be interpreted in the following way: an increase in one unite of x_j increases the odds of being in category *m* versus being in the reference category by a multiplicative factor of exp($ß_{mj}$), controlling for all other covariates.
[9] Columns 1 and 2 present the baseline model that includes demographic factors, partisanship and regional explanatory variables, while columns 3 and 4 reports the fully specified model that also include a variable measuring frequency of Internet use at work. The results of a single multinomial logistic regression is reported in two columns, with the first column being one category against the left-out category (in our case, dial-up vs. no Internet access) and in the second column the second category against the reference (broadband vs. no Internet access).

Americans are statistically less likely to have home high-speed *or* dial-up Internet access in their homes in comparison to the affluent, young, educated, males, and non-Hispanic whites. Asian Americans have comparable Internet access rates (dial-up and broadband) to whites. Consistent with previous research (U.S. Department of Commerce 2002), individuals who use the Internet more frequently at work are statistically more likely to have both dial-up and broadband Internet access at home.

A similar pattern of inequality based on income, age, education and race/ethnicity defines access to a home computer and home Internet access more generally (Mossberger, Tolbert and Stansbury 2003; US Department of Commerce 2002; Lenhart 2003).

There is a gender gap in broadband access, despite the fading of the gender gap in Internet access. An exception to the similarities between broadband and Internet access is the visible gender gap in broadband, in comparison with the disappearance of the gender gap in general computer use and dial-up Internet access (See Mossberger, Tolbert and Stansbury 2003, Chapter 2). Our analysis of the Pew data suggests males are statistically more likely to have home broadband access than females. Early studies of Internet use found females to have a lower propensity to use the Internet (Bimber 2000). Bimber (2000) found that male and female differences in Internet use were rooted in access at work. We find the gender gap remains, even after controlling for Internet use at work. The gender gap was the first (and only) of the demographic divides to close, with females reporting similar Internet access and use rates as males by 2000 (US Department of Commerce 2002). The reasons for the broadband gender gap are not entirely clear, but an interesting question would be whether employment has an influence on these gender differences in broadband access. Bimber (2000) found full-time employment had a positive effect on men's frequency of Internet use, but not women's. Typical employment for men appeared to facilitate greater Internet use than female employment opportunities. Some gender differences exist in use of technology for politics and government (see for example, attitudes about political participation online in Chapter 5 of Mossberger, Tolbert, and Stansbury 2003). The lower threshold of simply having home Internet access may mask real gender disparities in intensity or range of use, which the broadband access may better capture.

Rural residents are less likely to have broadband access, and some regions of the U.S. lag behind. Additional variables available only in the Pew survey data indicate that rural respondents are significantly less likely than those residing in urban or suburban areas to have broadband access, but rural residents are not disadvantaged in terms of dial-up Internet access. Distinctive regional differences emerge with residents of the Western states statistically more likely to have home broadband and dial-up Internet access than residents of the South and Midwest, while Northeastern states are statistically more likely to have broadband access at home than those of the South and Midwest. Clearly, the South and Midwest regions are lagging behind the West and Northeast in Internet access at home, either dial-up or broadband.

Measuring the Gaps: Estimates of Magnitude for Disparities

The tables below are used to help illustrate the relative size of the disparities discussed above. Some explanation is needed so that readers know how to interpret these numbers. While the figures reported in the tables look like simple percentages, they are expected differences based on the statistical analysis. Readers should interpret them as the estimated difference (or expected probability) that gender makes, for example, when we control for all other factors such as education, income, and race.[10] The simulations generating these estimates are based on a

[10] More precisely, probability simulations are used to understand the size of the disparities in broadband access based on demographic, partisan and geographic factors, while holding other explanatory variables constant (King, Tomz and Wittenberg 2000). The probabilities shown in Table 1 (and appendix Table 3 master table) are reported as

hypothetical respondent who is a female, white non-Hispanic, with independent partisanship, with average education, age, income and frequency of Internet use at work. The respondent is assumed to reside in a suburban area and in a Northeast state. The only statistically significant differences are the ones reported in Table 1.

Table 1: Who is Least Likely to Have Broadband Internet Access at Home? (2003)

Poor (11.7% for incomes of 20-30K vs. 23.8% for incomes 50-75k) **–12.1 point difference**

Older (9.6% for 64-year-olds vs. 30% for 29-year olds)**—20.4 point difference**

Less Educated (13.8% for high school diploma vs. 22.3% for bachelor's degree)**—8.5 point difference**

Latino (12% vs. 18% for non-Hispanic whites)**—6 point difference**
Latino (12% vs. 21.5% for Asian Americans)**—9.5 point difference**

African American (10.7% vs. 18% for non-Hispanic whites)**—7.3 point difference**
African American (10.7% vs. 21.5% for Asian Americans)**—10.8 point difference**

Female (18% vs. 21.3% for males)**---3.3 point difference**

Rural Areas (12.9% vs. 18% for those who live in suburban area)---**5.1 point difference**
Rural Areas (12.9% vs. 20.6% for those who live in urban area)**---7.7 point difference**

Less Exposure to Internet Use at Work (15.4% for less than several times a week vs. 25.1% for those who access the Internet several times a day)**---9.7 point difference**

Note: The only statistically significant differences are the ones reported above (See appendix Table 1, columns 3 and 4). When multinomial logistic regression is used, these are the variables that matter, holding other factors constant. Probabilities are based on a hypothetical respondent who is female, white non-Hispanic, with independent partisanship, and average education, age, income and Internet use at work. Region was set at Northeast and area at suburban. We have calculated the probability of broadband home Internet access, holding other factors constant. Probabilities based on the multinomial logistic regression coefficients presented in appendix Table 1.

Table 1 indicates that in 2003 the largest gap in home broadband access is based on age, with only a 9.6 percent probability of home access for older respondents (64-year-olds) compared to a 30 percent probability of access for the young (29-year-olds), all other factors held

percentages, but are based on the multinomial logistic regression coefficients reported in columns 3 and 4 of appendix Table 1.

constant. This is a 20 percentage point difference based on age alone. The second largest gap, however, is based on income. Lower-income respondents (with income of 20-30K) have a 12 percent lower probability of home broadband access than more affluent respondents (incomes 50-75K), all else equal. The poor are less able to afford technology access at home than those with higher incomes. A significant education gap emerges as well, with college graduates 8.5 percentage points more likely to have home broadband access than those with only a high school diploma.

Racial and ethnic gaps remain as in previous published research on the digital divide (Mossberger, Tolbert and Stansbury 2003; Norris 2001; US Department of Commerce 2002, Lenhart 2003). Holding constant socioeconomic status, African Americans have an 11 percent probability of broadband access, compared to 18 percent for whites, a 7 point gap based on race alone. Ethnicity also matters, as non-Hispanic whites are 6 percent more likely to have high speed access than Latinos. Latinos have a 12 percent probability of broadband home access, compared to 18% for non-Hispanic whites. Clearly, race and ethnicity matter in the digital divide. The gender gap in broadband is smaller than the other disparities in access, with males 3.3 percent more likely to broadband at home than females, but remains statistically significant.

Rural residents are estimated to be 8 percentage points less likely to have broadband access than residents of urban areas and 5 percent points less than suburban residents, holding constant other demographic factors such as income, education and age. This gap closely tracks that reported in large-scale surveys based on descriptive statistics. The US Census' 2000 Current Population survey of disparities in high-speed Internet access between metropolitan and non-metropolitan areas reported an 11 percent gap, providing additional confidence in our results. The 2000 CPS indicated 21 percent of the population in metropolitan areas had high-speed access versus 10 percent in rural areas (Mills and Whitacre 2003). This gap between rural and metropolitan areas has persisted.

A related finding from our analysis is that residents of the Midwest states are 6 percentage points less likely to have broadband access at home than residents of Northeast states, all else equal. Thus region alone, apart from urban/rural differences, is a significant factor in variation in broadband access in the American states. Interestingly, Northeast residents have the highest probability of broadband home access (18 percent), followed by residents of the South and West (14 percent), with Midwestern residents lagging behind with only a 12 percent probability of home access. Again, Mills and Whitacre (2003) report similar regional disparities in broadband access based on the 2000 Current Population Survey data, with the Northeast region leading and Midwest region lagging behind the South and West. The greatest disparities in high speed access are between urban and rural areas in the Western United States. In metropolitan Western regions, 23% of the population had high speed access in 2000, compared to only 8% in rural Western regions, a gap of 15 percentage points. The smallest disparities in high speed access between metropolitan and non-metropolitan areas is in the Midwest (Mills and Whitacre 2003). A plausible explanation is that infrastructure for providing broadband is more limited in some rural areas, and that this also varies by region.

WHO HAD BROADBAND ACCESS IN 2001?

Appendix Table 2 presents the multinomial logistic regression models based on the 2001 survey data.[11] We find consistent patterns of inequality across the 2001 and 2003 survey data.

---

[11]Mirroring the organization of the 2003 survey data, columns 1 and 2 present the baseline model with only demographic and partisanship control variables. Columns 3 and 4 show the complete model, including the explanatory variable frequency of Internet use at work. The discussion below is based on the complete model, but the baseline model is included as a reference.

Because broadband was such a new phenomenon in 2001, a significantly smaller percentage of the population had home access (14 percent of Americans), and this is reflected in the explanatory power of our models. In 2001, based on the statistical significance of the regression coefficients, only two demographic factors were statistically significant in separating those with home broadband access from those with no Internet access (column 4).

Broadband users in 2001 are most likely to be young and male. The young were statistically more likely to have high-speed Internet access as home, as were males, compared to females.

Disparities in Internet access are unchanged between 2001 and 2003. Little has changed in two years in terms of inequalities in Internet access more generally, measured by the factors predicting dial-up Internet access in 2001 compared to those with no access. The data suggests that low income, older, less-educated, and African-American individuals were statistically less likely to have home Internet access than affluent, younger, educated male and white Americans. There were no statistical differences in access rates for whites and Asian Americans. Consistent with the 2003 survey data analysis, individuals frequently using the Internet at work were statistically more likely to have home Internet access (dial-up) than those who are less reliant on the Internet at work.

Partisanship differences don't matter for broadband or Internet access. Previous research on the digital divide found Republican partisans (and independents) were statistically more likely to have home Internet access than Democrats in 2001 (Mossberger, Tolbert and Stansbury 2003, Chapter 2). This finding is replicated in column 1 of appendix Table 2, but when we control for frequency of Internet use at work, these partisanship differences disappear. There are no measurable differences in dial-up or broadband home Internet access between

Democrats, Republicans and Independent partisans. There are some apparent patterns that fall along partisan lines when attitudes about online politics are considered. Previous research found that Democrats are significantly more supportive of reforms to allow online voting and online voter registration than Republicans or independents (Mossberger, Tolbert and Stansbury 2003, Chapter 5), more likely to read news online (Pew Research Center 2004) and more likely to be politically active online (Graf and Darr 2004).

A number of additional demographic factors are statistically significant in predicting dial-up access from those with no access, including income, education, race and frequency of Internet use at work. As mentioned earlier, when using multinomial logistic regression, a stronger test of statistical significance is to compare the effects of a given variable across all possible outcomes (broadband and dial-up access) using predicted probabilities (Long and Freese 2001). This is done below.

Measuring the Gaps: Estimating the Magnitude of Disparities in 2001

Probability simulations are again used to gauge the substantive magnitude factors related to home broadband access (see Master Table 4 in the appendix). The simulations are again based on a hypothetical respondent who is female, white non-Hispanic, independent partisan, with average education, age, income, and Internet use at work. Again, the only statistically significant differences are the ones reported in Table 2 below.

Table 2: Who is Least Likely to Have Broadband Internet Access at Home? (2001)

Poor (3.5% for income less than 30K vs. 7.3% for Income greater than 30K) **–3.8 point difference**

Older (3.3% for 61-year-olds vs. 9.7% for 28-year olds)**—6.4 point difference**

Less Educated (4.9% for high school diploma vs. 6.7% for bachelor's degree)**—1.8 point difference**

African American (4.4% vs. 5.8% for non-Hispanic whites)**—1.4 point difference**
African American (4.4% vs. 26.7% for Asian Americans)**—22.3 point difference**

Female (5.8% vs. 8.9% for males)**---3.1 point difference**

Less Exposure to Internet Use at Work (4.8% for no Internet use from work last month vs. 10.8% for those who access over 100 times last month)**---6.0 point difference**

Note: The only statistically significant differences are the ones reported above (See appendix Table 2, columns 3 and 4). When multinomial logistic regression is used, these are the variables that matter, holding other factors constant. Estimates are based on hypothetical respondent who is female, white non-Hispanic, independent partisanship, with average education, age, income and Internet use at work. We have calculated the probability of broadband home Internet access, holding other factors constant. Probabilities based on the multinomial logistic regression coefficients presented in appendix Table 2.

While a smaller percentage of the population had high-speed access at home as of August 2001, statistically significant gaps are evident. The poor, with annual incomes below $30,000, were almost 6 and half percentage points less likely to have home broadband access than those with incomes higher than $30,000 year, controlling for other factors. Income represents the largest demographic gap in broadband access in 2001, not age. Older respondents (64 years old) were 4 percentage points less likely to have high-speed access than the young (29 years old), holding other factors constant. Racial gaps are evident. African Americans had only a 4.4 percent probability of home broadband access, compared to 26.7 percent probability for Asian Americans, a 22 percentage point gap. The magnitude of the gender gap remained virtually unchanged, with men 3 percentage points more likely to have home high-speed access than females, all else equal.

Rapid broadband expansion does not erase inequality. What is the purpose of measuring broadband access at two points in time? The survey data shows a consistent pattern of inequality in broadband access over a two-year period based on income, age, education, race/ethnicity, gender, region, Internet use at work and urban/rural place of residence. Even with the rapid diffusion of broadband access to American homes, persistent inequalities remain, stretching the access divide into another decade.

IMPACT OF BROADBAND ACCESS ON TECHNOLOGY SKILLS

Convenient access to the Internet, however, is only part of the equation. Access is undeniably important, but an incomplete description of the policy problem. Technology skills are critical, yet have been largely ignored in previous research and in policy debates. According to Mossberger, Tolbert, and Stansbury (2003), there are two distinct skill sets required to use computers and the Internet effectively. *Technical competence* involves the skills needed to operate hardware and software. Nearly one-fourth of survey respondents in the 2001 survey reported that they needed help using the mouse and keyboard, and larger percentages reported needing help with other tasks. *Information literacy* is the ability to search for and to use information effectively, and nearly forty percent of survey respondents reported needing help to find information on the web (Mossberger, Tolbert and Stansbury 2003, Chapter 3).

At the same time that broadband access is rapidly expanding, the increase in more general Internet access has leveled off. Recent studies reveal that roughly 45 percent of Americans do not have home Internet access (Lenhart 2003). Information literacy may hold the key to this flattening of the growth curve for Internet use. Respondents of a 2003 Pew Internet and American Life Project survey, *The Ever-Shifting Internet Population,* who did not go online, were asked why not. A fairly high percentage (48%) indicated that cost (access) was the greatest barrier to Internet usage. Another, almost equally large proportion (46%) pointed to lack of skills. This group of respondents indicated, "the Internet is too complicated and hard to understand." For these individuals market forces are not the primary reason they do not use the Internet.

Navigating the web and using the information on it requires a foundation of basic literacy – that is, the ability to read – and problem-solving and critical thinking skills as well. Segments of the population that have limited basic literacy and little education will not likely develop the more sophisticated skills entailed in information literacy. According to the National Adult Literacy Survey conducted in 1992, between 21 and 23 percent of the population operates at the lowest level of literacy, unable to perform more than the most rudimentary tasks (Kaestle et al. 2001). Inequalities in information literacy represent a new, technological dimension of the dilemma of unequal educational opportunities in America. Internet use is a complex policy problem that calls for both educational and technology solutions. The question, then, is whether improved connectivity through broadband represents at least a partial solution, assisting users in developing technical competency or learning to locate information on the Internet through practice.

DOES BROADBAND FACILITATE TECHNOLOGY SKILLS?

Drawing on 2004 Pew and Department of Commerce studies that found broadband access facilitates more frequent and sophisticated use of the Internet, we hypothesize that home broadband access may foster the acquisition of technology skills. One way to measure technology skills is by the range of uses of the Internet for political and economic (work-related or education) tasks. Using the 2001 survey (Mossberger, Tolbert and Stansbury 2003), we create an index of "digital experience" by summing responses to the following six questions included in the 2001 survey: whether an individual can 1) locate information on the web, 2) has searched for political information online, 3) has searched for government information online, 4) has seen a political campaign ad, 5) has search for or applied for a job online, and 6) has take a class online. Positive responses to each question were coded 1 (0 for negative responses), and then the six questions were summed to create an index ranging from 0 to 6. In appendix Table 5, this variable serves as our primary dependent or outcome variable to be explained. The same individual level explanatory variables used in the previous statistical analysis are included here, but we add whether the respondent has home broadband access coded 1 for yes and 0 for no as the primary explanatory variable. We also include some additional environmental control variables measuring characteristics of the respondent's zip code to determine if concentrated poverty and educational opportunities matter in digital experience. These include: zip code median household income, percent of the population with a high school diploma or higher and percent African American, Latino and Asian American populations, all with data from the 2000 US Census.

Do individuals with home broadband access have a wider range of experience using technology in their daily lives, controlling for basic demographic factors? What factors explain varying levels of digital experience (and technology skills) among the survey respondents? Since the index is a count of online activities, the statistical model is estimated using Poisson regression.

Broadband is related to greater skill, controlling for other factors. Appendix Table 5 indicates that home broadband access is a positive and statistically significant predictor of digital experience, suggested by previous research (Horrigan 2004; Rappoport, Kridel, and Taylor

2002).[12] Individuals with home broadband access are more likely to report using the Internet for a range of political and economic activities, after controlling for demographic and environmental factors, as well as partisan attitudes. Partisanship was not a predictor of digital experience. Democrats, Republican and independents were not statistically different in the range of tasks completed online. When we examine who is likely to have greater digital experience, we find that many of the factors associated with broadband access are also related to a greater range of activities online.

Gender, income, education, race, and ethnicity also matter for digital experience. In an earlier study we found that digital experience was related to home Internet access and education, but that controlling for Internet access, factors such as race, ethnicity, income, and gender didn't matter for breadth of use (Mossberger, Tolbert, and Stansbury 2003, 126-27). Once we take broadband access and community characteristics into account, however, we find that men, the young, the educated and the affluent have more digital experience, and likely greater levels of skill in using the Internet. We also find that Latinos are significantly less likely to have engaged in a variety of uses in the Internet, and that individuals who live in communities with higher educational attainment are also more likely to have greater digital experience. The earlier results showed the strength of the influence of individual educational attainment, but by introducing broadband and community (geographic) characteristics, we have a better picture of more subtle, but important differences in digital experience. These findings are consistent with other research that examines the influence of community characteristics such as concentrated poverty on technology access and use (Mossberger, Tolbert and Gilbert 2004), and research that uses measures other than access, such as frequency of use or skill.

[12] Even when we control for dial-up modem Internet access in the same model, broadband access remains a statistically significant predictor of digital experience, or use of the Internet for a variety of activities (data not shown).

Gender matters for Internet use and skill, though not for simple access. As this study has demonstrated, women are less likely to have broadband access at home, although there is no gender gap for Internet access if we ignore differences between dial-up and broadband. Women have tended to be later adopters of the Internet, however, have slightly lower levels of self-reported technical competence (Mossberger, Tolbert and Stansbury 2003, 47), and have lower levels of frequency of Internet use (Mossberger, Tolbert and Gilbert 2004). While we previously found that there was no gender difference in digital experience, the results of the more complete model used in this study are consistent with gender patterns of interest in online politics, job search and distance learning found in previous research (Mossberger, Tolbert and Stansbury 2003). Women are more likely to use the Internet for health information, which was not included in this index. But health information seekers often use the Internet sporadically, and there is evidence that they are unable to locate some types of information that commonly exist on medical websites (Fox and Fallows 2003). While the yawning gaps have disappeared, more discriminating measures show that more women are lagging behind in their use of the Internet.

Latinos are among those least likely to be experienced in using the Internet. Racial and ethnic divisions emerge, as Asian-Americans and Latinos are less likely than whites and African Americans to have digital experience, and this finding warrants further examination. Race and ethnicity were not significant factors in an earlier analysis of digital experience that controlled for home Internet and computer access, but did not control for environmental factors, such as living in a low-income zip code or a zip code with low average educational attainment (Mossberger, Tolbert, and Stansbury 2003). Why is it that Latinos and Asian-Americans stand out then, when we control for community characteristics? The findings for Asian-Americans may be due to the small sample of these respondents, because Asian-Americans are generally not among the digitally disadvantaged. For Latinos, there are other factors at work limiting digital experience in addition to individual education and income, community characteristics, or access measures. Language barriers may constrain digital experience, although there are other possible influences that we do not measure here – the quality of individual education, for example. For the most part, Latinos have the same positive attitudes toward Internet use as white, non-Hispanic Americans, and they are even more likely to believe that the Internet is important in some ways, such as keeping up with the times (Mossberger, Tolbert and Stansbury 2003). There is a positive foundation, then, for addressing disparities in access and use, but more research is needed on Internet use and skill among Latinos.

Some communities offer greater opportunities for developing digital experience. We also find place matters, as individuals residing in zip codes with higher educational attainment[13] are statistically more likely to use the Internet for a range of sophisticated activities. Living in an area with better-educated residents has some advantage for digital experience, beyond factors such as individual educational attainment. This finding could be the result of better awareness of the Internet because of social networks, or the educational opportunities available in communities with higher educational attainment. In other research, we have found that when we control for neighborhood income and educational attainment, that these account for lower rates of Internet access and use for African-Americans. This explains the apparent contradiction that African-Americans are more likely to express positive attitudes toward technology, and yet have lower rates of access and skill. African-Americans living outside areas with low income and low educational attainment actually have higher rates of access and use than similarly-situated whites (Mossberger, Tolbert and Gilbert 2004; see also Mossberger, Tolbert, and Stansbury 2003). The

[13] Measured by the percentage of those who have completed high school or have some post-secondary education.

findings for digital experience add another dimension to our understanding of how environment may shape digital opportunities.

While Latinos were less likely than whites to have broad digital experience, individuals residing in zip codes with higher Latino populations were more likely to be experienced Internet users. This likely reflects the geographical concentration of Latinos in the western United States, a region with employment structure reliant on information technology.

Our questions measuring digital experience are similar to those asked in the Pew 2004 survey (Horrigan 2004) on the migration of tasks to the Internet, and our results based on multivariate analysis are consistent with findings of Pew based on descriptive statistics. The multivariate analysis confirms that broadband access leads to more sophisticated (Horrigan 2004) and extensive use of the Internet (Rappoport, Kridel and Taylor 2002).

CONCLUSION AND RECOMMENDATIONS: TOWARD BROADBAND OPPORTUNITY

Based on our analysis of survey data from 2001 and 2003, we find that disparities in broadband access largely follow the contours of inequalities in general Internet access and skill (Mossberger, Tolbert and Stansbury 2003; Norris 2001). But some differences also appear, including a distinctive gender gap with males more likely to have home high speed Internet access. Internet use at work also matters, with individuals significantly more likely to have Internet access at home if they use the Internet frequently at work. One of the striking features of this analysis is that the rapid growth of broadband between 2001 and 2003 has not erased the disparities that emerged in the earlier survey. Income, age, education, gender, race, Latino ethnicity, Internet use at work and place are the most consistent factors that matter across the two surveys. Demand for broadband is likely influenced by prior inequalities in computer and Internet access and skill, as well as the greater cost of broadband compared with dial-up access.

Place of residence matters – individuals who live in rural communities are disadvantaged, but so are those who live in areas with low levels of educational attainment. The geography of disadvantage varies by region (with the Northeast leading and the Midwest lagging). How community characteristics matter is not entirely clear from this analysis, but areas of low educational attainment may represent places with lagging public schools or labor markets with a high percentage of low-skill jobs. Either of these conditions could influence demand for broadband (or the Internet more generally), if schools don't link Internet use to assignments, or if workers aren't introduced to technology in the workplace.

The supply or availability of broadband varies across geographical areas, and is at least one of the causes of lower broadband access in rural areas. Cable modem access is available in 80% of the United States, and DSL is available in approximately 75% of the country (OECD 2004, 12, 13). The areas most likely to lack broadband access are rural, and are served by smaller regional carriers (Prieger 2003). Broadband availability currently depends upon about a 3.5 mile proximity from local exchange carriers, creating a "last mile bottleneck" for sparsely populated rural areas (Prieger 2003; Ayres and Williams 2003).

Finally, broadband access and technology skills clearly go together. We find that broadband access at home is associated with more digital experience, including engagement in political and economic activities online. A strong argument can be made for expanding broadband access if it indeed is related to increased skill acquisition, an important component of education in a digital age. It is these digital skills and the positive externalities that broadband can generate that make this a significant policy issue.

That there is a "digital divide"—which falls between those who have and can afford the latest in technological tools, such as broadband, and those who have neither in our society—is indisputable. Computer and Internet access, however, are insufficient without the skill to use the technology, and economic opportunity and political participation provide primary justification for realizing that this inequality is a public problem and not simply a matter of private misfortune. Defying those who say the divide is growing smaller, this research shows otherwise.

How then, can public policy not only speed the diffusion of broadband and the social benefits that flow from its widespread use, but also ensure that currently underserved populations have broadband access? How can more Americans enjoy the opportunity to develop technology skills and use high-quality Internet access for political participation, economic opportunity, health information, education, and adaptive technology for the disabled? The barriers that now exist are related to the affordability of broadband connections (as well as computer equipment), technical assistance for showing more individuals how they can perform a variety of tasks online, and the availability of broadband in some geographic areas.

Improve affordability. Our analysis shows that income is a significant barrier for residential broadband access, even when we control for other factors that influence demand, such as education. The higher cost of broadband has limited its diffusion. Broadband use is highly sensitive to pricing (Varian 2002), and affordability likely accounts for continued dial-up modem use even among some heavy Internet users (Rapporport, Taylor, and Kridel 2002). Low-income individuals are among those who could reap the greatest social benefit from broadband connectivity. It is imperative that public policymakers find ways to reduce the cost of residential access to broadband. Our study demonstrates the need to give serious and immediate consideration to the use of regulatory and/or tax policy to make affordable access a reality.

Encourage the extension of access in rural areas. Rural residents often have no broadband carrier at all, and even where broadband access does exist, rural residents may not have competitive choices for broadband service (Prieger 2003; Ayres and Williamson 2003). Yet, broadband access may be particularly critical for rural residents who are distant from educational institutions and health care services. Financial incentives, tax policy, and regulatory policy are all instruments that could be tapped to address rural availability as well as affordability.

Encourage extension of access in African-American and Latino neighborhoods. Financial incentives or other policies may also encourage the extension of broadband services where inner-city neighborhoods are currently underserved.

Devise creative partnerships to encourage broadband access for low-income households. Public housing and subsidized housing developments offer targeted opportunities to decrease the cost of broadband access for low-income households. Public-private partnerships such as One Economy provide technical assistance and donated or low-cost equipment to promote the use of broadband in new or renovated affordable housing developments. One Economy is also commendable for addressing technology use beyond broadband, including low-cost computers or loans for equipment, training for residents, and interactive websites with information on jobs and community issues that can be customized for each housing provider.

Promote effective use of broadband at public access sites and within schools. The federal E-Rate program has subsidized the cost of Internet access at schools and public libraries within low-income communities, but not all of these connections feature broadband, and not all public institutions have used broadband effectively. High-quality transmission and interactivity mean that schools can take advantage of videoconferencing to connect classrooms around the globe or to bring other distant experiences into the classroom. Libraries can provide broadband access for those who can't afford it, and both libraries and schools can expose community residents to new information and new uses of the Internet through broadband. Public access has a special role to play in providing assistance and facilitating skill development, whether or not residents have broadband at home.

In general, wider diffusion of broadband promises to increase the social benefits of this technology (Ferguson 2004, 9; National Academy of Sciences 2002, 13-14). Expansion of the market can stimulate research and development for new and innovative uses for broadband, as well as improvements that simplify use. Along with the current applications of broadband for e-government, health, education and other public purposes, this provides a strong justification for addressing broadband as a public policy issue.

Appendix Table 1: Respondent Has Internet Access (Broadband or Dial-up) at Home (2003)

	Baseline Models—*Compared to No Access*				Models with Internet Access at Work—*Compared to No Access*			
	Dial-up		*Broadband*		*Dial-up*		*Broadband*	
Variables	β (robust se)	p>|z|	β (robust se)	p>|z|	β (robust se)	p>|z|	β (robust se)	p>|z|
Environmental								
West	**.35(.16)**	**.03**	.32(.20)	.12	**.37(.16)**	**.02**	**.36(.21)**	**.09**
North East	.04(.16)	.81	**.44(.20)**	.03	.06(.17)	.70	**.46(.20)**	**.02**
Midwest	.10(.14)	.48	-.07(.19)	.71	.11(.15)	.45	-.06(.19)	.73
Urban	.14(.16)	.38	**.64(.22)**	**.00**	.11(.16)	.52	**.60(.22)**	**.00**
Suburban	.21(.14)	.13	**.49(.20)**	**.01**	.20(.14)	.15	**.47(.20)**	**.02**
Individual								
Republican	.15(.14)	.25	.22(.17)	.20	.16(.14)	.24	.23(.18)	.18
Democrat	-.08(.14)	.58	.20(.19)	.29	-.09(.14)	.51	.17(.19)	.36
Income	**.29(.03)**	**.00**	**.49(.04)**	**.00**	**.26(.03)**	**.00**	**.45(.04)**	**.00**
Education	**.34(.04)**	**.00**	**.44(.05)**	**.00**	**.29(.04)**	**.00**	**.37(.06)**	**.00**
African American	**-.37(.20)**	**.06**	**-.67(.30)**	**.03**	**-.39(.20)**	**.06**	**-.68(.30)**	**.03**
Asian American	-.02(.44)	.96	.27(.48)	.57	-.09(.42)	.83	.18(.47)	.69
Latino	**-.39(.22)**	**.07**	**-.88(.30)**	**.00**	**-.37(.22)**	**.09**	**-.84(.31)**	**.00**
Age	**-.04(.00)**	**.00**	**-.06(.00)**	**.00**	**-.03(.00)**	**.00**	**-.06(.00)**	**.00**
Male	**-.20(.11)**	**.07**	.03(.15)	.85	**-.20(.11)**	**.08**	.02(.15)	.89
Frequency of Internet use at Work					**.15(.03)**	**.00**	**.18(.03)**	**.00**
Constant	-1.07(.27)	.00	-2.83(.36)	.00	-1.07(.27)	.00	-2.78(.36)	.00
Pseudo R^2	.1867		.1867		.1954		.1954	
Wald Chi^2	542.83	.00	542.83	.00	551.30	.00	551.30	.00
N	2255		2255		2255		2255	

Note: Models are estimated using multinomial logistic regression with robust standard errors in parentheses. Probabilities based on 2-tailed test. Statistically significant coefficients at .10 or less in bold. The models are estimated using probability/ sampling weights adjusting the survey sample to the population based on age, education, race, ethnicity and gender. **Source:** Data from the Pew Internet and American Life Project, a national random digit-dialed telephone survey focusing on e-government, August 2003. Models are estimated using no home access as the reference group. In each model, either dialup or broadband are being compared with no home Internet access.

Appendix Table 2: Respondent Has Internet Access (Broadband or Dial-up) at Home (2001)

	Baseline Models—*Compared to No Access*				Models with Internet Access at Work—*Compared to No Access*			
	Dial-up		*Broadband*		*Dial-up*		*Broadband*	
Variables	β (robust se)	p>|z|	β (robust se)	p>|z|	β (robust se)	p>|z|	β (robust se)	p>|z|
Republican	**.30(.10)**	**.09**	-.29(.29)	.32	.29(.19)	.13	-.33(.31)	.29
Democrat	-.19(.17)	.27	.32(.27)	.22	-.18(.17)	.28	.38(.28)	.17
Poor	**-.95(.14)**	**.00**	-.21(.27)	.42	**-.89(.15)**	**.00**	-.40(.30)	.17
Education	**.35(.06)**	**.00**	.06(.10)	.51	**.29(.06)**	**.00**	.05(.11)	.66
African American	**-.62(.18)**	**.00**	-.47(.35)	.18	**-.62(.19)**	**.00**	-.31(.35)	.38
Asian American	36.48 (4.5E7)	1.00	.91(.68)	.18	.33.56 (1.1E7)	1.00	1.15(.72)	.11
Latino	-.49(.23)	.04	-.29(.40)	.48	-.38(.22)	.12	-.36(.44)	.41
Age	-.03(.00)	.00	**-.02(.00)**	**.00**	**-.02(.00)**	**.00**	**-.02(.01)**	**.00**
Male	.15(.13)	.25	.33(.20)	.11	.13(.14)	.36	**.41(.22)**	**.06**
Frequency of Internet use at Work					**.33(.07)**	**.00**	.10(.08)	.22
Constant	.58(.30)	.06	-1.11(.50)	.03	.13(.33)	.69	-1.27(.56)	.02
Pseudo R^2	.1276		.1276		.1494		.1494	
Wald Chi^2	312.08	.00	312.08	.00	340.86	.00	340.86	.00
N	1319		1319		1238		1238	

Note: Models are estimated using multinomial logistic regression with robust standard errors in parentheses. Probabilities based on 2-tailed test. Statistically significant coefficients at .10 or less in bold. **Source:** Data from the K. Mossberger, C. Tolbert and M. Stansbury. 2003. *Virtual Inequality: Beyond the Digital Divide.* Washington, DC: Georgetown University Press Models are estimated using no home access as the reference group. In each model, either dialup or broadband are being compared with no home Internet access.

Appendix Table 3: Probability of Broadband Home Access in 2003 (Master Table)

REGION	**BROADBAND**	**DIALUP**	**NO ACCESS**
West	14.0% (.023)	56.8% (.034)	29.2% (.032)
Northeast	18.0 % (.025)	48.1% (.033)	33.8% (.034)
Midwest	12.1% (.019)	52.2% (.032)	35.7% (.032)
South	13.8% (.019)	49.6% (.031)	36.6% (.033)
Difference Northeast/Midwest	**5.9%**	**-3.9%**	
AREA			
Urban	20.6% (.031)	45.0% (.038)	34.4% (.041)
Suburban	18.0 % (.025)	48.1% (.033)	33.8% (.034)
Rural	12.9% (.023)	46.7% (.042)	40.4% (.044)
Diff. Urban/Rural	**7.7%**	**-1.7%**	
INCOME			
High (50-75K)	23.8% (.030)	50.6% (.034)	25.6% (.030)
Medium	18.0% (.025)	48.1% (.033)	33.8% (.034)
Low (20-30K)	11.7% (.019)	42.2% (.036)	46.1% (.036)
Difference	**12.1%**	**8.4%**	
AGE			
Low (29)	30.0% (.035)	50.3% (.035)	19.7% (.041)
Medium (47)	18.0% (.025)	48.1% (.033)	33.8% (.034)
High (64)	9.6% (.017)	40.2% (.037)	50.2% (.040)
Difference	**20.4%**	**10.1%**	
GENDER			
Male	21.3% (.027)	44.3% (.032)	34.4% (.034)
Female	18.0% (.025)	48.1% (.033)	33.8% (.034)
Difference	**3.3%**	**-3.8%**	
EDUCATION			
High (college)	22.3% (.029)	52.9% (.035)	24.8% (.030)
Medium	18.0% (.025)	48.1% (.033)	33.8% (.034)
Low (high school)	13.8% (.022)	41.6% (.036)	44.6% (.040)
Difference	**8.5%**	**11.3%**	
RACE/ETHNICITY			
White	18.0% (.025)	48.1% (.033)	33.8% (.034)
African American	10.7% (.028)	42.4% (.054)	46.9% (.057)
Asian American	21.5% (.069)	47.5% (.099)	31.0% (.108)
Latino	12.0% (.033)	43.8% (.057)	44.3% (.062)
Difference white/black	**7.3%**	**5.7%**	
INTERNET WORK			
High	25.1% (.037)	54.6% (.042)	20.2% (.032)
Mean	18.0% (.025)	48.1% (.033)	33.8% (.034)
Low	15.4% (.022)	44.5% (.034)	40.1% (.037)
Difference	**9.7%**	**10.1%**	

Note: Probabilities based on the multinomial logistic regression coefficients presented in appendix Table 1 (columns 3 and 4).

Appendix Table 4: Probability of Broadband Home Access in 2001 (Master Table)

INCOME	**BROADBAND**	**DIALUP**	**NO ACCESS**
High (> $30,000)	7.3% (.018)	58.9% (.036)	33.8% (.035)
Mean	5.8% (.035)	52.9% (.035)	41.3% (.035)
Low(< $30,000)	3.5% (.012)	40.3% (.044)	56.2% (.046)
Difference	**3.8%**	**18.6%**	
GENDER			
Male	8.9% (.022)	54.0% (.036)	37.1% (.036)
Female	5.8% (.035)	52.9% (.035)	41.3% (.035)
Difference	**3.1%**	**1.1%**	
AGE			
Low (28)	9.7% (.025)	58.4% (.037)	31.9% (.034)
Medium (44)	5.8% (.035)	52.9% (.035)	41.3% (.035)
High (61)	3.3% (.011)	45.5% (.039)	51.2% (.040)
Difference	**6.4%**	**12.9%**	
PARTISANSHIP			
Independent	5.8% (.035)	52.9% (.035)	41.3% (.035)
Republican	4.7% (.011)	60.1% (.031)	35.2% (.030)
Democrat	7.6% (.015)	47.6% (.030)	44.8% (.031)
Diff. GOP/Democrat.	**2.9%**	**-12.5**	
RACE/ETHNICITY			
White	5.8% (.035)	52.9% (.035)	41.3% (.035)
African American	3.3% (.013)	39.5% (.052)	57.2% (.053)
Asian American	26.7% (.138)	73.3% (.138)	0.0% (.000)
Latino	3.7% (.018)	45.1% (.064)	51.2% (.065)
Diff. White/black	**2.5%**	**13.4%**	
INTERNET USE AT WORK			
High	10.8% (.037)	70.0% (.050)	19.1% (.041)
Median	5.8% (.035)	52.9% (.035)	41.3% (.035)
Low	4.8% (.013)	47.4% (.036)	47.7% (.037)
Difference	**6.0%**	**22.6%**	**=**
EDUCATION			
High (College)	6.7% (.018)	58.2% (.036)	35.1% (.035)
Median	5.8% (.035)	52.9% (.035)	41.3% (.035)
Low (High School)	4.9% (.015)	46.8% (.038)	48.3% (.039)
Difference	**1.8%**	**11.4%**	

Note: Probabilities based on the multinomial logistic regression coefficients presented in appendix Table 2 (columns 3 and 4).

Appendix Table 5: Respondent has Digital Experience/Proxy Technology Skills (2001)

VARIABLES	MODEL 1	
	β (se)	p>|z|
Individual		
Home Broadband Access	**.198(.077)**	**.010**
Democrat	.026(.064)	.685
Republican	.033(.068)	.626
Age	**-.025(.002)**	**.000**
Male	**.183(.049)**	**.060**
Latino	**-.230(.111)**	**.037**
African American	.106(.086)	.215
Asian American	**-.486(.296)**	**.101**
Education	**.205(.024)**	**.000**
Income/Poor	**-.206(.059)**	**.001**
Environmental (zip code)		
Percent African American	.001(.001)	.913
Percent Asian American	-.002(.008)	.770
Percent Latino	**.007(.002)**	**.000**
Zip code % Median Household Income	-0.000(.000)	.702
Percent High School Graduate or Higher	**.008(.003)**	**.008**
Constant	.270(.249)	.278
Pseudo R^2	.134	
Wald Chi^2	489.81	.000
N	973	

Note: Models are estimated using Poisson regression, standard errors in parentheses. Probabilities based on 2-tailed test. Statistically significant coefficients at .10 or less in bold. **Source**: Survey data from K. Mossberger, C. Tolbert and M. Stansbury. 2003. *Virtual Inequality: Beyond the Digital Divide*. Washington, DC: Georgetown University Press.

References

Aldrich, J. H. and F. D. Nelson. 1984. *Linear Probability, Logit and Probit Models*. Beverly Hills, CA: Sage.

Alliance for Public Technology and the Benton Foundation. 2003. "A Broadband World: The Promise of Advanced Services." Available [Online]: http://www.benton.org/publibrary/broadband/broadband-world.html. Accessed 7/21/2004.

Ayres, R.U. and E. Williams. 2003. "The Digital Economy: Where Do We Stand?" *Technological Forecasting and Social Change.* 71 (4): 315-339.

Bimber, B. 2003. *Information and American Democracy: Technology in the Evolution of Political Power*. Cambridge University Press.

Bimber, B. 2000. "Measuring the Gender Gap on the Internet." *Social Science Quarterly*. 81 (3): 868-876.

Coglianese, C. 2004. "E-Rulemaking: Information Technology and Regulatory Policy." Regulatory Policy Program, Harvard University, John F. Kennedy School of Government. Avalable [online]: http://www.ksg.harvard.edu/press/E-rulemaking_Report.pdf.

Crandall, R. and C. Jackson. 2001. "The $500 Billion Opportunity: The Potential Economic Benefit of Widespread Diffusion of Broadband Internet Access," Criterion Economics, L.L.C., Washington, D.C.

Dataquest, Inc. 2002. "Gartner Dataquest Says Implementation of "True" Broadband Could Bolster U.S. GDP by $500 Billion a Year." Available [Online]: http://www4.gartner.com/5_about/press_releases/2002_08/pr20020826a.jsp. Accessed 7/30/2004.

European Commission. 2004. "eEurope 2005 Broadband." Available [Online]: http://europa.eu.int/information_society/eeurope/2005/all_about/broadband/index_en.htm. Accessed 7/30/2004.

Ferguson, Charles H. 2004. *The Broadband Problem: Anatomy of a Market Failure and a Policy Dilemma.* Washington, D.C.: Brookings Institution Press.

Graf, J. and C. Darr. (2004, February 5). "Political Influentials Online in the 2004 Presidential Election." Available [Online]: http://www.ipdi.org.

Horrigan, J. (2004a, April 19). "Broadband Penetration on the Upswing." Pew Internet and American Life Project. Washington, D.C. Available [online]: http://www.pewinternet.org.

Kaestle, C.F., A. Campbell, J.D. Finn, S.T. Johnson, and L.J. Mickulecky. 2001. *Adult Literacy and Education in America: Four Studies based on the National Adult Literacy Survey*. NCES publication number 2001534. Washington, D.C.: U.S. Department of Education, National Center for Education Statistics. Available [online]: http://nces.ed.gov/pubsearch/pubsinfo.asp@pubid=2001534 [23 May 2002].

King, G., M. Tomz, and Jason Wittenberg. 2000. "Making the Most of Statistical Analysis: Improving Interpretation and Presentation." *American Journal of Political Science* 44: 47-361.

Larsen, E. and L. Rainie. 2002. "Digital Town Hall." The Pew Internet and American Life Project. Washington, D.C. Available [online]: http://www.pewinternet.org/PFF/r/74/report_display.asp.

Lenhart, A. 2003. *The Ever-shifting Internet Population: A New Look at Internet Access and the Digital Divide*. The Pew Internet and American Life Project. Washington, D.C. Available [online]: http://www.pewinternet.org/

Long, J.S. 1997. *Regression Models for Categorical and Limited Dependent Variables*. Thousand Oaks, CA: Sage.

Long, J.S. and J. Freese. 2001. *Regression Models for Categorical Dependent Variables using Stata*. College Station, TX: Stata.

Lupia, A. and Z. Baird. 2003. "Can Web Sites Change Citizens: Implications of Web White and Blue 2000." *PS: Political Science and Politics* 37: 77-82.

Mills, B. and B. Whitacre. 2003. "Understanding the Non-Metropolitan--Metropolitan Digital Divide." *Growth and Change*. 34 (2): 219-243.

Mishel, L., Bernstein, J. Bernstein, and J. Schmitt. 2001. *The State of Working America: 2000-2001*. Ithaca, NY: Cornell University Press/ILR Press. http://www.epi.org/content.cfm/books_swa2000_swa2000intro

Mossberger, K. C. Tolbert and M. Gilbert. 2004. "Race, Concentrated Poverty and Information Technology." Paper presented at the annual meeting of the American Political Science Association, Chicago, IL.

Mossberger, K. and C. Tolbert. 2003. "Race, Place and Information Technology." Working paper for the National Center for Digital Government (NCDG), Harvard University, No. 03-013. Available [online]: http://www.ksg.harvard.edu/digitalcenter/research/working_papers/MossbergerTolbert_NCDG_03-13.pdf

Mossberger, K., C. Tolbert, and M. Stansbury. 2003. *Virtual Inequality: Beyond the Digital Divide.* Washington, D.C.: Georgetown University Press.

National Academy of Sciences. 2002. *Broadband: Bringing Home the Bits.* Washington, D.C.: National Academy Press.

NetImpact. 2002. "Study Overview" and "Key Findings." Available [Online]: http://www.netimpactusdy.com/nis_2002.html. Accessed 7/30/2004.

Norris, P. 2001. *Digital Divide: Civic Engagement, Information Poverty, and the Internet Worldwide.* New York: Cambridge University Press.

Organization for Economic Cooperation and Development. 2000. *Learning to Bridge the Digital Divide.* Paris: Organization for Economic Cooperation and Development.

Organization for Economic Cooperation and Development. Working Party on Telecommunication and Information Services Policies. 2004. "The Development of Broadband Access in Rural and Remote Areas." Available [Online]: http://www.oecd.or/document/43/0,2340,en_2649_34225_31718315_1_1_1_1,00.html.

Pew Internet and American Life Project. 2003. *The Ever-Shifting Internet Population: A new look at Internet access and the digital divide.* Available [online]: www.pewinternet.org/reports/ [16 April, 2003]

Pew Research Center for the People and the Press. (2004, January 11). "Cable and Internet Loom Large in Fragmented Political News Universe." Available [Online]: http://www.people-press.org.

Prieger, J.E. 2003. "The Supply Side of the Digital Divide: Is There Equal Availability in the Broadband Internet Access Market?" *Economic Inquiry*. 41 (2): 346-363.

Rappoport, P.N., D.J. Kridel, and L.D. Taylor. 2002. "The Demand for Broadband: Access, Content, and the Value of Time." In *Broadband: Should We Regulate High-Speed Internet Access?"* R.W. Crandall and J.H. Alleman, eds. Washington, D.C.: AEI-Brookings Joint Center for Regulatory Studies, 57-82.

Telecommunications Industry Association. 2003. "The Economic and Social Benefits of Broadband Deployment." Available [Online]: www.tiaonline.org. Accessed 7/21/2004.

Tolbert, C. and R. McNeal. 2003. "Unraveling the Effects of the Internet on Political Participation?" *Political Research Quarterly* 56(2): 175-85.

U.S. Department of Commerce. 1995. National Telecommunication and Information Administration. *Falling through the Net: A Survey of the "Have Nots" in Rural and Urban America.* Available [online]: http://www.ntia.doc.gov/ntiahome/fallingthru.html [18 March 2002].

U.S. Department of Commerce. 2002. National Telecommunication and Information Administration. *A Nation Online: How Americans are Expanding their Use of the Internet.* Available [online]: http://www.ntia.doc.gov/ntiahome/dn/anationonline2.pdf [18 March 2002].

U.S. Department of Commerce. 2004. Economics and Statistics Administration and National Telecommunications and Information Administration. *A Nation Online: Entering the Broadband Age.* Available [online]: http://www.ntia.doc.gov/reports/anol/NationOnlineBroadband04.htm. [26 February 2005].

Varian, H.R. 2002. "The Demand for Bandwidth: Evidence from the INDEX Project." In *Broadband: Should We Regulate High-Speed Internet Access?"* R.W. Crandall and J.H. Alleman, eds. Washington, D.C.: AEI-Brookings Joint Center for Regulatory Studies, 39-56.

Walsh, E.O., with M.E. Gazala and C. Ham. 2001. "The Truth about the Digital Divide." In *The Digital Divide: Facing a Crisis or Creating a Myth?* B.M. Compaine eds. Cambridge, Mass.: MIT Press, 279-84.

West, D.M. 2003a. State and federal e-government in the United States, 2003. Center for Public Policy, Brown University, September 2003. Available [online]: www.insidepolitics.org/egovt03us.pdf [4 January 2004].

Warschauer, M. 2003. *Technology and Social Inclusion: Rethinking the Digital Divide.* Cambridge, Mass.: MIT Press.

Wilhelm, A. 2000. *Democracy in the Digital Age: Challenges to Political Life in Cyberspace.* New York: Routledge.

Yankee Group. 2001. "The Collaborative Commerce Value Statement: A $223 Billion Cost Savings Opportunity Over Six Years," *Module B-to-B Commerce and Applications.* Vol. 6, No. 6, Boston, Mass.