

Factors Influencing the Adoption of Residential Broadband Connections to the Internet

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Abstract

Broadband adoption has been slower than anticipated in the United States resulting in a number of proposed policy interventions ranging from non-intervention to extreme measures. Digital divide advocates are concerned that demographics of broadband users will reveal the same digital divide gaps that are observed in computer ownership and home Internet access. This study analyzes the factors influencing the adoption of residential broadband services using the Current Population Survey data from September 2001. Three statistical models on computer ownership, home Internet access, and broadband access are analyzed to illustrate the differences in demographics between the dependent variables. Using a logit regression model, the results show that the digital divide is the widest for computer ownership and the narrowest for broadband access. The implications of this study are that public policy interventions to bridge the digital divide should focus more on computer ownership, and less on broadband specific policies.

1. Introduction

Historically, a gap has existed between socioeconomic classes and their ability to access new technologies. Those in the upper socioeconomic classes have the leisure time and resources to buy new technologies and have the education and opportunity to become skilled in their use. The less affluent classes may never have an opportunity to use a new technology or they are forced to wait until the price is reduced to make access possible. However, the third possibility is that the government can decide that access to the new technology is important and develop a public policy intervention to ensure access. The Internet has become one such critical technology.

The United States government is still determining the types of policy interventions necessary to ensure access to the Internet. An extreme intervention has

not yet occurred with access to the Internet, but more modest measures have been undertaken. The federal government has instituted policies to encourage communities to come online and has contemplated imposing public policies to bring faster broadband access to individual residences. That these measures have been undertaken is a testimony to society's belief that access to the Internet is a critical linchpin in today's communication network and how people interact with society.

The focus of the government intervention is moving from ensuring that communities have access to the Internet to performing a concentrated analysis of whether the government ought to support high speed access to the Internet. Broadband has become a battleground between the telecommunications marketplace and the cable industry, and with consumer advocates. This battle has been taken to the airwaves as the interest groups run ads to gain support for their positions and to encourage public involvement in the policy battle. But a key piece of information is lacking. Even with the hype, little evidence has been presented as to delineating factors that influence the adoption of broadband.

2. Literature Review and Policy Implications

The impact of the Internet has been experienced by many Americans in every aspect of their daily life. A majority of Americans connect to the Internet either through connections at home, work, or school and use the Internet to send e-mail, shop, bank, search for a new job, or find information. However, the Internet has not reached all Americans and a digital divide has been created between Internet haves and have-nots. If the Internet were merely a sophisticated entertainment device, the digital divide would not be so critical. However, the Internet has become part of an intricate communications network that people have developed, and disenfranchisement from that network creates barriers to education, jobs, and information access [1].

As greater numbers of households adopt high speed broadband access to the Internet through Digital Subscriber Lines (DSL) or cable modem access, the disparities in access to the communications network will continue to grow.¹

2.1 Broadband Connectivity to the Internet

Broadband connections to the Internet have a greater impact on the user beyond increasing the speed of a single transaction. According to the Pew Internet and American Life project, broadband access at home alters the online behavior of individuals. For Internet users with broadband connections, the Internet becomes a tool that is used more frequently for a greater variety of transactions than what is done by individuals with dial-up or narrowband connections [2]. According to the report, one of the key differences between users of broadband and narrowband connections is that one-third of broadband users will telecommute or work from home.

The Nielsen/Net Ratings found in January 2002 that the amount of time spent online by users of broadband was actually greater than the number of hours that narrowband users spent online, despite broadband connections comprising only 21 percent of the total number of home connections [3]. This information is impressive, although one unanswered question is whether the number of hours is higher because of the "always-on" nature of a broadband connection. Despite that caveat, as this trend continues, the content of the Internet will become more focused on providing the high bandwidth content for broadband users in the form of intense graphic displays and large files, limiting the usefulness of a narrowband connection. Particular types of online applications, such as educational content or online universities have already become extremely difficult to access without the aid of a high speed connection.

The media hype claims that broadband connectivity will drive dramatic changes to Internet content and to the American economy. However, the adoption rate of broadband services by residential users has been so slow that the 105th, 106th, and 107th sessions of Congress each had several legislative proposals to offer either tax credits to consumers for adoption of broadband services or tax benefits to the telecommunications and cable industry to encourage faster build out of broadband networks. None of these

measures has been passed and each has faced a variety of criticisms from economists. The criticisms range from a belief that broadband markets would be better off in a *laissez faire* market to calls for increased regulation on the broadband market [4]; [5]; [6]. One often cited reason for the slower buildout has been lack of demand by consumers for broadband connections. This reason has led to speculation that the demand is low due to lack of content to lure consumers onto broadband connections. Despite these speculations, the body of research surrounding the factors of this adoption has been limited to questions of price and access.

In February 2002, the Federal Communications Commission (FCC) announced in a report that 97 percent of all zip codes had a minimum of one broadband subscriber [7]. One subscriber per zip code does not necessarily mean that the entire zip code has access to broadband service, but it does begin to show that the access is moving beyond the high-density, metropolitan areas into less populated parts of the United States. Although the data in this report does not analyze satellite broadband connections, satellites have the potential to reach more remote locations and provide an alternative to DSL and cable access.

The other barrier to widespread broadband adoption has been the higher costs. One note on cost is the consideration of the expense of the monthly cable bill. The penetration rate for cable television is 69.8 percent of households that have a television, with the average cost for a basic cable television package of \$30 per month [8]. Over two-thirds of the households with cable subscribe to more than the basic package bringing their cable bill to a higher amount than the basic \$30. Cable television is somewhat less expensive than broadband connections, but the high subscription rate to cable demonstrates that people will pay for a service, if they feel that it is worth the expense.

One of the traits of current broadband users has been a higher than average income of those households. This has been attributed to the higher cost of broadband services as opposed to the lower cost of narrowband services [9]. However, evidence shows that the cost of broadband remains constant at \$45-\$55 per month throughout the United States despite the fluctuations in cost for narrowband connections [10]. The constant nature of broadband costs demonstrates that the market for broadband and narrowband connections is not identical. If the broadband and narrowband market was the same, then the broadband providers would take the opportunity to charge more for broadband services in the areas where narrowband services are more expensive [11]. The question

¹ Broadband access refers to high speed access to the Internet in excess of 128 kilobytes per second (kbs) and frequently much faster. The average dial-up or narrowband connection speed is no faster than 56 kbs download and 33.6 kbs upload speed, and is frequently much slower than these speeds. .

becomes whether the identical trends in the digital divide are occurring in the context of broadband.

2.2 Importance of the Digital Divide

The digital divide was first documented by the Department of Commerce's National Telecommunications and Information Administration (NTIA) in 1995 [12]. The data showed the socioeconomic differences in the people who had computers and modem access in their households and those who did not. The initial studies focused on the urban and rural geographical differences between those with access to the digital world and those without access, but further studies demonstrated a series of factors that influenced access, beyond geographical location [13]; [14]; [15]. These other factors were shown to be race, income, education, age, marital status, and school-age children. [14]; [16].

Over time, as the Internet has emerged from a fledgling network to a powerful influence on global society, the shape of the digital divide has also changed. In 2001, the number of households with computers was at approximately 56.5 percent [17]. The percentage of households with Internet access has grown from 26.2 percent in 1998 to 50.5 percent in 2001 [14]; [17]. The growth occurred not only in the higher income brackets, but across income and racial lines [10]. These findings have led the Bush Administration to declare that the digital divide has been closed and to propose reductions in federal dollars to combat the digital divide [18]. Despite the progress in connecting Americans to the Internet, disparities still remain that are driven by the factors listed earlier, e.g. race, etc. The gap has not been fully closed for Internet access with lower income and non-white households continuing to report lower penetration rates [17].

Policies implemented by the federal government to encourage local access to the Internet through community centers, schools, and libraries have created space for individuals without home Internet access to go online. These policies were enacted to address the lower penetration rates. However, this access does not connect individual households to the Internet, rather it is a provision to ensure that communities have locations from which to access the Internet. The public nature of a community access point limits the amount of time and privacy an individual has to explore the Internet. It follows that the behavior of an individual would be different in a public location than the behavior would be with the Internet connection in the privacy of a household. Research on the digital divide has concentrated more on whether or not a person has access to the Internet regardless of the

physical location of that access. However, one measure frequently used to determine the digital divide is a measure of the amount of time an individual spends online [1]. This analysis will not use that measure, due to lack of data, but that measure could easily be driven by the location of a person's access. There are inherent differences between at-home access to the Internet and communal access to the Internet. The difference can lead to a digital divide, even with community access. Access at home allows for anytime access without concern as to privacy issues or the duration of an online session. It is logical that those factors would be in the forefront of a person's mind while accessing the Internet at a public location. This is one of the considerations that make high speed access to a residence important.

2.3 Broadband and the Digital Divide

The current research on broadband connectivity and the digital divide do not show whether the digital divide extends into the area of broadband. It is not evident if the broadband demographic has the same characteristics as are found in the narrowband demographic, thereby signifying a digital divide between the have and have-nots with broadband. Most studies that have examined the issue have used data from 1998-2000. Those years were the height of the dotcom and telecommunications explosion and growth period. Broadband networks were being built-out by the cable and telecommunications industries. High bandwidth content was more limited two and three years ago. Despite the recent downturns in the telecommunications marketplace, broadband has continued to grow at a pace much faster than Internet connectivity as a whole [19].

Broadband connectivity does not seem to be following the same trend lines as narrowband connectivity. It is difficult to analyze based on the studies from several years ago, because those samples were self-selected. But new information shows a different penetration rate. According to a report by Jupiter Research, the East South Central region is last in the nation for overall household penetration rates, including narrowband and broadband connectivity, but they rank third for the percentage of online households with broadband. This information substantiates the DOC report showing the percentage of online users with broadband connections being similar for six income cohorts ranging from under \$15,000 to \$74,999 annually [17]. The real numbers for adoption in each income cohort vary, but the percentage of users adopting broadband appears constant. This information raises the issue as to what factors influence the adoption of broadband. The adoption of

broadband is not following the established narrowband trends.

2.4 Research Question

The preceding arguments entice one to ask what factors influence the adoption of residential broadband connections to the Internet. The broadband digital divide may be establishing itself along the same framework as it did with computer ownership and narrowband access to the Internet, but there are some indications that the adoption rate of broadband may be creating a new pattern.

3.0 Research Methods and Dataset Description

The analysis uses the Current Population Survey (CPS) Internet and Computer Use Supplement from September 2001, which contains more than 150,000 observations of cross-sectional data. The CPS data is collected on a monthly basis by the Bureau of Labor Statistics and the Bureau of Census. The Internet and Computer Use Supplement is a supplement to the monthly CPS data collection. The computer and Internet use data was collected in September 2000 and again in September 2001.

The CPS sample contains representation from the whole of the geographic United States using counties or groups of counties as the sample units [20]. The Bureau of Census and Bureau of Labor Statistics have developed the collection methodology and weighting schemes over time and have closely analyzed these methodologies to ensure accuracy. Data is collected from approximately 60,000 households every month using both telephone and face-to-face interview techniques. Observations in the dataset include the individual and household level of detail.

The average non-response rate for the sample is 7.5 percent. The September 2001 non-response rate was roughly 6.5 percent. The CPS documentation cites two primary reasons for non-responsiveness. Approximately 50 percent of the non-response rate is attributed to individuals' unwillingness to participate in the survey. The second reason is an inability of the interviewers to contact the family either over the telephone or face-to-face [21]. One factor that may affect this analysis is the number of dropped observations. Missing data for the education and income variables requires the elimination of a number of observations. This may cause bias, because it is unclear if the observations had commonalities or were missing randomly.

The data includes a weight variable to adjust for the under representation of the non-response groups, men, and non-whites [22]. These weights are structured to accurately represent the entire population of the United States, but the weight variable is deflated in the analysis to return the sample to the original size rather than to the size of the US population.

3.1 Plan of Analysis

The Current Population Survey September 2001 Computer and Internet Use Supplement contains the data necessary to analyze the question on the factors influencing the adoption of broadband access technologies by residential households in the United States. Three dependent variables are employed for examination of the data in regards to three different models. Further data to analyze the technology and demographic explanatory variables are also within the dataset.

The dataset has two potential limitations. The first limitation is the heavy reliance on qualitative information, thereby requiring the use of dummy variables. Recoding the categorical information into a series of dummy variables allows for a probability analysis to show which factors influence the adoption of broadband technology.

The second potential weakness in the dataset is that there may be relatively few members of the sample who have broadband access. However, if the dataset is representative of the general population, then 10 percent of the respondents should have broadband access which will be more than adequate to perform the analysis. Additionally, the limited percentage of observations that utilize broadband technology within the household can be offset by the high number of observations in the dataset to provide a statistically significant analysis. Neither limitation will prevent a good analysis to respond to the research question.

One caveat to this analysis is that one variable that is not included in the survey is whether the individual has access to broadband. The variable for whether or not an individual has access to broadband would be an important point, but the data set does not include information on that question. Therefore, the analysis on the penetration of broadband to the user community will be done through using more generalized statistics focused on the penetration rate throughout the country.

The data analysis employs three multivariate logit regression models with binary dependent variables. The first model examines whether the CPS data corresponds to previous studies as to the shape of the digital divide in regards to computer ownership. The

second model analyzes a subset of the data to observe the characteristics of computer owners, who have home Internet connections. The third model analyzes a further subset of the data by only looking at the individuals with home Internet access to analyze those people with broadband connections. Each model builds on the previous model to show if any change in the likelihood that broadband access transcends the digital divide.

The binary dependent variables, with the majority of the sample responding negatively, are best estimated using a linear probability regression with a logit estimate to ensure the most accurate results. The logit model assists in explicitly identifying the factors that are influencing households in their adoption rates of broadband by not over-emphasizing the portion of the sample that has not adopted broadband.

The specified model may also violate one of the multicollinearity assumption of the Best Linear Unbiased Estimator (BLUE). The multicollinearity assumption is frequently violated by social science research. The model includes variables about income, race, and education, which are frequently highly correlated with one another. As multicollinearity does not bias the estimates, the variables may remain as part of the model.

3.2 Descriptive Statistics

Table 1 provides the descriptive statistics for all of the proposed variables for this analysis, including the variable name, description, type of variable, valid number of observations, the minimum and maximum values, the mean, and the standard deviation. The descriptive statistics reveal that the variables in this study are either categorical or dummy variables, thereby necessitating the use of the logit regression model.

The categorical variables have no significant mean or standard deviation. The dummy variables *computer*, *hint*, and *female* each have a mean value showing that the observations are equally divided between the two values. The regional variables demonstrate that the sample is divided fairly evenly throughout the country, although *metro* indicates that a majority of the sample is located in larger metropolitan areas.

The key item of interest is the difference in the number of observations for each variable. The dependent variable, *broadband*, has the fewest observations with 82,210 observations, while some of the independent demographic variables have 158,865 observations. This difference between the number of observations for the different variables means that variables lacking data may have to be dropped from the data set to ensure that enough information is available for a statistically significant analysis.

A review of the dependent variables, *computer*, *hint*, and *broadband* revealed that the sample has approximately 64 percent, 57 percent, and 18 percent of the respondents with those characteristics respectively. This number provides a basis for a statistically significant analysis.

The mathematical models are shown below.

$$\text{Model 1: } \textit{computer} = \beta_0 + \delta_1\textit{less35k} + \delta_2\textit{thto50k} + \delta_3\textit{nohsdeg} + \delta_4\textit{hsdeg} + \delta_5\textit{black} + \delta_6\textit{amin} + \delta_7\textit{asian} + \delta_8\textit{marital} + \delta_9\textit{midwest} + \delta_{10}\textit{south} + \delta_{11}\textit{west} + \delta_{12}\textit{hisp} + \delta_{13}\textit{female} + \delta_{14}\textit{age} + \delta_{15}\textit{metro} + u$$

$$\text{Model 2: } \textit{hint} = \beta_0 + \delta_1\textit{less35k} + \delta_2\textit{thto50k} + \delta_3\textit{nohsdeg} + \delta_4\textit{hsdeg} + \delta_5\textit{black} + \delta_6\textit{amin} + \delta_7\textit{asian} + \delta_8\textit{marital} + \delta_9\textit{midwest} + \delta_{10}\textit{south} + \delta_{11}\textit{west} + \delta_{12}\textit{hisp} + \delta_{13}\textit{female} + \delta_{14}\textit{age} + \delta_{15}\textit{metro} + u$$

$$\text{Model 3: } \textit{broadband} = \beta_0 + \delta_1\textit{less35k} + \delta_2\textit{thto50k} + \delta_3\textit{nohsdeg} + \delta_4\textit{hsdeg} + \delta_5\textit{black} + \delta_6\textit{amin} + \delta_7\textit{asian} + \delta_8\textit{marital} + \delta_9\textit{midwest} + \delta_{10}\textit{south} + \delta_{11}\textit{west} + \delta_{12}\textit{hisp} + \delta_{13}\textit{female} + \delta_{14}\textit{age} + \delta_{15}\textit{metro} + u$$

Table 1: Descriptive statistics

Variable	Description	Type of Variable	Valid N	Minimum	Maximum	Mean	Standard Deviation
<i>computer</i>	Computer in Household	Dependent dummy	143,300	0	1	0.64	0.47
<i>hint</i>	Internet Home Use	Dependent dummy	143,300	0	1	0.57	0.49
<i>broadband</i>	Type of Home Internet Connection	Dependent dummy	82,210	0	1	0.18	0.38
<i>less35k</i>	Less than \$34,999 in the last 12 months	Independent dummy	123,949	0	1	0.39	0.49
<i>thto50k</i>	Between \$35,000--\$49,999 in last 12 months	Independent dummy	123,949	0	1	0.16	0.37
<i>fifplus</i>	Over \$50,000 last 12 months	Independent dummy	123,949	0	1	0.45	0.50

<i>nohsdeg</i>	No high school diploma	Independent dummy	112,202	0	1	0.20	0.40
<i>hsdeg</i>	High school diploma	Independent dummy	112,202	0	1	0.57	0.49
<i>collddeg</i>	College degree	Independent dummy	112,202	0	1	0.23	0.42
<i>marital</i>	Marital Status	Independent dummy	112,202	0	1	0.65	0.48
<i>black</i>	Black	Independent dummy	143,300	0	1	0.10	0.31
<i>amin</i>	American Indian	Independent dummy	143,300	0	1	0.02	0.13
<i>asian</i>	Asian	Independent dummy	143,300	0	1	0.04	0.19
<i>white</i>	White	Independent dummy	143,300	0	1	0.84	0.37
<i>female</i>	Female	Independent dummy	143,300	0	1	0.52	0.50
<i>age</i>	Age	Independent continuous	143,300	0	90	36.16	22.31
<i>hisp</i>	Ethnic Hispanic	Independent dummy	143,300	0	1	0.10	0.30
<i>midwest</i>	Midwest Region	Independent dummy	158,865	0	1	0.25	0.43
<i>south</i>	Southern Region	Independent dummy	158,865	0	1	0.29	0.45
<i>west</i>	Western Region	Independent dummy	158,865	0	1	0.22	0.41
<i>northeast</i>	Northeast Region	Independent dummy	158,865	0	1	0.22	0.41
<i>metro</i>	Metropolitan Area	Independent dummy	158,865	0	1	0.74	0.44

4. Results

All three models are highly significant according to the chi-squared likelihood number measuring the goodness-of-fit, as shown in Table 2. However, the most interesting characteristics of the models can be seen when comparing the changes in the variables across each of the three models and observing the changes in the odds ratios. This section begins with a brief description of the statistical calculations to describe the interpretation of the odds ratios numbers displayed in Table 2. The results of Model 1 are described in detail, followed by briefer descriptions of Model 2 and Model 3, and the section concludes by a comparison of the variables across all three models.

4.1 Statistical Calculations

The odds ratios in Table 2 are not interpreted directly. The odds ratios indicate a negative or positive relationship with the baseline category by the magnitude of coefficient where 1.0 as the neutral point. An odds ratio coefficient that is 1.0 indicates an equal chance of the event occurring between the categories. An odds ratio coefficient that is greater than 1.0 shows a greater likelihood for the event to occur for that category, and a coefficient below 1.0

shows a less likely chance of the event occurring in that category. For example, if *less35k* has an odds ratio coefficient of 0.189 in Model 1, the interpretation is that it is 81.1 percent less likely that a household with an annual income of less than \$34,999 will own a computer than a household with an annual income of greater than \$50,000.

4.2 Model Descriptions

Model 1 uses *computer* or computer ownership as the dependent variable and demonstrates that the data set exhibits the same characteristics that have been seen in other studies addressing the digital divide. The income, education, racial, and ethnic variables are highly significant at the 0.01 level and reveal the expected relationships with *computer*. The variable *less35k* illustrates that a family with an annual income of less than \$35,000 is 81 percent less likely to own a computer than a family with an income greater than \$50,000. And, *thto50k* echoes this finding with the information that a family earning \$35,000 to \$50,000 is 65 percent less likely to own a computer than a family with an income greater than \$50,000. The education variable analysis reflects the same trend with college graduates more likely to own a computer

than non-high graduates or high school graduates. The racial and ethnic variables also show that whites are more likely to own a computer than African-Americans, American Indians, or ethnic Hispanics. However, Asians are 26 percent more likely than whites to own a computer. These numbers agree with research that has already been conducted.

Model 2 has *hint* or home Internet access as the dependent variable and also has coefficients that exhibit digital divide characteristics. All of the variables remain statistically significant at the 0.01 level in Model 2 with two exceptions. The variable *marital* or married shifts to being significant at the 0.10 level, and the variable for American Indian, *amin*, is no longer statistically significant. The regional variables of *south* and *west* show a greater likelihood in the southern and western states to have home Internet access than the Northeastern portion of the

United States. Home Internet access is also 32 percent more likely in metropolitan areas than in rural areas as demonstrated by *metro*.

Model 3 examines the likelihood of broadband access in the home. Two of the race variables, *amin* and *asian*, are statistically insignificant, but the other variables remain statistically significant. The income and education variables continue to show that it is less likely for lower income households and non-whites to have broadband access than it is for households earning over \$50,000 annually and whites. Age is a continuous variable and cannot be interpreted in the odds ratio likelihood numbers of the logit model, but age is statistically significant in the model. The biggest indicator of *broadband* is found in the *metro* variable where being in a metropolitan area increases the likelihood of broadband by 222 percent over rural areas.

Table 2: Logit Model Odds Ratios

Variable	Description	Model 1 (Weighted)	Model 2 (Weighted)	Model 3 (Weighted)
Dependent Variable		<i>computer</i>	<i>hint</i>	<i>broadband</i>
<i>less35k</i>	Less than \$34,999 in the last 12 months	0.189*	0.318*	0.662*
<i>thto50k</i>	Between \$35,000--\$49,999 in last 12 months	0.448*	0.533*	0.719*
<i>nohsdeg</i>	No high school diploma	0.279*	0.467*	0.737*
<i>hsdeg</i>	High school diploma	0.473*	0.609*	0.835*
<i>marital</i>	Marital Status	1.639*	1.059***	0.920*
<i>black</i>	Black	0.433*	0.572*	0.749*
<i>amin</i>	American Indian	0.588*	0.978	0.874
<i>asian</i>	Asian	1.257*	1.274*	1.058
<i>female</i>	Female	1.067*	0.924*	0.902*
<i>age</i>	Age	0.969*	0.988*	0.993*
<i>hisp</i>	Ethnic Hispanic	0.433*	0.482*	0.756*
<i>midwest</i>	Midwest Region	0.825*	0.889*	0.680*
<i>south</i>	Southern Region	0.803*	1.124*	0.784*
<i>west</i>	Western Region	0.931*	1.346*	1.051**
<i>metro</i>	Metropolitan Area	1.239*	1.316*	2.215*
Likelihood Ratio		30.752	3749	1646
<i>n</i>		93,844	60,943	53,825

*Significant at the .01 level using the Wald Chi-Squared coefficient.
 **Significant at the .05 level using the Wald Chi-Squared coefficient.
 ***Significant at the .10 level using the Wald Chi-Squared coefficient.

Model 1 uses the full sample set to compute the regression.
 Model 2 uses only those members of the sample who have a computer.
 Model 3 uses only those members of the sample who have Internet access.

4.3 Comparison of Variables Across the Models

A comparison of results across the three models highlights changes in the socioeconomic and race variables. These variables have large changes in their odds moving from the likelihood of computer ownership to the likelihood of broadband access. The numbers appear to indicate that once a computer is

purchased, individuals desire greater access to the Internet through a faster broadband connection or a narrowing of the digital divide. For example, *less35k* changes from an 81 percent less chance of owning a computer than someone earning over \$50,000 to being only 68 percent less likely to have a home Internet connection, and finally to being only 34 percent less likely to have broadband access than the higher earner. A similar change is observed in the variable *thto50k* as

the likelihood declines from a 55 percent less likelihood of owning a computer than the household with the \$50,000 plus income to only a 28 percent less likelihood of having broadband access.

The race variable *black* repeats the same pattern of the income variables. The likelihood for *black* computer ownership is 57 percent less likely than white computer ownership, but the broadband connection is only 25 percent less likely to occur than with a white household. The *amin* variable is significant only in Model 1, and *asian* is not significant in Model 3, making the cross-comparisons for these variables difficult. However, the ethnic variable *hisp* chronicles a similar story as *black* with a shift from 57 percent less likely to own a computer than non-Hispanics to only 24 percent less likely to have broadband than non-Hispanics.

The geographic variables are not quite as consistent in their changes as the socioeconomic and race variables. Computer ownership in the Northeast is higher than the other regions of the country. However, the Southern Region is more likely to have home Internet access and less likely to have broadband access than the Northeast. And, the Midwest is less likely to have home Internet access or broadband access than the Northeast, while the Western Region has greater likelihood of home Internet access and broadband access than the Northeast Region.

The variable *metro* shows an expected relationship between metropolitan residents and the rural residents across the three models. Residents of a metropolitan area are 24 percent more likely to own a computer, 32 percent more likely to have Internet access, and more than twice as likely to have broadband access. This is a logical progression due to the better access to broadband technologies in more densely populated areas.

5.0 Policy Implications and Conclusions

Study Objective

The networked world of communications has changed rapidly over the past five years. One of the biggest advances was the increasing availability of accessible, affordable broadband technologies to consumers. Although, early studies were conducted and initial assumptions were made on the demographics of broadband users, no random data sample had been used to verify the likelihood of different racial and socioeconomic groups adopting broadband access for home use. This study analyzes data from the Current Population Survey to show the current trends in broadband adoption.

5.1 Policy Implications of Results

As discussed in the Results section, the income variables of *less35k* and *thto50k* reinforce conventional wisdom that income makes a difference in computer ownership, the decision to have home Internet, and broadband access. However, the income differences become less pronounced once the computer is initially acquired. The differences become progressively smaller until the gap is closed substantially in regards to broadband access.

The other socioeconomic variables of race, ethnicity, and education buttress the trends of the income variables. Each of these variables shows a wide gap at the level of computer ownership. After a computer is purchased, the variables are slightly less important for home Internet access. Finally, although race, ethnicity, and education impact the likelihood that the household will purchase broadband access, the observed differences are much smaller when it comes to broadband than for computer ownership.

One explanation for the narrowing of the gap is that once the household is exposed to the content available on the Internet the desire for easier and faster access grows and the income, race, ethnicity, and education disparities become less important than the access to information. This accounts for the consistent narrowing of the digital divide for all of the statistically significant racial and socioeconomic variables.

The geographic variables are likely to be more influenced by the access to broadband technologies. Broadband technology is not ubiquitously available anywhere in the country, although access to remote areas is becoming easier through satellite technology. However, this study does not include satellite access due to the lack of data. The largest digital divide among users of broadband appears in the differences between metropolitan and rural residents, which is a reasonable finding as metropolitan areas have better technology infrastructure than rural areas allowing for easier access. The regional variables support this conclusion with the more heavily populated Northeast and the Western Regions leading the South and the Midwest in adoption of broadband. The greater likelihood for the broadband adoption in these regions may be due to the higher concentration of metropolitan regions allowing for better access along the East and West coasts.

These trends illustrate that the broadband digital divide is more limited than assumed in digital divide literature. Although, a gap remains between racial and socioeconomic groups in their likelihood to adopt broadband technologies, this gap is appreciably smaller than the socioeconomic and racial divides with computer ownership and home Internet access. It is

evident that the purchase of a computer and access to a narrowband Internet connection have an effect on the willingness of the household to move forward to the more advanced technology in the form of broadband. The three statistical models show that the assumptions made about the digital divide and computer ownership cannot be applied to broadband access.

These conclusions suggest that a public policy intervention for broadband is not necessary to encourage consumer use. Rather, any policy intervention should concentrate more on the first step of assisting people in learning how to use a computer and gaining access to a computer and the Internet in their homes. Once someone has discovered the information available through technology, they seek it out on their own.

The other policy debate has focused on encouraging the telecommunications industry to upgrade networks to deliver DSL service to more remote areas. Cable modems and DSL are not yet ubiquitously accessible throughout all parts of the United States, even in metropolitan regions. The patchwork accessibility results in people having a desire for broadband that cannot be fulfilled by the cable or the telecommunications industries. Satellite companies are beginning to market their services for wireless broadband connections that require only a clear view to the sky as an alternative to the fixed wire technologies. Other technology advancements are being developed in the wireless networks that would remove some of these limitations. As more options are rapidly becoming available to consumers that address the metropolitan/rural divide, the need for a policy intervention in this area is also questionable.

5.2 Limitations of this Study and Directions for Future Studies

The limitations on this study offer direction as to possibilities for future studies in the area of the broadband digital divide. The first limitation was information on the accessibility of broadband connections. Second, satellite access was not part of the data set. Finally, broadband adoption has increased 70 percent, since the CPS survey was conducted [23].

The omission of accessibility information in the CPS data set may mean that individuals, who desire broadband, do not have it available for purchase. This would have provided another piece of information to the study. Accessibility is difficult to determine, because it is neighborhood specific and individuals may not know if broadband is available in their area. However, the access question is becoming less

important as fixed and mobile wireless broadband services continue to expand.

One of the ways of making broadband more accessible to remote areas is through fixed and mobile wireless networks that only require a clear view of the sky, such as broadband service provided via satellite. The marketing for satellite broadband has intensified over the past two years. Inclusion of data on satellite usage would increase the number of respondents with broadband access and possibly narrow the gap between metropolitan and rural users of broadband.

The final limitation of this study and future studies is the rapid adoption of the broadband technology in the consumer marketplace. Between September 2001 and 2003, the number of people subscribing to broadband has increased from 10.4 million households to more than 17 million households [23]. The changes in the market potentially mean large changes in the demographics of the broadband user community, which are difficult to measure regularly.

The limitations addressed above set the direction for future studies. An inquiry that addresses the access question and the demographics would be useful to observe any changes in the likelihood of socioeconomic groups to adopt broadband. Additional information as to the motivations of individuals, who purchase broadband connections are useful to determine the drivers behind the decision to have broadband connections in the home. Current studies have examined the use of broadband, but not the reason that an individual chooses to connect to broadband. This may assist in explaining why the digital divide shrinks moving from computer ownership to home Internet access, and finally to broadband access.

6. Conclusion

The demographics for broadband access do not replicate the demographics found for computer ownership and home Internet access. The digital divide shrinks as users adopt broadband connections. The public policies currently being debated do not acknowledge this smaller divide nor do they acknowledge the emerging technologies for broadband access that will make it easier for remote areas to have high speed Internet connections. These factors will change the broadband policy debate. Future research should try to explain why the broadband digital divide has a different shape than the traditional digital divide to better understand how technology policy can be better targeted to reduce the gap.

7. References

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