Broadband Use by Rural Small Businesses

by

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for

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This research explores two popular beliefs pertaining to the deployment and use of broadband services. First, that these services provide tangible benefit to the overall economy. Second, that rural deployment lags urban deployment. It has often been suggested that the universal provision of broadband services in rural areas was cost prohibitive; thus creating the urban-rural digital divide. This study investigates and verifies these assertions, specifically, as they apply to rural small businesses. It relies primarily on data from the Federal Communications Commission (FCC) and an Office of Advocacy survey.[1]

Overall Findings

The study finds that an urban-rural digital divide does exist in the provision and adoption of broadband services. This difference in broadband use is statistically significant. A major concern is that many benefits have been associated with the availability and adoption of broadband services, and rural small businesses are not obtaining them.

Highlights

- Broadband investment (and more generally investment in information technology) appears to provide substantial benefits to both consumers and the overall economy. Broadband investment and services appear to stimulate economic productivity and output, as well as create jobs.
- This study finds that rural small businesses do not subscribe to broadband services as frequently as urban small businesses do, and finds the difference in broadband use between rural and urban areas to be statistically significant.
- One of the drawbacks of the apparent urban-rural digital divide is that rural small businesses are less likely to benefit from new technologies facilitated by access to broadband services. For instance, this study finds a statistically significant difference in voice-over-Internet protocol (VoIP) use between metropolitan and non-metropolitan areas, apparently due to the lack of broadband use in rural areas.[2]

Scope and Methodology

The report uses data from the FCC and an Office of Advocacy survey, *A Survey of Small Businesses' Telecommunications Use and Spending*. The tabulations using FCC data tell the story as it relates to the U.S. economy, comparing urban and rural usage, and depicting the availability of broadband services by population density. This report was peer-reviewed consistent with Advocacy's data quality guidelines. More information on this process can be obtained by contacting the director of economic research at advocacy@sba.gov or (202) 205-6533.

Ordering Information

The full text of this report and summaries of other studies performed under contract with the U.S. Small Business Administration's Office of Advocacy are available on the Internet at ***www.sba.gov/advo/research***. Copies are available for purchase from:

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1. The results of this survey were published in *A Survey of Small Businesses' Telecommunications Use and Spending,* Telenomic Research, 2004. Available at ***www.sba.gov/advo/research/rs236.pdf***.

2. VoIP services use Internet-based protocol to replicate voice telephone services. For existing broadband users, these telephone services are often priced less than traditional telephone services.

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Executive Summary

This study explores two popular beliefs pertaining to the deployment and use of broadband services[1] – first, that these services are enormously important to consumers and the overall economy, and second, that rural deployment and use of these services lags urban broadband deployment and use. If both of these beliefs are true, then it follows that the benefits of broadband services are failing to reach many rural consumers.

While the topic of a digital divide is not new,[2] this research is somewhat unique in that it focuses primarily on rural small businesses' use of broadband services. Based on the empirical evidence from a survey of small businesses and other research presented in this study, the following are key highlights of the findings:

- Broadband investment (and more generally investment in information technology) appears to provide substantial benefits to both consumers and the overall economy. Broadband investment and services appear to stimulate economic productivity and output, as well as create jobs.
- This study finds that rural small businesses do not subscribe to broadband services as frequently as urban small businesses do, and finds the difference in broadband use between rural and urban areas to be statistically significant.
- One of the drawbacks of the apparent rural digital divide is that rural small businesses are less likely to benefit from new technologies facilitated by access to broadband services. For instance, this study finds a statistically significant difference in Voice-over-Internet Protocol (VoIP) use between metropolitan and

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[1] Broadband services are also referred to *as high-speed services for Internet access*.

[2] The term *digital divide* refers to various demographic differences in online usage. This study will use the term *rural digital divide* to describe the shortfall in rural broadband deployment and use.

non-metropolitan areas, apparently due to the lack of broadband use in rural areas.[3]

For small businesses, what causes the rural digital divide? This study investigates and finds several factors that contribute to the shortfall in rural broadband use by small businesses. These factors are:

- *Firm Size.* Rural small businesses (on average) tend to have fewer employees, which coincides with lower broadband subscription rates and lower spending levels.
- *High Cost and Price.* According to survey data on small businesses, rural small businesses tend to pay higher prices for broadband services than urban small businesses do. This fact may reflect the added cost of serving higher cost areas and/or a lack of competition in rural areas.
- *Price Elasticity*. Because broadband services are price elastic, when rural small businesses face higher broadband prices, they tend to demand proportionately less broadband services.

This study also offers indirect evidence that demographic factors play a role in broadband use in rural areas. Evidence shows that broadband users tend to be somewhat more educated, affluent, and young, and these characteristics tend to be more prevalent in metropolitan areas. If consumers in metropolitan areas are more apt to subscribe to online services, small businesses will find broadband services to be a more effective means to reach the public, advertise and sell services, provide product information, and communicate with employees. Therefore, based on differences in demographic characteristics, rural small businesses may not demand broadband service to the same extent as urban small businesses do. However, further evidence and work is needed to measure the extent to which this poses a significant factor.

[3] VoIP services use Internet-based protocol to replicate voice telephone services. For existing broadband users, these telephone services are often priced less than traditional telephone services.

In summary, there appears to be evidence supporting two commonly held beliefs: first, that broadband services can be beneficial to consumers and the economy; and second, that rural consumers (including small businesses) are not using broadband services to the extent that urban consumers do. Therefore, compared to their urban counterparts, rural small businesses are not seeing the benefits resulting from the investment and use of broadband services. More research is needed to measure the importance that supply and demand-side factors play in causing the rural digital divide.

Broadband Use By Rural Small Businesses

Stephen B. Pociask

I. Introduction

This study reviews numerous reports on the benefits of information technology (IT) and broadband investment, and discusses how broadband services can be used to improve consumers' daily lives. This study also investigates whether broadband deployment in rural areas lags behind deployment in urban areas: first by analyzing data from the FCC; and second by analyzing data specific to small businesses. For this second part, this study uses the results of a survey of small businesses to test the hypothesis that small businesses located in non-metropolitan areas are less likely to subscribe to broadband services than small businesses located in metropolitan areas.[4]

If rural small businesses are not using broadband services to the same extent as urban small businesses, what factors cause this disparity? Is it possible that rural small businesses are more costly to serve, which makes them relatively unattractive for competitors and investors? This study will discuss these questions.

[4] The results of this survey were published in "A Survey of Small Businesses' Telecommunications Use and Spending," Stephen Pociask, TeleNomic Research for the Office of Advocacy, Small Business Administration, Contract No. SBA-HQ-02-M-0493, Washington, DC, March 2004. The survey includes broadband use by small businesses operating in metropolitan and non-metropolitan areas. The definitions for metropolitan and non-metropolitan areas are analogous to urban and rural areas, respectively, with some exceptions in fringe areas.

II. Importance of Broadband Services to Small Businesses

A. Useful Benefits

A common belief is that broadband services are capable of providing enormous economic benefits, so much so that Congress directed the Federal Communications Commission (FCC) to promote the timely deployment of these advanced communications services.[5] According to this belief, the presence of broadband services works to facilitate the advancement of innovative applications, thereby fulfilling many needs common to peoples' daily lives, including communications, entertainment, games, computing, productivity, security, and information needs.[6] Examples of business applications and services include online training, public safety, support for the disabled,[7] and real time sign language interpreting.[8] While dial-up Internet services can provide some of the same applications and services, broadband services permit faster downloading and uploading of bandwidth-rich applications, video, music, pictures and data. As producers or consumers of these services and applications, small businesses stand to benefit from broadband deployment and its use.

Some broadband-based applications and services appear to have clear benefits for rural communities, compared to urban communities. For example, if broadband services were available, they would facilitate distance learning, which would permit rural students access to a wide choice of educational curriculums and programs.[9] Telemedicine applications are another commonly cited example of broadband benefits to rural residents and businesses. Telemedicine applications allow doctors and hospitals to share and send

[5] The Telecommunications Act of 1996 in §706, Pub. L. 104-104, Title VII, Feb. 8, 1996, 110 Stat. under 47 U.S. C. 157.

[6] Case studies on some of these topics can be found in Matthew D. Bennett, "A Broadband World: The Promise of Advanced Services," Co-sponsored by the Alliance for Public Technology and The Benton Foundation, 2003 (see http://apt.org/confer/broadband-world.pdf); and "Advance Services, Enhanced Lives," Alliance for Public Technology, 2002, (see http://www.apt.org/publica/casestudy.pdf).

[7] For example, see Frank G. Bowe, "A Hofstra Professor's Adventures in Policy Research," Hofstra, Department of Counseling, Research, Special Education and Rehabilitation, Spring 2003, (seehttp://www.hofstra.edu/pdf/ORSP_Bowe_Spring03.pdf.).

[8] For example a video interpreting program is available at http://signlanguage.com/clients/video.php.

[9] For example, Old Dominion University in Norfolk, VA has graduated 3,500 students from its distance learning program, which services students from across the state, as well as areas as far away as Arizona and Washington state (see http://www.odu.edu/oduhome/distance.shtml).

video telecommunications, as well as X-ray and digital images, to other doctors and hospitals located in other parts of the country, thereby giving patients living in remote communities better quality of care and increased convenience. Broadband services work to facilitate medical access to and advice from multiple medical specialists.[10] Today, telemedicine applications are being used to diagnose diseases such as osteoporosis, arthritis and cancer. They are also being used to monitor homebound patients with diabetes, congestive heart failure and other serious illnesses. Broadband services are the means by which services and applications are made possible – by exchanging bandwidth-rich content, connecting patients to their doctors and giving doctors access to a pool of experts from across the country.

Besides the benefits that come directly from deploying and using broadband services, communities that have broadband services may have a competitive edge in terms of attracting and retaining businesses. That edge can become a significant competitive factor between businesses, as well as serve as an important aspect of economic development for rural communities.[11]

Consider for a moment rural communities where broadband Internet services are currently deployed. Small businesses that locate in these communities can use the Internet to sell products far beyond traditional geographic boundaries. The presence of high-speed connections permits more cost-effective and efficient processing of large volumes of transactions than can be achieved with slower dial-up services. This means that "connected" businesses can expand their markets; and, as they do, these businesses can grow and add jobs.

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[10] For one example of telemedicine applications, see the Center for Telehealth at the University of Georgia, Augusta, GA at http://www.mcg.edu/telehealth.

[11] This view is presented in the press, government and rural organization. For examples, see "Wireless Broadband Can Keep Small Companies Competitive," *USAToday*, posted August. 20, 2003, at www.usatoday.com/tech/news/techinnovations/2003-08-20-wifi-broadband_x.htm; Jo Min, Balaji Sukhumaran, Siju Varghese, "Internet-Based Economic Development for Rural Communities," U.S. Economic Development Administration, Reviews of Economic Development Literature and Practice: No. 9, 2001; and the Rural Telecommunications Congress' mission statement, which can be found at www.ruraltelecon.org/congress.

There are many ways that high-speed services can benefit small businesses. For example, many manufacturers now require suppliers be capable of Electronic Data Interchange (EDI). As a result, many suppliers need to be connected, as evident from the fact that twenty-one percent ($843 billion) of all manufacturing shipments were purchased using EDI.[12] Being connected can produce savings for businesses. According to one study, high-speed services can aide businesses in saving billions of dollars.[13] Simply put, faster Internet speeds can save time and money for businesses. Also, being connected permits businesses to build web pages that advertise and market their services, provide information to shareholders, and attract potential employees and customers. In fact, the presence of broadband infrastructure in rural communities can serve to develop a pool of online workers, which may attract information-based businesses, such as IT development, software and IT service businesses, as well as back-office telecommunications centers.

As broadband services are deployed and used, demand and supply for various broadband-based applications increases. Furthermore, since many of these applications and services are bandwidth-intensive, as the speed of online services increases, applications will continue to improve and be more extensively used in households and small businesses. In short, the current applications being used are only the beginning of the technical innovation that is sweeping the country, with more to follow as the deployment of broadband services continues.

B. Empirical Evidence of Benefits

1. IT Investment Stimulates Economic Growth

The perception that broadband investment spurs economic growth is, in part, supported by numerous studies showing that (more broadly) IT investment has had

[12] "E-Stats," United States Census Bureau, May 11, 2005, P.1, see www.census.gov/estats. This figure is for the year 2003.

[13] "The Collaborative Commerce Value Statement: A $223 Billion Cost Savings Opportunity Over Six Years, *Module B-to-B Commerce & Applications*, Vol. 6:6, Yankee Group, June 14, 2001.

enormous stimulative effects on the productivity and growth in the economy.[14] Since broadband investment is a component of IT investment, the perception is that broadband investment (by association) produces similar benefits. Before reviewing the handful of studies that make a direct link from broadband investment to economic growth, it is useful to review the more general importance of IT investment to the economy.

There are numerous studies showing an inextricable link between IT investment and the health of the U.S. economy. While total IT manufactured output accounted for a mere two percent of Gross Domestic Product GDP during 1990-1995,[15] IT capital investment contributed to nearly thirty percent of GDP growth for the same period.[16] Thus, IT investment appears to have large stimulative effects, meaning that an increase in IT investment produces a much larger increase in U.S. economic output.

According to a number of studies, IT investment, including investment in broadband networks, has provided an important catalyst for operational efficiency in the U.S. In one such study, Kevin Stiroh showed that industries with higher capital stock in telecommunications and computing equipment experienced higher productivity gains.[17] His conclusion is consistent with other studies. For the period 1989 to 2001, IT-intensive industries experienced a 3.0% increase in productivity, while less IT-intensive industries had productivity growth of only 0.4%. During the recent economic recession, IT-intensive industries experienced a 3.1% improvement in productivity, while less IT-intensive industries had a decline in productivity of –0.3%. Effectively, IT-intensive industries are responsible for *nearly all* of the productivity gains experienced in the

[14] Investments in IT include purchases of communications and computer equipment, as well as software. In terms of industry composition, the broader IT sector includes communications and computer manufacturing and service industries. The total IT sector accounted for $872 billion of Gross Domestic Product (GDP) in the year 2003, or roughly 8% of the total U.S. economy. This figure and the definition of the IT sector are consistent with work produced by the U.S. Department of Commerce. See "Digital Economy: 2003," Department of Commerce, December 2003.

[15] "Digital Economy 2002," Appendix, Table A-3.2, based on the gross product originating for all IT manufacturers.

[16] Dale W. Jorgenson, "Information Technology and the U.S. Economy," Presidential Address to the American Economic Association, New Orleans, January 6, 2001, p. 27.

[17] Kevin J. Stiroh, "Investing in Information Technology: Productivity Payoffs for U.S. Industries," *Current Issues in Economics and Finance*, Federal Reserve Bank of New York, 7:6, June 2001.

economy in recent years.[18] Another study estimated that IT investment was responsible for 40% of the growth in total factor productivity and 68% of the accelerated growth in labor productivity.[19] Since IT manufacturing prices have fallen relative to the prices of other goods and services, the IT sector has been credited with reducing overall inflation by as much as one percent per year.[20]

Because IT investment has led to increased economic activity, it has created many new well-paying jobs. On average, IT jobs pay more than double ($73,800) the wages of other private sector jobs ($35,000).[21] In a recent issue of the *Occupational Outlook Handbook*, the Bureau of Labor Statistics projects eight of the nine fastest growing occupations to be in the IT sector.[22] These jobs were in programming and Internet-related occupations. In addition, the creation of IT jobs can have large spillover effects into other industries. For example, one report estimated that every Microsoft job leads to the creation of 6.7 other jobs.[23] From these statistics, it appears that growth in IT and Internet related industries have become an important source of job growth and real wage increases for the U.S. economy.

2. Broadband Investments Stimulate Economic Growth

Consistent with the general conclusion that IT investment spurs economic growth and productivity, a handful of studies have made a direct link between broadband investment and consumer benefits. According to one study by Crandall and Jackson, the ubiquitous deployment of broadband services would create $500 billion of consumer

[18] *Digital Economy 2003*, Economics and Statistics Administration, U.S. Department of Commerce, Dec. 2003.
[19] Stephen D. Oliner and Daniel E. Sichel, "The Resurgence of Growth in the Late 1990s: Is Information Technology the Story?" *Journal of Economic Perspectives*, 14:4, Fall 2000, pp. 3-22.
[20] Estimates have varied over the years. See *The Emerging Digital Economy II*, United States Department of Commerce, June 2000; and *Digital Economy*, United States Department of Commerce, (Various years).
[21] *Digital Economy 2002*, Chapter 5, p. 41.
[22] Occupational Outlook Handbook: 2002-2003 Edition, Bureau of Labor Statistics, Washington, DC, Chapter on Tomorrow's Jobs, Chart 8.
[23] Michael Mandel, "The New Business Cycle," *BusinessWeek*, March 31, 1997; and "The New Economy," The Keystone Spirit: Putting Technology to Work at sites.state.pa.us/PA_Exec/DCED/tech21/b-neweconomy.htm. These sources report the multiplier effects for the general economy to be 1.5 to 2.0.

benefits.[24] The study's authors predict benefits from e-commerce, entertainment, telecommuting, telephone services and telemedicine, as well as other areas. Two studies estimated that a ubiquitous deployment of broadband services would create 1.2 million new jobs, both direct to building and maintaining a broadband network as well as spillover effects into other industries.[25] In terms of investment, one of these studies reported that for every one million dollars of broadband investment, eighteen new jobs are created in the economy.[26] Another one of these studies estimated that every worker employed in manufacturing and constructing a broadband network produces 4.1 other workers elsewhere in the economy.[27] Thus, a number of studies have concluded that spurring broadband investment can have sizable multiplier effects, far beyond the direct effects of broadband investment.

The precision of these study results should be accepted cautiously, since these results are very sensitive to modeling assumptions. For example, if the economy were near full employment, investments that create jobs would lead to competing resources across industries. Therefore, what may seem to stimulate economic growth may actually lead to wage inflation and higher production costs. Similarly, these study results are dependent upon an assumption about the extent to which broadband investments substitute capital for labor. To highlight this variability, a recent study assumed that broadband deployment would result in very high productivity gains, and thus create only

[24] Robert W. Crandall and Charles L. Jackson, "The $500 Billion Opportunity: The Potential Economic Benefit of Widespread Diffusion of Broadband Internet Access," Criterion Economics, L.L.C., July 2001.
[25] This result was reported in two independent studies using different methodologies, see Stephen Pociask, "Building a Nationwide Broadband Network: Speeding Job Growth," TeleNomic Research, Herndon, VA, February 25, 2002; and Robert W. Crandall, Charles L. Jackson and Hal J. Singer, "The Effect of Ubiquitous Broadband Adoption on Investment, Jobs and the U.S. Economy, Criterion Economics for the New Millennium Research Council, September 2003. The former study by Pociask assumed deployment of passive optical network, capable of far exceeding today's broadband speeds, while the later study by Crandall et. al. assumed a mix of high-speed technologies over the next twenty years. A *direct* effect in the deployment and maintenance of broadband technologies is likely to produce *indirect* (spillover) effects in the industry as well as in other industries. The relation between the direct effect and the total effect (direct and indirect) is sometime referred to as the multiplier effect, and is usually used in the context of economic output, investment and employment.
[26] This was the assumption used by Crandall, Jackson and Singer, 2003, p.14. They based their assumption on data from Bureau of Economic Analysis' Regional Input-Output Modeling System, specifically citing multiplier for telecommunications apparatus (17.2278) and communications equipment (18.9885) investment.
[27] Stephen Pociask, "Building a Nationwide Broadband Network: Speeding Job Growth," TeleNomic Research, released by the New Millennium Research Council, Washington, DC, February 25, 2002.

212,000 direct and indirect jobs, while producing a massive $634 billion in economic output.[28] Assumptions about the adoption of broadband services, mix of broadband services, and the years needed to fully deploy networks can also have a substantial effect on estimates of broadband benefits. However, while the exact size of these potential broadband benefits is debatable, numerous studies agree that broadband deployment would yield large economic benefits to consumers (such as small businesses) and the general economy.[29]

[28] Thomas W. Hazlett, Coleman Bazelon, John Rutledge and Deborah Allen Hewitt, "Sending the Right Signals: Promoting Competition Through Telecommunications Reform," A Report to the U.S. Chamber of Commerce, Washington, DC, September 22, 2004. The authors are from the Manhattan Institute, Analysis Group, Rutledge Capital and the College of William and Mary, respectively.

[29] For two more examples, see "The Economic and Social Benefits of Broadband Deployment," Telecommunications Industry Association, Arlington, VA, October 2003; and Wayne T. Brough, "State Economies Can Benefit from Broadband Deployment," Issue Analysis, Citizens for a Sound Economy, Washington, DC, December 1, 2003.

III. Lagging Broadband Deployment

Based on the general perspective that broadband services create economic benefits and given the emphasis the Telecommunications Act of 1996 put on timely broadband deployment, a review of the state of deployment and use of broadband services is warranted and expected to provide a useful assessment of whether benefits are reaching rural small businesses.

Compared to urban areas, the general consensus is that rural broadband deployment has been slow, leaving many consumers and small businesses without high-speed access to Internet services. This view is supported by government reports, which found a disparity among demographic groups, a disparity sometimes referred to as the *digital divide*.[30] Specifically, these reports found that rural and less affluent communities were not using broadband services as extensively as urban and more affluent communities. Another government report found that "rural areas are currently lagging far behind urban areas in broadband availability."[31]

Does a rural digital divide exist? FCC data provide a good starting point for addressing this question as it pertains to the total broadband market. The FCC data are collected from broadband providers having more than 250 lines (or wireless channels) in any state.[32] The data are collected biannually, making it suitable for time series analysis. The data also break services down into type of broadband service, such as cable modem versus digital subscriber line service, and by geographic area. In its latest report, the FCC reported 37.9 million high-speed lines as of December 31, 2004, growing 34% since December 31, 2003.[33]

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[30] "Falling Through the Net: A Survey of the *Have Nots* in Rural and Urban American." U.S. Department of Commerce, National Telecommunications and Information Administration (NTIA), July 1996; and "Falling Through the Net: Toward Digital Inclusion: A Report on America's Access to Technology Tools," U.S. Department of Commerce, NTIA, October 2000.

[31] "Advanced Telecommunications in Rural America: The Challenge of Bringing Broadband Services to All Americans," jointly produced by the United States Department of Commerce, NTIA, and the United States Department of Agriculture, Rural Development and Rural Utilities, April 2000, p. ii.

[32] The FCC will soon be requiring all broadband providers to report, according to "High-Speed Services for Internet Access: Status as of December 31, 2004" FCC, July 2005, p. 1, fn. 4.

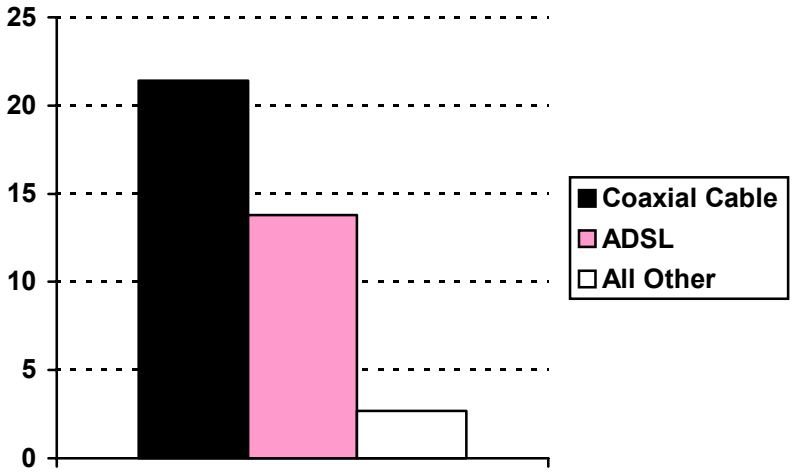
[33] Ibid., Table 1. In this instance, the FCC defines a *high-speed line* as capable of transmitting over 200 kilobits per second in at least one direction. Table 2 shows that 28.9 million lines are capable of meeting that transmission speed in both directions, a definition that the FCC refers to as *advance service lines*.

The FCC does estimate the number of high-speed lines that are (collectively) used by consumers and small businesses.[34] When counting consumer and small business high-speed lines, the FCC counts only lines associated with residential broadband service, which underreports those firms subscribing to small business broadband services. Based on this imprecise calculation, the FCC reports that 35.3 million high-speed lines are provided to residential and small businesses, but it reports no separate estimate for the small business market. **Figure 1** (below) shows the FCC's estimate of residential and small business high-speed lines by type of technology and indicates that coaxial cable, followed by ADSL, account for most of the broadband services in use today.[35]

Figure 1:

Residential and Small Business High-Speed Lines

(Type of Technology in Millions)



Source: FCC, Table 1.

[34] Ibid., p. 3, fn. 8.

[35] Ibid, Table 3. ADSL stands for asymmetric digital subscriber lines, a broadband technology that typically provides much higher download speeds than upload speeds. The technology category *all other* includes the less common symmetric DSL, T-1, satellite, other wireless, fiber, and powerline high-speed data services. T-1 and T-3 lines are telephone facilities that provide dedicated point-to-point transmission, usually at a much higher price than mass market broadband services, such as cable modem and DSL services.

While the FCC does not collect information on how many lines are provided to small businesses, it does collect ample data to estimate the disparity of broadband services between urban and rural areas based on population density.[36] **Figure 2** shows that as population density decreases, the availability of broadband services to consumers decreases, albeit modestly.[37]

Figure 2:

High-Speed Service Availability by Population Density
(As of December 31, 2004)

Population Per Sq. Mile	% Population in Zip Codes Served by High-Speed Services
Greater than 3,147	100.0%
947-3147	99.9%
268-947	100.0%
118-268	99.8%
67-118	99.7%
41-67	99.3%
25-41	98.5%
15-25	96.8%
6-15	95.0%
Less than 6	91.8%

Source: FCC, Table 14.

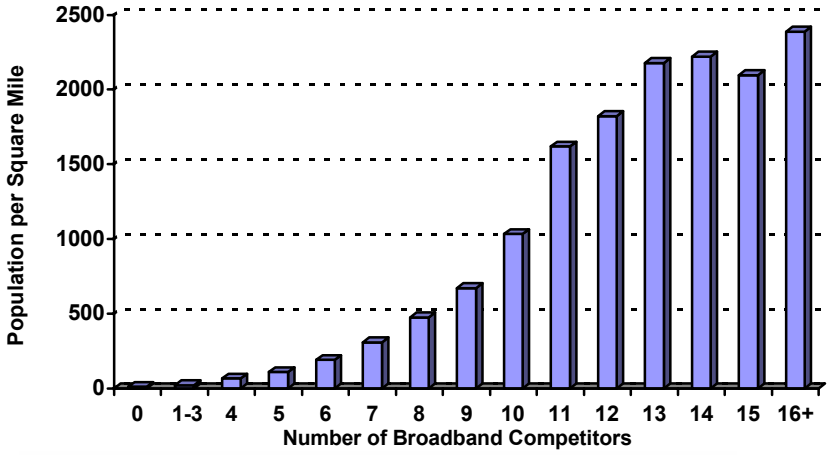
The FCC concludes, "High population density has a positive association with reports that high-speed subscribers are present, and low population density has an inverse association."[38] This conclusion is consistent with the explanation that rural areas are

[36] The FCC collects data from broadband providers in every zip code where they serve at least one customer, even if the provider's network is unable to serve all customers in that zip code area. Zip code data can be matched to demographic information, thereby permitting an analysis of population density (population per square mile), income, number of broadband providers and other characteristics.
[37] Ibid, Table 14.
[38] Ibid., p. 5.

more costly to serve and that higher costs serves as a deterrent for investment in rural high-speed services.

If, in fact, investment and demand is weaker in rural markets, then there should be fewer competitors in these markets. Using an FCC's file *Zip Codes by Number of High Speed Service Providers*, covering data for the period December 31, 2003, and matching these data to a U.S. Census Bureau zip code file containing estimates of population and square miles, the FCC data can be depicted to show a much stronger influence between broadband deployment and density, based on the number of broadband service providers.[39] **Figure 3** shows that the number of providers operating in a zip code declines as average population density within zip codes falls. Therefore, consumers living in low-density markets have fewer choices among broadband providers.

Figure 3: Population Density



Source: FCC and Census, compiled by TeleNomic Research.

Thus, the FCC data shows a strong disparity in the number of competitors between urban and rural areas, confirming the existence of a rural digital divide. However, it is not clear from the data whether high deployment costs or a lack of broadband demand (or both) are responsible for fewer broadband competitors and the

[39] The FCC zip code data can be found at www.fcc.gov/wcb/stats.

lower availability of broadband services in rural areas. Moreover, there is a lack of public information on how the rural digital divide affects small businesses.

IV. A Survey of Small Business Broadband Use

Under contract with the Small Business Administration's Office of Advocacy (referred to in this study as *SBAOA*), 458 small businesses were surveyed and information was collected on the spending and use of telecommunications services.[40] The survey collected information on firm size, industry and spending on telecommunications services, including broadband services. Since non-metropolitan areas are generally defined as rural areas, and since the survey asked respondents if their businesses were located in metropolitan or non-metropolitan areas, the survey provides data for analyzing small business broadband use in rural areas.[41] The survey results represent a snapshot of spending and use by small business perceptions covering the period from September to October 2003.

A. General Review of Survey Results

While small businesses are often defined as businesses having fewer than 500 employees, most small businesses have very few employees. For instance, the survey estimated the average small business to have less than nine employees, with nearly one-third of small businesses reporting one employee or less.[42] The survey results showed wide variation in telecommunications expenditures by industry and firm size. The results showed that small businesses averaged $543 per month in spending on all telecommunications services, including $42.24 per month for high-speed Internet services.[43] Cable modem services (26%) and DSL (21%) were most often used by small businesses, while high-speed satellite (4%), wireless broadband (3%) and T-1 (4%) services were less commonly used.[44] Whether it is DSL, cable modem, T-1, satellite or other wireless high-speed service, when combined, 48% of small business used some form of broadband service, an indication that some small businesses may be using

[40] "A Survey of Small Businesses' Telecommunications Use and Spending," Stephen Pociask, TeleNomic Research for the Office of Advocacy, Small Business Administration Contract No. SBA-HQ-02-M-0493, Washington, DC, March 2004 available at http://www.sba.gov/advo/research/rs236tot.pdf. The survey's sample was representative of the population of small businesses and the sample's size was sufficiently large, providing reasonable confidence in its results.
[41] With some exceptions at the fringe, the U.S. Census Bureau defines rural areas as those not belonging to metropolitan areas.
[42] Pociask, 2004, p.7.
[43] Ibid. p. 10.
[44] Ibid, p. 69.

multiple forms of broadband services at the same time.[45] The survey also reported that 3.3% of small businesses used VoIP services.[46]

Of those responding to the survey, 247 (57%) small businesses reported their business to be in a metropolitan area, while 185 (43%) reported their business to be in a non-metropolitan (rural) area.[47] The survey showed that, because small businesses in metropolitan areas had more employees, they (on average) demand and spend more on telecommunication services.[48]

This study seeks to go behind these descriptive statistics and better understand the effects of the rural digital divide on small businesses. Since the SBAOA study results have been compiled into a database, statistical analyses of the data can be performed in order to test a number of hypotheses on the nature of rural broadband use by small businesses. These tests will be discussed in the sections to follow.

B. Does the Rural Digital Divide Apply to Small Businesses?

The FCC data demonstrates that rural consumers use broadband services less frequently than urban consumers do. While this may suggest that small businesses face a similar fate in rural communities, the FCC data provides no direct evidence to validate this point. However, using the SBAOA survey results, the hypothesis that rural small businesses subscribe to broadband services less frequently than urban small business can be tested.

Based on the SBAOA survey results, **Figure 4** shows the number of small businesses reporting their use of broadband services in urban and rural areas, compared to those small businesses not using broadband services in those areas.[49] This analysis shows that nearly half of small businesses (202 of 410 firms in the sample or 49%) use

[45] Ibid, p. 71. Of those small businesses responding to the question on geographic location, 49% used broadband services.
[46] Ibid, p. 68.
[47] Ibid.
[48] Ibid, p. 71.
[49] Again, urban and rural are defined as metropolitan and non-metropolitan areas, respectively.

broadband services of some kind. In urban areas, 54% (125 of 232 firms) use broadband services, while in rural areas only 43% (77 of 178 firms or 43%) use broadband services, according to the survey results. Therefore, urban small businesses appear to be more likely to use broadband services, compared to rural small businesses. In this data set, rural broadband subscription would have to increase by 25% to close the gap between urban and rural small business take-rates. This is consistent with the hypothesis that broadband services are less frequently used by small businesses located in rural areas.

In order to test whether this result could have happened by mere chance, a Chi-square test was used to measure if the difference in urban and rural broadband use is significantly different.[50] As **Figure 4** shows the Chi-square value is relatively high, indicating a statistically significant difference between urban and rural broadband use. Therefore, the null hypothesis is rejected – namely, that broadband use by small businesses is statistically the same in rural and urban areas. This result agrees with common perceptions that rural broadband deployment and use, in fact, lags urban deployment and use. However, it is not clear whether the shortfall in subscription is due to demand-side issues, supply-side issues, or both.

Figure 4: The Number of Small Businesses Reporting Broadband Use in Rural and Urban Areas

	Broadband	No Broadband	Total
Rural	77	101	178
Urban	125	107	232
Total	202	208	410

Chi-square = 4.55
P-value = 3.3%

[50] If the Chi-square value equals or exceeds 3.841, then rural small businesses use of broadband services is significantly less than urban small businesses (at the 5% level of significance). The P-value shows the probability that the result may have occurred by chance.

C. Does the Rural Digital Divide Impede VoIP Use?

The shortfall in broadband use by rural small businesses can have consequences on the availability of IP-based services by small businesses. Recall that the SBAOA survey found that 3.3% of small businesses used VoIP services in 2003. These Internet-based telephone services are a new, fast growing and often offer a lower cost alternative to traditional voice telephone services. When used over a broadband connection, the quality of VoIP services is similar to traditional telephone services. Since broadband services are less often used by small businesses in rural areas, it must also be that small businesses use VoIP less frequently in rural areas. Again, this is a testable hypothesis. As **Figure 5** shows, not one of the surveyed small businesses in rural areas reported VoIP use, while thirteen small businesses in urban areas reported VoIP use. The resulting Chi-Squared value is high, indicating that the rural and urban differences are statistically significant.[51]

Figure 5: The Number of Small Businesses Reporting VoIP Use in Rural and Urban Areas

	VoIP	No VoIP	Total
Rural	0	178	178
Urban	13	201	214
Total	13	379	392

Chi-square = 11.18 Yates' correction = 9.37
Critical level = 0.1% Critical level = 0.2%

[51] Because one of the cells in the contingency table is less than 5, a Yates' correction for continuity was calculated. This more conservative result also supports the hypothesis.

This result shows that, just as broadband services are less prevalent in rural areas, VoIP services are less prevalent in rural areas. Therefore, some rural small businesses are missing the potential savings from VoIP service use.[52]

In summary, the survey results indicate that rural small businesses are less likely to subscribe to broadband services than their rural counterparts. This finding is consistent with FCC data for the broader broadband user market. However, these results provide no insight as to whether there is lagging demand by rural small businesses.

[52] VoIP services are not always cost-effective for consumers. For instance, a small business may incur more costs to switch to VoIP, if that requires buying a high-speed connection. Therefore, potential savings are more likely to benefit existing broadband users and will depend on individual calling and usage patterns by small businesses.

V. What Causes the Rural Digital Divide?

The previous section showed that rural small businesses are less likely to use broadband services, confirming the presence of a rural digital divide. This section will discuss two broad explanations for the digital divide, notably *demand-side* and *supply-side factors*.

A. Demand-Side Factors

It is possible that rural small businesses may not demand broadband with the same vigor as urban consumers do. If consumers do not subscribe to broadband services out of their own choice, it is not clear what role public policies should take to encourage broadband subscribers.

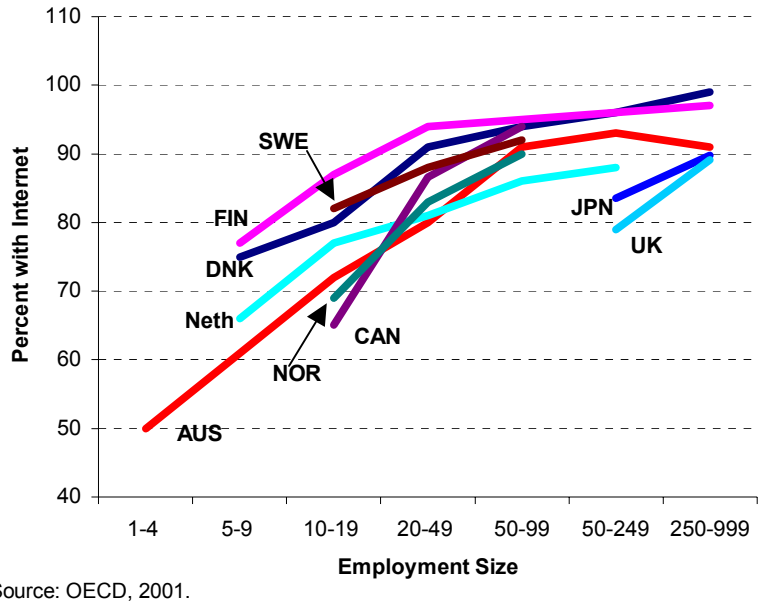
One demand-side factor that may contribute to lower broadband penetration in rural areas is firm size. Larger firms tend to buy more broadband services than smaller firms, everything else being equal. This is supported by the SBAOA survey report, which showed that small businesses that use broadband services spent more on these services when they had more employees. For instance, small businesses with 0 to 4 employees spent $45.74 per month for cable modem services and $47.57 per month for DSL services, while small businesses with 5 to 9 employees spent $69.99 per month for cable modem services and $68.78 per month for DSL services.[53] Larger firms, those with 10 to 499 employees, spent more in general because they are more apt to purchase T-1 services – dedicated data services that average $720 per month.[54]

International statistics on small businesses from the Organization for Economic Co-operation and Development (OECD) show that larger firms (those with more employees) tend to use online services.[55] As **Figure 6** shows, larger firms are more

[53] Pociask, 2004, Tables 32-34. For each employee size category, these averages include only small businesses subscribing to broadband services.
[54] Ibid.
[55] "OECD Science, Technology and Industry Scoreboard 2001 – Towards a Knowledge-Based Economy," Organization for Economic Co-operation and Development (OECD), Paris, 2001, section B.5.3 (Internet Access by Enterprise Size and Industry).

likely to have Internet access than smaller firms.[56] Unfortunately, small business data for U.S. is not available in the OECD data. However, the SBAOA survey can provide some data on U.S. firms.

Figure 6: Business Internet Access



Source: OECD, 2001.

The SBAOA survey indicates that rural small businesses have, in fact, fewer employees (on average) than urban small businesses.[57] Specifically, the survey results show that rural small businesses averaged 5.4 employees, while urban businesses averaged 11.3 employees.[58] This may reflect the fact that rural small businesses are serving smaller scale markets. Therefore, urban small businesses, by virtue of the fact that they tend to be larger than rural small businesses, are more likely to have Internet access, subscribe to broadband services, and spend more on broadband services.

[56] Ibid. The OECD data comes from the ITC database for July 2001. Finland's largest employment grouping includes firms with 250 or more employees, Netherlands' largest reported employment groups ranges from 50 to 199 employees, Japan's largest employment grouping ranges from 300 to 499 employees, and Canada's smallest employment grouping includes firms with 1 to 19 employees. Data for these countries also can be downloaded at http://www1.oecd.org/publications/e-book/92-2001-04-1-2987/gB-5-3-a.htm.

[57] Pociask, p. 8 and Tables 10 - 11.

[58] This figure was compiled from a recent tabulation of the survey results.

Another demand-side reason is that demographic and cultural characteristics may account for differences in broadband demand between urban and rural areas. If residential broadband customers are less likely to want broadband services, then small businesses may not see as much benefit in using high-speed services to communicate and sell to their customers. Before comparing the demographic characteristics between urban and rural areas, it is helpful to understand the underlying demographics of Internet and broadband users.

Figure 7 shows the results of a U.S. Department of Commerce report, which provides evidence that broadband users tend to be younger, more educated and wealthier individuals.[59] This finding is consistent with data on Internet users.[60] Therefore, broadband and Internet usage varies by market demographics.

Figure 7: Demographic Characteristics of Broadband Users

Family Income	% Broadband Households
Less than $15,000	7.5%
$15,000 - $24,999	9.3%
$25,000 - $34,999	13.4%
$35,000 - $49,999	19.0%
$50,000- 74,999	27.9%
$75,000 and above	45.4%

Age Group	% Broadband Households
18 to 24	7.5%
25 to 49	25.9%
50 and above	25.5%

Head of Household	% Broadband Households
Less than High School	5.9%
High School / GED	14.5%
Some College	23.7%
Bachelor's Degree	34.8%
Beyond Bachelors' Degree	39.0%

Source: "A Nation Online: Entering the Broadband Age," Department of Commerce, September 2004, pp. A-1 to A-3. Data for October 2003.

[59] The demographic data in this paragraph comes from "A Nation Online: Entering the Broadband Age," Department of Commerce, September 2004, pp. A-1 to A-3. Data for October 2003.
[60] Demographic data for online users is available from the Pew Internet & American Life Project and can be downloaded at http://www.pewinternet.org/.

Just as the Department of Commerce report finds broadband users to be younger, more educated and wealthier individuals, data from the U.S. Census Bureau finds urban consumers to be younger, more educated, and wealthier. According to the data, metro area median family income was $52,754, while non-metro area median family income was $40,490.[61] In terms of age, U.S. Census Bureau data report the percent of population aged 65 and above to be 11.8% in metro areas, compared to 15.9% in non-metro areas. People living in metro areas are less likely to have finished only high school education (18.7% versus 23.3%) and more likely to have at least a college degree (26.6% versus 15.4%), compared to people living in non-metro areas. If consumers are less likely go online and use broadband services, small businesses have less incentive to sell their wares online or communicate with their customers online.

Therefore, firm size and demographics can explain, in part, why broadband demand lags in rural communities.

B. Supply-Side Factors

The more common explanation for the disparity of broadband deployment between urban and rural communities is that rural broadband networks are much more costly to deploy, because rural areas have lower population density, longer loop lengths and sometimes have more rugged terrain.[62] It is suggested that high deployment costs discourage broadband investment and, as a result, the availability of broadband services to residential and small business customers in rural areas. Because transport costs can be high in rural areas, small businesses and residential consumers would likely pay higher prices for broadband services than their urban counterparts, which would have a dampening effect on the demand for broadband services in rural areas. In short, there are two supply-side explanations for why rural customers are not using broadband services as

[61] The data in this paragraph come from the *Census 2000*, FS-1 data set, Profile of Selected Economic Characteristics: 2000, Table DP-1, U.S. Census Bureau, Washington, DC.

[62] Loop length refers to the distance from the customer to a point of network concentration, such as a server, node, router, switch or hub. There are many studies that demonstrate the stark increase in telecommunications costs for rural carriers. For a broadband cost study, see Victor Glass, "NECA Rural Broadband Cost Study: Summary of Results," National Exchange Carrier Association (NECA), June 21, 2000.

readily as urban customers – (first) broadband carriers avoid investing in high-cost areas and (second) higher costs lead to higher consumer prices, which suppresses demand.

Broadband services may be more costly to deploy in rural areas, because some broadband costs (investments and operating expenses) are negatively correlated with density. For instance, in the case of DSL services, as the length of the DSL copper loop increases (the distance from the customer to a centralized hub or remote terminal), the speed of the high-speed service quickly decreases and the quality of service deteriorates. This means that serving rural areas can be more costly, since networks require more remote terminals in order to shorten loop lengths and maintain service quality. In addition, transporting aggregated traffic from the local broadband network provider to an Internet backbone provider is another expense that is very distance sensitive. Finally, since rural areas have lower population density, having fewer customers to ride on a network requiring extensive capital investment will logically increase network costs per subscriber, making network costs volume sensitive. The increase in network costs facing rural broadband providers will, in turn, put pressure on these providers to increase high-speed Internet service prices. If rural areas are more costly to serve, then rural small businesses could face higher broadband prices. Furthermore, because high-cost areas are less attractive to serve, some competitors avoid entering these markets. Fewer competitors may result in higher market prices.

The SBAOA survey does not provide adequate information to know the availability of broadband providers in rural areas. It does, however, have information on use and expenditures. A recent tabulation of the SBAOA survey results provides estimates of the average price paid by small businesses.[63] **Figure 8** (on the next page) summarizes this tabulation and shows that metropolitan areas (labeled as *metro*) pay more on average for high-speed services. However, this is because the larger urban

[63] Since urban small businesses tend to have more employees, a comparison of average price is more appropriate than average expenditures.

businesses are more apt to purchase expensive T1 services.[64] When we eliminate T1 services from the mix, the survey results show that rural small business pay 9.9% more for broadband services, predominantly from purchasing cable modem and DSL services. Based on these survey results, rural small businesses pay more for their broadband services than their urban counterparts do.[65]

Figure 8:

Average Monthly Broadband Prices
(Number of Connections Sampled in Parenthesis)

	Metro	Non-Metro	% Difference
Cable	**$33.70 (43)**	**$44.70 (33)**	**32.6%**
DSL	**$52.13 (45)**	**$57.85 (19)**	**11.0%**
All Services Without T1	**$43.76 (95)**	**$48.11 (64)**	**9.9%**
All Services With T1	**$87.66 (103)**	**$51.54 (68)**	**-41.2%**

Source: SBAOA survey results, see fn. 65 regarding a potential discrepancy in reported non-metro T1 prices.

If the price of broadband services is higher in rural communities than the price of broadband services in urban communities, then some rural consumers may be shunning the service based on price. This is because broadband services seem to be *price elastic*,

[64] It should be noted that these survey results rely on the ability of the firm to self-identify the type of broadband service and its monthly price. There appears to be two instances where a T1 line in a non-metropolitan area was priced below $50 per month, raising the strong possibility that some respondents believed incorrectly that they were using a T1 service. This study makes no attempt to second-guess the accuracy of the survey responses.

[65] This analysis makes no attempt to control for the quality or speed of the broadband connection, or whether small businesses are using residential or businesses high-speed connections. There is a high likelihood that work-at-home businesses are paying lower priced residential rates.

meaning that consumer demand for the service is easily affected by changes in price.[66] That means that a small percentage change increase in broadband price would produce a greater percentage change decrease in broadband demand. How sensitive is broadband demand to changes in price? Kridel, Rappoport and Taylor developed a demand equation for cable modem services using a large data set and concluded that a 1% decrease in price would yield an increase between 1.1% and 1.8% in cable modem subscriptions.[67] Another study found both cable and DSL services to be similarly elastic.[68] Later work by Kridel, Rappoport, Taylor and Duff-Demo concluded that the price elasticity for broadband services was econometrically measured to be –1.5,[69] meaning if rural broadband prices are 9.9% higher (as shown in **Figure 8**), then the demand by rural small businesses should be 14.9% lower.[70] Therefore, there appears to be some evidence that prices affect rural small business use of broadband services.

Unlike the demand-side, the role of public policies in addressing supply-side problems has taken the form of policies that encourage the widespread availability of affordable broadband services. Federal, state and local government, as well as private organizations, have established a number of subsidies and grants, designed for the sole purpose of encouraging broadband deployment in rural areas.[71] However, despite these incentives the conclusion that rural communities "are being left behind" persists in the media,"[72] as well as in the academic literature.[73]

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[66] If services are said to be *price inelastic*, the opposite is true – an increase in price leads to a smaller (in terms of percent) decrease in demand.
[67] Don Kridel, Paul Rappoport and Lester Taylor, "The Demand for High-Speed Access to the Internet: The Case of Cable Modems," presented at the Thirteenth Biennial Conference of the International Telecommunications Society, Buenos Aires, Argentina, July 2000.
[68] J. Gregory Sidak, Robert W. Crandall and Hal J. Singer, "The Empirical Case Against Asymmetric Regulation of Broadband Internet Access," *Berkeley Technology Law Journal*, Vol. 17, No. 3, summary 2002.
[69] Paul Rappoport, Don Kridel, Lester Taylor and Kevin Duffy-Demo, "Residential Demand for Access to the Internet," University of Arizona Working Paper, Spring 2001, Table 10.
[70] Assuming similar elasticities prevail in both settings.
[71] A list of some of these programs and grants can be found in the **Appendix** of this study.
[72] Erik Stetson, "Rural Broadband in Economic Spotlight," *Associated Press*, AP Alert, January 18, 2005.
[73] For example, see Sharon Strover, "The Prospects for Broadband Deployment in Rural America," *Government Information Quarterly*, Vol. 20:2, 2003, pp. 95-106.

VI. Conclusions

This study has cited numerous studies and examples showing the benefits of broadband services. Various studies have concluded that broadband investment and services create jobs, increase productivity and economic output, and hold down inflation. This study investigates a common belief that there exists a rural digital divide and that rural consumers are not benefiting from broadband services and investment. Based on the evidence presented in this study, there does, in fact, appear to be a digital divide – namely, rural small businesses use broadband services less than urban small businesses. There are several reasons for this rural digital divide unveiled in this report. The demographic characteristics of rural households appear to be somewhat older, less wealthy and less educated than urban households – factors that appear to correlate with less online and broadband usage. While, intuitively, it may follow that small businesses will use online services less when their customers are less likely to use these services, the extent and importance of this demographic link is not clear and needs further research. What is clear, however, is that rural small businesses tend to have fewer employees, which correlates with lower broadband and online usage. As a result, the lack of demand explains the lower rollout of broadband services in rural communities. Some small businesses are choosing not to subscribe to broadband services.

There also seem to be supply-side reasons that explain why rural small businesses are using broadband services less than urban small businesses. If rural areas are more costly to serve, then broadband service prices may be correspondingly higher priced and some areas may be underserved. This study finds some evidence that small businesses are paying higher prices for broadband services, compared with urban small businesses. The result of higher prices means that demand in rural communities is curtailed.

In summary, there appears to be both supply-side and demand-side effects influencing the deployment and use of broadband services in rural communities. More work is needed to quantify these effects. Future work should consider controlling for the quality and the speed of the service. Also, since there tends to be less broadband competition in rural areas, future work should also consider the effects that competition

and rural subsidies can have in influencing prices and investment. A better understanding of these supply-side and demand-side effects would be helpful determining whether public policies a re needed to encourage broadband adoption in order to speed the benefits of broadband services to rural consumers, including small businesses.