ANALYSIS GROUP
ECONOMIC, FINANCIAL and STRATEGY CONSULTANTS

Early Evidence Suggests Gigabit Broadband Drives GDP

David Sosa
Principal

EXECUTIVE SUMMARY

Over the past 20 years the Internet has been an economic catalyst, enabling productivity growth, facilitating innovation, creating jobs and raising incomes in the U.S. and around the world. Numerous studies have documented the benefits of the first transformative leap in Internet connectivity speeds, as "always on" broadband was deployed, replacing dial-up Internet. At the dawn of the next generation of Internet connectivity, we investigate whether the deployment of gigabit broadband, which represents a 100-fold increase in throughput speeds for households and small businesses, can be expected to produce economic benefits similar to the previous transition from dial-up to "always on" broadband. Although gigabit broadband is in its infancy, we have an initial opportunity to empirically examine the relationship between availability of gigabit broadband services and economic activity at the community level. Our study suggests that communities where gigabit broadband was widely available enjoyed higher GDP, relative to similar communities where gigabit broadband was not widely available. The 14 communities with widely available gigabit broadband that we studied enjoyed over $1 billion in additional GDP when gigabit broadband became widely available, relative to communities where gigabit broadband was not widely available.

INTRODUCTION

Beginning in the late 1990s, Internet connectivity was transformed by disruptive broadband technologies – "always on" DSL and cable modem services – which dramatically increased throughput speeds relative to dial-up connections. As consumers and small businesses adopted these first generation broadband services, the improved broadband connectivity to the Internet facilitated the development of new inventions, new and improved goods and services, new processes, new business models, and has increased competitiveness and flexibility in the economy. More generally, broadband has demonstrated the ability to fundamentally change how and where economic activity is organized.

Many studies have quantified the benefits to consumers and economies from the initial deployment of broadband networks and adoption of high speed broadband connections by businesses and consumers. These studies have evaluated the effect of current broadband offerings on a range of economic metrics, including consumer surplus, employment and GDP. As policymakers have shifted to focus on the next generation of connectivity – gigabit broadband – advocates of the technology have argued that the introduction of the transformative general purpose technology will provide a significant contribution to economic growth and competition, similar to the previous generation of broadband. However, some skeptics have argued that the expected incremental benefits of the next generation of broadband may be overstated.

Although gigabit broadband is in its infancy, we have an initial opportunity to empirically examine the relationship between availability of gigabit broadband services and economic activity at the community level. In this report, we describe the results of this initial study. Our initial results suggest incremental economic benefits from widely available gigabit broadband on the order of an additional 1.1 percent GDP, which are consistent with the measured economic benefits from the introduction of first generation broadband technologies.

BACKGROUND

With the advent of broadband services in the second half of the 1990s, economists and policy analysts began a decade-long examination of the economic benefits of high-speed Internet connectivity. In one of the first comprehensive studies, Crandall & Jackson (2003) examined the economic benefits of broadband. They hypothesized that the deployment of first generation broadband Internet connections would facilitate continued improvements in information technology, with significant positive effects on the economy, including lower input costs, increased labor productivity, and new and more efficient production processes. Their study concludes that the long run benefits of first generation broadband services may be a one percent or higher increment to GDP.[1] Following Crandall & Jackson, other researchers have also investigated the economic benefits of first generation broadband. Lehr, Gillett, Sirbu & Osorio

[1] Robert Crandall & Charles Jackson, "The $500 Billion Opportunity: The Potential Economic Benefit of Widespread Diffusion of Broadband Internet Access," in: Shampine, A.L. (ed.), Down to the Wire: Studies in the Diffusion and Regulation of Telecommunications Technologies (2003) Haupauge, NY: Nova Science Press.

(2005) concluded that communities with broadband experienced faster job and firm growth, and realized higher market rates for rental housing (a proxy for property values) than non-broadband communities.[2] Ford and Koutsky (2006) also examined the impact the introduction of first generation broadband had on economic activity. They concluded that broadband is likely to be a significant contributor to economic growth, based on evidence that economic growth doubled in a Florida city after an extensive broadband network was installed.[3] Crandall, Lehr & Litan (2007) also studied the effects of broadband on both output and employment. They concluded that broadband increased private employment by 0.2 to 0.3 percent per year and that broadband has had a positive impact on GDP as well.[4] The OECD (2007) has noted additional evidence from several firm-level studies for various OECD countries, including Sweden and the U.K., of the economic benefits of broadband.[5]

GIGABIT BROADBAND

According to Akamai's State of the Internet Report, at the end of 2013, American consumers experienced average broadband speeds of 10 Mbps and average peak speeds of 44 Mbps. However, among all industrialized nations, the U.S. ranked 10th in both performance categories; average speed was 50 percent of the first-ranked country (South Korea) and average peak speed was 65 percent of the first-ranked country (Hong Kong).[6] Over the past several years, new services using fiber-to-the-home (FTTH) technology that offers speeds up to 1,000 Mbps (gigabit) have been deployed in several communities across the U.S. These services, which represent the next generation of broadband, deliver Internet speeds more than 100 times faster than what is available today to most Americans. These dramatically higher speeds allow users to access higher quality data intensive services and will enable the next generation of new technologies.

As broadband has become an important factor in economic growth and job creation, the quality of broadband services, including availability and throughput speeds, has become a major topic of discussion. As discussed earlier, the benefits of previous waves of Internet connectivity have been well documented. The evidence of a 'broadband bonus' in the macroeconomic statistics has been shown by numerous researchers in the transition from dial-up Internet to first generation "always on" broadband. Now we are faced with the question of the macroeconomic impact of the deployment of optical fiber and gigabit connections. An open question is "do we really need a hundredfold increase in Internet connectivity?" Gigabit skeptics posit that there appears to be a declining return to additional bandwidth. Gigabit advocates make the opposite case: gigabit

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[2] Sharon Gillett, William Lehr, Carlos Osorio & Marvin Sirbu, "Measuring Broadband's Economic Impact," *Broadband Properties*, vol. 24, no. 12, 2006.
[3] George Ford & Thomas Koutsky, "Broadband and Economic Development: A Municipal Case Study from Florida," *Review of Urban and Regional Development Studies*, Vol. 17, 2006.
[4] Robert Crandall, William Lehr & Robert Litan, "The Effects of Broadband Deployment on Output and Employment: A Cross-sectional Analysis of U.S. Data," *Issues in Economic Policy*, Vol. 6, 2007.
[5] OECD, "Broadband and the Economy," Ministerial Background Report DSTI/ICCP/IE(2007)3/FINAL.
[6] David Belson (2014), Q4 2013 Executive Summary, Akamai's State of the Internet, Vol. 6, No.4, <http://www.akamai.com/dl/akamai/akamai-soti-q413-exec-summary.pdf >

broadband will allow the development and deployment of high-value applications which cannot be delivered in any other way, suggesting additional bandwidth carries considerable returns.

Past studies have framed the analysis of economic benefits from broadband in two categories: direct benefits from infrastructure investment and direct consumer expenditures on broadband services; and indirect benefits such as cost savings, productivity gains and incremental economic activity from new products and services facilitated by broadband.[7] Although it is very early in the development of gigabit services, we expect that to the extent there are economic benefits from the next generation of broadband connectivity, these benefits will be realized in similar patterns as first generation broadband. We would expect to see direct benefits realized in the near term and indirect benefits as gigabit broadband becomes more widespread and widely adopted. In this brief, we report the results of a study of several U.S. communities where gigabit broadband services have recently become widely available.

DATA AND METHODOLOGY

For this study we have constructed a panel dataset of metropolitan statistical area (MSA) level economic data obtained from the National Telecommunication and Information Administration (NTIA), the Bureau of Economic Analysis (BEA), and the Bureau of Labor Statistics (BLS). NTIA provides data about the percentage of homes passed by broadband service providers offering gigabit broadband. We used the NTIA data to identify MSAs in which more than 50 percent of households have access to gigabit broadband in the years 2011 and 2012. Then, we matched this data with the 2011 and 2012 GDP per capita and unemployment data provided by the BEA and BLS to analyze the relationship between the availability of gigabit broadband and output at the MSA level.

This unique dataset allowed us to examine whether MSAs with high levels of gigabit broadband availability enjoyed higher GDP per capita than other similar communities where gigabit broadband was not widely available. In other words, do we find evidence that gigabit broadband has a positive impact on economic activity? We focused our analysis on 14 MSAs, in nine states, in which more than 50 percent of households have access to gigabit broadband service (see Table 1 below). On average, 70 percent of households in these 14 communities had access to gigabit broadband in 2012.

We compared these MSAs to 41 other similarly sized MSAs in the same nine states. Gigabit broadband was not widely available in the 41 communities in the control group. On average, only one percent of households in these communities had access to gigabit broadband. By limiting the dataset to geographically proximate MSAs we obtained a control group of MSAs that are more comparable to the MSAs with high gigabit broadband availability. Similarly, we further limited our sample to MSAs with populations of less than one million.

[7] International Telecommunications Union (ITU) & United Nations Educational, Scientific and Cultural Organization (UNESCO), Broadband: A Platform for Progress (June 2011).

The dataset that we created allowed us to analyze the variation in the GDP per capita across MSAs and over the period 2011-2012. There are numerous factors that affect GDP per capita, and differences in these factors across MSAs and over time will drive variation in GDP per capita. However, it is difficult to observe or accurately measure many of these factors. We use a year and MSA fixed effects regression model to control for these unobserved, time-invariant MSA-specific GDP drivers, such as industry mix, geography or resource endowments, and MSA-invariant year-specific GDP drivers. Therefore, the results that we provide about the impact of gigabit broadband on GDP control for MSA and year specific effects.

RESULTS

In order to measure the economic impact of gigabit connection we examined economic output in relation to unemployment, MSA and year fixed effects, and whether or not gigabit broadband was widely available. If the widespread availability of gigabit broadband speeds (defined as more than 50 percent of households have access to gigabit services) has a positive impact on economic activity we should observe higher output levels in areas that adopted gigabit broadband.

Using a fixed effects panel data regression model that controls for idiosyncratic differences across MSAs and over time, we found that in MSAs where gigabit broadband service was introduced between 2011 and 2012, GDP per capita levels were significantly higher. More specifically, our model suggests that for the MSAs with widely available gigabit services, the per capita GDP is approximately 1.1 percent higher than in MSAs with little to no availability of gigabit services. These results suggest that the 14 gigabit broadband communities in our study enjoyed approximately $1.4 billion in additional GDP when gigabit broadband became widely available. Extending the results to the 41 MSAs in our study that did not have widely available gigabit broadband suggests foregone GDP in 2012 of as much as $3.3 billion.

Regression Results

	Dependent Variable (GDP per capita)
Gigabit Broadband Availability Greater Than 50%	0.011*
	(0.007)
Unemployment	-0.005
	(0.007)
Observations	110
R^2	0.142
F Statistic	2.857**
	(df = 2, 52)

Note: *p<0.1; **p<0.05; ***p<0.01

CONCLUSION

Beginning in 2011, the NTIA has published statistics on the availability of gigabit broadband. These data have allowed us to conduct one of the first empirical studies of the benefits of next generation Internet connectivity on economic activity. Looking at 14 communities in nine states, we conclude that next generation broadband is likely to have a substantial impact on economic output and, consequently, consumer welfare. These gains are likely due to numerous factors, including the direct effect of infrastructure investment and increased expenditures, as well as early shifts in economic activity (e.g., job creation and occupational changes) and productivity gains. For example, recent reporting on gigabit broadband service in Chattanooga, Tennessee has attributed 1,000 new jobs, increased investment, and "a new population of computer programmers, entrepreneurs and investors" to gigabit broadband.[8] As more communities adopt gigabit broadband and the economy adapts to this new technology, economists will be able to extend the research on the economic impact of gigabit broadband.

[8] Edward Wyatt, "Fast Internet Is Chattanooga's New Locomotive," *New York Times* (February 3, 2014)

Table 1

	Metropolitan Statistical Areas (MSA)	
	Household Access to Gigabit Broadband Services	
State	**< 50%**	**> 50%**
Alabama / Georgia / Tennessee	Anniston-Oxford-Jacksonville, AL Auburn-Opelika, AL Decatur, AL Dothan, AL Florence-Muscle Shoals, AL Gadsden, AL Huntsville, AL Montgomery, AL Tuscaloosa, AL Albany, GA Athens-Clarke County, GA Augusta-Richmond County, GA-SC Brunswick, GA Columbus, GA-AL Dalton, GA Gainesville, GA Hinesville-Fort Stewart , GA Macon, GA Rome, GA Savannah, GA Valdosta, GA Warner Robins, GA Clarksville, TN-KY Cleveland, TN Jackson, TN Johnson City, TN Kingsport-Bristol-Bristol, TN-VA Knoxville, TN Morristown, TN	Mobile, AL Chattanooga, TN-GA
Minnesota / North Dakota / South Dakota	Duluth, MN-WI La Crosse-Onalaska, WI-MN Mankato-North Mankato, MN Rochester, MN St. Cloud, MN	Fargo, ND-MN Bismarck, ND Grand Forks, ND-MN Rapid City, SD Sioux Falls, SD
Oregon	Albany, OR Grants Pass, OR	Bend-Redmond, OR Corvallis, OR Eugene-Springfield, OR Medford, OR Salem, OR
Utah	Logan, UT-ID Ogden-Clearfield, UT Provo-Orem, UT	St. George, UT
Connecticut	New Haven-Milford, CT Norwich-New London, CT	Bridgeport-Stamford-Norwalk, CT