# Broadband Research Roundup

New research shows how critical broadband is to economic health and reveals some mechanisms by which broadband affects growth.

## Raising Broadband Speed Boosts Economic Growth

If broadband is good, is faster broadband better?

This question – unanswered until now – lies at the heart of many debates about broadband policy. Users demand faster broadband than providers or governments think will be economically justified. Providers are reluctant to undertake upgrades whose costs they may not recoup. Governments often focus on making lowest-common-denominator broadband more widely available.

In the last two years, survey research has shown that broadband *speed* – not just availability – influences business location decisions. (See "Big Broadband Is Needed, Say Development Officials" and "High-Speed Networks Attract Commercial Tenants" in this issue.) However, statistical research quantifying the effects of broadband speed on income has been lacking.

This year, equipment supplier Ericsson collaborated with management consulting firm Arthur D. Little (ADL) and the Chalmers University of Technology in Gothenburg, Sweden, on the first major econometric study to address the effect of broadband speed on economic growth. In a report published in September 2011, the researchers concluded that increases in broadband speeds have contributed significantly to economic growth.

Economic development officials and property owners often think about growth in competitive terms. They aim to attract or retain businesses that would otherwise locate elsewhere. A gain for one city, business park or commercial property is assumed to represent a loss for another one.

*Increasing broadband speed creates entirely new economic opportunities. The gain from increased broadband speed is not necessarily offset by a loss somewhere else.*

However, the Ericsson study found that increasing broadband speed benefits an *entire* economy – in this case, the combined economy of all 33 countries in the Organization for Economic Co-operation and Development (OECD). In other words, the gain from increased broadband speed was not necessarily offset by a loss somewhere else. Rather, broadband is a true enabler of economic development because it creates entirely new economic opportunities.

### MEASURING THE IMPACT OF SPEED

Last year, Ericsson and ADL worked together on a meta-analysis of 120 studies of the economic impact of broadband penetration. Taking the median result of all those studies, they concluded that, for every 10 percentage point increase in broadband penetration, gross domestic product (GDP) increases by 1 percent.

Their first report garnered a great deal of attention. Because many people who saw the study asked the authors whether broadband speed also affected GDP, Ericsson and ADL decided to analyze the research on this topic as well. According to Erik Almqvist, a director at ADL, they quickly realized there were no studies for them to analyze – because the necessary data simply didn't exist. "We realized we were going to need to do the pioneering work," Almqvist says.

By early 2011, enough data about broadband speed had accumulated to make such a study possible, and Ericsson and ADL recruited economists from the Chalmers University to help analyze the data. Using quarterly observations from 2008 to 2010 for each of the 33 OECD countries, they correlated GDP and average broadband speed. To measure broadband speed, they used speed-test data from Ookla, a testing service used by most of the world's ISPs.

Ookla's data reflect actual speeds (rather than advertised speeds) for both residential and business broadband users. The Ookla tests are used on broadband networks of all kinds, both fixed and mobile, from computers, smartphones, tablets and various other devices.

The study found that broadband speed was strongly related to economic

growth. However, economists often remind us that correlation is not causation. Even when two variables move in lockstep, it's hard to know which affects the other – or whether both are affected by a third factor. This issue often arises in discussions of broadband and economic growth. Do broadband speed increases drive economic growth, or do people buy faster broadband because their incomes are rising?

After applying advanced statistical techniques to establish the direction of causality and rule out various sources of bias, the team concluded that broadband speed has a log-linear relationship to GDP – that is, exponential changes in broadband speed produce linear changes in GDP. Specifically, doubling broadband speed increases GDP by 0.3 percent. Though this effect is smaller than the effect of broadband penetration, it is quite large. The long-term average growth rate for the OECD economies is about 3 percent per year, so doubling broadband speed could boost the growth rate by about 10 percent, or $126 billion per year.

## WHAT CAUSES THE IMPACT?

Increasing average broadband speed has three separate effects on economic growth, Almqvist explains. In the short term, upgrading networks to support higher speeds creates a stimulus effect. The stimulus effect, of course, isn't directly related to broadband – any major investment injects money into the economy, and "you could just as well be digging holes in the ground," Almqvist says, paraphrasing Keynes's famous tongue-in-cheek suggestion.

As the stimulus effect begins to wear off, productivity increases appear. Better bandwidth allows businesses to automate more functions and simplify their business processes. Employees can do more work from home and from other remote locations. Households gain better access to such services as education and health.

"Broadband has the power to spur economic growth by creating efficiency for society, businesses and consumers," explains Johan Wibergh, head of business unit networks for Ericsson. "It opens up possibilities for more advanced online services, smarter utility services, telecommuting and telepresence. In health care, for instance, we expect that mobile applications will be used by 500 million people [in 2016]."

Finally, as these productivity increases level off, "induced effects" appear. New companies are founded, and entirely new services that were not envisioned before are created. The economy is reshaped. As Wibergh puts it, "Connectivity and broadband are just a starting point for new ways of innovating, collaborating and socializing." These induced effects are the most sustainable in the long term.

Because the study covered only a three-year period, it could not determine the relative size of the three effects,

though future studies with longer time series may arrive at more definitive conclusions. However, based on the findings of broadband penetration studies, the three effects appear likely to be of roughly comparable size, each accounting for about a third of the observed impact.

### THE BOTTOM LINE FOR POLICY

Two major questions for policymakers:

- Will the relationship between broadband speed and economic growth continue into the future?
- Which will have more impact on economic growth: investing in broadband penetration or in broadband speed?

The answer to the first question appears to be a qualified yes. At least in the short term, further increases in average broadband speeds should continue to spur economic growth. However, the researchers are cautious about extrapolating far into the future or discussing broadband speeds far beyond the averages for the 2008–2010 time period. Almqvist explains that saturation effects may eventually be seen and that the productivity effects of "superfast broadband" such as 1 Gbps speeds are still unknown.

*If penetration rates are low, invest in broadband availability. If penetration rates are high, invest in making broadband faster.*

The answer to the second question is more complicated. The "biggest bang for the buck" will vary depending on the situation. When the broadband penetration rate is low – say, below 50 percent – then making broadband more readily available will have the biggest impact, and speed is secondary.

As penetration rises, speed becomes relatively more important. Once penetration rates are high and the remaining unserved areas are extremely costly to connect to the Internet (the situation in most of the U.S. today), then investing in broadband speed will have a higher payback in terms of economic growth.

Almqvist notes, "Until now, there has been an absence of hard facts [about] the effects of broadband speed on the economy. This unique empirical study may help governments and other decisions makers in society make more correct trade-offs and policy choices."

# Broadband Introduction and Diffusion Drive Economic Growth

In a paper published in the May 2011 Economic Journal, Nina Czernich and others at the University of Munich compared broadband introduction and economic growth across 25 OECD countries. Their preliminary analysis indicated that "after a country has introduced broadband, GDP per capita is on average between 1.9 and 2.5 percent higher than before its introduction." They then compared broadband diffusion across OECD countries and found that as penetration increased, economic activity continued to grow. Each 10 percentage-point increase in the broadband penetration rate was associated with an increase in the annual growth rate of GDP per capita by 0.65 to 0.91 percentage points.

However, the Munich team warns, these associations don't prove whether broadband affected economic growth or economic growth created a demand for broadband. Furthermore, the relation of telecom regulation to both economic growth and broadband penetration might have biased the results. Finally, other important technologies, such as mobile telephones and computers, that were becoming popular at the same time as broadband might have accounted for some of the economic growth.

*Introducing broadband increases per capita GDP; raising penetration causes growth rates to increase.*

To sort out the causality issues, the researchers plotted a broadband adoption curve for each country based solely on supply factors – the preexisting cable and telephony infrastructure and typical diffusion patterns. They found that these predicted curves differed only slightly from actual broadband adoption curves; the differences were due to such factors as state subsidies of broadband or the competitive environment.

By using the preexisting infrastructure (which didn't suffer from the same mixed causality problems) as a proxy for actual broadband deployment, the researchers were able to show that the causation ran from broadband to economic growth and not vice versa – and that such external factors as the diffusion of cellphones were not responsible for income growth.

After taking all these elements into consideration, the researchers showed that broadband's effects on economic growth were even larger than their preliminary estimates indicated. In the final version of the model, they found that introducing broadband in a country raises per capita GDP by 2.7 to 3.9 percent and increasing the broadband penetration rate by 10 percentage points raises the annual growth in per capita GDP by 0.9 to 1.5 percentage points.

# Minnesota Rural 'Brain Gain' Responds to Broadband

Rural economic development can depend as much on attracting residents as on attracting employers. In 2009, researcher Ben Winchester of the EDA Center at the University of Minnesota, Crookston, documented a surprising in-migration to rural Minnesota.

Though young people aged 16 to 29 were still leaving rural areas to seek education and jobs in metropolitan areas (the "brain drain" that worries so many rural advocates), adults in their prime earning years of 35 to 45 were returning in almost equally large numbers to raise children in the slower-paced, more community-oriented environments where they had grown up. These newcomers contributed strongly to their local economies, boosting tax revenues and providing jobs by spending their incomes in their new locations. Because so many of the returnees are college-educated, Winchester called this influx the "brain gain."

The following year, Winchester surveyed returnees, as well as realtors who had helped them relocate, to find out what brought them back and what would help them stay.

In "Regional Recruitment: Strategies to Attract and Retain Newcomers," recently published by the EDA Center, Winchester notes that "brain gain" newcomers have a variety of motivations, including being close to family, escaping the stress of city life and finding affordable housing and land. When they return, some buy farms or businesses or find local jobs. Others telecommute to metropolitan businesses where they previously worked or set up remote offices for those businesses.

One returnee, asked for advice about recruiting more newcomers, said, "You need to promote the telecommuting option … there is so much telecommuting going on that if you can find the ones that want to move here and telecommute, they'll bring in good jobs."

Another said, "Better Internet, too, out here. … If we get that, it would be huge."

The strategies that Winchester suggested for recruiting and retaining the "brain gain" returnees included, among other things, the following:

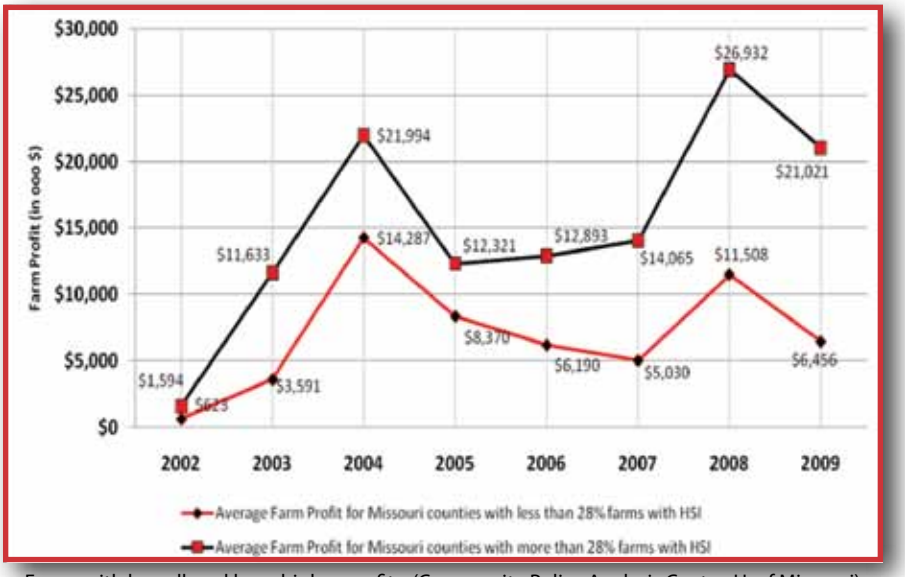
- Provide avenues for potential newcomers to learn more about the region. Although there are tremendous assets, such as the natural amenities and FTTH broadband, it can be difficult for those outside the region to find out about them.
- Build on existing connections to metropolitan businesses that allow skilled employees to telecommute from rural Minnesota.

# Inadequate Broadband Harms Missouri Agriculture

Farming today requires high-speed connectivity. In combination with GPS, broadband allows farmers to practice precision farming, reducing their inputs (water, fertilizer and so forth) and increasing product quality and quantity. Broadband also helps farmers compete in national and global markets.

Traditionally, farmers accessed information about commodity prices, supplies and market trends from radio, television, newspapers and state extension services – sources that were equally accessible no matter how remote their farms. Today, however, a digital divide exists between farmers with and without broadband access; farmers without broadband simply don't have the information they need to operate their farms efficiently.

A recent study by the Community Policy Analysis Center of the University of Missouri found that only 52 percent of farms in Missouri had Internet access – a full 10 percentage points below the national average of 62 percent. What's more, farms in counties where broadband was widely available were considerably more profitable than farms in counties where broadband was less available. This profitability gap has widened over the last decade.




Farms with broadband have higher profits. (Community Policy Analysis Center, U. of Missouri)

The authors call for removing impediments to broadband buildout and for "the development of effective partnerships between the private sector (including providers and users of broadband), governments and not-for-profits."

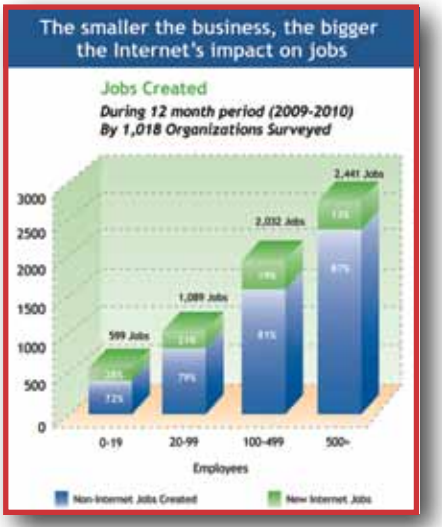
# Bigger Broadband, Bigger Productivity Gains

The greater the Internet speed available to them, the more efficient organizations become, according to research from Strategic Networks Group, an economic research firm based in Ottawa, Canada. The message: Speed matters, regardless of how it is delivered.

The return on investment on e-solutions for improving productivity is 8.9 percent higher for FTTP users than for cable users and 14.2 percent higher for FTTP users than for DSL users. The importance of broadband to FTTP users in adopting new operational processes is 8.1 percent higher than for cable users and 10.3 percent higher than for DSL users. Finally, the importance of broadband to FTTP users in improving staff skills is 14.3 percent higher than for cable users and 14.8 percent higher than for DSL users.

Other recent findings by Strategic Networks Group include the following:

- Nearly one in five new jobs overall, and one in three new jobs in small organizations, can be directly attributed to broadband and e-solutions.
- The smaller the business, the bigger percentage of its new jobs can be directly attributed to broadband and e-solutions.
- In a North Carolina study, more than 30 percent of households ran an Internet-enabled business from the home. The percentage was even higher in rural areas.
- Significant numbers of households and businesses indicated they would move if they could not access the broadband they need. ❖



Source: Strategic Networks Group