

THE FUTURE OF DIGITAL COMMUNICATIONS RESEARCH AND POLICY

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"Prediction is very difficult, especially about the future." – Niels Bohr

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Over the past decade broadband has become nearly ubiquitously available to households and firms throughout the industrialized world. This rapid growth has spurred interest by policymakers and academics in understanding how public policies affect—and hopefully, encourage—investment and adoption. While such knowledge is useful, it is important to recognize that broadband investment and adoption are only *inputs* into societal well-being. We are ultimately interested in *outputs*: how does investment and use affect our standard of living and the economy more broadly?

These questions have become especially timely given recent poor economic growth and high unemployment. In the search for ways to increase economic growth and to "create" jobs, policymakers have identified broadband as a promising policy lever. In particular, they hope that stimulating broadband investment and adoption will accelerate its integration into the economy and translate into economic growth.

Unfortunately, the belief that broadband can address short-term economic concerns has led to a certain degree of incoherence in research and policy discussions about broadband.

First, if broadband is a general purpose technology that has the potential to fundamentally affect the economy, then we must recognize that its benefits will not be distributed evenly. Unfortunately, in the short run some will lose out in a broadband-connected world.

Second, though policy and research has focused almost exclusively on residential broadband, use in the home is unlikely to be the primary driver of productivity improvements and, thus, radical improvements in our standard of living. Instead, it is how new communications technologies affect business that will affect productivity and determine whether those technologies radically reshape the economy.

Finally, if broadband has the potential to fundamentally affect the economy, then those changes are likely to take place over a fairly long time. Even to the extent that such changes have begun, we do not yet know what to measure to capture those changes.

This essay begins by discussing at a broad level whether broadband and digital communications technology in general are likely to fundamentally affect the nature of the economy. The remainder of the essay discusses what those effects may be, where they will originate, and how we should think about measuring them. It concludes with suggestions on how to build a more robust foundation for future research on the economic effects of broadband.

Is broadband a general purpose technology?

At the core of the idea that broadband can enhance economic growth is the belief that the Internet, and broadband in particular, is a General Purpose Technology (GPT). If that is the case then it does indeed have the potential to fundamentally alter the nature of the economy, just as electrification did.

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To some, it may seem self-evident that broadband is a GPT. After all, it is by now cliché to note that broadband affects the way we work and play—that it has become a ubiquitous presence in our day-to-day lives. Pervasiveness is a necessary but not sufficient condition for a technology to truly become a GPT. Bresnahan and Trachtenberg (1995) lay out the full requirements:

“GPTs are characterized by pervasiveness (they are used as inputs by many downstream sectors), inherent potential for technical improvements, and innovational complementarities, meaning that the productivity of R&D in downstream sectors increases as a consequence of innovation in the GPT. Thus, as GPTs improve they spread throughout the economy, bringing about generalized productivity gains.”

Broadband's high commercial penetration rates and large numbers of consumer and business applications make it safe to say that broadband is pervasive. Its rapid increases in quality (e.g., speed), demonstrate its inherent and continuously realized potential for technical improvements. But has broadband access improved innovation in downstream sectors in ways that have brought about generalized productivity gains? Perhaps, but it is not yet possible to convincingly identify generalized productivity gains resulting specifically from the Internet or broadband. This is either because they have not yet happened, or because we do not know what to measure. Thus, almost by definition we cannot yet know whether broadband is truly a GPT. It is probably never possible to know whether any given technology is “general purpose” until decades after its introduction.

For the sake of this essay, however, let's assume that broadband is a GPT, or at least that it will fundamentally affect the economy, as so many people expect it will. Broadband as a GPT would have certain implications that policymakers may not like.

In particular, net improvements for society and the economy do not necessarily mean improvements for everyone. To date, most research on the economic effects of broadband has emphasized “job creation” with little discussion of jobs lost because of broadband.¹

In the long run, technological change increases productivity and economic growth. That's why technological change is so important and why industrialized countries are so much richer today than they were a hundred years ago. But in the short run radical changes can cause economic disruption, as well. The Luddite movement, for example, was a reaction to jobs lost as mechanization introduced in the industrial revolution rendered some occupations irrelevant. Whether the Luddites were merely opposed to change or organized as a means of protecting their jobs, they clearly were threatened by technological changes that ultimately led to vast increases in productivity and wealth.

Similarly, today we see opposition to certain uses of information technologies, though not generally to the technologies themselves. For example, digital communications technologies have made labor outsourcing more efficient. The resulting surge in help desks and data processing centers outside of the U.S. probably is good for productivity but has become a perennial political issue because people believe outsourcing has contributed to American job losses.

Additionally, as discussed in more detail below, much business-to-consumer e-commerce represents transfers of economic activity from one part of the economy to another. This transfer generates winners and losers. The net economic effect of buying a book from Amazon rather than from your local bookstore may be similar, but Amazon rather than the local bookstore

¹ Two studies (Kolko 2010; Katz 2009) are notable exceptions in that they explicitly incorporate the possibility that broadband can lead to job losses.

benefits from the transaction. The Bureau of Labor Statistics estimates that the number of workers in “book, periodical, and music stores” decreased by nearly 30 percent between 2002 and 2009, compared to a two percent increase in total employment. BLS predicts that between 2008 and 2018 the number of those workers in will decrease by another 12 percent, compared to an eight percent increase in total employment throughout the economy.²

The disruptive aspects of these changes in economic activity are likely to be offset by productivity improvements that ultimately contribute to new economic growth. While it is inherently difficult to identify and measure indirect effects, we at least need to be looking in the right place. The next section discusses why we should be looking harder at business use than at residential use to find economic effects.

Economic growth will flow primarily from business, not residential, use

When Robert Solow famously quipped that “You can see the computer age everywhere but in the productivity statistics” in 1987, he implicitly acknowledged that productivity improvements come from business use of computers. Yet, today, policymakers appear to hope that home broadband access will spur economic growth, and that it will do so quickly.

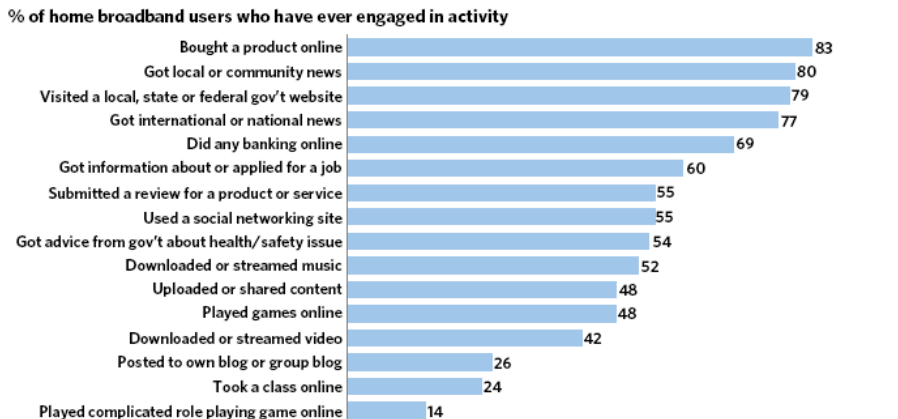
Today's focus on residential broadband is understandable. Politicians have a taste for populist themes and want to bring benefits to their constituents, both of which appear consistent with promoting residential broadband. The focus is also consistent with our historical policy focus on residential telecommunications access, often funded through implicit cross-subsidies from business, in part to achieve social equity goals. Researchers, meanwhile, want to answer relevant policy questions. To do so they need data, which are more readily available for residential broadband than for business broadband. These factors create an incentive to investigate empirical links between residential broadband and economic growth.

To be sure, additional investment in residential broadband would require materials and labor that the economy would not have otherwise consumed had the investment not occurred. This is especially true if unemployment is high and credit markets are not working as smoothly as they typically do. The broader economic effects that might flow from such investment, however, are more difficult to estimate. One problem was discussed above—it is not realistic to expect to be able to measure macroeconomic effects of broadband on employment and economic growth yet. A second problem is that no direct conceptual reason exists why residential broadband connections would have large effects on net economic activity.

Residential connections are used primarily for personal communication, shopping, and consuming news and entertainment (Figure 1). These activities largely represent transfers of economic activity rather than net new economic activity. Much of business-to-consumer ecommerce, for example, reflects a shift in economic activity from “brick and mortar” to online retail rather than new economic activity, as the changes in bookstore employment discussed above illustrates.

² [ftp://ftp.bls.gov/pub/special.requests/ep/ind-occ.matrix/occ_xls/occ_41-2031.xls](http://ftp.bls.gov/pub/special.requests/ep/ind-occ.matrix/occ_xls/occ_41-2031.xls)

Figure 1



Source: National Broadband Plan, Exhibit 3-B.

Even activities that did not exist before widespread broadband—like massively multiplayer online games such as World of Warcraft—represent economic transfers. The time spent playing those games comes from time no longer spent in some other activity, probably another type of entertainment.

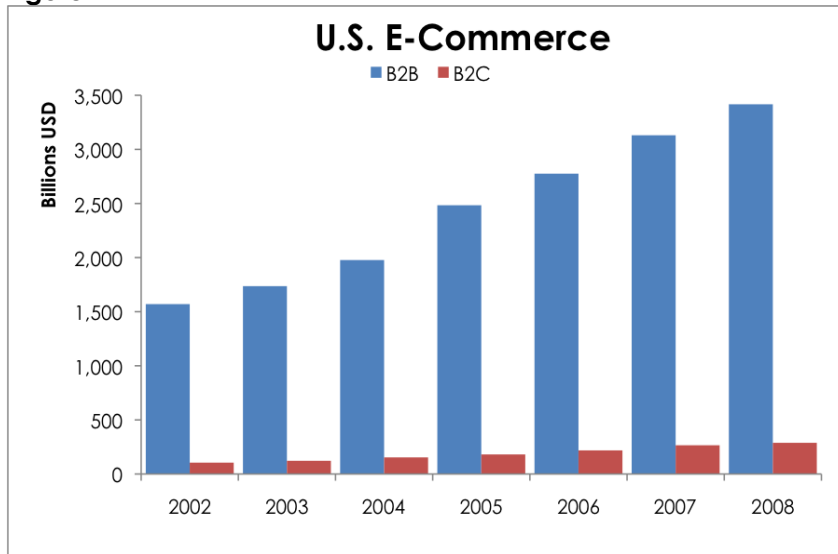
Pointing out that much of residential broadband activity involves economic transfers does not imply that it has no net economic value. If people prefer engaging in activities online instead of those same or different activities offline, then those new activities must have at least some incremental value over the activities they replaced. That is, those activities generate new consumer surplus, which is a real economic effect, and would be reflected in increasing willingness to pay for broadband connections.

Rosston, Savage, and Waldman (2010) estimate that consumers are willing to pay about \$80 a month for a fast, reliable broadband connection, which would imply a large amount of consumer surplus at an average price of \$41 per connection (Horrigan 2010) and multiple users per connection. Dutz, Orszag, and Willig (2009) estimate that consumer surplus was about \$32 billion in 2009, up from about \$20 billion in 2005. But this additional consumer surplus, while substantial, is unlikely to have large effects on productivity, and therefore, economic growth over time.

To be sure, other benefits may ultimately flow from residential broadband. Telecommuting, for example, has the potential to reduce resources society consumes, such as those used physically commuting.

Nevertheless, how digital communications technologies change business production processes will determine whether these new technologies will have transformative economic effects. In fact, the direct economic effects of business use dwarf residential use. Figure 2 shows e-commerce revenues for business-to-consumer (B2C) and business-to-business (B2B) transactions. The figure shows that while B2C revenues reached almost \$300 billion in 2008, they were an order of magnitude less than B2B revenues of about \$3.4 trillion. In short, how business incorporates digital communications technologies will have a much bigger effect on our standard of living over the next 20 years than will whether we reach 70 percent household broadband penetration in six months or in a year.

Figure 2



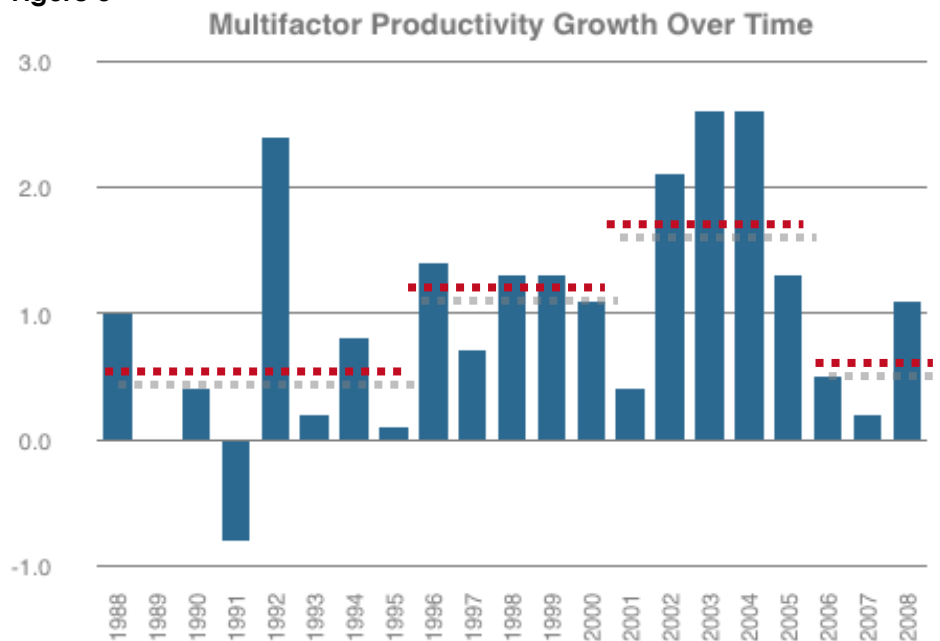
Source: Derived from U.S. Census <http://www.census.gov/econ/estats/2008/2008tables.html>

Identifying a likely pathway for broadband to increase economic growth, however, is not the same as measuring those changes. The next section discusses those measurement challenges.

We cannot measure the most important effects of radical new technologies in the short run

If one believes that broadband has large, positive macro-economic effects that can already be measured, then some recent indicators present something of a puzzle. In particular, productivity growth surged between 2001 and 2004, but then fell back to lower levels (Figure 3). Jorgenson, Ho, and Stiroh (2004) explain that much of the growth beginning in the mid-1990s came from the production and, in particular, use of information technology by businesses. The recent decline begs the question, why would productivity growth retreat just as this transformative technology became widespread?

Figure 3



One possibility is that broadband, and new digital communications technologies in general, simply do not have large economic effects, while computerization did. But that seems unlikely. Instead, as Paul David (1990) noted when discussing the productivity paradox of the 1980s—the apparent lack of a productivity effect of business computerization—it is not realistic for us to even expect to be able to measure such effects in the early days of a new technology that turns out to be revolutionary.

Some economic effects are well-defined and can therefore be measured rigorously. Greenstein and McDevitt (2009) estimate that the upgrade from dialup to broadband residential Internet access generated about \$10 billion annually to GDP. This number is big, but is probably dwarfed by the indirect effects—changes in economic activity and behavior that result from the presence of these technologies.

Those externalities are exceedingly difficult to measure, even assuming we knew what to measure. The measurement problem is probably exacerbated in the business sector. It takes time for firms to figure out how to incorporate such technologies into their production processes in meaningful ways. Additionally, we do not yet know what to measure since, almost by definition, a revolutionary technology creates goods and services that we have not yet incorporated into our national statistics.

Accurately measuring the economic effects of broadband use will therefore require a timeline longer than is in the interest of most politicians. Nevertheless, if we believe that broadband and digital communications technologies will have the effect of a GPT, then it is important to focus on ways of measuring those effects.

Research should focus on business and on fixing national income accounts

Scholars studying the economic effects of broadband should focus on microeconomic effects, which are more likely to be identifiable and measurable, in order to establish conceptual and tested pathways from micro to macro effects.

I do not claim that these are original observations. Some scholars, such as Erik Brynjolfsson of MIT, have spent years studying business IT and have identified key ways in which IT does and does not improve productivity.³ Others, like Dale Jorgenson of Harvard, Steve Landefeld of the U.S. Bureau of Economic Analysis, and others are working on modifying national statistics to better capture the effects of new technology.⁴ Their efforts represent rigorous, incremental steps in the difficult process of identifying and measuring the economic significance of digital communications on the economy.

The disconnect is that while some scholars and government officials are carefully evaluating how to go about properly measuring the effects of new technologies on the economy, other policymakers are not willing to wait for this solid data foundation to be built. It may be unrealistic to expect politicians to embrace the long view, but serious researchers and others who want to understand and foster the digital economy should recognize the need for an empirical and conceptual foundation. Until we have it, we should be wary about strong statements on the macroeconomic effects of broadband.

³ See, for example, Brynjolfsson and Hitt (2000, 2003) and Brynjolfsson (2010).

⁴ See, for example, Jorgenson (2008), and materials presented at a 2009 session of the American Economics Association annual conference on the "New Architecture for U.S. National Accounts:" <http://www.bea.gov/about/director.htm>.

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