

SCHOLARS' ROUNDTABLE:
THE EFFECTS OF EXPANDING
BROADBAND TO RURAL AREAS



A b o u t t h e C e n t e r f o r R u r a l S t r a t e g i e s

The Center for Rural Strategies seeks to improve economic and social conditions for communities in the countryside and around the world through the creative and innovative use of media and communications. By presenting accurate and compelling portraits of rural lives and cultures, we hope to deepen public debate and create a national environment in which positive change for rural communities can occur.

Rural Strategies helps communities and nonprofit organizations incorporate media and communications into their work in support of strategic goals. We also design and implement information campaigns that educate the public about the problems and opportunities that exist in contemporary rural communities.

Rural Strategies publishes the Daily Yonder (www.dailyyonder.com), coordinates the Rural Broadband Policy Group, is a founding member of the Rural Development Philanthropy Collaborative, and is managing partner of the National Rural Assembly.

A c k n o w l e d g m e n t s

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INTRODUCTION :

*Scholars discuss what we can
expect from our investments
in rural broadband*

This forum conversation occurred in December and January of 2009–2010. The impetus for the dialogue was twofold: First, in 2009, the Obama Administration made major commitments through its programs at NTIA and the Rural Utilities Service (RUS) to enhance broadband for populations lacking adequate service; second, as a nation we continue to debate whether the market will, in fact, deliver adequate Internet services and whether government investment is required. With the recent mid-term elections and the prospect of renewed scrutiny of federal investments, the significance of the following conversation is greater than ever.

Four leading experts participated in the forum, responding both to one other and to moderated questions regarding broadband investment in the U.S., especially with respect to rural regions. The participants include: Shane Greenstein, Elinor and Wendell Hobbs Professor of Management and Strategy at the Kellogg School of Management, Northwestern University; Ken Flamm, Dean Rusk Chair in International Affairs, University of Texas at Austin; Amy Glasmeier, Department of Urban Studies and Planning Department Head, MIT; and Bill Lehr, with the MIT Research Program on Internet & Telecoms Convergence, MIT, all well-respected scholars whose work on the economic and social impacts of broadband is frequently cited in academic and policy essays and the popular press. The moderator was Sharon Strover, Philip G. Warner Professor of Communication and director of the Telecommunications and Information Policy Institute, who recently worked with the Broadband Initiatives Program at the Rural Utility Services program and who also has written on telecommunications in rural regions.

About the Participants



Kenneth Flamm is a professor and the Dean Rusk Chair in International Affairs at the Lyndon B. Johnson School of Public Affairs in the University of Texas at Austin. An economist, Flamm specializes in international trade, the high technology industry, and technology policy. In addition to his work in academia, Flamm has served as the senior official charged with supervising international R&D programs and dual use technology policy in the United States Defense Department, and as a Senior Fellow at the Brookings Institution.



Amy Glasmeier is head of the Department of Urban Studies and Planning in the School of Architecture at the Massachusetts Institute of Technology. A specialist in economic geography and the spatial implications of poverty, Glasmeier's work often focuses on the intersections between rural America, technology, and public policy.



Shane Greenstein is a Professor of Management and Strategy in the Kellogg School of Management at Northwestern University. Greenstein brings his economic training to bear on the business economics of computing, telecommunications, and Internet infrastructure. His interests and research span a wide range of telecommunications-related areas, from technical matters—such as the adoption of client-server systems—to the industrial economics of platform adoption, and macro-analyses of communications policy.



William Lehr is a research associate in the Computer Science and Artificial Intelligence Laboratory at the Massachusetts Institute of Technology. Lehr's academic work focuses on the economic and regulatory policies guiding Internet infrastructure industries; outside of academia, he provides various consulting services for information technology firms.



Sharon Strover is the Philip G. Warner Regents Professor in Communication at the University of Texas. Strover brings social science training to issues of economic development impacts of telecommunications. Also, she has done extensive research on rural populations in the Appalachian region and Texas, as well as in other parts of the country. In 2010 she assisted the Rural Utilities Service in the Department of Agriculture with implementing the Broadband Initiatives Program.

EXECUTIVE SUMMARY

Expanding broadband to rural areas

By Sharon Strover

“While broadband will not bring immediate economic transformation to rural America, regions that lack broadband will be crippled.”

-Sharon Strover

Communications technologies have enormous consequences even though most of them go unrealized when those technologies are young. No one would have anticipated that Facebook or Twitter might one day figure in revolutions, just as no one could have anticipated that the telegraph would catalyze both the standardization of time keeping in the U.S. as well as the creation of national economic markets. So, too, we are now in the midst of a national debate – indeed, an international debate – around the impact of broadband networks. This topic is central to the current administration’s efforts to expand access to broadband, especially in rural regions that have lacked fast access to the Internet. Broadband’s importance undergirds the more than \$7 billion in federal stimulus funds dedicated to broadband programs in 2009–2010 as well as the high speed wireless initiative that promises to bring 4G services to most of the country. Critics of these measures wonder exactly what broadband yields, and especially whether external jolts to broadband infrastructure, such as the stimulus investment, are justified. A look at what broadband provides to rural regions is necessary to understand the need for large scale investments.

Rural communities will be economically crippled without broadband access.

One major conclusion of this discussion is that while broadband will not bring immediate economic transformation to rural America, regions that lack broadband will be crippled. Having broadband may not necessarily mean a sharp increase in jobs; however,

not having broadband will probably mean fewer jobs. This paradox exists because Internet connectivity increasingly is necessary for many political, economic and social transactions – in everything from contacting elected representatives to filing insurance papers to keeping up with classes offered at the local community center. Not having access to these mechanisms means being cut off from opportunities and from what are increasingly being defined as normal communication channels. These channels are expected by employers and necessary for job seekers to find job opportunities as well as for businesses to bring goods to market. Having access to broadband, therefore, is simply treading water or keeping up. Not having it means sinking.

By the same token, the regions that could profit the most from broadband in straightforward economic terms probably already have it: businesses that need that connectivity purchased it some time ago, and more economically prosperous regions are also the populous regions where broadband competition developed earliest. Several earlier economic studies demonstrate the positive relationship between broadband and economic productivity, but looking for comparable returns from the most recent round of investment in broadband probably will be disappointing: the regions that now lack broadband are more remote, less populous, and for the most part less prosperous. The job of reaching these communities is not finished.

Diverse rural communities require specific solutions that work best for their unique regions.

The broad term “rural” comprises a diverse collection of places, some close to metro areas, others quite remote, some with extremely small county-based populations and others with populations close to 20,000 in one town alone, and with economic bases that are wildly divergent. This heterogeneity means that one-size-fits-all solutions – even on matters as seemingly straightforward as technology – are untenable. There may be some regions where broadband will nicely boost productivity or create new opportunities. We know, for example, that tourist areas benefit from broadband connectivity because they can offer vacationers the opportunity to stay connected or to continue to work in those locations.

However, fundamentally, regional economic factors predate investments in broadband, and those factors are “in place,” and unlikely to change, whether they are the existence of a certain telecommunications-intensive industry (such as occurs in Silicon

“This means that more investment in broadband availability might increase competition and shift prices down, a potential boon to rural regions.”

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Valley) or the presence of coal or gas deposits. While broadband connectivity usually cannot fundamentally change those underlying regional economic factors, it can play a significant role in enhancing them. The large variation across rural regions also means that different ways of measuring the outcomes attributable to broadband may be in order: better connection speeds may create new ways of doing things, but it is difficult to measure the utility of conducting business or doing anything in a different fashion. We do not have good methods for assessing the “GDP” of a county or for apprehending microlevel economic change. Indeed, much of our conversation has to do with the difficulty of measuring broadband’s contributions. While this technology is not the sea change that electricity was for rural regions, it nevertheless embodies the prospect for profound changes in the future, changes we cannot begin to foresee.

Sharp disparities exist between rural and urban areas, putting rural communities at a disadvantage.

The most recently released statistics (Digital Nation, 2011) show that 68.2% of American households have broadband connections, but a 10% penetration urban-rural disparity still exists. With their less attractive market conditions rural regions have not had robust competition among service providers, and some data suggest that prices are higher in those regions because there is no competition. This means that more investment in broadband availability might increase competition and shift prices down, a potential boon to rural regions.

Effective solutions require considering factors beyond simple short-term job impacts to widen opportunities in rural America.

Even with broadband services, however, U.S. rural regions will compete on the same technological plane as foreign countries that have lower labor costs, so the rapid diffusion of new technological capabilities will not eliminate fundamental competitive disadvantages in labor costs. Our forum suggests that we consider looking for something beyond new jobs as the marker of what broadband means for rural regions. Institutions such as libraries, schools, and health clinics and hospitals have unique roles in developing rural populations’ familiarity with technology and its applications and benefits. One of our commenters points out that rural regions are less adept at technology utilization,

while another emphasizes that those same institutions are the key to the future. E-health, distance education and e-government services are poised to explode in the next decade, and rural communities need to be ready to exploit their value for their environment and livelihood if they are to stay vital and connected.

SCHOLARS' ROUNDTABLE ON RURAL BROADBAND DEPLOYMENT

Sharon Stover: Many people are hopeful that the federal government's \$7 billion investment in improved broadband availability -- allocated through the stimulus program in 2009-2010 -- will catalyze economic activity throughout the country. What does your research suggest would be the likely results of such heightened investments, particularly with regards to America's rural regions?

Shane Greenstein: The effects of broadband depend on many factors, and cannot be easily forecast without first saying a great deal about the setting.

The effect of the historical deployment of broadband earlier in the millennium differs from its deployment today. Let me start with a typical contemporary example: I presume we are discussing a place that does not yet possess any wire-line broadband provider, typically because it is an isolated low-density and low-population area in which satellite coverage provides access to residences.

If this is the setting, then the effect of introducing wire-line broadband will be minimal. The number of users at homes will increase, provided that the price for wire-line service falls below that for satellite. The amount of time spent online at these homes may also increase, especially if the amount of available bandwidth is increased. In the short run, for the first few years, that is about all that can be expected at homes—a little more of the same. That will show up as an increase in traffic levels in both directions.

Stover: Can we expect home use to amount to anything in terms of economic productivity? How about other helpful outcomes such as access to education, medical information, and so forth? Some of our research in Texas revealed the significance of what we called “soft outcomes,” namely the impact of information that would contribute indirectly to better job outcomes by, for example, finding new locations to market one's services or learning something about one's craft (we had an example from a shepherd who learned some new ways to take care of his herd from online sources). For certain populations, using the Internet did not lead immediately to new jobs, but it could make subtle improvements to their lives.

Greenstein: As for changes in business practices, once again, there will be a few

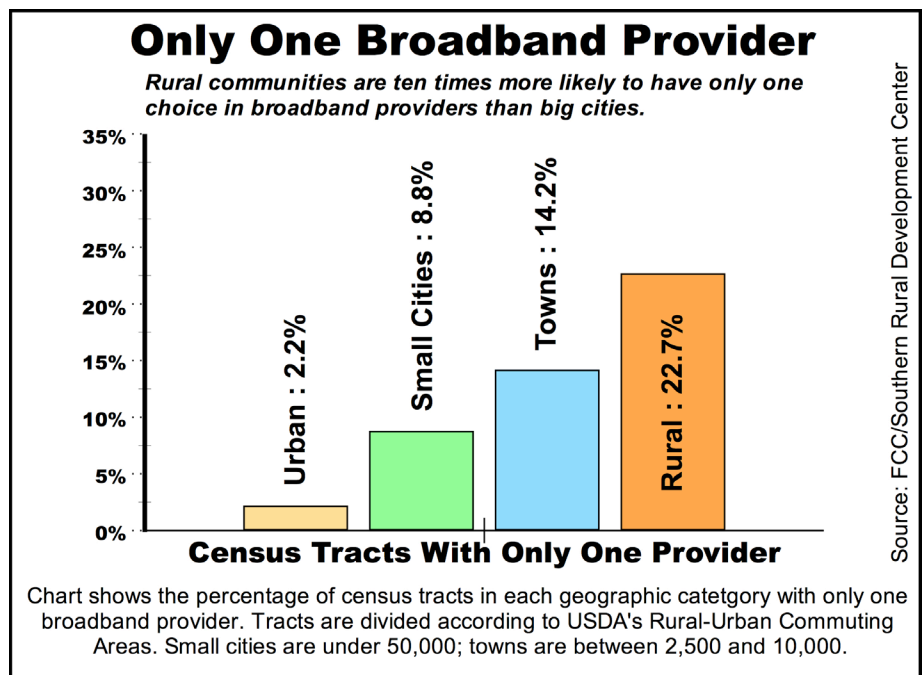
more users—that should show up as a few additional small-establishment users (most big establishments already have wire-line service, even in low density locations). Traffic levels also should increase. As in the prior case, selection bias largely shapes the anticipated result.

Strover: In other words, are you saying that those users who felt they could make improvements by having broadband have generally already made the necessary investments to acquire broadband services?

Greenstein: Businesses that depend on information technology largely avoid being in areas where they cannot get what they need. So, almost by definition, we will be observing the effects of broadband on a population of firms who do not have a high willingness to pay much for it. I would expect to see a bit more of the same, but no dramatic change.

Ken Flamm: At some level, this is an easy question to answer, without even referring to empirical research. Increased investments in any kind of area—rural, urban, or suburban—relative to some baseline scenario with less investment, are going to “shift out” the supply curve for broadband information services, and lower prices for these services relative to a “but-for” world without the additional investment, if there is any kind of competition in service provision.

Strover: So having the government invest in broadband increases supply, but your caveat is interesting since in most rural regions there is not much competition in service provision. Satellite services exist, but the current bandwidth constraints and higher costs bring complaints. Can we really ex-



pect lower prices in rural regions?

Flamm: If demand is completely inelastic with respect to price--i.e., demand for broadband is totally insensitive to price--then the cost of broadband services will decline, but there will be no increase in broadband services consumed, so existing broadband consumers will benefit to some extent, but there would no increase in their numbers.

Note that deciding that something is the result of “heightened investments,” as opposed to its cause, is not easily settled, so I am assuming that the relationship is causal and I am considering the effects of an exogenous shock, like a government program, to broadband investment.

Strover: What do we know about demand elasticity with respect to broadband? Are there any data that might differentiate rural from urban consumers?

Flamm: If there is any kind of demand elasticity with respect to price, as well as some degree of competition in service provision, not only will broadband consumers benefit from lower prices, but there will be additional consumers of broadband services who cross the adoption threshold as the result of lower prices.

Focusing more specifically on the issue of rural areas, the adjective “rural” is not a very precise concept. Typically, empirical studies have taken “rural” to mean “located outside of a metropolitan statistical area,” but this does not capture some heuristic ideas that we hold about what might be rural. For example, there may be “rural” areas, with low population density, agricultural economic activity, etc., within a metropolitan area. Alternatively, there may be areas with high population density, non-agricultural economic activity, etc., outside of the boundaries of metropolitan statistical areas. And there may be areas with low population density, and predominantly agricultural activity within its boundaries, but with a high percentage of the population commuting to an urbanized area (some of the more distant communities now feeding workers into the San Francisco Bay Area come to mind, or even Austin high-tech workers living in nearby Blanco County).

Different definitions of rural are used by the Census Bureau (areas outside of urbanized areas and clusters, based on population density), the USDA [United States De-

partment of Agriculture] (metropolitan areas include areas with a 25% commuter rate to an urbanized area, regardless of population), and the OMB [Office of Management and Budget] (25% of workers commute to urban counties, or 25% of employment in county coming from an outside urbanized county). So employing the OMB or USDA definitions, for example, one could spin scenarios where broadband infrastructure investment in a rural county has very different effects across different types of “rural” counties.

Strover: These different definitions do have a great deal to do with how we assess the “rural” component of broadband outcomes. We can see more on this at the Rural Policy Research Institute (www.rupri.org).

More generally, since we know that competition is reduced in rural regions, what impact might this have on broadband prices?

Flamm: With a monopoly now providing the services to an area, a government subsidy will not necessarily translate into a lower price, and the profits of the monopoly provider might merely increase.

Strover: What sorts of differences should we look for in terms of the impact of more available broadband in rural versus urban regions?

Flamm: There are three sets of studies I have worked which bear on the issue of whether or not rural areas are at an initial disadvantage relative to urban areas. The first set of studies (Chaudhuri, Flamm, & Horrigan, 2005; Flamm & Chaudhuri, 2007) find that holding other household characteristics constant, urban and suburban households have a greater and statistically significant propensity to purchase an internet or broadband service subscription. It is important to note that both sets of studies control for price differences among urban, suburban, and rural areas. (Note that the datasets used in these studies employ an urban/suburban/ rural classification assigned to households by the Pew Internet Project survey on the basis of a telephone respondent’s county.)

A second set of studies (preliminary papers still undergoing revision) estimates the impact of a variety of factors, including rural and urban status, on the availability of broadband within a zip code. Again, rural status (in this case, share of households filing a Schedule F [farm income] tax return) is associated with a statistically significant reduc-

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-Bill Lehr

tion in the probability of broadband availability.

A third study (in process) analyzes the determinants of the Universal Service Fund's eRate program, specifically subsidies going to libraries. Preliminary results indicate that, holding all library characteristics constant, rural libraries receive significantly lower levels of funding from the eRate program than urban libraries. Because a reduced form relationship is being estimated, it is uncertain whether this is due to factors on the demand side (e.g., lower levels of funding being requested, *cet. par.*), or the supply side (e.g., higher service costs for rural libraries, or an urban-biased funding process, *cet. par.*).

All these studies detect some form of rural disadvantage, or negative differential, relative to urban areas, in broadband demand or supply.

Bill Lehr: I agree with Shane on the general matter of broadband's economic impact on small communities. The results from my earlier research found there was a positive impact on jobs and other metrics of economic growth associated with expanded broadband deployment. BUT, that was based on the first generation of broadband deployment and we are not talking about that at this point.

I think the jobs impact (as Jed Kolko's 2010 study for the Public Policy Institute of California points out) associated with future deployments will be more complex and nuanced. As broadband becomes essential infrastructure, it will be taken for granted as a baseline service. Its absence may be associated with a loss of jobs, but its presence may not create jobs. The remaining places that do not have broadband are places that face many more challenges than just a lack of availability, and are not representative of the communities that provided initial evidence of broadband's positive economic impacts.

I also think we will need to be realistic about the different qualities of broadband that we should expect to see in rural and urban settings.

Strover: You are suggesting that certain disadvantages for some rural locations are more or less already in place? Are you saying that technology fixes and digital literacy programs cannot be expected to produce profound changes?

Amy Glasmeier: The issue for rural areas is not whether there is supply, but what governs demand. More technology will be available. More opportunities will emerge for

the use of the technology. While there are places still without technology, nonetheless, my research on Pennsylvania indicates two major concerns: price; and inability or reluctance to use the technology. Making wires available is one step, but this will not guarantee utilization. Education, reductions in the cost of services, and opportunities for learning-by-doing are necessary complements to the availability of the technology.

Strover: Amy, you disagree that no “meaningful” changes can be expected? Perhaps the focus on improving employment statistics does not tell the complete story.

Glasmeier: The human side of broadband utilization should not be underestimated.

There are demographic barriers—age, education, ethnicity—that seriously limit appreciation for, and use of, interconnectivity. For example, we did a study of broadband utilization by health care personnel. We found that doctors over the age of 50 lacked exposure to and the skills required to use telemediated information retrieval. They resisted accessing knowledge through telemediation from specialists, choosing instead to use the telephone for verbal confirmation of treatment. Overall, we found that broadband availability was no longer the problem as 95 percent of the land area had access to some type of broadband service. What remained powerful residual problems were price and utilization.

Strover: Your point on utilization might have interesting repercussions on how important some people believe broadband should be in terms of government investment. A recent Pew Internet survey reports that by a 53%-41% margin, Americans say they do not believe that the spread of affordable broadband should be a major government priority. And contrary to what some might suspect, non-Internet users are less likely than current users to say the government should place a high priority on the spread of high-speed connections. (<http://www.pewinternet.org/Reports/2010/Home-Broadband-2010.aspx>)

If short term outcomes are difficult to assess, what might be the long-term influence of investment in rural broadband infrastructure, specifically in terms of economic and employment conditions in these regions?

“The human side of broadband utilization should not be underestimated. There are demographic barriers—age, education, ethnicity—that seriously limit appreciation for, and use of, interconnectivity.”

- Amy Glasmeier

Greenstein: For most places the long run will be a series of short runs, so for MOST PLACES I would not expect dramatic changes of any sort. Employment levels, wages, establishment size, and the specialization of economic activity should remain roughly in the same place. There is a brutal economic truth behind that forecast. Most economic decisions depend on a multitude of factors, and broadband is but one of many.

Other key determinants of a region's economy include its resource endowments (e.g., being naturally beautiful, endowed with minerals or forest, etc), the quality of its labor force (e.g., well-educated, etc), the specialization of its existing businesses (e.g., ranching, agriculture, tourism, etc., which has been determined over decades), and other facts, such as the nature of the vehicle traffic in the area (e.g., near a major highway or not). The presence or absence of broadband cannot change those factors, and cannot massively change long-term economic trends established over decades (e.g., prevalence of entrepreneurship, loyalty to a region or out-migration of youth, the ability of a regional economy to generate revenue through exporting to other parts of the country).

Strover: What about opportunities to recruit new businesses to rural regions, ideas that often are tied up with improvements in broadband infrastructure? In the 1990's, for example, there was a small boom in recruiting call centers to rural regions that had surplus labor and good telecommunications.

Greenstein: I would NOT expect information technology to help much in economies that depend on call centers or manufacturing, or other activities that depend on improving logistics through use of information technology. I expect this for a simple reason; the same trends that benefit an isolated, low-density location in the US also benefit an isolated location in India, Ireland, and Malaysia, where wages are drastically lower. In short, while things might be getting better, they get better everywhere, and usually not to the comparative advantage of a US location.

Having said all that, I am not a complete pessimist. There is the potential for an exceptional outcome here or there. I would expect that in economic activities which

make intensive use of information technology; hotels and resorts, for example, are big users of information technology. So it would not be surprising if an isolated and beautiful location uses its broadband to find a way to translate the technology to develop new services and attract new tourists, or longer stays among visitors. Agriculture and mining have made use of information technology in the past to become more efficient, and that should be anticipated in this case again. In short, when information technology is highly complementary to the endowment of an area, there might be a bigger response in the long run. But such places should be the exception rather than the rule.

Flamm: I think there is already empirical evidence that Internet and broadband access work as a complement to other inputs in providing more efficient agricultural marketing services in rural areas. There are also obvious complementarities in lowering the cost of access to information and entertainment resources in remote rural areas.

Strover: Some of the new stimulus-funded broadband programs are looking at improving the delivery of health services, and while health care services are complicated and enmeshed with many other organizational systems (especially insurance), it seems to me that a long-term outcome of improved broadband in rural regions could bring some positive developments in terms of healthcare. With rural populations being generally older, and with a large proportion of veterans, the health care motivations to exploit broadband are certainly present.

Flamm: I enumerated a number of the possible long term effects earlier. Some longer term outcomes include induced investment in broadband-using industries and increased employment in broadband-using industries. Improved investments in human capital by households, including both health and education, may be induced by less expensive and more ubiquitous broadband. Cheaper and more widely available broadband may also make markets for labor, capital, and various goods and services work more efficiently.

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- Shane Greenstein

Strover: For rural regions, can you specify which labor, capital, or services you believe broadband could improve?

Lehr: The effects will be complex and long-term. I think the case for broadband has to be based on our view that it is basic infrastructure and so is therefore something we need to ensure is available at a minimal level. Its absence will be a reason for slower growth, poorer economic conditions, lower property values (all else being equal, which is very hard in a world in which most people already have at least first-generation broadband), but its presence will not be a major contributor to economic growth absent complementary investments that would make the enhanced IT infrastructure usable (e.g. smart grids and the lower energy costs associated with them). Note, also, that it is unclear how much broadband is needed to take advantage of things like smart grids.

One long-term effect may be associated with human capital improvements, because broadband may support better access to educational materials. This may not require broadband at home but in libraries and schools, which seems close to universal already.

Strover: That is a good point, although we do know that rural libraries have shorter hours and typically lack the staff that can solve technology problems; when a computer breaks down, it may take several days before a technician from 50 miles away can come and take a look at it. The same is true for many rural schools. In general, computer expertise is less available in rural regions, so relying on these institutions—schools and libraries—cannot come with the same expectations that we bring to those institutions in urban settings.

Glasmeyer: Exactly. Again, this depends on the cost of the technology and its usability. I can speculate about this, but I feel certain rural areas will always be behind in technology. By and large, rural areas have older-vintage technology and institutions that are less adept at technology utilization.

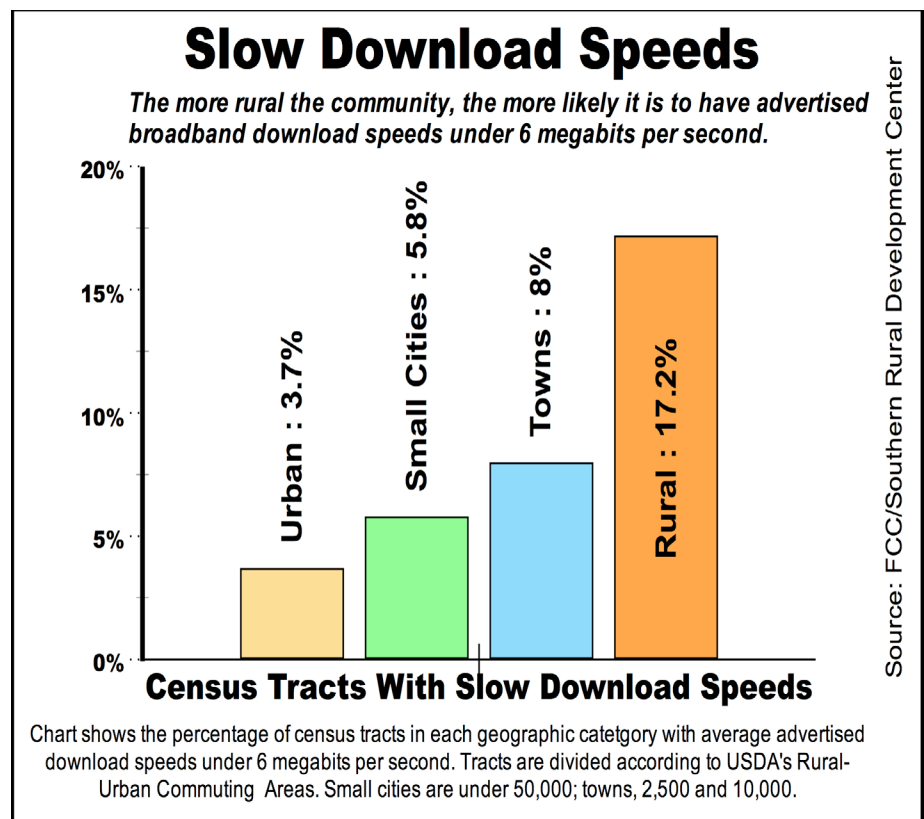
Strover: So, how should we think about measuring the impact of broadband expenditures in rural regions?

Flamm: I assume that “broadband expenditures” is synonymous with “increased investment in broadband infrastructure.” Some of the impacts can be thought of as direct--i.e., reductions in the price of broadband service induced by lower variable costs for broadband providers, increased availability of broadband in new areas, and increased demand for broadband services induced by both lower prices and increased availability. In addition, some forms of increased investment in infrastructure may be associated with new competitive entry, and increased competition in broadband service provision, which may stimulate additional reductions in price and increased availability beyond what would otherwise be observed, absent new entry.

Other impacts are indirect. Since broadband services can be an input to business activity, lower prices and greater availability can stimulate new investment and output in other economic activities. Similarly, lower prices and increased availability of broadband might stimulate consumer and household investment in human capital (think of online health and educational programs, for example). Lower prices and increased availability of broadband might also enable labor markets and even product markets to operate more efficiently. For example, farms might be able to react more quickly and efficiently to changes in weather, input price changes, and output price changes, because of the availability of specialized services and information over the Internet.

Strover: How can we actually measure these outcomes?

Flamm: Actually measuring the impact of investment on these factors is a very difficult problem, and there are few, if any, persuasive empirical studies of either direct



or indirect effects. The fundamental problem is that it is almost impossible to untangle whether observed increases in broadband investment cause the measured impacts, or the measured impacts are causing the increased broadband investment to occur.

It is further complicated by the fact that very little is known about the time lags that might be relevant to seeing the effects of increased investment on broadband service output, or the lags between increased economic activity and induced increases in infrastructure investment.

Strover: What about the current situation, in which large government investments in broadband in rural areas represent a clear input to greater broadband availability? Can that make measuring outcomes a little clearer?

Flamm: In an ideal scenario, one might consider an experiment where one stimulated broadband infrastructure investment in a randomly drawn sample of rural communities, then attempt to track both direct and indirect effects subsequently over time. One would still be concerned about whether the communities that agreed to participate in such a program, or qualified for participation, would be truly random, that is, whether or not willingness to participate—or qualifying to participate—might be correlated with measured or unmeasured characteristics of the communities.

Glasmeier: I would not expect short-term effects, but I would expect long-term job change, if only measured in terms of job preservation.

If job generation is the measure of impact, then I would propose two methods to underpin future research. The first is a quasi-experimental design using paired-comparisons. The second would be longitudinal studies of the impact of telehealth and tele-education, currently being implemented in rural areas to help care for the needs of wounded soldiers returning from Iraq and Afghanistan, and to facilitate VA service delivery to rural vets more generally. Significant investments are being made to provide higher quality and more spontaneous care for these two populations. Careful study of the local capacity impact is a promising opportunity to understand how telecommunications access improves the well-being and effectiveness of members of rural communities.

Strover: Right now we have many communities and providers that have

received grants from NTIA or RUS. NTIA has commissioned a study on the outcomes of its programs, and RUS is certainly interested in learning more about the impact of its grants and loans. One problem concerns the self-selection factor related to actually applying for and receiving a grant--the communities or providers better able to apply for a grant are likely to have more avid users and perhaps greater support. Communities that lack the wherewithal to even apply for loans or grants are, in general, worse off in terms of local infrastructure, support, and digital literacy.

How does this situation bear on assessing outcomes?

Flamm: With non-experimental data--such as data from a natural field setting, like those communities that just received grants--one would be even more concerned about whether observed broadband investments were correlated with measured or unmeasured characteristics of communities that would also be correlated with the impact variables. With measured characteristics of communities, one can at least attempt to control for such variables, though assumptions about functional form and homogeneity of effects across different types of communities remain as potential issues hindering correct inference. Concerning unmeasured characteristics that might be correlated with both broadband investments and impacts, no such attempt at statistical control is even possible.

Strover: So for example, the organizational capacity of communities would be an unmeasured variable that could not be accounted for in normal sorts of impact studies.

Lehr: Shane's approach is a good first step, but a word of caution. I believe his approach is conservative and will tend to underestimate the economic value of broadband services. I think, as with other forms of basic infrastructure and ICT in general, broadband is an input to many valuable social and economic activities that are not easily measured. And, to the extent broadband creates new ways to do things (or of doing things), again, such impacts are hard to measure. For example, if consumers can use broadband to make better purchasing decisions that save them money, this has large consumer surplus benefits, but it is very hard to associate with specific rural investments in broadband. And

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it is possible that the effects of better information about retail pricing that the Internet may make available may spill over to consumers who lack broadband access. Finding good instruments to control for causality will remain a difficult challenge for empirical analyses of broadband.

To measure rural effects in specific areas/regions, we will need geographically granular data, but that then makes it more difficult to study the impact on economic aggregates (e.g., there is no real measure of local GDP).

Strover: You're suggesting that we need detailed case studies that can produce a more microscopic level of understanding about outcomes. The downside of such studies is always that they lack generalizability to other settings and other populations.

Lehr: The passage of time should aid our analysis, but that is not a great consolation for folks trying to frame policies today. To better understand the nuances of broadband's effects we will need to be opportunistic about data. What will be especially interesting will be data on broadband usage at the firm or sub-firm (business unit) level and for individual consumers. This will require the integration of Internet traffic data.

We are just now in the midst of a project to characterize broadband user behavior, but prospects for linking that data to economic behavior and characteristics are challenged by privacy concerns. Getting better data will remain a difficult challenge for those seeking to measure the economic impacts of broadband.

Greenstein: Chris Forman, Avi Goldfarb, and I laid out a methodology for doing this in our recent working paper, NBER Working Paper 14750, "The Internet and Local Wages: Convergence or Divergence?". These types of questions could be thought of in terms of a "difference-on-difference" econometric framework, with modification of the standard diff-on-diff for "endogenous selection" into the "treated and untreated" categories. That is a mouthful, so let me unpack it.

First of all, measuring the impact of any IT investment requires measuring a meaningful economic outcome at a regional level. Candidate outcomes to measure include average wages (or income levels), level of unemployment (or employment), num-

ber of establishments (of a certain size). That outcome should be compared before and after the key activity, such as investment in broadband. Then differences in places in “the relationship of after to before” can be related to differences between places in the degree of “investment in broadband.” On one level, the core prediction is quite straightforward: If broadband has any meaningful economic effect, places which had some broadband investment should do better than those without any, and places with lots of investment should do better than those with a little.

However, statistical estimates are not sufficient because the places with some broadband might have gotten that way due to selection. That is, such places were going to grow anyway (for reasons unobserved by the statistician) and the investment occurred as a result of that growth. For example, if a resort area would have gotten a new resort with or without broadband, and its presence simply led to more broadband being installed during a building phase, it would be a statistical mistake to infer that the broadband causes more economic growth. The correct statistical approach is to predict what would have happened in the absence of the broadband investment, that is, to use an instrumental variables approach or propensity score approach or some other correction for endogenous selection. That requires an instrument that is not otherwise correlated with economic growth, but alters the cost of broadband.

Two remarks about instruments: First, the recent stimulus bill might generate comparatively random assignment of new broadband to rural areas, so it might generate statistical properties that are as good as exogenous. I am not sure until the data become available, but I am generally skeptical. Second, this is a very common error in studies today, despite the well-known statistical foundations for it. For example, the study by Connected Nation about the benefits of rural broadband contains this error. It effectively uses the statistical relationship between employment and broadband in Manhattan to predict the effects of bringing broadband into rural areas. The effect is massively overestimated as a result.

Glasmeyer: I am treating the measurement question as an empirical question. For me this depends on the sector in question.

If you are interested in local government, medical facilities and non-profits, web site analysis points up opportunities and limits of interactivity. Regarding businesses,

surveys of use and changes in use over time offer perspectives on learning over time. Developing a standard based on average levels of use in the same business is easy to do and is relatively unobtrusive. Canvassing businesses in small towns is a matter of walking the street and interviewing proprietors.

Strover: Amy, you seem to think that we can illustrate the impact of broadband on businesses in a grounded, empirical way by simply gathering data at the root level--the street level. This might satisfy Bill's interest in learning more about the firm-level outcomes, but it probably will not satisfy the economists who would want proof that better, or more, broadband enhances development or quality of life. Perhaps one constructive response is to emphasize which questions we can answer, and why they are important.

Glasmeier: The introduction of broadband has many features of the telephone. When originally introduced, it was utilitarian and eventually moved into emergency service and then finally served higher order functions, such as, at first, distance-enabling business transactions and then more localized business networking. This follows from the tradition of face-to-face contact within localized commerce. This is well-documented in the literature in geography.

Judging the value of broadband as measured by job generation over-simplifies the developmental impact of the introduction of a new technological capability. Notice I did not say technology. In our work in Pennsylvania, which was a combination of statistical and interview-based research, we evaluated the impact of broadband using a model of developmental change. We evaluated the technological capability looking for (a) replacement effects; (b) efficiency effects; (c) transformative effects. The first reflects the use of broadband to replace dial-up, no other changes. The second reflects improvement of existing operations, by augmenting existing practices, possibly leading to a reduction in cost, such as enhanced supply acquisition through on-line ordering; the third reflects new capabilities and new approaches to problem-solving and service provision. We noted in our interviews that firms and organizations moved through these states over time, as in a search process, in which the distance of the search expands over time after exhaustion of the value derived in a more localized context. Job generation may occur in stage

two or three, but stage two could lead to job loss as efficiency is improved. In the transformative stage, new capabilities arise and the prospect for job generation increases. The model discussed in some of the responses would be significantly enlivened if respondents addressed the process through which they saw job generation occurring. The most obvious example of job generation is the impact of broadband on the expansion of remote call centers. For reasons of absolute cost and competency advantages, this type of activity has limited prospects for expansion in rural areas of the US due to a lack of entrepreneurial capacity and highly effective global competitors. I believe the value of broadband in rural areas (and the real disadvantage associated with its absence) is the developmental cycle accompanying incorporation of the technological capability into everyday life.

Strover: How should we think about the possible advantages of e-government, distance education, and health-related services that many believe justifies investment in broadband networks?

Greenstein: These are all great services for the user community if they get used. They all require skilled labor to perform on some level, and to varying degrees. These services help low density and isolated areas if they are designed to be as close to “self-service” as humanly possible. I am quite willing to believe there are going to be exemplary users of these services, but I have not yet read a compelling case that there will be widespread use of such services for widespread and large gain. It will be great that a few rural hospitals will be able to find experts to read complicated X-rays, but how often will that occur? It will be great for somebody to enroll in an on-line, self-taught course, and consult Wikipedia faster than they could have in the past, but does anyone really expect a large number of such users? It will be great for government services in such areas to be able to send email to their constituents, but how much gain will that generate over what they already could do similar by mail and/or over the telephone? In short, all this stuff is great, but expectations should be aligned to the situation. This is not anywhere near the equivalent of the diffusion of electricity to rural areas.

Strover: That is a pretty provocative analogy. Why was electricity so much more important, within the context of the 1930s and 40s?

“Call me a skeptic, I see lots of entertaining software, and incremental gains from better information, but so far, I just do not see widespread economic and large impact across a wide array of business activities.”

- Shane Greenstein

Greenstein: That’s a good question, and I am not sure I can give a precise answer. Let me give a metaphor for why I see a difference.

Context matters. Rural electrification in the 1930s took place after a wide array of complementary inventions had been introduced, and for which there were few substitutes. So electrification in 1930 did not merely support cheap interior lighting at night inside homes, which was an enormous change from alternatives, to be sure, it also did more. Electrification in 1930 also brought radio with it, for which there were no close substitutes. Plenty of appliances inside kitchens and tool sheds and for laundry had less dramatic impact, if I had to make a guess on the rank of impact, but that is just a guess. But focusing on the home misses the biggest impact. For business—particularly manufacturing—electricity had immediate and enormous consequences for productivity—and across a wide range of activities. Once again, partly this was due to timing. By the 1930s tons of tools/motors/etc. had been invented for manufacturing. It also had to do with rural economies. Even the most basic economic activities of low-density locations, such as ranching, farming, mining, lumbering, transportation, or small-scale manufacturing, were all helped by the production of reliable and cheap electricity (which is what everyone got in the 1930s).

I just do not see anything equivalent in its economic impact coming from broadband, at least not yet. Sure, widespread broadband has started to motivate the invention of complementary activities that take advantage of broadband—YouTube, Facebook, Netflix downloads, and interactive gaming being among the most prominent. Within business some of the telepresence activities, and maybe a couple high bandwidth applications from the cloud computing world, also enable something completely new, especially in mobile platforms. And this stuff is cool to examine, and maybe someday it will be transformational. But, call me a skeptic, I see lots of entertaining software, and incremental gains from better information, but so far, I just do not see widespread economic and large impact across a wide array of business activities. Incremental gains, yes. But on the same scale as introducing cheap and reliable electrical tools into farming and ranching and mining? Not yet.

Flamm: These types of services—distance education, egovernment, telehealth—are

likely to be very important. It is already obvious that many government services (drivers licenses, legal records, business licenses, taxes, voting, etc.) are increasingly being provided most efficiently and cheaply (including citizen time as a cost) over the Internet. In addition, government-provided services, which include education, and increasingly, health infrastructure, are provided in ways that make them cheaper to deliver over the Internet.

Lehr: I do believe that eGovernment, distance education, and eHealth hold great promise for the future. I agree with Shane that this is not like rural electrification in its potential. In many cases the benefits may be realized by targeted access (in government buildings, schools, public libraries, hospitals). I think we can do much more than we have, but the key to realizing these benefits rests first in those specialized access environments and then will be extended to homes. BUT, I do not view wider home access of broadband as critical to realize those specialized services.

Greenstein: Maybe I could say it another way. Diffusing broadband twenty years from now into a place that has not had it might be equivalent to diffusing electricity in the 1930s, but right now I think we are too close to the frontier, especially in the development of the complements. Right now the frontier is producing lots of great path-breaking stuff, but that is not the same as producing large economic value. As a society we are still just figuring that out. Unless the creation of something equivalent to the web (in terms of its transformative power) shows up next year (it is always possible!), the creation of high value, I believe, is unlikely in the short run. Rather, it is most likely that we will muddle through, as usual, and over time the incremental changes in business will add up, and a transformative economic outcome will not be apparent for a decade or two.

Glasmeier: If there is sufficient training and investments in adaptation, rural areas can and will benefit from broadband technology.

Strover: **As we are one decade into the 21st century, does the absence of broadband services in rural regions translate into real disadvantages or merely slight inconveniences?**

“If there is sufficient training and investments in adaptation, rural areas can and will benefit from broadband technology.”

-Amy Glasmeier

“The real issue is likely to be price and quality of service, not complete absence of broadband service.”

-Kenneth Flamm

Greenstein: Satellite services and (increasingly) cellular technology offer alternative paths to email, albeit more expensive and cumbersome paths. That (increasingly) defines the absence of wire-line broadband as an inconvenience for most of the use that is prevalent today. Frontier Internet use—such as use of high speed video on the Internet—will continue to have better quality in urban settings. Nobody yet sees such use as a necessity.

Flamm: I am unaware of any compelling answer to this empirical question in the literature. However, my educated guess is that absence of broadband service provision is currently a significant disadvantage. In the future, it is likely to be a crippling disadvantage.

On the other hand, there are a few, if any, rural regions in the United States where broadband is truly and completely unavailable, at any price. The real issue is likely to be price and quality of service, not complete absence of broadband service.

Lehr: In the long-run, I think the absence of broadband services will translate into real disadvantages because I believe broadband is basic infrastructure.

However, the locations where there is no access to at least first-generation broadband are relatively rare. I think the problem of rural access to broadband is overstated. As Shane has noted, with improvements in wireless technology and coverage (fixed, satellite, mobile), those who face no options will become even fewer.

I believe we will need to have needs-based support for broadband and that selective community-based or regional investment in second-mile infrastructure may be needed to enable broadband connectivity to communities (for hospitals, libraries, schools, government buildings—and potentially to provide backhaul for rural WISPs [Wireless Internet Service Providers]); but I do not think that we need large government subsidy programs to ensure access to broadband. If the services are sufficiently valuable, folks will pay just as they do for basic telephony service. Some things cost more in rural areas, and other things cost less (e.g., parking).

Strover: **Bill, many rural regions of the country are served by telephone companies that receive universal service payments so that they can continue**

to offer lower cost service. If your analogy is correct, aren't you really saying that broadband access services also should receive a subsidy? The idea of supporting broadband investments in truly targeted fashion—for second-mile infrastructure— could be a useful way to direct future universal service payments.

Glasmeier: The lack of broadband access is a real disadvantage for people living in rural areas. It reduces productivity, increases isolation, and limits access to critical services such as health care, education, and those provided by government. It is relatively easy to prove these disadvantages. The challenge is not access or utilization alone that restricts the benefits of new technology in rural areas. Price is a major factor limiting broadband uptake.

“The challenge is not access or utilization alone that restricts the benefits of new technology in rural areas. Price is a major factor limiting broadband uptake.”

-Amy Glasmeier

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