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Supporting Regional Economic Development through Analysis and Education

A Profile of the Broadband Internet Industry in Kansas

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About The Center for Applied Economics

The KU School of Business established the Center for Applied Economics in February of 2004. The mission of the Center for Applied Economics is to help advance the economic development of the state and region by offering economic analysis and economic education relevant for policy makers, community leaders, and other interested citizens. The stakeholders in the Center want to increase the amount of credible economic analysis available to decision makers in both the state and region. When policy makers, community leaders, and citizens discuss issues that may have an impact on the economic development potential of the state or region, they can benefit from a wide array of perspectives. The Center focuses on the contributions that markets and economic institutions can make to economic development. Because credibility is, in part, a function of economic literacy, the Center also promotes economics education.

About the Author

Arthur P. Hall is the founding Executive Director of the Center for Applied Economics at the University of Kansas School of Business. Before joining the KU School of Business, Hall was Chief Economist in the Public Affairs group of Wichita, KS-based Koch Industries, Inc. In that capacity, he worked with business leaders to define how public policy initiatives would influence the structure of the markets in which the company participates. Koch sponsored Hall's directorship of Kansas Governor Sebelius' Budget Efficiency Savings Teams from April 2003 until his departure from the firm in February 2004.

Before joining Koch Industries in May 1997, Hall was Senior Economist at the Washington, D.C.-based Tax Foundation, where he produced quantitative and qualitative research pertaining to the economics of taxation and acted as an economic advisor to The National Commission on Economic Growth and Tax Reform. Before that, he worked as a financial economist at the U.S. General Accounting Office. Hall has taught university-level economics at both the undergraduate and MBA level. He received his doctorate in economics from the University of Georgia and his bachelor of arts in economics from Emory University.

The opinions expressed are those of the author; they should in no way be interpreted as the viewpoints of the University of Kansas (or any subunits thereof) or the Kansas Board of Regents.

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A PROFILE OF THE BROADBAND INTERNET INDUSTRY IN KANSAS

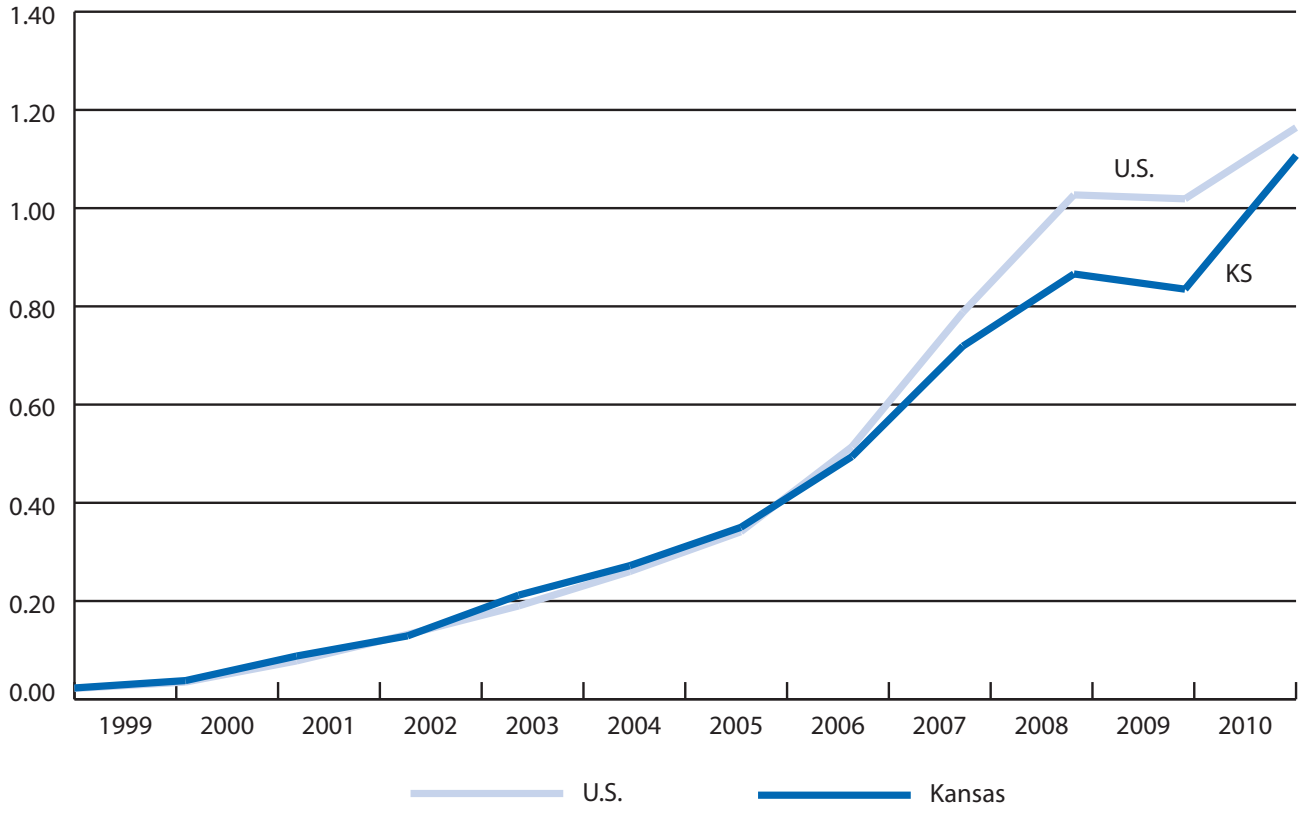
Everyone who has had meaningful interaction with the entire ecosystem of internet-related technologies understands that it is transformative, both economically and culturally. Too often, however, it becomes easy to forget that this ecosystem has been evolving for decades. Past stages of the evolution are taken for granted while newly-apparent stages of the evolution take on an economic and political urgency.

Such urgency characterizes the current stage of evolution defined by mobile wireless broadband. Evolution is messy business because the forces of evolution must rely on a trial-and-error process to build self-sustaining (yet perhaps temporarily unstable) business ecosystems. The mobile wireless broadband stage of evolution would not now be possible without the wireline stage that preceded it. Mobile wireless broadband is more than wireless infrastructure per se; it is an amalgam of system-reinforcing services, technologies, and infrastructures that must cohere into self-sustaining business models.

The economic growth process necessarily results from the same trial-and-error process that discovers self-sustaining business models. Business models that become self-sustaining tend to drive economic growth through increased productivity—the process creating ever-more economic value with an ever-more efficient use of resources. Business models that do not become self-sustaining tend to deter economic growth because they end up misallocating resources in a manner that undermines the quest for increased productivity. Public policy interventions that place too much stress on specific

Chart 1

Broadband Internet Connections per Housing Unit, 1999-2010



Source: Federal Communications Commission, Form 477

elements of the ecosystem—like the subsidization of current broadband infrastructure technologies without due recognition for their economic interaction with the whole ecosystem, or how that ecosystem might evolve in more productive directions if left unsubsidized—may inadvertently undermine the economic growth process by creating false signals related to the self-sustainability of business models.

The mobile (and fixed) wireless broadband phase of the internet-related communications evolution is a welcome one for Kansas. Wireless technologies hold the greatest promise for serving citizens in rural areas within the context of self-sustaining business models. But it will take time and substantial investments that must provide an adequate return to investors.

BROADBAND ADOPTION AND SERVICE PROVISION IN KANSAS

Chart 1 shows for Kansas and the United States the trends in broadband internet connections per housing unit. Unless otherwise specified, the definition of broadband in this report follows the Federal Communications Commission (FCC) definition of transmission speeds of at least 200 kilobits per second (kbps) in at least one direction (download or upload). The FCC began to collect broadband data in 1999. Content and applications have evolved to require significantly higher transmissions speeds (e.g., VPN capabilities, VoIP, streaming video and larger file sizes).

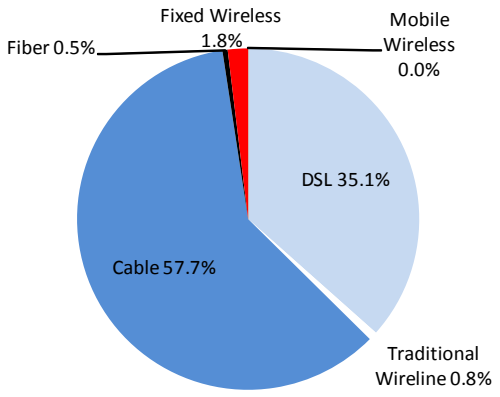
Chart 1 demonstrates that Kansas followed broadband adoption rates that tracked with the nation. Over the 1999-2010 time frame illustrated by the chart, Kansas had an average annual growth rate in connections of 42 percent; the U.S. had a growth rate of 43 percent. The growth rate of connections in Kansas ranked 36th among the states.

Broadband provision and adoption, especially in the early years, should be thought of as a function of local economic characteristics. Early broadband technology required a wire—a DSL connection that ran over a copper telephone wire or a cable connection that ran over a coaxial cable. Business models that use these technologies work best when housing units (and business units) are closely clustered geographically. This feature of broadband deployment may help explain why a mountainous, but low-income, state like West Virginia had the highest average annual growth rate (77 percent) of broadband connections (people cluster in valleys); or why a state like New Mexico, with a low statewide measure of population density, would rank second. Both North Dakota and South Dakota also ranked in the top 10 average annual growth rates.

Kansas, despite a below-average growth rate of broadband connections over the past decade, now ranks above average (23rd) in terms of connections per housing unit,

Chart 2a

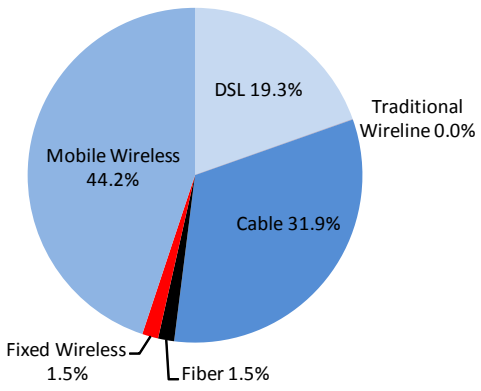
How Kansans Connected in 2005



Source: Federal Communications Commission, Form 477

Chart 2b

How Kansans Connected in 2010



Source: Federal Communications Commission, Form 477

as of the latest 2010 data. A comparison of Chart 2a and Chart 2b suggests that the 2009 surge in connections shown in Chart 1 resulted from a rapid adoption of mobile wireless connections. Mobile wireless connections also explain why the number of connections per housing units in Kansas is now (on average) greater than one. (Note in Chart 2a, how dial-up, or Traditional Wireline, had become virtually extinct by 2005.)

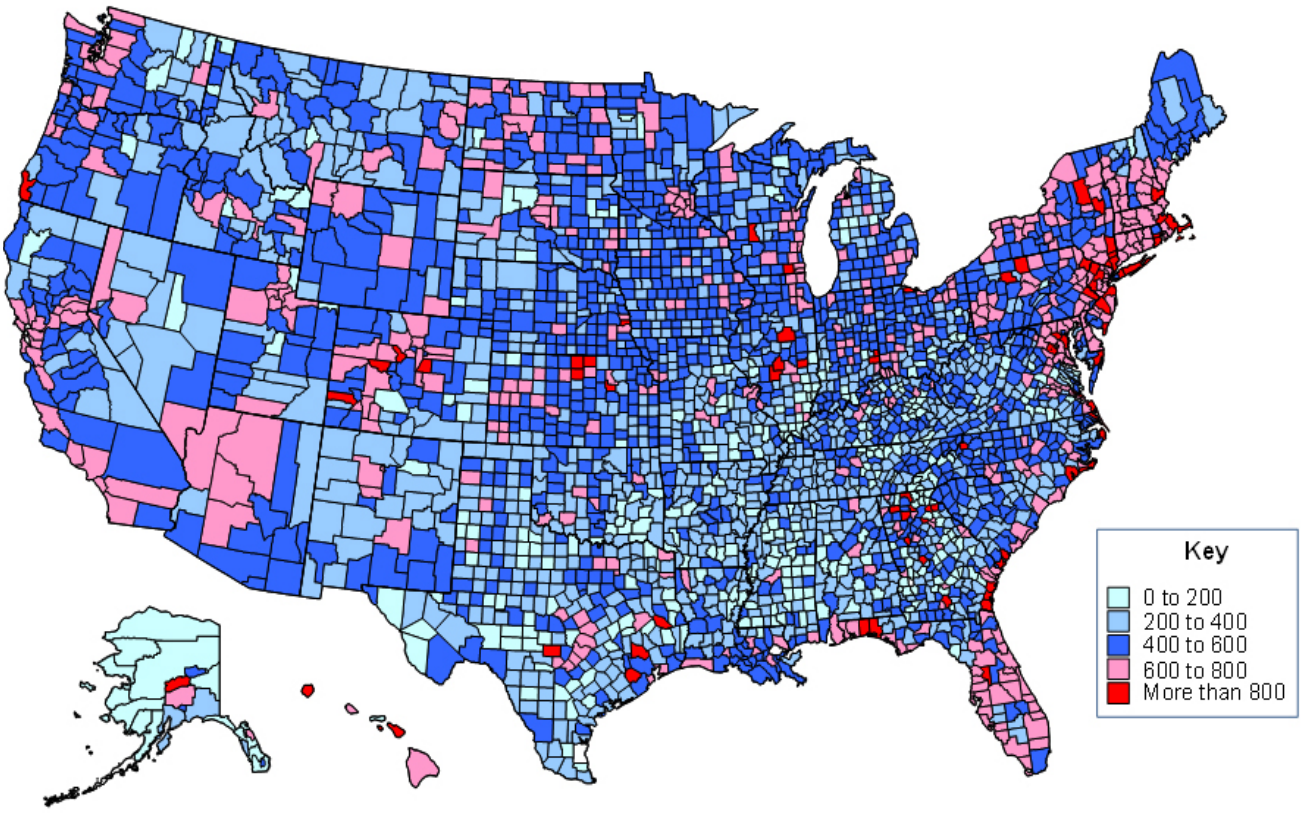
Chart 2a and Chart 2b focus on shares. However, the raw numbers of connections that generate the shares changed substantially from 2005 to 2010. Connections related to the DSL and cable technologies increased by more than 60 percent. Connections related to fiber optics increased almost 950 percent (to about 21,000). Wireless mobile connections increased to about 607,000 from less than 1,000.

Map 1 and Map 2 further reinforce the fact that Kansans have ample access to broadband internet. The data that support the maps has a more current definition of broadband than discussed with regard to the previous charts. Starting in about 2008, the FCC began to define basic broadband speeds as at least: 768 kbps for downloads and 200 kbps for uploads. (The National Broadband Plan has set a goal for 4 mbps for downloads and 1 mbps for uploads.)

Under the updated FCC speed definition, an examination of Map 1 demonstrates that Kansas has connectivity rates comparable to most of the nation—even in most of the "rural" Kansas counties. Map 2 makes it easy to see that Lawrence, Manhattan, Wichita, and the cities of Johnson County have high broadband connections rates. Counter to what may be a popular perception, many of the lesser populated counties also have high broadband connection rates. (For reference, the numbers under the county names in Map 2 represent the number of providers for mobile wireless broadband service, an issue discussed in more detail below.)

Map 1

Broadband Connections per 1,000 Households



Source: Federal Communications Commission, Form 477 (June 30, 2010)

Comparing Map 2 with Map 3 draws attention to an important issue when discussing broadband access and connectivity. Jewell and Republic counties, in the north central part of the state, have below-average access to broadband, based on the definition of "access" used by the FCC. However, those counties also have the highest measured level of broadband connection rates. This discrepancy underscores the importance of analyzing broadband in the specific context of local markets.

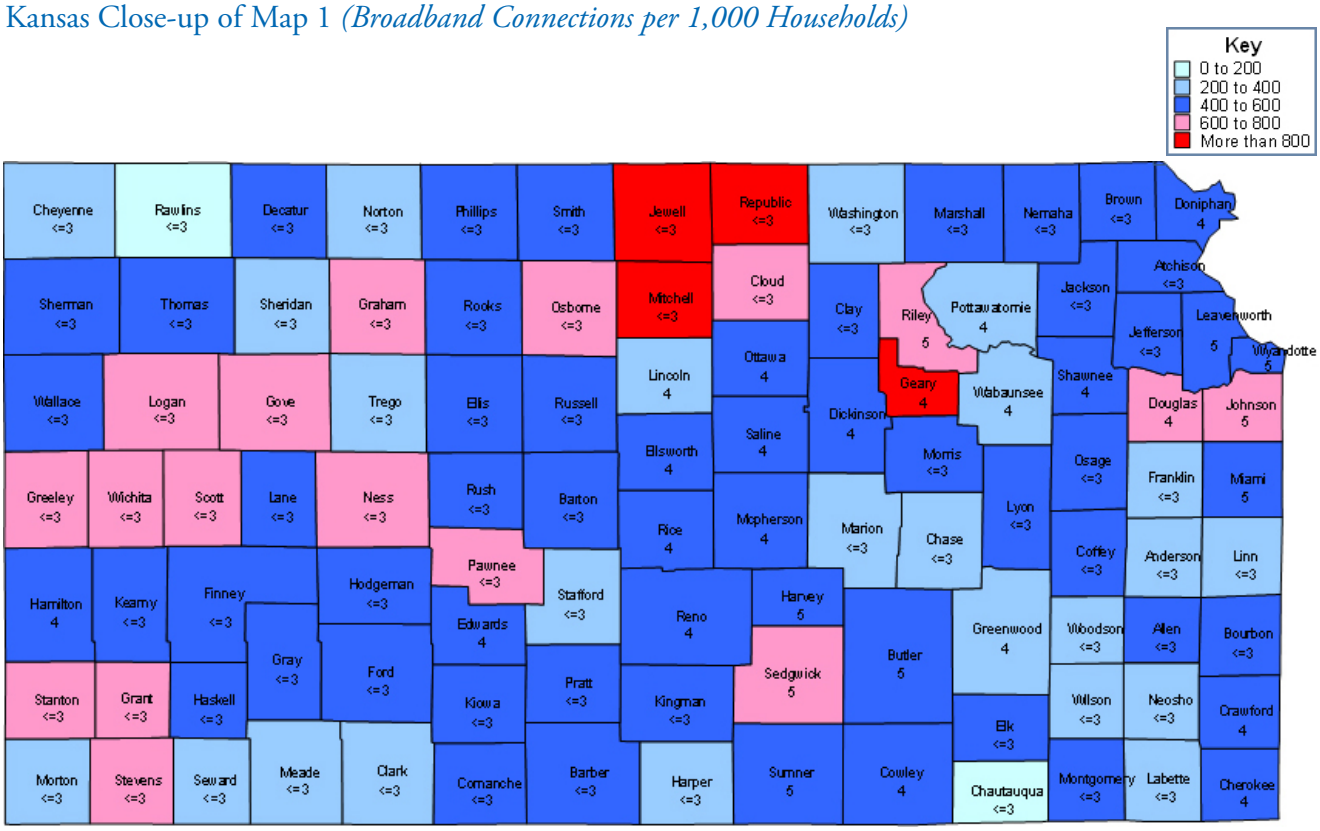
From the time the FCC began to measure broadband access, critics have complained that the definition had the potential to grossly misrepresent the conditions of local markets. In brief, the FCC definition measures "access" at the zip-code level according to whether or not an internet service provider has a customer in that zip code—even if it is only one customer. The definition is subscriber based not infrastructure based; it assumes that access for one implies access for all. Further, if more than one internet service provider serves a customer in a zip code, then all providers are implied to be in competition with one another. But a more detailed understanding of the local market could indicate that the providers do not compete for customers in any economically meaningful way.

A 2006 report by the U.S. Government Accountability Office, critical of the FCC definition of broadband access, found that:

> In the 16 major metropolitan areas we examined, available data suggest that facilities-based competitive alternatives for dedicated access are not widely available. Data on the presence of competitors in commercial buildings suggest that competitors are serving, on average, less than 6 percent of the buildings with demand for dedicated access in these areas. For buildings with higher levels of demand, facilities-based competition is more moderate, with 15 to 25 percent of buildings showing competitive alternatives, depending on the level of demand. Limited competitive build out in these MSAs

Map 2

Kansas Close-up of Map 1 *(Broadband Connections per 1,000 Households)*



Source: Federal Communications Commission, Form 477 (June 30, 2010)

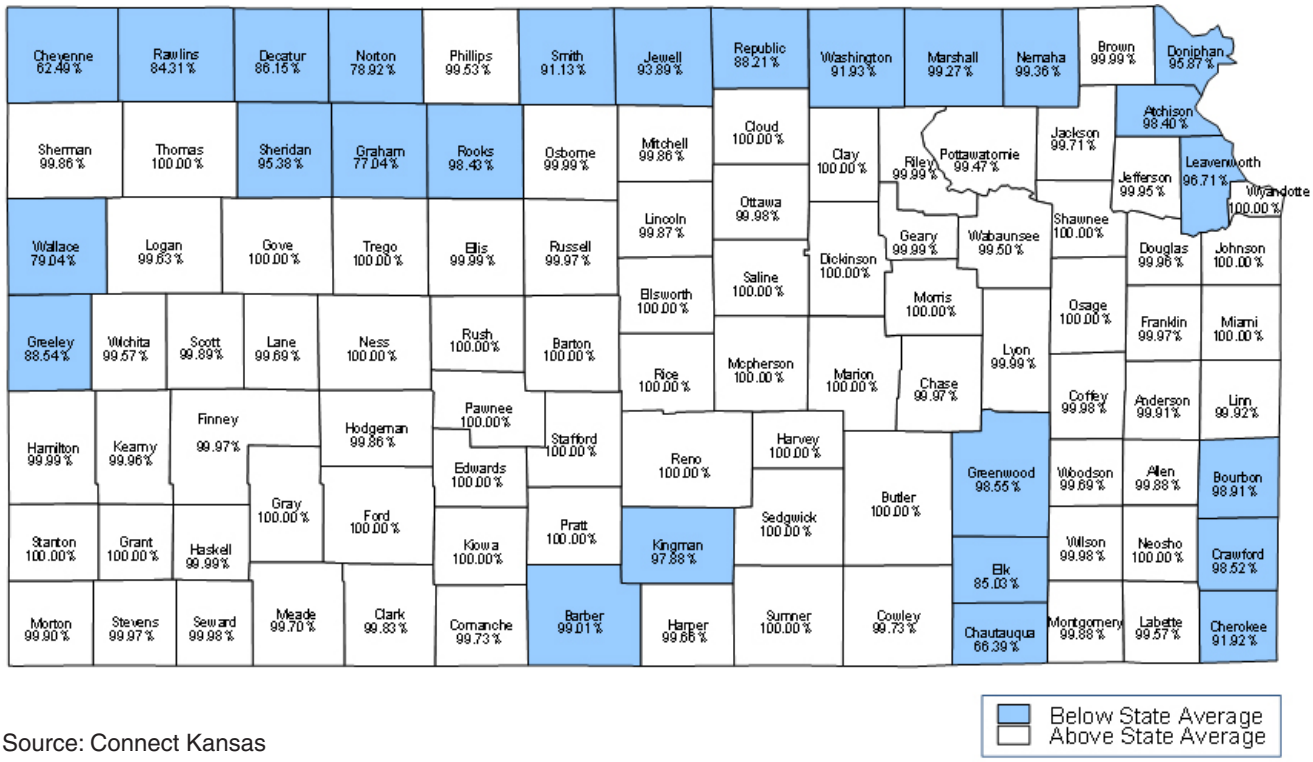
could be caused by a variety of entry barriers, including government zoning restrictions and difficulty gaining access to buildings from building owners. *In addition, where demand for dedicated access is relatively small, it is unlikely to be economically viable for competitors to extend their networks to the end user*. FCC has also noted that, where competitors can lease unbundled network elements from incumbent providers, there may be less incentive for competitors to invest in their own facilities.[1]

Given the speed of change in broadband services, the GAO report may have evaluated a bygone era of the internet, but the added emphasis in the quotation regarding the economics of local market conditions has just as much relevance in the dynamic market of today—in the space related to mobile wireless internet: the trial-and-error race is on to discover which combination of technologies and service packages creates the most consumer value in the context of the most profitable business models. More to the point, GAO's analysis indicates that self-sustaining business models may often require fewer competitors than a theoretical ideal; but that structure makes the service economically viable—and many customers pay the price willingly. Economic viability, in turn, generates the basis for competitive dynamics over time.

At the time this report was being drafted, the U.S. Department of Justice sued to block a proposed merger of two mobile wireless broadband providers: T-Mobile (a U.S. affiliate of a German company) agreed to be acquired by AT&T. The situation offers a convenient context in which to think about dynamic economic competition. A press release from the Department of Justice argued that "the proposed $39 billion transaction would substantially lessen competition for mobile wireless telecommunications services across the United States, resulting in higher prices, poorer quality services, fewer choices and fewer innovative products for the millions

Map 3

Percent of Households with Broadband Internet Access Compared to State Average (99.4%)



Source: Connect Kansas

1 U.S. Government Accountability Office, "FCC Needs to Improve Its Ability to Monitor and Determine the Extent of Competition in Dedicated Access Services," GAO-07-80, November 2006, p. 1. Emphasis added. Available at: www.gao.gov/cgi-bin/getrpt?GAO-07-80

Table 1

Providers of Broadband Services in All Kansas Cities of the First and Second Class, 2010

Mobile Wireless Providers	Cities Served	Share of Cities Served	Down Speed	Up Speed
AT&T Inc.	34	28.1%	1.5 to 3 mbps	768 kbps to 1.5 mbps
Leap Wireless International Inc.	29	24.0%	768 kbps to 1.5 mbps	768 kbps to 1.5 mbps
Sprint Nextel Corporation	61	50.4%	768 kbps to 1.5 mbps	200 to 768 kbps
T-Mobile USA	22	18.2%	1.5 to 3 mbps	200 to 768 kbps
United Telephone Association Inc.	7	5.8%	768 kbps to 1.5 mbps	200 to 768 kbps
Verizon Communications Inc.	112	92.6%	3 to 6 mbps	1.5 to 3 mbps
Fixed Wireless Providers				
Benson Tel Service Inc.	2	1.7%	3 to 6 mbps	200 to 768 kbps
Blue Valley Tele-Communications Inc.	1	0.8%	768 kbps to 1.5 mbps	768 kbps to 1.5 mbps
Broadband Wireless Internet (BBWI)	4	3.3%	1.5 to 3 mbps	768 kbps to 1.5 mbps
Cyber Lodge Internet Services Inc.	2	1.7%	768 kbps to 1.5 mbps	768 kbps to 1.5 mbps
Eagle Communications Inc.	10	8.3%	1.5 to 3 mbps	200 to 768 kbps
Epic Touch Company	1	0.8%	3 to 6 mbps	3 to 6 mbps
FairPoint Communications Inc.	4	3.3%	1.5 to 3 mbps	768 kbps to 1.5 mbps
KanOkla Telephone Association Inc.	12	9.9%	3 to 6 mbps	200 to 768 kbps
Kansas Broadband Internet Inc.	6	5.0%	3 to 6 mbps	1.5 to 3 mbps
Kansas Data Internet Inc.	2	1.7%	1.5 to 3 mbps	768 kbps to 1.5 mbps
KeyOn Communications Holdings Inc.	17	14.0%	1.5 to 3 mbps	1.5 to 3 mbps
Lawrence Freenet	2	1.7%	6 to 10 mbps	200 to 768 kbps
LICT Corporation	1	0.8%	768 kbps to 1.5 mbps	768 kbps to 1.5 mbps
Mercury Wireless LLC	1	0.8%	3 to 6 mbps	768 kbps to 1.5 mbps
Mobilcom Pittsburg Inc.	4	3.3%	6 to 10 mbps	3 to 6 mbps
Mutual Telephone Company (KS)	2	1.7%	1.5 to 3 mbps	768 kbps to 1.5 mbps
Nautilus Net	5	4.1%	1.5 to 3 mbps	1.5 to 3 mbps
North Central Kansas Community Network	6	5.0%	768 kbps to 1.5 mbps	768 kbps to 1.5 mbps
Pixius Communications LLC	13	10.7%	768 kbps to 1.5 mbps	768 kbps to 1.5 mbps
Rainbow Telecommunications Association Inc.	3	2.5%	768 kbps to 1.5 mbps	200 to 768 kbps
Rural Telephone Service Company Inc.	5	4.1%	3 to 6 mbps	1.5 to 3 mbps
SandT Telephone Cooperative Association	2	1.7%	768 kbps to 1.5 mbps	768 kbps to 1.5 mbps
Sumner Cable TV Inc.	8	6.6%	1.5 to 3 mbps	200 to 768 kbps
The Computer Generation Inc.	2	1.7%	1.5 to 3 mbps	200 to 768 kbps
The Golden Belt Telephone Association Inc.	1	0.8%	768 kbps to 1.5 mbps	200 to 768 kbps
Tri County Telephone Association Inc.	4	3.3%	768 kbps to 1.5 mbps	768 kbps to 1.5 mbps
Tri-Rivers Internet	1	0.8%	1.5 to 3 mbps	768 kbps to 1.5 mbps
Twin Valley Management Inc.	1	0.8%	1.5 to 3 mbps	200 to 768 kbps
Twinmounds.com	1	0.8%	3 to 6 mbps	1.5 to 3 mbps
United Wireless Communications	2	1.7%	1.5 to 3 mbps	200 to 768 kbps
Valnet Telecommunications Inc.	5	4.1%	1.5 to 3 mbps	200 to 768 kbps
Wave Wireless	2	1.7%	1.5 to 3 mbps	1.5 to 3 mbps
Wheatland Electric Cooperative Inc.	2	1.7%	3 to 6 mbps	768 kbps to 1.5 mbps
Cable Broadband Providers				
Allegiance Communications Holdings LLC	5	4.1%	6 to 10 mbps	768 kbps to 1.5 mbps
Blue Valley Tele-Communications Inc.	1	0.8%	6 to 10 mbps	200 to 768 kbps
Cable One Inc.	5	4.1%	10 to 25 mbps	1.5 to 3 mbps
Cequel Communications LLC	4	3.3%	1.5 to 3 mbps	200 to 768 kbps
Comcast Corporation	1	0.8%	6 to 10 mbps	6 to 10 mbps
Cox Communications Inc.	39	32.2%	50 to 100 mbps	1.5 to 3 mbps
Cunningham Management Inc.	2	1.7%	10 to 25 mbps	3 to 6 mbps
Eagle Communications Inc.	10	8.3%	10 to 25 mbps	1.5 to 3 mbps
FairPoint Communications Inc.	2	1.7%	50 to 100 mbps	768 kbps to 1.5 mbps
Mediacom Communications Corp.	4	3.3%	10 to 25 mbps	10 to 25 mbps
Pioneer Telephone Association Inc.	3	2.5%	6 to 10 mbps	200 to 768 kbps
Rainbow Telecommunications Association Inc.	4	3.3%	10 to 25 mbps	3 to 6 mbps
Sumner Cable TV Inc.	1	0.8%	3 to 6 mbps	768 kbps to 1.5 mbps
Time Warner Cable Inc.	14	11.6%	10 to 25 mbps	768 kbps to 1.5 mbps
DSL Broadband Providers				
Access One Online Services	1	0.8%	3 to 6 mbps	200 to 768 kbps
AT&T Inc.	82	67.8%	6 to 10 mbps	768 kbps to 1.5 mbps
CenturyTel Inc.	18	14.9%	10 to 25 mbps	10 to 25 mbps
Craw-Kan	2	1.7%	1.5 to 3 mbps	1.5 to 3 mbps
KanOkla Telephone Association Inc.	1	0.8%	3 to 6 mbps	768 kbps to 1.5 mbps
Pioneer Telephone Association Inc.	2	1.7%	10 to 25 mbps	768 kbps to 1.5 mbps
SandT Telephone Cooperative Association	2	1.7%	6 to 10 mbps	768 kbps to 1.5 mbps
South Central Telephone Association Inc.	1	0.8%	6 to 10 mbps	200 to 768 kbps
The Golden Belt Telephone Association Inc.	1	0.8%	6 to 10 mbps	768 kbps to 1.5 mbps
Tri County Telephone Association Inc.	1	0.8%	3 to 6 mbps	1.5 to 3 mbps

Source: Connect Kansas via National Broadband Map Website

of American consumers who rely on mobile wireless services in their everyday lives."[2] Yet, as the GAO report indicates, broadband internet successfully proliferated under the same conditions Justice contemplates as being counter-productive.[3]

The broadband provider data in Table 1 indicates that the Department of Justice's evaluation would likely not apply to the market conditions in Kansas. The table lists the service providers for the major technological forms of broadband internet service in all Kansas cities of the first and second class—121 cities in all. Based on tabulations by the League of Kansas Municipalities, these geographically dispersed cities represent about 73 percent of the Kansas population. (Kansas has 506 cities of the third class, the largest one having a population of about 5,300.)

In Kansas, Verizon is the dominant mobile wireless broadband provider, with a presence in 93 percent of the represented cities. According to Connect Kansas, an entity that operates out of the Kansas Department of Commerce and compiled the data in Table 1, Verizon is the sole provider in 44 of the 121 cities. Sprint is the sole provider in one city. All other cities have multiple providers: 19 cities have 5 providers; 9 cities have 4 providers; 7 cities have 3 providers; and 31 cities have 2 providers. (Refer to the provider counts in Map 2.)

Table 1 indicates that T-Mobile operates in 22 of the represented Kansas cities. AT&T operates in 21 of those same cities, so a merger between the two companies would technically reduce the number of competitors (which is the complaint driving the Department of Justice's legal action). However, both Verizon and Sprint operate in all 22 cities in which T-Mobile operates. Leap Wireless operates in 19 of the 22 cities. Furthermore, Leap Wireless offers a more flexible mobile broadband plan that is about half as expensive as that offered by T-Mobile.[4]

(As an aside, referring back to the passage from GAO's report, note the large number of single-city fixed wireless operators. Even the companies operating in many cities are often the sole provider in a city. Some markets simply may not be capable of sustaining multiple operators: potentially 43 of 83, in the context of the fixed wireless markets represented by Table 1. Of the 83 cities with a fixed wireless broadband option, 24 have 2 providers, 10 have 3 providers, and 1 has 4 providers.)

More generally, rather than being an economic threat to consumers, the proposed merger of AT&T and T-Mobile offers evidence of a regular pattern of industry evolution: The Rule of Three. The mobile phone market has been evolving in earnest for almost two decades. The advent of mobile wireless broadband is essentially a new inflection point putting pressure on service providers to adapt to the rapidly changing characteristics of an exploding market. Such rapid change can often lead to consolidations—especially in the context of systemic innovations combined with capital-intensive processes (exactly the features that define the current mobile wireless broadband industry).[5]

Marketing scholars Jagdish Sheth and Rajendra Sisodia developed an industry evolution framework that they call The Rule of Three. Other scholars have analyzed this framework and it has held up under rigorous empirical testing across 160 different industries.[6]

> "Simply put, the Rule of Three states that naturally occurring competitive forces—if allowed to operate without excessive government intervention—will create a consistent structure

2 http://www.justice.gov/atr/public/press_releases/2011/274615.htm Accessed on September 2, 2011.

3 Jed Kolko, "A New Measure of U.S. Residential Broadband Availability," *Telecommunications Policy* 34: 132-143. Kolko finds that the relationship between provider count and availability is neither binary nor linear: The marginal provider implies a bigger increase in the share of households within a ZIP code with broadband availability at low provider counts than at higher provider counts.

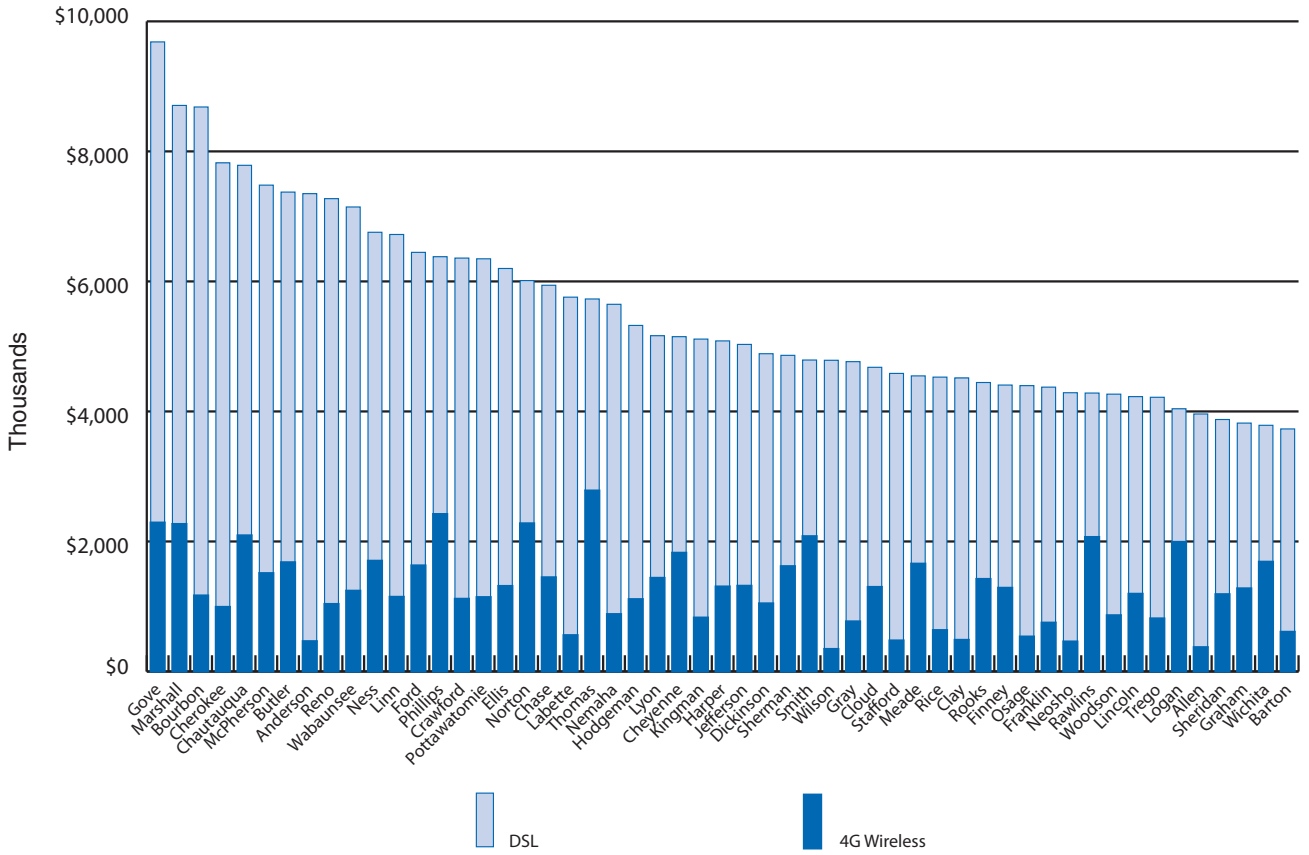
4 http://news.cnet.com/8301-1035_3-20068758-94/sprint-the-winner-if-at-t-absorbs-t-mobile/ (accessed on September 4, 2011).

5 See, for example, Richard N. Langlois and Paul L. Roberts, *Firms, Markets and Economic Change: A Dynamic Theory of Business Institutions* (New York: Routledge, 1995).

6 Can Uslay, Ayca Altintig, and Robert D. Winsor, "An Empirical Examination of 'The Rule of Three': Strategy Implications for Top Management, Marketers, and Investors," *Journal of Marketing*, Vol. 74, March 2010, pp. 20-39.

Chart 3

Estimated Up-Front Capital Investments by County for Achieving "Universal" Broadband Access in Kansas



Source: Federal Communications Commission http://www.broadband.gov/plan/broadband-working-reports-technical-papers.html

across nearly all mature markets. In one group, three major players compete against each other in multiple ways: they offer a wide range of related products and services, and they serve most major market segments… As a market matures, the Big 3 become better defined and better able to solidify their positions. Anyone who wants to participate in that market has to play by the rules the big boys set. Because it is extremely difficult to go toe-to-toe against a full-line generalist, smaller players begin to carve out those areas in which they can effectively specialize… The Big 3 usually control between 70 and 90 percent of the market share, whereas each product or market specialist, by appealing to a small group with specialized needs, controls between 1 and 5 percent of the market."[7]

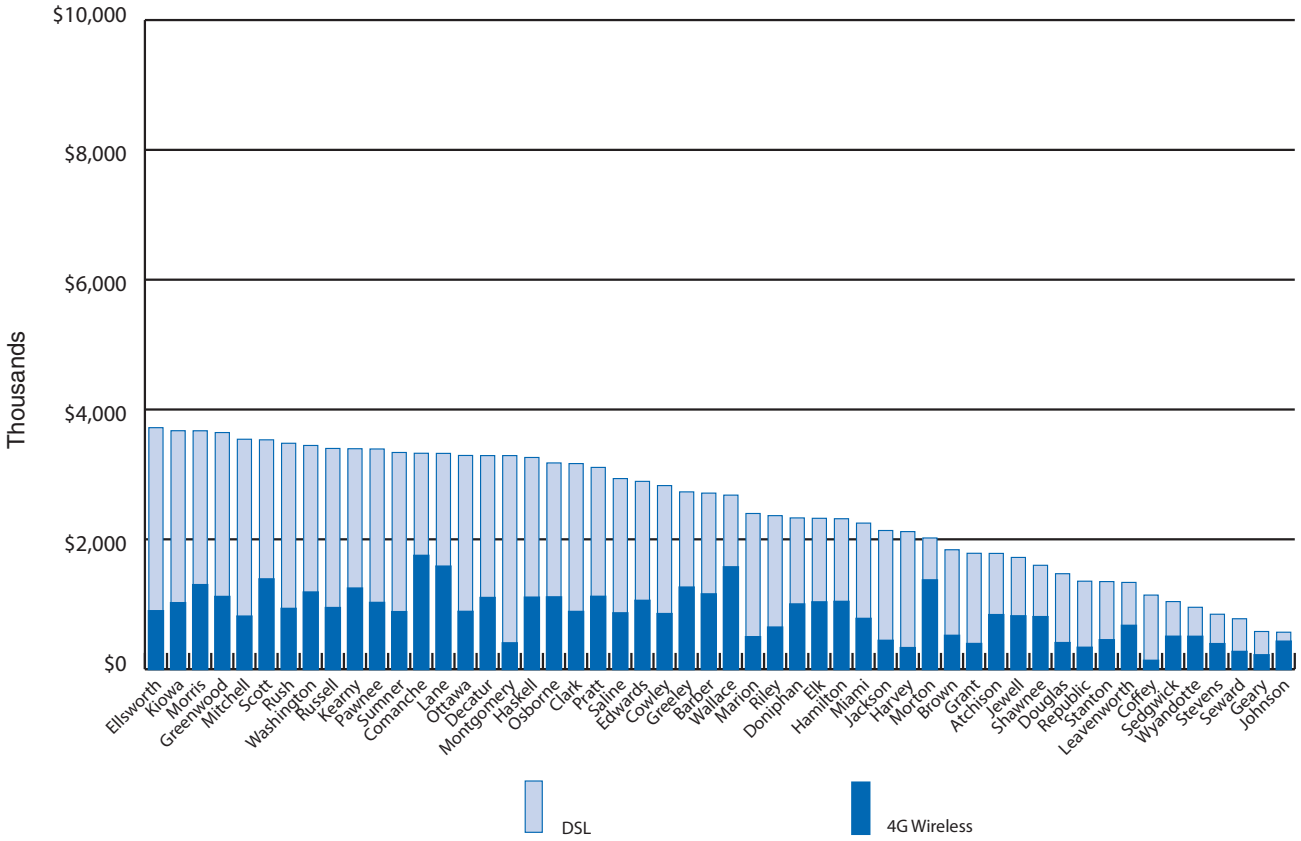
Clearly, the mobile wireless broadband industry is evolving as The Rule of Three would predict, with Verizon, AT&T, and Sprint representing the "Big 3." Sheth and Sisodia also note that a market structure comprised of three generalists and select specialists tends to create a competitive environment that supports both consumer choice and sustainable business models. Consumers can become confused by too much choice. Competition in the context of too many competitors offering the same product or service can degenerate into price wars that lead to poor quality.[8] This conclusion essentially turns on

7 Jagdish Sheth and Rajendra Sisodia, *The Rule of Three: Surviving and Thriving in Competitive Markets* (New York: The Free Press, 2002), pp. 1-3.

8 *Ibid.*, p. 6.

Chart 3 *(continued)*

Estimated Up-Front Capital Investments by County for Achieving "Universal" Broadband Access in Kansas



Source: Federal Communications Commission http://www.broadband.gov/plan/broadband-working-reports-technical-papers.html

its head the Department of Justice complaint regarding the proposed merger of AT&T and T-Mobile.

Even though Kansans have a high degree of internet connectivity, sustainable wireless business models offer the best promise for maximizing the number of Kansans with access to broadband internet connections. Wireless technologies can blanket an area with connectivity, but wires allow for connections only along linear pathways. The new generations of mobile wireless technologies (4G, for example)—along with ever-improving fixed wireless technologies (to help act as "backbones" for internet traffic)—offer faster data transmission speeds but also wider transmission radiuses. Wider radiuses mean fewer towers and, therefore, the potential for lower overall broadband deployment costs.

Chart 3 provides one set of measurements that illustrates the up-front capital investment differences between wireless broadband (4G) and DSL broadband deployment for currently unserved areas of Kansas. The height of each light-blue line in the chart represents an estimate of the up-front capital investment, by Kansas county, required to deploy DSL broadband in order to achieve

A Glossary of Terms

- G stands for generation of wireless technology.
- 3G should be capable of 2 mbps.
- 4G should be capable of up to 100 mbps in a mobile context. (Most so-called 4G offerings do not yet meet that standard.)
- WiMax: the 4G technology used by Sprint.
- LTE: the 4G technology used by Verizon and AT&T.

Source: http://www.tecca.com/columns/the-battle-to-define-4g-tech/

"universal" access in Kansas. The dark-blue line shows the same metric for 4G wireless (assuming the WiMax technology used by Sprint). In terms of state totals, the DSL option (which is less expensive than fiber optic "wires") would require an estimated capital investment of $310 million. The 4G wireless option would require an estimated capital investment of $112 million.[9]

Providers must have a sound expectation of sustainable business models in order to risk such large capital investments. In addition, on-going operating costs (on a present value basis) quite likely will equal or exceed the magnitude of the up-front capital investments depicted in Chart 3. Providers cannot cover these costs without adequate long-term customer revenues. It is likely that revenues from one market will help motivate service provision in marginal (or revenue-risky) markets. Such cross-subsidization offers one element of a potential sustainable business model.

Verizon has already begun deploying its version of 4G wireless in the Wichita and Kansas City area. Sprint and AT&T have already begun deploying their respective versions of 4G in the Kansas City area. Based on public statements, a key motivation for AT&T in pursuing the T-Mobile merger is to acquire T-Mobile's spectrum (and tower locations) to better allow it to deploy its 4G wireless broadband offering.[10] (No doubt the acquisition of T-Mobile's customers is also a key motivator from a sustainable business model perspective.) The growing scarcity of wireless spectrum is beyond the scope of this report, but it is a major policy issue at the national level.

EVIDENCE RELATED TO BROADBAND AND ECONOMIC GROWTH

The expansion of broadband use has taken place incrementally on a locality-by-locality basis. Consequently, a locality-based perspective should drive an understanding of the influence broadband expansion has had on economic development. That perspective perhaps explains why research efforts that attempt to discern the economic benefits of broadband at larger areas of geography—like the nation or the states—have not found consistent results. For example, a recent investigation seeking to discover the relationship between broadband penetration and per capita gross state product (a common measure of economic well-being) found "little or even a negative impact associated with broadband services." Despite this finding, the study also found "that increasing the broadband network significantly reduces inefficiency in state economies."[11]

This apparent contradiction actually has a straight forward interpretation. Broadband internet use is one among a complex array of economic factors that drive productivity. Productivity growth is the driving force behind per capita GDP growth, but isolating the influence of one factor is extremely difficult, especially given the perspective that broadband expansion is best analyzed in terms of localities rather than states.

Indeed, productivity itself is best evaluated as a local phenomenon—a phenomenon that happens on the frontlines of individual business units that constantly seek to create more economic value with the use of fewer resources. For example, a case-study based analysis undertaken in an attempt to quantify the productivity potential of mobile wireless broadband (estimated to be over $528 billion during the 2005-2016 time period)

9 These data come from the "base case" source data used in: Federal Communications Commission, "The Broadband Availability Gap," *OBI Technical Paper* No. 1, April 2010. The data are available for download from: http://www.broadband.gov/plan/broadband-working-reports-technical-papers.html

10 *USA Today,* "AT&T CEO Talks Optimistically about T-Mobile Deal," April 4, 2011.

11 Herbert G. Thompson, Jr. and Christopher Garbacz, "Broadband Impacts on State GDP: Direct and Indirect Impacts," 2008, p. 1. Available at: http://www.imaginar.org/its2008/62.pdf

12 Roger Entner, "The Increasingly Important Impact of Wireless Broadband Technology and Services on the U.S. Economy," A Study for CTIA-The Wireless Association, 2008. Available electronically at: http://files.ctia.org/pdf/Final_OvumEconomicImpact_Report_5_21_08.pdf

identified the following six areas in which the technology has had a measurable positive influence on productivity (with small businesses reaping the greatest proportional benefits):[12]

1. Resource and inventory management and documentation
2. Health care efficiency enhancements
3. Field service automation
4. Inventory loss reduction
5. Sales force automation
6. Replacement of desk phones with mobile wireless devices

Although use of the technology is ubiquitous, broadband internet use, from an economic development research perspective, is relatively new. Scholars have done their best with less-than-perfect data sources and different research strategies to develop an empirical understanding of the cause-and-effect relationship between broadband use and economic development. The best research necessarily relies on the lack of uniformity related to broadband proliferation in order to construct the best "natural experiments" possible.

To date, perhaps the most careful and complete research effort has been conducted by Jed Kolko of the Public Policy Institute of California.[13] The salient conclusions of his study follow (paraphrasing liberally from the report):

- Overall, most studies find that broadband has a positive relationship with employment and business establishment growth. The relationship between broadband and income (or wages) is mixed—consistent with Kolko's findings.[14]
- Broadband expansion has a positive relationship with economic growth, especially in industries that rely more on information technology and in areas with lower population densities. The evidence leans in the direction of a causal relationship, but that conclusion is not definitive (p. 1).
- The relationship between broadband expansion and employment growth appears to be mostly contemporaneous; the impact is not associated with long time lags. This finding suggests that broadband expansion did not happen more rapidly in areas with more robust future employment growth (pp. 19-20). Furthermore, the broadband-growth relationship is not driven by the relocation of jobs from lower broadband areas to higher broadband areas (p. 21).
- Population growth has an influence on the statistical results, but it does not account for most of the relationship between employment growth and broadband expansion (p. 20).
- The relationship between broadband expansion and employment growth varies by industry. The sectors whose growth is more strongly associated with broadband expansion are generally those that are more technology-intensive. The relationship is strongest for utilities; information; finance and insurance; professional, scientific, and technical services; management of companies and enterprises; and administrative and business support services. In these sectors, the same increase in broadband availability is associated with at least a 12 percentage point higher employment growth. The relationship is statistically weaker for mining and public administration. With adequate controls for the influence of population growth, the statistical

13 Jed Kolko, "Broadband and Local Growth," August 2010. Electronic copy available at: http://ssrn.com/abstract=1680597. A version of the study was published as: "Does Broadband Boost Local Economic Development?" Public Policy Institute of California, January 2010.

14 See, for example: Crandall, R., Lehr, W., & Litan, R. (2007), "The Effects of Broadband Deployment on Output and Employment: A Cross-Sectional Analysis of U.S. Data"; LynneHolt and Mark Jamison, "Broadbandand Contributions to Economic Growth: Lessons from the US Experience," *Telecommunications Policy,* Vol. 33 (2009), pp. 575–581; Kristin Van Gaasbeck, et. al, "Economic Effects of Increased Broadband Use in California," Sacramento Regional Research Institute, November 2007; Peter F. Orazem, "The Impact of High-Speed Internet Access on Local Economic Growth," Kansas, Inc. Research Report, August 2005.

relationship with employment growth in manufacturing; educational services; and arts, entertainment, and recreation become insignificant (pp. 21-22).

- Broadband expansion has a positive, statistically significant relationship with growth due to the births and deaths and expansions and contractions of business establishments. The relationship between average business establishment size and broadband expansion is positive, suggesting that the benefits of broadband might have favored larger firms earlier and smaller firms more recently. This situation could arise if early adopters of a technology faced higher fixed costs of adoption and later adopters faced lower costs of adoption as costs fell with broader market penetration (p. 21).
- Aside from the obviously high consumption value of internet services, the economic benefits of broadband for residents appear to be limited. Broadband does not affect the average wage or the employment rate (the share of working-age adults that is employed). Expanding broadband availability does not change the prevalence of telecommuting or other home-based work (p. 1 & 28).

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