ECONOMIC IMPACT OF WIRELESS BROADBAND IN RURAL AMERICA

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EXECUTIVE SUMMARY

This study, utilizing federal and state level statistics and relying on econometric analysis, estimates the economic impact that full deployment of rural wireless broadband would have on rural America. It is based on the premise that requiring interoperability among all carriers operating in the 700 MHz band and data roaming, the fundamental building blocks for rural and regional broadband deployment, will enable investment and, consequently, rapid deployment of wireless broadband infrastructure in unserved and underserved geographies. This investment will result in the creation and/or retention of 117,000 jobs in the nineteen states that have the lowest broadband availability and penetration in the United States.[1] Jobs will be primarily concentrated in the wholesale trade, health and financial services sectors. Of the total 117,000 jobs, approximately 38,500 will be new jobs created as a result of the economic boost provided by wireless broadband in rural areas. The remaining 78,500 jobs will be saved as a result of the combination of economic growth and increased capabilities resulting from the ability to gain access to broadband services.

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Rural America comprises the largest portion of unserved and underserved broadband population. Of the 7,035,613 housing units identified as either unserved (cannot access broadband service) or underserved by the National Broadband Plan,[2] a plurality is located in what the Census Bureau classifies as rural counties. This is no surprise since the broadband deployment plans of national carriers do not prioritize rural fixed or mobile broadband capital investment.[3] In these territories, lower customer density and/or populations that are depressed socio-economically do not result in attractive economics of network deployment.

Given this systematic lack of investment in providing rural areas with broadband services, the Federal Communications Commission in its 2010 National Broadband Plan identified the deployment of broadband technology in unserved and underserved communities as a national priority. In particular, the National Broadband Plan emphasized that wireless broadband, specifically the service offered within the 700 MHz frequency band, was among the most viable technologies for addressing these gaps.[4] In

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[1] For purposes of the analysis, states with less than 90 % of households served by 4 megabytes per second broadband service (standard of service defined by the FCC) were selected. Based on the statistics gathered by the Federal Communications Commission, the list comprises West Virginia, Arkansas, Mississippi, Alaska, South Dakota, Montana, North Dakota, Kentucky, New Mexico, Missouri, Wyoming, Oklahoma, Louisiana, North Carolina, Alabama, Kansas, Virginia, Tennessee, and Maine. This approach has the advantage of considering only those geographies that are facing major infrastructure access shortfalls, as opposed to a demand (penetration) problem.

[2] Source: FCC (2010). National Broadband Plan estimated housing units without service of 4 Mbps download speed in http://www.broadband.gov/maps/availability.htm.

[3] See Atkinson and Schultz (2009). *Broadband in America: where it is and where it is going.* New York: Columbia Institute for Tele-Information

[4] See Federal Communications Commission (2010).

addition, one of the basic objectives of the Broadband Technology Opportunity Program (BTOP) and Broadband Initiatives Program (BIP) is to stimulate deployment of broadband facilities in unserved or underserved communities. In light of these priorities, the current assumption is that the desired coverage goals will result from a combination of the investment of the private sector, primarily rural carriers, and government stimulus, such as the BTOP and the USDA Broadband Loan programs.

However, two obstacles challenge this goal. First, while rural carriers have acquired 700 MHz spectrum to deliver broadband services in their footprint, they face interoperability and data roaming challenges with service providers operating in other bands. This situation has the potential to significantly arrest the deployment of wireless infrastructure in areas currently unserved by broadband. The FCC has not completed action on these issues which have been pending before the Commission since 2009 and 2005, respectively. This is will not help to support the shared goal of the President, Congress and the FCC to spur broadband deployment throughout the U.S.

Second, a large portion of the public funds that are dedicated to broadband deployment as part of the BTOP and BIP programs are being assigned to fiber optics infrastructure, which is more suited economically and technically to providing service in urban and suburban environments. Furthermore, a portion of the BTOP spending has focused on middle mile infrastructure as opposed to *last mile* access enablement. A similar problem of fund misallocation was identified in a 2005 audit by the USDA's Inspector General of the RUS (Rural Utility Service) Broadband Loan Program, determining that nearly 12 percent of total loans went to suburban communities located near large cities (USDA, Office of Inspector General, Southwest Region 2005).[5] Under these conditions, it is fair to assume that, if public funds do not flow to rural wireless projects and rural wireless providers are not supported by the right interoperability framework, the deployment of wireless broadband in rural America will be delayed.

The objective of this study is to evaluate the employment and income opportunity costs that result from not mandating data roaming nor requiring interoperability in the 700 MHz band for wireless carriers serving rural America. The study focuses on three specific states with different characteristics (Kentucky and West Virginia, with high rural population and Ohio, which exhibits larger urban and suburban concentrations) and estimates, by means of econometric analysis, the economic impact that broadband has had in the past years. With this evidence in hand, the study projects the potential economic impact of wireless broadband deployment in the unserved and underserved areas of the three States, and then extrapolates the results for the nineteen states with less than 90% coverage of broadband service of at least 4 Mbytes.

The study shows how the broadband supply gap represents a critical issue for states with

[5] A follow-up audit found that this situation was not remedied, noting that between 2005 and 2008, broadband loans were extended to 148 communities within 30 m of cities with populations greater than 200,000 - including Chicago and Las Vegas (USDA. 2009. *Audit report: Rural utilities service broadband grant and loan programs. Audit Report* 09601-8-TE. http://www.usda.gov/oig/webdocs/09601-8-TE.pdf.

a considerable rural economy. While at the national level, unserved or underserved broadband households represent 6.1% of all households, this metric increases dramatically in rural geographies, for example reaching 14.0% in Kentucky, and 21.8% in West Virginia. Obviously, the supply gap, which measures service coverage, does not equate to penetration, which measures adoption of broadband. However, the rural lag still exists: while national broadband penetration has reached 64% of households, in Kentucky it is 54% and in West Virginia it is 52%[6].

It is expected that, even under universal coverage conditions, a portion of the non-adopting households would not be subscribing to broadband service simply due to demand issues such as affordability and educational factors. [7] Nevertheless, unless these communities are given the opportunity to connect to the Internet, they will remain permanently marginalized and the economic penalty would be significant. Below we review our results for Kentucky, Ohio and West Virginia in turn, and extend the analysis to the 19 states that rank lowest in broadband availability and penetration.

THE BROADBAND OPPORTUNITY IN KENTUCKY

According to the latest FCC statistics, [8] there are 1,221,000 broadband lines in Kentucky. The growth of broadband lines has increased at an average rate of 57% over the past ten years, reaching a penetration of 20% of the population, or 54% of households. On the supply side, broadband service (at download speeds higher than 4 megabytes per second, which is the standard defined by the FCC for universal broadband service) is currently available to 86% of households, leaving 14% (266,000) either unserved or underserved.[9]

Broadband availability has had an important and statistically significant impact on job creation and the increase of median income in Kentucky. Our estimations, based on econometric analyses of data between 2004 and 2007, show that the lack of broadband service availability has an impact on job creation and income in both metropolitan and rural counties (see Table A).

[6] Economics and Statistics Administration and National Telecommunications and Information Administration (2010).
Exploring the digital nation: home broadband internet adoption in the United States. Washington, D.C., November.
[7] Source: Horrigan (2009). *Home broadband adoption* 2009. Pew Internet and American Life Project.
[8] Source: FCC's report "Internet Access Services: Status as of June 30, 2009." (2010)
[9] Source: National Broadband Plan (2010).

Table A. Kentucky: Impact of a 1 % point increase in Broadband Availability on Employment and Median Income

	Impact on Median Income	Impact on Employment
Metropolitan Counties	0.0968*	0.0303
Rural Counties Adjacent to Metro counties	0.0704*	-0.1953*
Rural Counties Isolated from Metro Counties	0.0800*	

*Significant at the 1 % level

Source: Data compiled from Connect Kentucky databases, and ESRI Business Analyst Sourcebook for County demographics; analysis by the authors.

In particular, broadband penetration has been found to be statistically significant on the growth in employment in the financial services and insurance, wholesale trade, and health sectors of Kentucky, even within rural counties (see Table B).

Table B. Kentucky: Impact of a 1% increase in Broadband Penetration on Industrial Sector Employment

Industry Sector	All Counties	Rural Counties
Financial Services and Insurance	0.678 (**)	0.517 (***)
Wholesale trade	0.846 (*)	0.836 (**)
Health Services	0.126 (*)	0.122 (**)

(*) Significant at 1% level
(**) Significant at 5% level
(***) Significant at 10% level

Source: Data compiled from US Census Bureau, Connect Kentucky databases, and ESRI Business Analyst Sourcebook for County demographics; analysis by the authors.

Based on the historical (2004-9) effect of broadband on Kentucky's county employment and median income, the impact of broadband availability on future economic growth and employment was estimated. Thus, if broadband availability were to increase to 100 % through deployment of 700 MHz wireless technology, this would result in 10,235 jobs created or saved resulting from business expansion enabled by broadband between 2011 and 2014.[10] Of these jobs, 3,254 will be new jobs resulting from new economic activities triggered by wireless broadband deployment in rural counties. Conversely, 6,981 jobs will be saved as a result of the combined impact of economic growth and enhanced capabilities that will be provided to those workers as a result of wireless broadband. The largest portion of jobs created or saved would be concentrated in the rural counties adjacent to metropolitan areas (6,017 jobs), although a significant portion would also be

[10] It is important to recognize that the number of jobs saved/created is limited by the natural unemployment rate, and therefore we cannot expect to realize the projected level of jobs if people are already employed. However, as of now, the unemployment rate in Kentucky is at 10%, well above the natural rate of 4-5%.

created or saved in rural isolated counties (4,218). Increasing broadband availability to 100% would also cause the median income of each county to grow on average by 2.1% ($ 914) of Kentucky's median income, which is $43,765.

THE BROADBAND OPPORTUNITY IN OHIO

Based on the FCC latest reported statistics,[11] there are 4,107,000 broadband lines in Ohio. The growth of broadband lines has increased at an average rate of 34% over the past ten years, reaching a penetration of 30% of the population, or 61% of households. On the supply side, broadband service at download speeds higher than 4 megabytes per second is currently available to 98% of households, leaving 2% (123,456) either unserved or underserved.[12]

If broadband availability were to increase to 100 % through deployment of 700 MHz wireless technology, this would result in 5,744 jobs created or saved resulting from business expansion between 2011 and 2014.[13] Of this amount, it is estimated that 860 will be new jobs resulting from new economic activities triggered by wireless broadband deployment in rural counties and 4,884 jobs will be saved as a result of the combined impact of economic growth and enhanced capabilities that will be provided to those workers as a result of wireless broadband.

The largest number of jobs would be created in rural isolated areas (4,817), which raise the likelihood of retention of population in these environments. As above, the number of jobs saved/created is limited by the natural unemployment rate. Increasing broadband availability to 100% would also cause the median income of each county to increase by $428 on average which represents 0.8% increase in Ohio's median income of $52,047. Again, the study estimates that there is an opportunity cost of not deploying 700 MHz service in Ohio and achieving 100% broadband availability.

THE BROADBAND OPPORTUNITY IN WEST VIRGINIA

According to the FCC,[14] there are 518,000 broadband lines in West Virginia. The growth of broadband lines has increased at an average rate of 55% over the past ten years, reaching a penetration of 24% of the population, or 52% of households. Fixed broadband service (at speeds higher than 4 Mbps) is currently available to 78% of households, leaving 194,789 households unserved or underserved.

Based on the historical effect of broadband on West Virginia's county employment and

[11] Source: FCC's report "Internet Access Services: Status as of June 30, 2009." (2010)
[12] Source: National Broadband Plan (2010).
[13] Because data for the panel regression was only available for Kentucky, projections for Ohio relied on the econometric estimates from the former. It is considered, however, that these estimates are relatively reliable due to the rich set of controls and the inclusion of county fixed effects. Therefore, the projections assume that, given the set of controls (such as income, population density, etc.), rural counties in Ohio respond to broadband in a way that is similar to rural counties in Kentucky. The same assumption applies for metro counties in Ohio and West Virginia.
[14] Source: FCC's report "Internet Access Services: Status as of June 30, 2009." (2010)

income, the impact of broadband availability on future economic growth and employment was estimated. Thus, if broadband availability were to increase to 100% through deployment of 700 MHz wireless technology, this would result in 4,793 jobs created or saved from business expansion between 2011 and 2014. Of the total jobs, 910 will be new jobs resulting from new economic activities triggered by wireless broadband deployment in rural counties. Conversely, 3,883 jobs will be saved as a result of the combined impact of economic growth and enhanced capabilities that will be provided to those workers as a result of wireless broadband. The largest portion of jobs created or saved will be in rural isolated environments (3,042). Increasing broadband availability to 100% would also cause the median income of each county to increase by $1,264 on average. This represents 3.43% increase in West Virginia's median income, which is $36,804. In sum, the study also concludes that there is a significant opportunity cost of not deploying 700 MHz service in West Virginia and achieving 100% broadband availability.

ESTIMATING THE IMPACT ON RURAL AMERICA

In addition, the study estimated the economic impact of making broadband fully available in the nineteen states with 4 megabytes per second broadband access below 90%. According to these estimates, by relying on wireless broadband and therefore, providing 100% of coverage, 116,862 jobs can be created or saved between 2011 and 2014, while on average, the median income per county in those states could be increased by $1,201. (see Table C).

TABLE C. Employment Impact of Full Broadband Availability in 19 States

State	Percent of Unserved or Underserved Households	Population Penetration	Jobs Created /Saved	New Jobs	Saved Jobs
Alabama	12.0%	19%	7,587	2,585	5,002
Alaska	20.7%	23%	1,845	507	1,338
Arkansas	25.2%	18%	8,960	3,733	5,227
Kansas	11.6%	23%	3,056	1,114	1,942
Kentucky	14.0%	20%	10,235	3,254	6,981
Louisiana	12.8%	20%	6,237	1,771	4,466
Maine	10.0%	25%	1,537	242	1,295
Mississippi	23.0%	15%	13,077	3,430	9,647
Missouri	13.6%	21%	10,016	1,964	8,052
Montana	17.3%	22%	2,280	742	1,538
N. Carolina	12.3%	23%	13,288	5,540	7,748
N. Dakota	16.5%	24%	660	206	454
N. Mexico	15.1%	19%	3,771	1,226	2,545
Oklahoma	13.1%	20%	5,855	1,815	4,040
S. Dakota	18.7%	22%	1,314	539	775
Tennessee	10.1%	20%	11,192	4,188	7,004
Virginia	11.2%	24%	10,163	4,141	6,022
W. Virginia	21.8%	24%	4,793	910	3,883
Wyoming	13.5%	22%	996	502	494
Total	14.1%	21%	116,862	38,409	78,453

Source: Data compiled from US Department of Labor: Local Labor Unemployment Statistics; analysis by the authors Federal Communications Commission, Economics and Statistics Administration and National Telecommunications and Information Administration

The employment generation number comprises both new jobs to be created as a result of the deployment of wireless broadband in rural areas, and jobs in those regions that can be preserved as a result of both economic growth and the added capabilities that workers would develop as a result of gaining access to broadband. Considering the total employment impact of 116,862 jobs, it is estimated that new jobs would amount to 38,409, while 78,453 jobs would be preserved.[15]

In conclusion, the opportunity cost of not allowing rural carriers to roam or interoperate

[15] Estimates are provided to the last digit to provide traceability to economic calculations.

with national carriers at the 700 MHz band is significant. Service deployment in this band is the only choice for unserved and underserved households to gain access to broadband at the service speed stipulated in the National Broadband Plan. If these policy changes were to be enacted, accessibility to service would have a significant economic impact. In the three states analyzed in this study, filling up the supply gap (14% in Kentucky, 2.5% in Ohio, and 22% in West Virginia) could result in 20,772 jobs created or saved resulting from business expansion between 2011 and 2014, and an increase in median income, ranging from $914 in Kentucky to $428 in Ohio, and $ 1,264 in West Virginia. In addition, by making broadband fully available in the nineteen states with lowest broadband coverage, 116,862 jobs could be created or saved between 2011 and 2014, of which 38,409 are new jobs.

TABLE D. Impact of Full Broadband Availability

	Kentucky	**Ohio**	**W. Virginia**	**19 States***
Unemployment (October 2010)	10.0 %	9.9 %	9.3 %	8.39 %
Jobs created or preserved by broadband (2011-4) New Jobs Preserved Jobs	10,235 3,254 6,981	5,744 860 4,884	4,793 910 3,883	116,862 38,409 78,453
Median income (2010)	$ 43,765	$ 52,047	$ 36,804	$47,055
Increase in median income	$ 914	$ 428	$ 1,264	$1,201

(*) Comprises West Virginia, Arkansas, Mississippi, Alaska, South Dakota, Montana, North Dakota, Kentucky, New Mexico,
Missouri, Wyoming, Oklahoma, Louisiana, North Carolina, Alabama, Kansas, Virginia, Tennessee and Maine.

Source: Data compiled from US Census Bureau, Connect Kentucky, Connect Ohio databases, and ESRI Business Analyst Sourcebook for County demographics; analysis by the authors

1. INTRODUCTION:

Rural America comprises the largest portion of unserved and underserved broadband population. Of the 7,035,613 housing units under this category highlighted in the Broadband Map developed for the National Broadband Plan, a large portion is located in what the census bureau classifies as rural counties. This is no surprise since, as expected, the broadband deployment plans of national carriers do not include in their priorities the construction of either fixed or mobile broadband facilities in these territories because their lower customer density and/or low socio-economic population do not result in attractive economics of network deployment. In addition to the unserved populations, the broadband map estimates that of the 7,035,613 households that can only purchase service with a download speed that is less than 4Mbps 4,326,299 are located in rural counties[16].

It is in this context that the National Broadband Plan enacted in 2010 identified as a national priority the deployment of broadband technology to address the unserved and underserved communities. In particular, the National Broadband Plan emphasized that wireless broadband, more specifically the services offered within the 700 MHz frequency band, was one of the primary technologies suited to address these gaps. In addition to the goals outlined in the National Broadband Plan, one of the basic objectives of the Broadband Technology Opportunities Program (BTOP), a stimulus program included in the American Recovery and Reinvestment Act, is to promote deployment of broadband facilities covering what are today unserved or underserved communities.

In light of these priorities, one could assume that achieving the desired coverage goals would result from a combination of the investment of the private sector, primarily rural carriers, and government stimulus, such as the BTOP program. However, two obstacles have appeared that do not allow this goal to be achieved. First, while rural carriers have acquired 700 MHz spectrum to deliver broadband services, they face the lack of interoperability framework with service providers operating in other bands. This situation has the potential to hamper the deployment of wireless infrastructure in areas currently unserved by broadband. Second, a portion of the public funds being dedicated to broadband deployment as part of the BTOP program are being assigned to fiber optics infrastructure, which is more suited economically and technically to providing service in urban and suburban environments.

Given this situation, it is fair to assume that unless rural wireless providers are not supported by the right interoperability framework and supply conditions (e.g. interoperability with national carriers), the private sector investment of wireless broadband in rural America will be delayed. The negative impact of this state of affairs in terms of job creation and economic growth could be significant.

The objective of this study is to evaluate the employment and income opportunity costs that result from not allowing wireless broadband interoperability in rural America. First, it reviews evidence from other studies regarding the economic impact that broadband has on the economy in general and in rural America in particular. Second, it focuses on three

[16] Rural counties denoted by USDA rural-urban continuum codes 4 and up.

specific states (Kentucky, Ohio, and West Virginia) and studies, by means of econometric analysis; the economic impact that broadband has had in the past years. With this evidence, the study projects the potential economic impact of deploying broadband in the unserved and underserved areas of the three States, thereby providing the basis for assessing the opportunity cost of not providing carrier interoperability to rural service providers in the 700 MHz band.

2. OUTLINING THE PROBLEM:

The broadband supply gap in rural America is significant. At the national scale the 7,035,613[17] unserved or underserved households represent 6.1 % of all units. However the unserved and underserved households within these three states amount to 584,285 or 7.97 % overall, reaching 14.0 % in Kentucky, and 21.8% in West Virginia.

Table 1. Unserved and Underserved Households in Kentucky, Ohio and West Virginia (2009)

		Kentucky	Ohio	West Virginia	Total
Number of Households		1,934,973	4,495,000	893,771	7,323,744
Unserved Households	Number of Households	96,749	94,395	107,253	298,397
	Percent of Households	5 %	2.1%	12 %	4 %
Underserved Households	Number of Households	169,291	29,061 (*)	87,536	285,888
	Percent of Households	8.7 %	0.64 %(*)	9.8 %	3.97 %
Total (unserved and underserved)	Number of Households	266,040	123,456	194,789	584,285
	Percent of Households	13.7 %	2.74%	21.8 %	7.97%

NOTES:

- Total (unserved and underserved) number is captured in the statistics gathered as part of the National Broadband Plan and include both unserved and households served by less than 4 Mbps service
- Unserved households is calculated by dividing the total number of covered residential lines (with service above 200 Kbps) presented in FCC Form 477 by total number State households; in Kentucky, the Connect Kentucky data on service availability was used, in Ohio, the Connect Ohio data on service availability was used
- Underserved households is calculated by subtracting the unserved households to the total (unserved and underserved)

(*) Statistic underestimated because, according to the FCC database, 18 out of 87 counties have not reported results

Sources: Broadband Map; US Census Bureau (Population Bureau); Connect Kentucky Survey; analysis by the authors

[17] Source: FCC National Broadband Plan estimated housing units with service under 4 Mbps download speed.

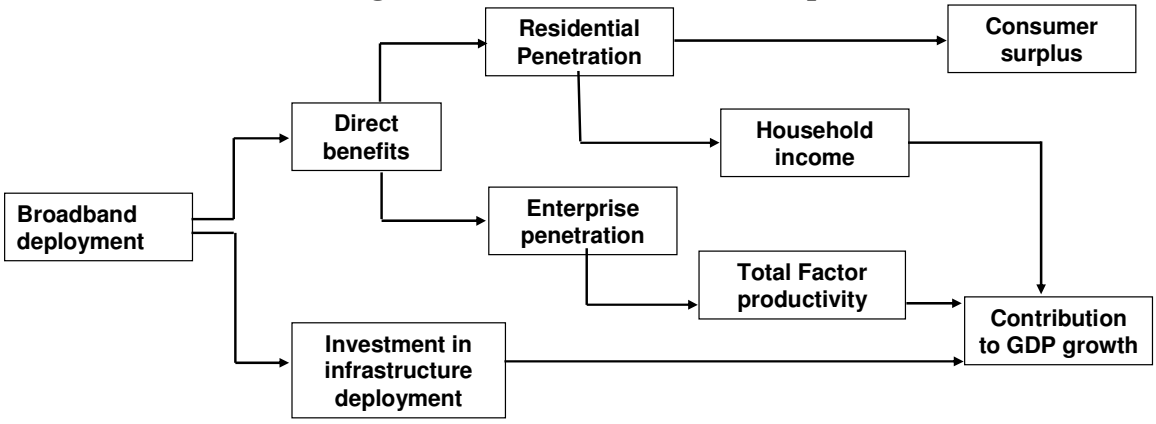
Obviously, supply gap does not equate to penetration in the sense that even under universal coverage conditions it would be expected that a number of these households would not be subscribing to broadband service simply due to issues related to affordability and educational factors[18]. Nevertheless, unless these communities are not given the opportunity to connect to the Internet they will remain permanently marginalized.

If the Internet does not become available to the rural population, there could be significant opportunity costs to job creation and economic development. This study will estimate how large these social costs are. It will review the evidence from rigorous economic studies and perform our own analysis for the three states under consideration. In this vein, it will estimate the economic returns (in terms of jobs created and income) of deploying broadband in the unserved geographies of the three states.

3. RESEARCH EVIDENCE OF THE ECONOMIC IMPACT OF BROADBAND:

The economic impact of broadband is composed of four types of effects (see figure 1).

Figure 1. Broadband economic impact



The first effect results from the construction of broadband networks. Like any infrastructure project, the deployment of broadband networks creates jobs and acts over the economy in a way that is encapsulated by multipliers measuring the interrelationship between industrial sectors. The second effect results from calculated gains and "spill-over" externalities, (such as network effects and innovation), which impact both enterprises and consumers. For enterprises, the adoption of broadband within firms leads to a multifactor productivity gain, which in turn contributes to growth of GDP. On the other hand, residential adoption has a multiplier effect that increases real household income. Beyond these direct benefits which contribute to GDP growth, residential users receive a benefit to their consumer surplus, which is defined as the difference between what they would be willing to pay for broadband service and its price. While this last parameter is not captured in the GDP statistics, it can be quite large. Consumers may be willing to pay substantially above the market price for benefits such as enhanced access to information, entertainment and public services.

[18] See Horrigan (2009).

Broadband research that shows hard evidence of an economic impact is fairly recent. The evidence generated so far falls into three categories:

- Contribution of broadband deployment to employment and output ("countercyclical effect")
- Impact on GDP growth and employment ("externalities")
- Creation of consumer surplus

Each set of studies will be briefly reviewed.

3.1. Contribution to employment and output of broadband deployment:

Six national studies have estimated the impact of network construction on job creation: Crandall et al. (2003), Katz et al. (2008), Atkinson et al. (2009), Liebenau et al. (2009) Katz et al. (2009), and Katz et al. (2010). They all relied on input-output analysis and assumed a given amount of capital investment: US $ 63 billion (needed to reach ubiquitous broadband service) for Crandall et al. (2003), CHF 13 billion for Katz et al. (2008) (to build a national multi-fiber network for Switzerland), US $ 10 billion for Atkinson et al. (2009) (as a US broadband stimulus), US$ 6.3 billion to implement the Broadband Technology Opportunity Program (Katz et al., 2009), US $ 7.5 billion for Liebenau et al. (2009) (needed to complete broadband deployment in the United Kingdom), and US $ 45 billion for Katz et al. (2010) (required to implement Germany's National Broadband Strategy).

Since these studies evaluate countercyclical plans devised to face the economic crisis, their primary focus is estimating the impact of broadband on jobs. All studies calculate multipliers, which measure the total employment change throughout the economy resulting from the deployment of a broadband network. In addition to network construction (direct employment), broadband deployment has two other employment effects. Network deployment results in indirect job creation, which is incremental employment generated by businesses selling to those industries that are directly involved in network construction. It also causes induced job creation, which is additional employment induced by household spending of the income earned from the direct and indirect effects (see Table 2).

Table 2. Broadband Construction Impact on Job Creation

Country	Study	Objective	Results
United States	Crandall et al. (2003)	Estimate the employment impact of broadband deployment aimed at increasing household adoption from 60% to 95%, requiring an investment of US $ 63.6 billion	• Creation of 140,000 jobs per year • Total jobs: 1.2 million (comprising 546,000 for construction and 665,000 indirect)
	Atkinson et al. (2009)	Estimate the impact of a US $10 billion investment in broadband deployment	• Total jobs: 180,000 (including 64,000 direct and 116,000 indirect and induced
	Katz et al. (2009)	Estimate the impact of a US $6.3 billion investment in the BTOP program	• Total jobs: 127,800 (comprising 37,300 direct, 31,000 indirect, and 59,500 induced)
Switzerland	Katz et al. (2008)	Estimate the impact of deploying a national broadband network requiring an investment of CHF 13 billion	• Total jobs: 114,000 (including 83,000 direct and 31,000 indirect)
United Kingdom	Liebenau et al. (2009)	Estimate the impact of investing US $ 7.5 billion to achieve the target of the *"Digital Britain*" Plan	• Total jobs: 211,000 (including 76,500 direct and 134,500 indirect and induced)
Germany	Katz et al. (2010)	Estimate the impact of a US $45 billion investment in the National Broadband Strategy	• Total jobs: 541,000 (comprising 281,000 direct, 126,000 indirect, and 75,000 induced

Source: Compiled by the authors

There are two types of multipliers. Type I multipliers measure the direct and indirect effects (direct plus indirect divided by the direct effect), while Type II multipliers measure Type I effects plus induced effects (direct plus indirect plus induced divided by the direct effect). Cognizant that multipliers from one geographic region cannot be applied to another, it is useful to observe the summary results for the multipliers of the six input-output studies (see table 3):

Table 3. Employment Multiplier Effects of Studies relying on Input-Output Analysis

Country	Studies	**Type I**	**Type II**
EE.UU.	Crandall et al. (2003)	N.A.	2.17
	Atkinson et al. (2009)	N.A.	3.60
	Katz et al. (2009)	1.83	3.42
Switzerland	Katz et al. (2008)	1.38	N.A.
United Kingdom	Liebenau et al. (2009)	N.A.	2.76
Germany	Katz et al. (2010)	1.45	1.92

Note: Crandall et al. (2003) and Atkinson et al. (2009) do not differentiate between indirect and induced effects, therefore we cannot calculate Type I multipliers; Katz el (2008) did not calculate Type II multiplier because induced effects were not estimated.

Source: Compiled by the authors

The results indicate that multipliers are significant. According to the sector interrelationships depicted above, European economies appear to experience lower

indirect effects than the US economy. Furthermore, the decomposition also indicates that induced job creation is an important effect that occurs as a result of household spending based on the income earned from the direct and indirect effects.

3.2. Impact on GDP growth and employment through externalities:

The study of broadband externalities covers numerous aspects. These range from the aggregate impact on GDP growth, to the differential impact of broadband by industrial sector, the increase of exports, and changes in intermediate demand and import substitution. While the research has confirmed that broadband has a significant positive impact on GDP growth, it has also yielded results that vary widely. Constrained by data availability, the analyses have primarily focused on OECD countries (generally Western European and North American) and states in the United States (see table 4).

Table 4. Research results of Broadband Impact on GDP growth

Country	Study	Data	Effect
United States	Crandall et al (2007)	48 States of US for the period 2003-2005	Not statistically significant results
	Thompson and Garbacz (2009)	46 US States during the period 2001-2005	A 10% increase in broadband penetration is associated with 3.6% increase in efficiency
OECD	Czernich et al. (2009)	25 OECD countries between 1996 and 2007	The adoption of broadband raises per-capita GDP growth by 1.9-2.5 percentage points
	Koutroumpis (2009)	2002-2007 for 22 OECD countries	An increase in broadband penetration of 10% yields 0.25% increase in economic growth
High Income Economies	Qiang et al. (2009)	1980-2002 for a high income subset of 120 countries	10 % broadband penetration yielded an additional 1.21 percentage points of GDP growth
Low and Middle income economies	Qiang et al. (2009)	1980-2002 for the remaining 120 countries (low and middle income)	10 % broadband penetration yielded an additional 1.38 in economic growth

Source: Compiled by the authors

As the data in table 4 indicates, most studies conclude that broadband penetration has an impact on GDP growth. However, the estimates of the impact coefficient vary widely, from 0.25 to 1.38 percent for every increase in 10 % of penetration[19].

There are several explanations for this variance. Clearly, some of the discrepancies come from the usage of different datasets as well as model specifications. However, in some cases differences may be due to methodological shortfalls. For one, at very high levels of data aggregation such as country data, cross-sectional econometric models cannot account for the wide discrepancy between regions that are caused by fixed effects. For

[19] Or .36% if we make the standard assumption that 1% increase in productivity or efficiency results in 1% increase in GDP.

example, a large portion of the variance in the study by Qiang et al. (2009) is explained by dummy variables for Africa and Latin America (nearly 10 times as much as the estimate given by Barro (1991) in the original formulation of the model). This suggests that the preferred methods of analysis are to perform differences-in-differences or to use fixed effects with panel data. It also justifies the need to conduct the analysis at lower levels of aggregation such as states and, where data is available, even counties or postal codes.

In addition to analyses of the contribution to GDP growth, researchers have studied the impact of network externalities on employment, which are variously categorized as "innovation", or "network effects" (Atkinson et al., 2009). Studies have identified numerous externalities that result from broadband. They include: 1) innovative applications and services, such as telemedicine, Internet search, e-commerce, online education and social networking (Atkinson et al., 2009), 2) new forms of commerce and financial intermediation (Atkinson et al., 2009), 3) business revenue growth (Varian et al., 2002; Gillett et al, 2005), and 4) growth in service industries (Crandall et al. (2007).

Most of the research regarding the impact of broadband externalities on employment has been conducted using US data. Two types of studies analyze these effects: regression analyses and top down multipliers. The first ones attempt to identify the macro-economic variables that can impact employment[20], while the second ones rely on top-down network effect multipliers. An examination of the results from regression studies suggests that the evidence regarding broadband employment externalities is quite conclusive (see table 5).

Table 5. Research results of Broadband Impact on Employment

Country	Study	Data	Effect
United States	Crandall et al. (2007)	48 States of US for the period 2003-2005	For every 1 % point increase in broadband penetration in a state, employment is projected to increase by 0.2 to 0.3 percent per year "assuming the economy is not already at 'full employment'"
	Thompson and Garbacz (2009)	46 US States during the period 2001-2005	Positive employment generation effect varying by industry
	Gillett et al. (2006)	Zip codes for the US for the period 1999-2002	Broadband availability increases employment by 1.5%
	Shideler et al. (2007)	Disaggregated county data for state of Kentucky for 2003-4	An increase in broadband penetration of 1% contributes to total employment growth ranging from 0.14% to 5.32% depending on the industry

Source: Compiled by the authors

Again, the impact of broadband on employment creation appears to be positive. However, the estimated impact on employment growth varies widely, ranging from 0.2 %

[20] In general, studies based on regression analysis do not differentiate between construction and spill-over effects.

to 5.32 % for every increase in 1% of penetration. There are several explanations for this variance. As Crandall indicated, the overestimation of employment creation in his study is due to employment and migratory trends which existed at the time and biased the sample data. In the case of Gillett et al. (2006), the regressions might not adequately represent labor markets. Researchers should be careful about analyzing local effects because zip codes are small enough areas that cross-zip code commuting might bias estimates on the effect of broadband. For example, increased wages from broadband adoption in one zip code would probably raise rent levels in neighboring zip codes because of commuters. Finally, the wide range of estimates in the case of Shideler et al. (2007) is explained by the isolation of industry-specific effects.

Beyond regression studies, "network effect" multipliers have been used to assess the impact of broadband on job creation in a top down fashion. For example, Pociask (2002) and Atkinson et al. (2009) relied on estimated "network effect" multipliers which were applied to network construction employment estimates. Pociask relied on two multiplier estimates (an IT multiplier of 1.5 to 2.0 attributed to a think tank and another multiplier of 6.7, attributed to Microsoft) and calculated an average of 4.1. Similarly, Atkinson et al. (2009) derived a multiplier of 1.17 from Crandall et al. (2003). While easy to implement, the top-down approach for estimating broadband impact does not have a strong theoretical basis. Network effects are not built on interrelationships between sectors. They refer to the impact of the technology on productivity, employment and innovation by industrial sector.

3.3. Creation of consumer surplus:

This type of analysis estimates the utility consumers gain from broadband rollout. Consumers have a utility gain because they can purchase a product at a lower price than they are willing to pay. To estimate the consumer surplus gains that are generated by an investment, one has to compare the initial (before the investment) consumer surplus with the consumer surplus at the end of the investment. During an investment period consumer surplus may change because of two reasons. The first is an outward-shift of the demand curve and the second is a price reduction. A shift in demand may occur because of broader broadband penetration. A price reduction can result from productivity gains and competition. In the case of deployment of broadband infrastructure, competition becomes effective at the applications layer. This development is responsible for an increase in consumer surplus in future periods compared to former periods.

Consumer surplus can also be conceptualized in terms of the benefits of broadband to the end user. The variables driving willingness to pay include rapid and efficient access to information, savings in transportation for conducting transactions, and benefits in health and entertainment. This approach has been utilized by Crandall and Jackson (2003) to estimate the US consumer surplus derived from new services like shopping, entertainment and telemedicine enabled by broadband infrastructure. Similarly, Lee and Lee (2006) relied on regression techniques to estimate the consumer surplus for the Korean telecommunications market.

Greenstein and McDevitt (2009) estimated the consumer surplus generated by broadband adoption in the United States. In their analysis the authors determined that in 2006 the consumer surplus generated by broadband was US $ 7.5 billion. This was 27 % of the total US $ 28.0 billion of broadband surplus (the other part being producer surplus). The figure was calculated on the basis of what users would be willing to pay to adopt broadband rather than narrowband access. The authors also recently estimated the surplus generated as a result of broadband adoption in Canada, United Kingdom, Spain, Mexico, Brazil and China (Greenstein & McDevitt, 2010). In this case, due to the data limitations, they restricted their analysis to the benefit derived from price declines, which necessarily underestimates the total impact. Nevertheless, the researchers determined that for 2009, the total Brazilian broadband surplus represented US $ 7.03 billion, of which 22 % was consumer driven. In the case of Mexico, the total surplus is US $ 2.30 billion, and the consumer portion was 8%. In general terms, the authors concluded that the total broadband surplus is directly related to broadband penetration.

4. THE ECONOMIC IMPACT OF BROADBAND IN RURAL GEOGRAPHIES:

The impact of broadband on rural economies is composed of several effects that are specific to the geographic area. On aggregate, the impact of broadband on states with a predominantly rural geography is significant. For example, in a recently published survey of 30,000 households and 70,000 businesses in North Carolina, the Strategic Networks Group (2010) found that:

- 18% of new jobs were created “on direct account of broadband internet" (This included 28% of jobs created at small firms (<20 employees))
- 54% of businesses said they could not operate without broadband
- 45% of North Carolina’s broadband households are either running a business from their home (31%) or planning to run (14%) one in the next 12 months
- 65% of households use (42%) or plan to use (21%) broadband to sell things online
- 85% percent of establishments said that broadband was essential to their business

However, while the aggregate impact appears to be significant, it is important to differentiate broadband impact within three distinct regions: metropolitan areas, rural environments that are adjacent to metropolitan areas ("rural peripheries") and remote rural areas. Each of these areas has geographic and economic specificities that impact the effect of broadband. In fact, research suggests that due to the spill-over effects of metro areas on rural peripheries, (e.g., labor arbitrage costs, transportation and warehousing, etc.), the economic impact of broadband on the latter region is significant. On the other hand, the specific features of rural economies, (e.g., heavy agricultural sector emphasis with particular production functions), may limit and cause an extended time lag for the impact of broadband in non-metro adjacent areas. The following chapter reviews current research on the rural/metro differentiated impact of broadband.

4.1. Broadband economic impact in rural peripheries:

Rural peripheries, defined as the geographies surrounding metropolitan areas, are subject to a specific set of interrelationship with urban centers. For example, the ease of access to labor pools with some cost differentials facilitates the recruitment of employees resident in the periphery. Similarly, lower real estate costs results in the relocation of certain facilities and functions to adjacent rural areas.

In this context, broadband, in a way similar to transportation infrastructure, acts as an enabler of the spatial spill-over, allowing the rural peripheries to benefit from the economic growth of metropolitan centers. The research has identified the multiple economic effects that broadband results in:

- Firm relocation with consequent impact on employment and payroll
- Growth in the number of establishments that benefit from lower real estate costs while serving the large metropolitan markets
- Facilitation of telecommuting with consequent reduction in transportation costs and less quantifiable increase of consumer surplus

The research literature has pointed out the direct relationship existing between economic impact of broadband and proximity to urban concentrations. Reasons could range from supply side (e.g. economics of deployment favor early entry of competitive providers) to demand side (e.g. sectoral composition of the economy emphasizing industries with high transaction costs). This point was already made in the research reviewed in chapter 3 (in particular, Gillett et al., 2006; and Shideler et al., 2007).

In their evaluation of the USDA Broadband Loan Program, Kandilov and Renkow (2010) found that the communities closest to urban centers benefited substantially from loans for broadband deployment[21]. In particular, they identified substantial positive impact on employment, annual payroll, and the number of business establishments. Table 6 presents the comparative impact of receipt of a USDA loan, first on an aggregated basis, and then, differentiating by metro, and metro-adjacent rural.

Table 6. Economic Impact of Receipt of a USDA Broadband Loan

	Employment	Payroll	Establishments
All ZIP codes (excluding "rural areas")	5 %	4.5 %	6.8 %
ZIP codes in metro counties	7.2 %	5.5 %	5.3 %
ZIP codes in metro-adjacent rural counties	2.5 %	- 1.6 %	0.8 %

Source: adapted from Kandilov and Renkow (2010)

As the data in table 6 indicates, the broadband economic impact in metropolitan counties is higher than in those rural counties lying in the periphery of metropolitan areas. Nevertheless, broadband deployment appears to impact employment and, minimally, the number of establishments in rural counties. Why is broadband having some, albeit

[21] The authors mention that, according to a program audit, it was found that between 2005 and 2008, broadband loans were extended to 148 communities within 30 miles for cities with populations greater than 200,000.

attenuated, positive effect in rural counties adjacent to metropolitan areas? The analysis the authors perform by industry indicates that the strongest positive contribution of broadband to employment and payroll lies in the transportation and warehousing sector. This would confirm the trend that metro-adjacent rural counties benefit from relocation of firms to the periphery enabled by broadband and related infrastructure.

A similar finding was reached by Burton and Hicks (2005) in their study of the Central Appalachian region, according to which new businesses are unlikely to locate in areas without broadband. The study concludes that, while broadband is NOT a significant indicator of firm productivity in general, for firms of *the same age*, productivity increases 14-17% if located in a broadband area. As such, there is a "tendency for productive firms to locate in places with broadband". This finding is also supported by a study of the impact of Iowa's Municipal Telecommunications Network (2003) on the relative success of the previously "bedroom community" Cedar Falls, IA over the neighboring community of Waterloo[22]: Cedar Falls invested in municipal fiber optics, allowing for a blossoming of IT, while Waterloo has not rolled out fiber and relies on whatever the private sector is willing to provide. While this study is not based on statistical analysis, it notes that businesses have relocated to Cedar Falls from Waterloo and from outside of Waterloo, while no businesses have relocated to Waterloo from Cedar Falls. Furthermore, anecdotal evidence such as statements from public figures, land prices, and the relative similarity of the two cities in terms of geography, source of workforce, and the like are presented as additional evidence for IT infrastructure investment as the deciding factor.

Shideler et al. (2007) also found that broadband deployment had a statistically significant positive impact on overall employment in Kentucky, accounting for between 0.14% and 5.32% of overall employment growth during the observed period. It also found that additional broadband deployment was most effective at stimulating employment growth in locales that already had an average broadband saturation instead of areas with sparse deployment or high saturation, suggesting increasing employment returns to deployment in underserved (likely rural) areas.

On an industry-by-industry basis, Shideler et al. (2007) found broadband to be the main driver of increasing employment in the "information" sector (25.27% to 87.07% of growth), the "administrative, support, waste management, and remediation service" sector (23.74% to 84.56% of growth) and the "construction" sector (0.62 to 21.76% of growth). This is unsurprising for the information sector, and the authors point to both technology companies requiring broadband to operate and the increased ability to telecommute as reasons broadband improved employment in the sectors. The authors rationalize broadband helped growth in the "administrative, support, waste management, and remediation service" sector due to telecommuting and because that sector includes the call center business, which requires broadband infrastructure to operate and has been expanding in rural Kentucky. The authors believe that growth in construction

[22] As a note, neither of the areas can really be considered rural; Cedar Falls had a population of 36,000 and Waterloo had a population of 69,000, making them much more "small city" or suburban.

employment attributed to broadband was mainly a secondary effect from demand for construction brought about by increased growth in other sectors affected by improved broadband access. Broadband deployment improved (though was not the primary driver of) employment in the "real estate, rental and leasing," "arts, entertainment and recreation," and "other services" segments. "Accommodations and food services" were negatively impacted by increasing broadband penetration, the authors argue, because of the reduced need for travel agencies and the substitution of broadband-enabled technology for otherwise low-wage labor. Broadband's effect on other sectors was either neutral, not statistically significant, or could not be generalized due to too small a sample size.

However, other studies exist that cast some doubt on Shideler et al.'s upbeat picture. Shideler et al. noted broadband deployment was the primary driver of employment in only two areas: the information sector, and the "administrative, support, waste management, and remediation" sector. For the information sector, the study pointed to the necessity of broadband to IT companies and the increased possibility of telecommuting as the likely mechanisms by which broadband supported employment growth. In the "administrative, support, waste management, and remediation," they point to telecommuting and promulgation of call centers in rural areas where business inputs, including labor, become affordable when broadband infrastructure is available. However, although the increased possibility to telecommute is common to both sectors and is cited as a major reason for employment growth, Song (2006) found in its study of broadband impact in Iowa no statistically significant economic benefit to telecommuting as a whole besides the consumer surplus of being able to work from home[23]. In other words, telecommuting cannot yet be proved to create jobs or increase GDP.

On the other hand, regarding the argument that upgraded broadband infrastructure may make it cost-effective for IT companies to do more business and increase employment, and for call center operations to be expanded given generally lower expenses in rural areas once broadband is installed, Greenstein and McDevitt (2010) argue that growth in employment in businesses enabled by broadband may just as easily be "cannibalism" of jobs from elsewhere in the state or in the country instead of the creation of truly "new" rural jobs. This argument was also raised by Katz and Suter (2009) in their analysis of potential impact of the Broadband Technology Opportunity Program. In the case of call centers in particular, it is easy to imagine a net loss scenario where urban, higher-paying jobs are cannibalized by lower-paying rural jobs made possible by government-sponsored deployment of rural broadband. While obviously difficult to quantify either way, the logic of cannibalism cuts against the economic potential of broadband deployment on both the sector and aggregate level, raising some doubts about the optimistic conclusions of Shideler et al.(2007). However, it has also been indicated that job creation in rural

[23] Song (2006) states that after controlling for endogeneity, returns to rural IT adoption are not significant, implying that the gains from telecommuting are more likely to come from people moving to rural areas instead of enabling existing rural residents to telecommute.

areas could take place not as a result of urban decline, but driven by relocation of enterprises from overseas back to the United States[24].

4.2. Broadband economic impact in remote rural areas[25]:

The impact of broadband in remote rural areas comprises the combination of multiple countervailing effects, some impacting economic development and others enhancing consumer surplus:

- Relocation of establishments to rural counties in specific industry sectors, combined with employment losses in other sectors (e.g. retail distribution)
- Productivity gains in selected sectors (e.g. travel, lodging and entertainment) which can result in employment losses
- Improvements in access to health, education, social inclusion and entertainment

A study of residential internet behavior in Shippagan, Canada (Selouani et al., 2007)[26], reveals that primary impact of the technology is in the area of social inclusion, with consequent consumer surplus increase. Internet usage rate in the study area was as of March 2006 26%, of which 94% had broadband and 6% had dial-up. Internet usage was almost daily (76% of respondents with home internet access use the internet "most days" and 41% used it at work most days). In terms of usage pattern, the primary applications evolved around communications (60% used email "most days", 49% used instant messaging or chat rooms "most days", and 29% used audio/visual conferencing "most days). However, entertainment and access to selected applications and government services were also of note (41% surfed the internet for fun "most days", 17% listened to or downloaded music on a regular basis, 33% of respondents used "daily online banking", while 48% of residents used e-government services).

A similar study to Shipaggan albeit relying on input-output matrices[27], was conducted for South Dundas, a Canadian township located around 150 kilometers away from Montreal and 120 kilometers away from Ottawa (Strategic Network Group, 2003). Between June 2001 and April 2003, the following economic effects can be directly attributed to the deployment of a fiber network in the town:

- $25.22 million increase in GDP for Dundas County and $7.87 million increase for the Province of Ontario
- 207 person years of employment for Dundas County and 64 for the rest of Ontario

[24] A noted case in point is the attraction of call centers back to this country. Virtual call centers rely on rural population linked to a centrally located supervisor. They have become increasingly popular in the US due to the quality of the labor pool and economics that can get close to matching call centers overseas.

[25] It is important to observe that a large portion of research on broadband impact in rural isolated areas has been conducted in Canada. This raises the need to emphasize the development of research in this realm within the United States.

[26] The community is extremely rural; it is 255 kilometers from the nearest city of more than 100,000 (Moncton), and is 500 kilometers from Quebec City.

[27] The data for the input-output model used in the study was collected from a survey of every business in the Dundas area.

- $3.5 million increase in provincial tax revenues and $4.5 million increase in federal tax revenues

These results can be viewed as a return on the $1.3 million investment made to date by the Township of South Dundas. Additional findings suggest that there is a correlation between the use of broadband technology and job growth. Nineteen out of 38 (50.0%) businesses with broadband access to the Internet experienced job growth. This number includes 24 organizations using the fiber network, 13 of which (54.2%) experienced job growth. The data suggests that there is a link between job growth and broadband access to the Internet in South Dundas. A causal link could not be established due to the limited nature of this study, though the correlation appears to hold across industry sectors and organization size.

4.3. Conclusion:

The research results indicate the positive contribution that broadband makes to economic growth and job creation in rural areas. The effects appear to be most significant in the rural peripheries of metropolitan areas, where broadband operates as an enabler of spatial spill-over, resulting in an expansion of labor markets. However, it is important to emphasize that job creation in the rural peripheries might result from labor displacement from either the metropolitan areas or other regions. In addition, the technology facilitates the redeployment of industries to the rural peripheries to gain access to lower real estate costs, and better link to transportation networks. Finally, while still not significant, the effects of telecommuting appear to be playing a role in economic growth of the rural peripheries.

With regards to isolated rural areas, research results are beginning to yield some insights on the economic impact of broadband. As expected, employment, payroll, and firm relocation appear to be less influenced than rural peripheries. However, some case studies indicate that broadband can facilitate some job creation, and more importantly, counter rural-urban migration trends by enhancing social inclusion through communications and information access.

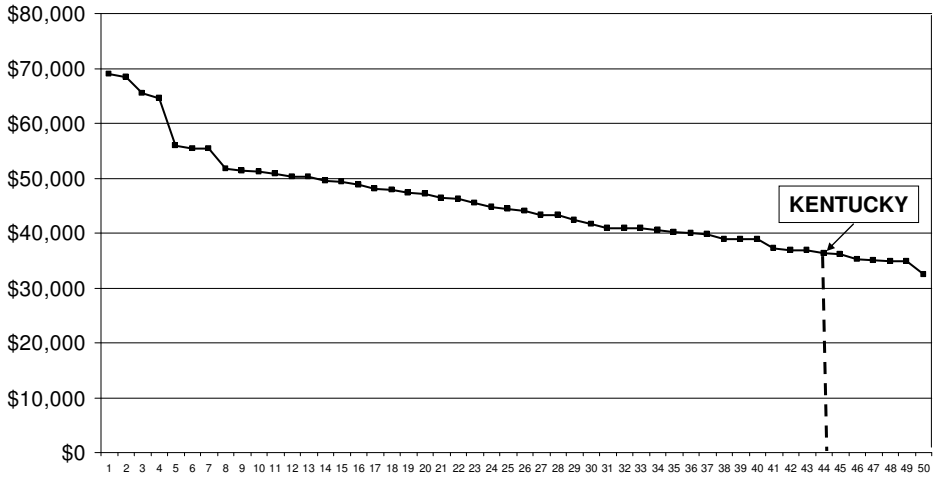
5. THE ECONOMIC CONTRIBUTION OF BROADBAND IN KENTUCKY

This chapter analyzes the impact that broadband has had on the economy of Kentucky. It begins by reviewing the diffusion of broadband technology and related IT platforms in the state. Following this, econometric models estimating the past impact of broadband on employment and other economic indicators are presented. Finally, based on the statistical models, the impact of future broadband adoption is estimated.

5.1. Economic profile of Kentucky:

The state of Kentucky ranks 44th in the United States in terms of GDP per capita (see figure 2).

Figure 2. United States: States Ranking by GDP per Capita (2009)

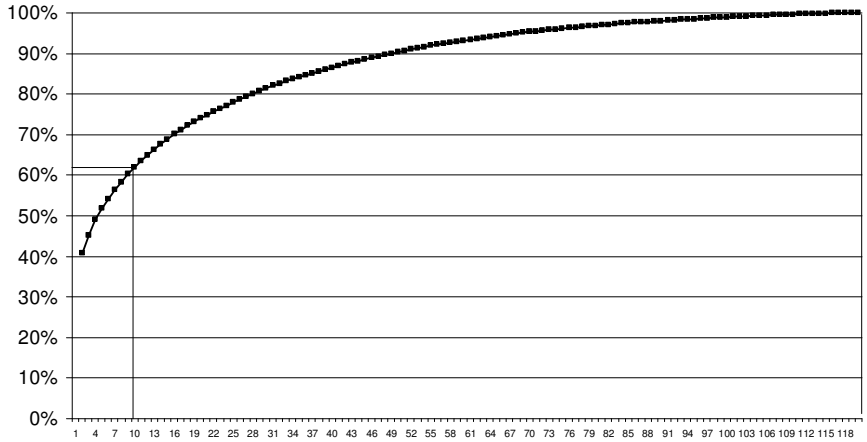


Source: Bureau of Economic Analysis, US Department of Commerce; US Census Bureau; analysis by the authors

The growth of Kentucky's GDP since 2000 has averaged 3.7 %, slightly lower than that of the United States, 4.1[28]. In 2009, Kentucky's population was 4,314,113[29], and its income distribution, as measured by the Gini coefficient was 0.464[30], which ranked 36th among US states.

From a geographical standpoint, the state's economic activity is very concentrated. Of 120 counties, ten account for 63.45% of the Kentucky's income (see figure 3).

Figure 3. Kentucky: County Distribution of State Income (2009)



County Income is calculated as the number of employees multiplied by average income
Sources: Census Quarterly Workforce Indicators; analysis by the authors

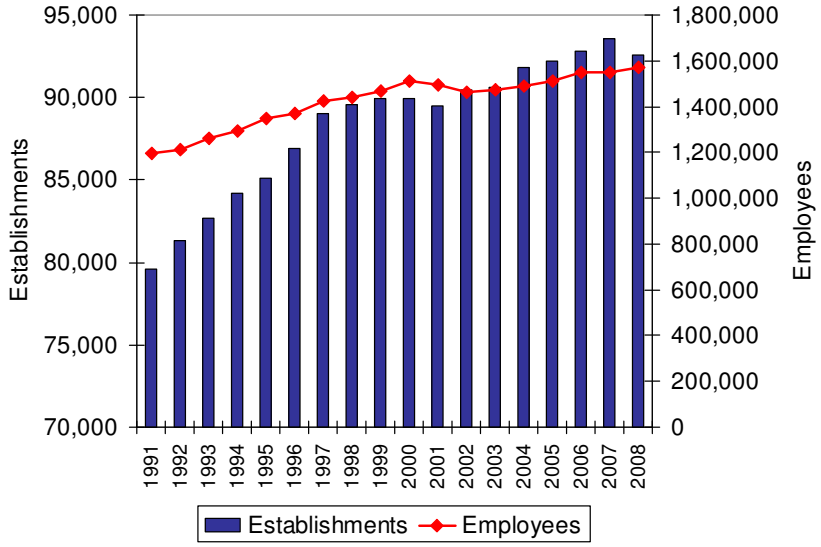
[28] Source: Bureau of Economic Analysis, US Department of Commerce.

[29] Source: 2010 Census; US Census Bureau, Population Division.

[30] The Gini coefficient is a measure of the inequality of a distribution used to measure income inequality; a value of 0 expressing total equality and a value of 1 maximal inequality. Source: 2009 American Community Survey.

In 2008, there were 92,587 business establishments, employing 1,570,800 residents[31]. In The past eight years, the number of establishments has been fairly stable, while the number of employees had been growing consistently until 2008 when it contracted due to the economic crisis (see figure 4).

Figure 4. Kentucky: Business Establishments and Employees (1991-2008)



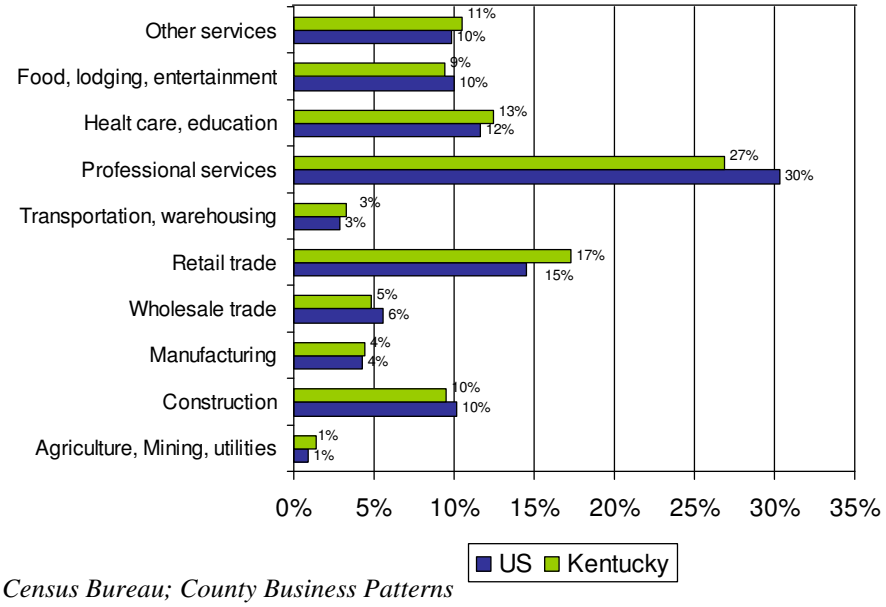
Sources: US Bureau of the Census; County Business Patterns

According to these statistics, the average number of employees per establishment is 20, up from 16 in 1998. In 2008, half of all Kentucky establishments employed fewer than five employees, while 3 % employed more than 100 employees[32].

According to the sector decomposition, professional services comprise the largest share (26.9 %) of business establishments, followed by retail trade (17.3 %) (see figure 5).

[31] Source: US Census County Business Patterns
[32] Source: US Census Bureau Country Business Patterns. (2008)

Figure 5. Kentucky: Number of establishments by Industry Sector (2008)



Source: US Census Bureau; County Business Patterns

Relative to national figures, Kentucky has a greater concentration of retail trade establishments (17.3 % to 14.5 %) and a lesser concentration of professional service businesses (26.9 % to 30.3 %). Both sectors are likely beneficiaries of broadband deployment (see Shideler et al., 2007).

Since the advent of the economic crisis, Kentucky has performed weakly. GDP grew by 3.2% from 2007-2008 and by -0.43% from 2008-2009. This is slightly better than the US averages, which were 2.6% and -1.3%, respectively. Unemployment in Kentucky has soared. In 2007 average seasonally adjusted monthly unemployment was steady at 5.5%, but this figure grew to 6.6%, 10.4% and 10.3% in the following years. Unemployment began to grow (year over year) in March of 2008, reached its peak growth rate (77.2 %) in March of 2009, and only started to diminish in May of 2010. However, the unemployment rate has hovered around 10.0% since July 2010[33]. Bankruptcies have grown steadily since 2007. Totals for the 2007, 2008, 2009 and the first three quarters of 2010 are 17,155, 21,468, 25,218 and 19,458, respectively. During the first quarter of 2007 there were 4,294 but in the third quarter of 2010 they had increased by 46 %[34]. In this context, it is critical to consider all policy initiatives likely to have a positive impact on economic growth and job creation.

5.2. Broadband deployment in Kentucky:

According to the FCC[35], there are 1,221,000 broadband lines in Kentucky (see table 7).

[33] Source: Bureau of Labor Statistics. (2010)
[34] Source: American Bankruptcy Institute (2010)
[35] Source: FCC's report "Internet Access Services: Status as of June 30, 2009. (2010)

Table 7. Kentucky: Breakdown of Broadband Lines

Technology	Number of lines
DSL	431,000
FTTx	4,000
Cable modem	483,000
Satellite	---
Mobile broadband (WiMax, 3G, etc.)	303,000
Total	1,221,000

Source: FCC; Operator Reports

The growth of broadband lines has increased at an average rate of 57 % over the past ten years, reaching a penetration of 20 % of the population, and 52 % of households[36] (see table 8).

Table 8. Kentucky: Growth in Broadband Lines and Household Penetration (2000-2009)

Year	Total Lines	Residential	Business	Population	Households	Penetration per pop.	Household Penetration
1999	23570						
2000	32,731	12,443 (*)	20,288	4,048,903	1,590,647	0%	1%
2001	67,870	47,060 (*)	20,810	4,069,191	1,604,851	1%	3%
2002	99,265	78,890 (*)	20,375	4,091,330	1,619,056	2%	5%
2003	243,005	211,719 (*)	31,286	4,118,627	1,633,260	5%	13%
2004	360,903	323,532 (*)	37,371	4,147,970	1,647,464	8%	20%
2005	319,160	257,204	61,956	4,182,293	1,653,898	6%	16%
2006	774,736	612,529	162,207	4,219,374	1,651,911	15%	37%
2007	1,161,667	843,641	318,026	4,256,278	1,655,767	20%	51%
2008	1,154,000	829,000	325,000	4,287,931	1,686,277	19%	49%
2009	1,221,000	876,000	345,000	4,314,113	1,690,237	20%	52%

(*) Includes small businesses

Source: FCC; US Census Bureau, American Community Survey

According to Connect Kentucky, fixed line broadband currently covers 95 % of households, which amounts to 57 % growth in broadband availability since 2002. The FCC estimates that the underserved supply gap of broadband (<4 Mbps) in Kentucky amounts to 266,000 households (see table A.1 in Appendix).

Based on the difference between broadband coverage and service purchasing, the demand gap amounts to 33 %. A number of reasons explain this gap (see table 9).

[36] The study recently published by the Economics and Statistics Administration and National Telecommunications and Information Administration (2010) estimates broadband penetration at 54%.

Table 9. Kentucky. Drivers of Demand Gap (2007)

Reasons Household does not have Broadband	Percentage
No need for broadband or Internet	20 %
Does not own a computer	18 %
Too expensive	11 %
Can access somewhere else	4 %
Other/not sure	4 %

Note: the remaining percentage is due to lack of service in area, a supply gap
Source: Connect Kentucky Residential Survey

In 2006, 56 % of business reported actively using the internet to handle business functions, up from 36 % in 2002. Of these businesses, 85 % access the Internet via broadband. This has risen from 50% in 2002. Of these, DSL comprises 54 % of business access lines, while the rest are cable or fixed wireless access[37]. Broadband adoption is fairly homogeneous across industry sectors. The most recent enterprise survey, (which was conducted in 2006), showed that, with the exception of Health Care, most sectors relied on broadband for Internet access. According to the research reviewed above, these adoption trends should have had an important impact on the economy. This will be assessed in the next section.

5.3. Economic impact of broadband in Kentucky:

In order to ascertain the economic impact that broadband has had in Kentucky two approaches were implemented: 1) a panel regression that measured the impact of broadband availability on county employment and county median income, and 2) a cross-sectional regression that measured the impact of broadband by industry sector. The following section reviews the methodological assumptions, data utilized and results.

5.3.1. Methodology:

Impact of broadband availability on employment and median income

Several studies (Katz et al., 2010; Katz, 2010; Koutroumpis, 2009; Gillett et al., 2005) demonstrated that broadband has a lagged effect on the economy. Thus, the growth of unemployment and income from year *t* to year *t+1* was modeled as a function of average broadband availability, (the percentage of homes passed), between year *t-1* and year *t*. Controls for each of the factors that determine broadband availability (in accordance with the literature) were also included. These are median income, unemployment, ethnicity, the percentage of young population (aged 15 to 25), population density and the growth rate in labor force. There are also other variables that may affect broadband availability such as education and the number of schools in an area, and the percentage of a county that is rural. These other variables were accounted for by including fixed effects in the model (over a period of four years it is expected that they will not change significantly.)

[37] Only 4% relied on satellite technology.

Controlling for the effect of the variables that influence broadband availability removes selection bias. Finally, dummy variables were included to control for the economic recession. Hence, the specified model is:

$$Econ_{t+1}/Econ_t - 1 = \alpha + \beta_1 (Bb_{t-1} + Bb_t)/2 + \beta_2 X_t$$

Where Econ is the economic indicator of interest-unemployment or income-, Bb is broadband availability, X is the set of controls, and t is from 2005-2008. Moreover, note that we do not control for median income in our unemployment growth rate regression and vice versa (we do not control for unemployment in our median income growth rate regression.) This is because there should not be a relationship between these variables. Preliminary regressions confirmed that the relationship was insignificant, while not significantly altering any other coefficients.

Many studies also suggest that the impact of broadband may be area specific, (i.e., it may differ for rural and urban communities.) Most recently, Kandilov et al. (2010) identified three areas that experienced very different effects[38]. Accordingly, their models were tested for following sub-samples: metro counties, (rural-urban continuum codes 1-3)[39], rural counties adjacent to metro counties (rural-urban continuum codes 4, 6 and 8), and isolated rural counties (rural-urban continuum codes 5, 7 and 9.)

Impact of broadband by industry sector

In order to assess the impact of broadband on specific industry sectors of Kentucky, a similar methodology to that of Shideler et al. (2007) was used. The model establishes a relationship between the current growth rate of employment and its lagged values, controlling for variables that affect the economic activity and also variables that explain differences with other observations, (i.e., other counties). The econometric model used in the estimations is:

$$Ln(Empl_{t+1}/Empl_{t-1}) = \alpha + \beta_1 (Bb_{t-1} + Bb_t)/2 + \beta_2 X_t$$

This equation states that the employment growth rate is a function of the average broadband penetration, some explanatory variables (X), and an error term, ε, (which has a log-normal distribution). Because there is not county-level time-series available for broadband adoption, the model relies on a cross-sectional analysis rather than a data panel analysis.

5.3.2. Data utilized:

Impact of broadband availability on employment and average income

[38] Though the Kandilov et al. (2010) study is specific to the USDA's Broadband Loan Program, we suspect that the impact of broadband availability may act upon similar lines.

[39] See below for further information on rural-urban continuum codes.

In the panel regression which measures impact of broadband on employment and income, the data covers the years 2004 to 2009. Broadband availability (2004-2008) is taken from the Connect Kentucky residential survey. Median household income, the percentage of people aged 15 to 25, the percentage of people aged 65 and more, and the population (2005-2009) are taken from the ESRI Business Analyst Sourcebook for County Demographics. Country size, in square km, is gathered from the 2000 Census, while labor force and unemployment data is taken from the Bureau of Labor Statistics.

Rural counties were identified using the classification system of the Department of Agriculture for 2003 (Rural-Urban Continuum code). The codes that denote non-metropolitan areas (4-9) were used to identify rural counties. They comprise both rural counties adjacent to metro counties and isolated rural counties.

Rural Urban Continuum Codes	
Code	**Description**
Metro counties	
1	Counties in metro areas of 1 million population or more
2	Counties in metro areas of 250,000 to 1 million population
3	Counties in metro areas of fewer than 250,000 population
Non-metro counties	
4	Urban population of 20,000 or more, adjacent to a metro area
5	Urban population of 20,000 or more, not adjacent to a metro area
6	Urban population of 2,500 to 19,999, adjacent to a metro area
7	Urban population of 2,500 to 19,999, not adjacent to a metro area
8	Completely rural or less than 2,500 urban population, adjacent to a metro area
9	Completely rural or less than 2,500 urban population, not adjacent to a metro area

The distribution of Kentucky counties according to the Rural-Urban Continuum codes is as follows:

Code	Kentucky
1	16
2	10
3	9
4	3
5	2
6	22
7	24
8	13
9	21
Total	**120**

Impact of broadband by industry sector

For the cross-sectional analysis of broadband impact on industrial sectors, the U.S. Census Bureau's county business patterns data series for 2004, 2005, 2006 and 2007 was used. It provides both total and sectoral employment at the two-digit North American Industrial Classification System (NAICS) level. This dataset contains private, non-agriculture production employment data measured annually as of the week of March 12.

Using this data, employment growth rates for the periods 2004-05 and 2005-07 were estimated for each of the two-digit NAICS codes. A combination of zero employment levels in rural counties and suppressed data due to Census disclosure rules led to missing values in the data and reduced the number of observations and counties available for analysis. After eliminating industries with this type of problems, only six sectors were available for the study: financial services and insurance, wholesale trade, construction, health, retail trade and accommodation sectors.

The following explanatory variables were included. Average broadband adoption level of households, calculated with information provided by Connect Kentucky, was used to measure broadband. The percentages of population without a high school degree and with college education were used as measures of the supply of unskilled and skilled labor. These variables were constructed using information from the U.S Census 2000. To measure labor availability several variables were included: growth in employment for 2004-2005, percentage of population between 15-25, percentage of population 65 years old and older for 2005 and the population growth between 2005 and 2007. Age and population growth variables were obtained using the ESRI Business Analyst Sourcebook for County Demographics (2005 and 2007). Finally, the income per capita variable was included as a control variable for the characteristics of the county (2005 ESRI Sourcebook for County Demographics).

5.3.3. Results:

Impact of broadband availability on employment and average income

The results of the panel regression models show that broadband availability has a statistically significant positive impact on employment and income. Similarly to Kandilov et al.'s (2010) results regarding broadband loans in rural areas, we find that the impact of broadband availability is dependent upon the area of deployment. Though broadband availability impacts rural as well as metropolitan counties, the effect is area-specific (see table 10).

Table 10. Kentucky: Impact of a 1 percent increase in broadband availability on employment and median income

	Impact on Median Income	Impact on Employment
Metropolitan Counties	0.0968*	0.0303
Rural Counties Adjacent to Metro counties	0.0704*	-0.1953*
Rural Counties Isolated from Metro Counties	0.0800*	

*Significant at 1 % level

The models show that the impact of broadband on median income is statistically significant for each of the three types of counties. They also suggest that this impact is the highest for metro counties, followed by isolated rural counties, and lastly rural counties that are adjacent to metro counties. On the other hand, the impact on unemployment is only significant for rural counties[40]. The impact on employment in metropolitan counties is not statistically significant.

The broadband coefficients for the income regressions will be reviewed in turn. In the regression for metro counties it is estimated that the coefficient of average broadband is about 0.097 percentage points[41] (see Table 11).

Table 11. Kentucky: Broadband Impact Median Household Income Growth Rate - Metropolitan Counties -

Variable	Coefficient	Std. Err.	T Score	P Value	95% Confidence Interval	
Bb	0.096846	0.015821	6.12	0	0.065446	0.128246
mIncome	-6.27E-06	1.38E-06	-4.53	0	-9.01E-06	-3.52E-06
pWhite	-0.0317	0.008379	-3.78	0	-0.04833	-0.01507
pAge15to25	-0.00877	0.004044	-2.17	0.032	-0.0168	-0.00075
pAge65+	0.005607	0.006434	0.87	0.386	-0.00716	0.018377
Density	0.001861	0.000712	2.61	0.01	0.000448	0.003274
Labor Force	-0.09664	0.052553	-1.84	0.069	-0.20095	0.007659
Recession09	-0.03199	0.0041	-7.8	0	-0.04012	-0.02385
constant	3.035282	0.795267	3.82	0	1.456898	4.613666

That is, on average, increasing broadband average availability by one percentage point leads to a 0.097 percent increase in median income over the following year. For example, if average broadband availability between 2006 and 2007 were one percent higher, then one would expect median income to grow an extra 0.097 percentage points between 2007 and 2008[42].

As noted above, the income regressions[43] suggest that the effect of broadband availability is specific to metro, (0.0968), adjacent rural, (0.0704), and isolated rural counties, (0.0800). It is likely that these relationships stem from a combination of productivity and employment effects. We will return to this point after we review the unemployment regressions.

[40] The models run for employment impact on rural-adjacent and rural isolated yielded non-significant results.

[41] The number of observations is 140.

[42] Note however, that increasing broadband availability by one percent in 2007 (and not also 2006) would only result in an extra 0.048 percentage points between 2007 and 2008. Because we are dealing in averages, it takes two years to reap the full 0.097 effect of increasing broadband availability by one point.

[43] The number of observation for the adjacent rural regression is 152 and for the isolated rural regression it is 188

Table 12. Kentucky: Broadband Impact on Median Household Income Growth Rate - Rural Counties Adjacent to Metro Counties-

Variable	Coefficient	Std. Err.	T Score	P Value	95% Confidence Interval	
Bb	0.070443	0.010996	6.41	0	0.048642	0.092244
mIncome	-1.2E-05	1.92E-06	-6.14	0	-1.6E-05	-7.97E-06
pWhite	-0.01316	0.00677	-1.94	0.055	-0.02658	0.000262
pAge15to25	-0.00861	0.003154	-2.73	0.007	-0.01486	-0.00235
pAge65+	-0.00141	0.006511	-0.22	0.829	-0.01431	0.011503
Density	0.006206	0.002069	3	0.003	0.002104	0.010307
Labor Force	-0.05826	0.049348	-1.18	0.24	-0.1561	0.039578
Recession09	-0.01202	0.003525	-3.41	0.001	-0.01901	-0.00503
constant	1.614729	0.654341	2.47	0.015	0.317435	2.912024

Table 13. Kentucky: Broadband Impact on Median Household Income Growth Rate - Rural Counties Isolated from Metro Counties-

Variable	Coefficient	Std. Err.	T Score	P Value	95% Confidence Interval	
Bb	0.080035	0.011564	6.92	0	0.057162	0.102908
mIncome	-2.4E-05	2.33E-06	-10.34	0	-2.9E-05	-2E-05
pWhite	-0.03062	0.00792	-3.87	0	-0.04629	-0.01496
pAge15to25	-0.00736	0.003211	-2.29	0.023	-0.01371	-0.00101
pAge65+	0.00227	0.006054	0.37	0.708	-0.0097	0.014244
Density	0.010555	0.003211	3.29	0.001	0.004204	0.016907
Labor Force	-0.05583	0.044519	-1.25	0.212	-0.14388	0.032232
Recession09	-0.00614	0.003664	-1.67	0.096	-0.01338	0.00111
constant	3.382363	0.800888	4.22	0	1.798239	4.966488

Our results suggest that broadband availability impacts income the most for metro counties, then isolated counties, and finally adjacent counties. As discussed above, there is solid theoretical backing for these estimations. However, it is evident that the interplay of unemployment and productivity effects is complex. For example, the theory offers little in the way of reasons why isolated counties should be impacted more than rural counties that are adjacent to metro areas. However, these complex effects make it unlikely that each type of county experiences the same impact and coefficient. Moreover, it is very likely that metropolitan areas experience the highest income effects.
In the unemployment regressions a slightly different model was used, adding a dummy variable to control for the recession in 2008[44] (See Tables 14, and 15). This approach was chosen because the recession affected Kentucky unemployment before it affected the state's median income[45]. While the data shows that the growth rate of unemployment changed markedly from 2006-2005 to 2007-2008 (the average for Kentucky counties

[44] Again, the number of observations is 140, 152, and 188 for metro, rural adjacent, and rural isolated respectively.

[45] There are several possible explanations for why this may have happened. For example, it may be that people that have incomes below the median levels had less job security. Then the unemployment rate would grow early, but median income would remain unaffected until later on.

changed from -.0394 to .1694), we did not observe the same phenomenon for median income, (which changed from .02755 to .0216). Moreover, two separate dummy variables were used for 2008 and 2009 because monthly unemployment data showed that the recession did not begin to affect Kentucky counties until half way through 2008[46].

Table 14. Kentucky: Broadband Impact on Unemployment Growth Rate - Metropolitan Counties -

Variable	Coefficient	Std. Err.	T Score	P Value	95% Confidence Interval	
Bb	0.0303	0.1146	0.26	0.7940	-0.1973	0.2575
Unemployment	-0.1119	0.0233	-4.81	0.0000	-0.1581	-0.0657
pWhite	-0.0215	0.0614	-0.35	0.7270	-0.1434	0.1003
pAge15to25	0.0371	0.0290	1.28	0.2030	-0.0203	0.0946
pAge65+	0.0007	0.0453	0.01	0.9890	-0.0893	0.0906
Density	-0.0006	0.0041	-0.15	0.8770	-0.0087	0.0074
Labor Force	1.2926	0.3954	3.27	0.0010	0.5077	2.0775
Recession09	0.7392	0.0404	18.31	0.0000	0.6590	0.8193
Recession08	0.2370	0.0233	10.19	0.0000	0.1908	0.2832
constant	2.1051	5.6980	0.37	0.7130	-9.2054	13.4157

Table 15. Kentucky: Broadband Impact on Unemployment Growth Rate - Rural Counties -

Variable	Coefficient	Std. Err.	T Score	P Value	95% Confidence Interval	
Broadband	-0.1953	0.0808	-2.42	0.0160	-0.3544	-0.0363
Unemployment	-0.0926	0.0118	-7.86	0.0000	-0.1158	-0.0694
pWhite	0.0056	0.0491	0.12	0.9080	-0.0910	0.1023
pAge15to25	-0.0319	0.0222	-1.44	0.1510	-0.0756	0.0118
pAge65+	-0.0814	0.0419	-1.94	0.0530	-0.1640	0.0012
Density	-0.0091	0.0174	-0.52	0.6040	-0.0434	0.0252
Labor Force	-1.3835	0.3201	-4.32	0.0000	-2.0140	-0.7530
Recession09	0.7375	0.0269	27.38	0.0000	0.6845	0.7906
Recession08	0.1526	0.0203	7.52	0.0000	0.1126	0.1926
constant	2.0011	4.7359	0.42	0.6730	-7.3269	11.3291

The interpretation for the broadband coefficient is much the same as above. For example, the regressions show that, on average, increasing broadband average availability by one percentage point in rural counties leads to a -0.1953 percent decrease in unemployment over the following year. For example, if average broadband availability between 2006 and 2007 were one percent higher, then one would expect the unemployment rate to shrink by .19 percent between 2007 and 2008.

Unlike the income regressions, the unemployment regressions show significant broadband effects on job creation solely in rural. This is a reasonable result. One context which provides a strong theoretical backing is the merging of labor markets. In this

[46] We believe that alternate regressions (not shown here) validated our methodological choices. For example, when we included a dummy for the 2008 recession in the income regressions it resulted positive.

context, it is to be expected that broadband will have the smallest impact on metro counties. These counties have the lion's share of establishments and employment opportunities so increasing the size of the labor market should have only marginal if any positive effects. However, broadband may extend labor markets to rural areas, e.g., by enabling telecommuting. Of these rural counties, the primary beneficiaries are rural counties that are adjacent to metro areas because the labor force is more technologically skilled (in accordance with the industries that are present). We expect that isolated rural areas will also benefit, but at a lower rate.

Theoretically, we also expect that firms in the services industries can reap greater productivity gains from broadband, (see below for the results on sector-specific broadband effects). Hence it is expected that metro counties, which account for the vast majority of such firms, will experience the largest impact on income. This indicates that the employment opportunities created by broadband in these areas are far more lucrative than the median job. Though the portion of the population that is technologically skilled in these areas may be small, it is likely that the incremental benefits of broadband for this population are quite high. However, it was not possible to identify a statistically significant result for metro counties.

Impact on Industry Sector

The impact of broadband penetration was found to be statistically significant on the growth in employment in the financial services and insurance, wholesale trade, and health sectors (see table 16).

Table 16. Kentucky: Impact of Broadband Penetration by 1% on Industrial Sector Employment

Industry Sector	All Counties	Rural Counties
Financial Services and Insurance	0.678 (**)	0.517 (***)
Wholesale trade	0.846 (*)	0.836 (*)
Health Services	0.126 (*)	0.122 (**)
Construction	Not significant	Not significant
Retail Trade	Not significant	Not significant
Accommodation	Not significant	Not significant

(*) Significant at 1% level
(**) Significant at 5% level
(***) Significant at 10% level

The industries comprising higher transaction costs and network-based business models appear to benefit more from broadband penetration[47]. Furthermore, as in the models presented above, the impact of broadband in all counties (comprising metro regions) always appears to be higher than in rural counties. Each model will be reviewed in turn.

[47] The conclusions of these results should not be extended to industries that could not been analyzed.

The impact of broadband on the growth of the financial sector was high and significant. According to the model, an increase of 1 percentage point in broadband penetration (from 5% to 6%) would yield an increase of 0.67% in the employment level in the financial sector[48] (see table 17).

Table 17. Kentucky: Broadband Impact on Finance & Insurance Employment Growth (2005-7) - All Counties -

Variable	Coefficient	Std. Err.	T Score	P Value	95% Confidence Interval	
BB_Penetration 0507	0.6789	0.2939	2.31	0.024	0.0932	1.2646
Income per capita 05	-0.0019	0.0025	-0.74	0.463	-0.0069	0.0032
Age15_25	-3.7938	1.6475	-2.3	0.024	-7.0765	-0.5111
Age65up	-0.5222	1.1855	-0.44	0.661	-2.8844	1.8400
Employment 0405	-0.4734	0.5631	-0.84	0.403	-1.5953	0.6486
High School	-0.4558	1.0031	-0.45	0.651	-2.4546	1.5430
College	0.7516	0.9257	0.81	0.419	-1.0929	2.5960
Population Growth	1.3764	1.0661	1.29	0.201	-0.7479	3.5007
Constant	78.1400	93.8077	0.83	0.408	-108.7760	265.0560

Number of Observations	83
F(8,45)	1.29
Prob>F	0.2605
R^2	0.1317
Root MSE	25.605

The impact of broadband on the Finance and Insurance sector declines when metro counties are excluded, although the results are still significant[49] (see table 18).

Table 18. Kentucky: Broadband Impact on Finance & Insurance Employment Growth (2005-7) - Rural Counties -

Variable	Coefficient	Std.Err.	T Score	P Value	95% Confidence Interval	
BB_Penetration 0507	0.5172	0.3021	1.71	0.094	-0.0913	1.1256
Income per capita 05	-0.0031	0.0022	-1.41	0.166	-0.0074	0.0013
Age15_25	-2.9850	2.0412	-1.46	0.151	-7.0963	1.1263
Age65up	-3.1947	0.9727	-3.28	0.002	-5.1539	-1.2355
Employment 0405	-0.4356	0.5514	-0.79	0.434	-1.5461	0.6750
High School	-1.4830	0.8319	-1.78	0.081	-3.1585	0.1925
College	-0.2288	1.3765	-0.17	0.869	-3.0012	2.5436
Population Growth	-0.0512	1.2448	-0.04	0.967	-2.5584	2.4560
Constant	179.9645	77.7988	2.31	0.025	23.2697	336.6592

[48] The other variable that was significant was the percentage of population between 15 and 25 years old.
[49] The other significant variable is the percentage of the population without high school education.

Number of Observations	54
F(8,45)	2.29
Prob>F	0.0377
R^2	0.2153
Root MSE	17.545

The impact of broadband on the wholesale distribution sector was high and significant. According to the model, an increase of 1% in broadband penetration would yield an increase of 0.84% in employment level in the wholesale distribution sector[50] (see table 19).

Table 19. Kentucky: Broadband Impact on Wholesale Trade Employment Growth (2005-7) - All Counties -

Variable	Coefficient	Std. Err.	T Score	P value	95% Conf.Interval	
BB_Penetration 0507	0.8460	0.2066	4.090	0.000	0.4328	1.2592
Income per capita 05	0.0395	0.0089	4.420	0.000	0.0216	0.0573
Age15_25	40.2643	7.0237	5.730	0.000	26.2196	54.3090
Age65up	6.1638	4.4070	1.400	0.167	-2.6485	14.9762
Employment 0405	-3.9565	2.3117	-1.710	0.092	-8.5791	0.6661
High School	9.7185	3.1161	3.120	0.003	3.4876	15.9495
College	-18.4412	3.8614	-4.780	0.000	-26.1626	-10.7198
Population Growth	1.4344	4.0535	0.350	0.725	-6.6711	9.5400
Constant	-1492.3740	325.7489	-4.580	0.000	-2143.7500	-840.9990

Number of Observations	70
F(8,61)	8.93
Prob>F	0.0000
R^2	0.5395
Root MSE	70.502

The broadband impact remains stable when the metro counties are excluded. The change in impact coefficient is minimal with the prior model (see table 20).

[50] Other significant variables include per capita income, population between 15 and 25 years old, employment growth in the preceding period. Unexpected results include the inverse impact of educational attainment in sector employment.

Table 20. Kentucky: Broadband Impact on Wholesale Trade Employment Growth (2005-7) - Rural Counties -

Variable	Coefficient	Std. Err.	T Score	P value	95% Conf.Interval	
BB_Penetration 0507	0.8363	0.2444	3.42	0.001	0.3421	1.3306
Income per capita 05	0.0332	0.0116	2.87	0.007	0.0098	0.0567
Age15_25	43.0622	8.0558	5.35	0.000	26.7678	59.3567
Age65up	-0.2356	6.6017	-0.04	0.972	-13.5888	13.1176
Employment 0405	-4.8324	2.7257	-1.77	0.084	-10.3457	0.6809
High School	5.7727	4.4967	1.28	0.207	-3.3227	14.8682
College	-22.1127	5.1582	-4.29	0.000	-32.5461	-11.6792
Population Growth	-7.5727	6.0644	-1.25	0.219	-19.8391	4.6937
Constant	-1135.5810	431.2029	-2.63	0.012	-2007.7710	-263.3904

Number of Observations	48
F(8,45)	9.38
Prob>F	0.0000
R^2	0.658
Root MSE	72.852

In the case of the Health sector, broadband has a smaller impact in comparison to the other two sectors analyzed (see table 21).

Table 21. Kentucky: Broadband Impact on Health Employment Growth (2005-7) - All Counties -

Variable	Coefficient	Std. Err.	T Score	P Value	95% Conf.Interval	
BB_Penetration 0507	0.1260	0.0427	2.95	0.004	0.0409	0.2110
Income per capita 05	0.0031	0.0017	1.85	0.068	-0.0002	0.0065
Age15_25	4.7554	1.5205	3.13	0.002	1.7305	7.7803
Age65up	0.6802	0.9908	0.69	0.494	-1.2908	2.6513
Employment 0405	-0.7191	0.4313	-1.67	0.099	-1.5771	0.1389
High School	0.2372	0.5824	0.41	0.685	-0.9214	1.3959
College	-1.9197	0.8022	-2.39	0.019	-3.5157	-0.3237
Population Growth	-0.0179	0.8623	-0.02	0.983	-1.7334	1.6976
Constant	-119.7998	61.1014	-1.96	0.053	-241.35	1.7503

Number of Observations	91
F(8,82)	4.10
Prob>F	0.0004
R^2	0.2856
Root MSE	18.144

The impact of broadband is slightly lower when the sample is restricted to rural counties, nonetheless the significance remains (see table 22).

Table 22. Kentucky: Broadband Impact on Health Employment Growth (2005-7) - Rural Counties -

Variable	Coefficient	Std. Err.	T Score	P value	95% Conf.Interval	
BB_Penetration 0507	0.1228	0.0509	2.41	0.02	0.0206	0.2251
Income per capita 05	-0.0006	0.0024	-0.26	0.8	-0.0055	0.0042
Age15_25	6.4617	1.7706	3.65	0.001	2.9085	10.0148
Age65up	-0.0241	1.4481	-0.02	0.987	-2.9299	2.8817
Employment 0405	-0.6067	0.48452	-1.25	0.216	-1.5789	0.3656
High School	-1.7665	0.87062	-2.03	0.048	-3.5136	-0.0195
College	-3.1649	1.1894	-2.66	0.01	-5.5517	-0.7781
Population Growth	-1.8002	1.3589	-1.32	0.191	-4.5272	0.9267
Constant	24.7846	80.752	0.31	0.76	-137.2572	186.8264

Number of Observations	61
F(8,52)	5.91
Prob>F	0.0000
R^2	0.4763
Root MSE	18.736

The results of the sector impact models are quite illuminating in terms of determining which industries are most benefited by rural broadband. While effects are statistically significant in finance, wholesale trade and health services, the impact is largest in the trade sector, reflecting the value of broadband as an enabler of relocation of warehouses and distribution centers to areas outside the metropolitan counties. Furthermore, while employment is also positively impacted by broadband in finance, its contribution diminishes in rural environments reflecting the difficulty of locating financial back offices in rural areas, primarily due to limits in labor pool availability. On the other hand, the decline in impact of health services for rural areas is not that important revealing both the existence of demand in rural areas and the value of broadband in enabling the redeployment of health facilities.

5.4. Estimating the economic impact of filling the broadband supply gap in Kentucky

Based on the historical effect of broadband on Kentucky's county employment and income, the impact of broadband availability on future economic growth and employment is estimated. For this purpose, it is first necessary to assume how broadband availability will evolve over time by county. According to the FCC, as of 2010, broadband was available to 86.2 % of households, ranging from 17% in Elliot County to 100 % in Boone County and others. The benefit of closing this broadband gap by deploying wireless broadband, reaching 100 % availability in all counties throughout the state, is calculated.

Based on the effects analyzed in section 5.3, the increase in broadband availability to 100 % will drive an augmentation in median income by county and could help reduce the growth rate of unemployment by creating or preserving jobs. According to the models, an

increase in broadband availability of 1% would result in a decrease in unemployment of 0.1953% for rural counties. Based on these coefficients and assuming a full deployment in 2011[51], impact on the unemployment rate was estimated for the period 2011-2014. It should be noted that while the model estimates the lagged impact of broadband on unemployment growth, there is obviously no data for the size of the 2011 labor force. Thus, in these estimates the 2010 labor force was used, which is a conservative constraint since it is expected the labor force to be larger in 2011. This resulted in 10,235 jobs created or saved from effects of broadband on business expansion (see Table 23).

Table 23. Kentucky: Impact of Broadband Availability on Rural Job Creation Key Figures

County Type	Total Jobs Saved/Created 2011-14	Number of Counties with Supply Gaps
Rural Adjacent to Metro Counties	4,218	33
Rural, Isolated from Metro Counties	6,017	42
Total Rural	10,235	75

This estimate is fairly consistent with the state of Kentucky Occupational Outlook, which projects that the state economy will generate 63,000 job openings per year going forward. Accordingly, based on this estimate, 13% will be enabled/ facilitated by the fulfillment of full broadband availability.

The number of jobs saved/created is limited by the natural unemployment rate. We cannot expect to realize all these jobs if people are already employed. However, as of now the unemployment rate is at 10%, well above the natural rate of 4-5%. In order to account for this phenomenon, we also do not allow the impact of broadband on unemployment to exceed 5% in any year for any county. Table A.2. in appendix presents the detailed results of this analysis by county.

While the econometric models do not allow breaking down the total employment number between those jobs that will be created versus those that will be preserved, we utilized the projections of Kentucky's Occupational Outlook which state that the structure of the change in employment for the 2008-2018 period would be new jobs (32%) and replacement jobs (68%). This structure applied to our model helps us to break the total job impact of broadband in two categories: new jobs created and jobs saved. According to this, it is estimated that of the 10,235 jobs saved or created in Kentucky, 3,254 will be new jobs resulting from new economic activities triggered by wireless broadband deployment in rural counties. Conversely, 6,981 jobs will be saved as a result of the combined impact of economic growth and enhanced capabilities that will be provided to those workers as a result of wireless broadband.

In addition, according to the models, an increase in broadband availability of 1% also drives an area specific effect on income. In metro counties, rural counties adjacent to metro counties, and isolated metro counties broadband causes income to grow by

[51] This assumption was made for purposes of the estimation of economic impact.

0.0968%, 0.0704%, and 0.0800% respectively. Based on these coefficients and assuming a full deployment in 2011[52], impact on each county median income was estimated for 2011-2013[53] (see table 24).

Table 24. Kentucky: Impact of Broadband Availability on Median Income Key Figures

County Type	Average Increase in Median Income 2011-2013	Number of Counties
All Counties	**$914.56**	**120**
With supply gaps	$1,097.48	100
Metro Counties	**$668.97**	**35**
With supply gaps	$936.57	25
Rural	**$1,015.69**	**38**
With supply gaps	$1151.12	33
Rural Adjacent to Metro Counties	$1033.16	47
With supply gaps	$1189.70	42
Rural, Isolated from Metro Counties	$1001.57	85
With supply gaps	$1120.80	75

An increase in broadband availability to 100 % would drive an average increase in median income of $914.56, which represents 2.0 % increase in the median income of Kentucky, $43,765. Though metro counties experience a greater impact per percentage of broadband supplied, rural counties are expected to benefit more from universal coverage. Because the supply gap is so much larger in rural areas, the average growth in median income is $1,015 for rural counties, whereas it is only $668 in metro counties. However, the difference is much smaller between rural counties and metro counties with supply gaps ($1,151 to $936). Table A.3. in appendix presents the detailed results of this analysis.

6. THE ECONOMIC IMPACT OF BROADBAND IN OHIO:

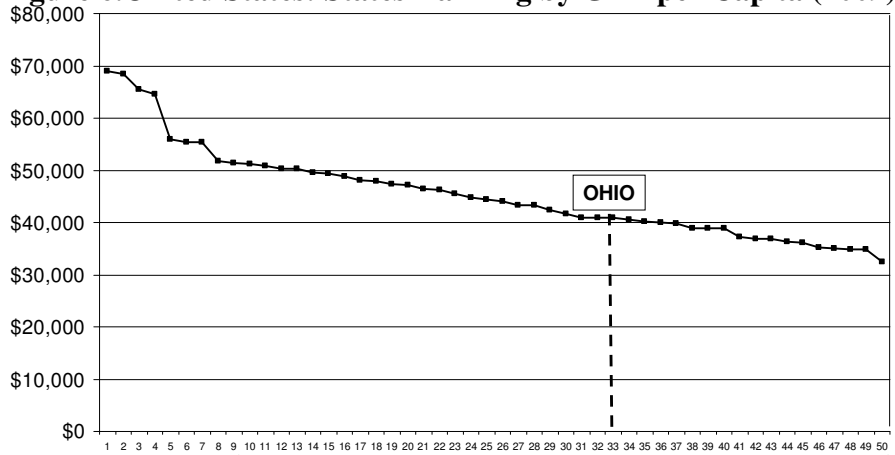
6.1. The Ohio economy:

The state of Ohio ranks thirty-third in the United States in terms of GDP per capita (see figure 6).

[52] This assumption was made for purposes of the estimation of economic impact.

[53] Note that similarly to labor force above, we use current 2010 median income for our estimations, though the impact will be on 2011 median income.

Figure 6.United States: States Ranking by GDP per Capita (2009)

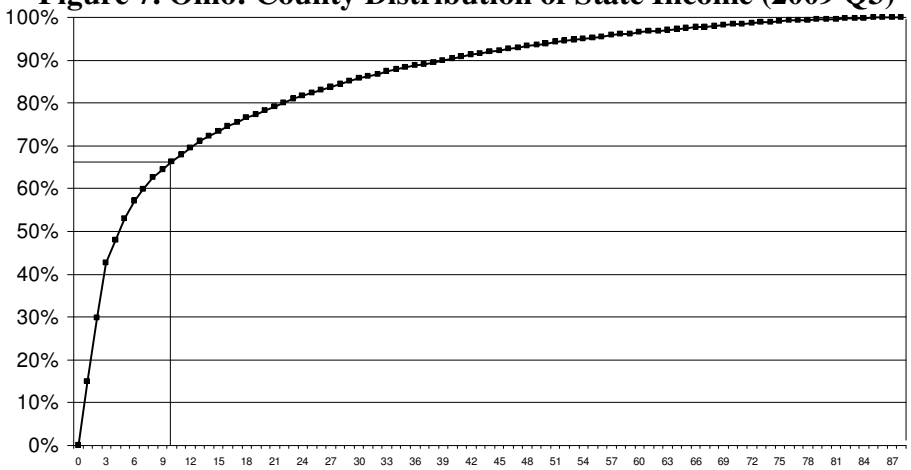


Source: Bureau of Economic Analysis, US Department of Commerce; US Census Bureau; analysis by the author

The growth of Ohio's GDP since 2000 has averaged 2.3%, which falls well behind the US average, 4.1%[54]. It performed similarly in terms of GDP per capita, growing at an average rate of 2.2% since 2000, which is also significantly lower than the US average, 3.5%. In 2009, Ohio's population was 11,542,645[55] and its income distribution, as measured by the GINI coefficient, was 0.453, which ranks it 28th among US states.

From a geographical standpoint, the state's economic activity is largely concentrated. Of 88 counties, ten account for 66.15% of the state's income (see figure 7).

Figure 7. Ohio: County Distribution of State Income (2009 Q3)

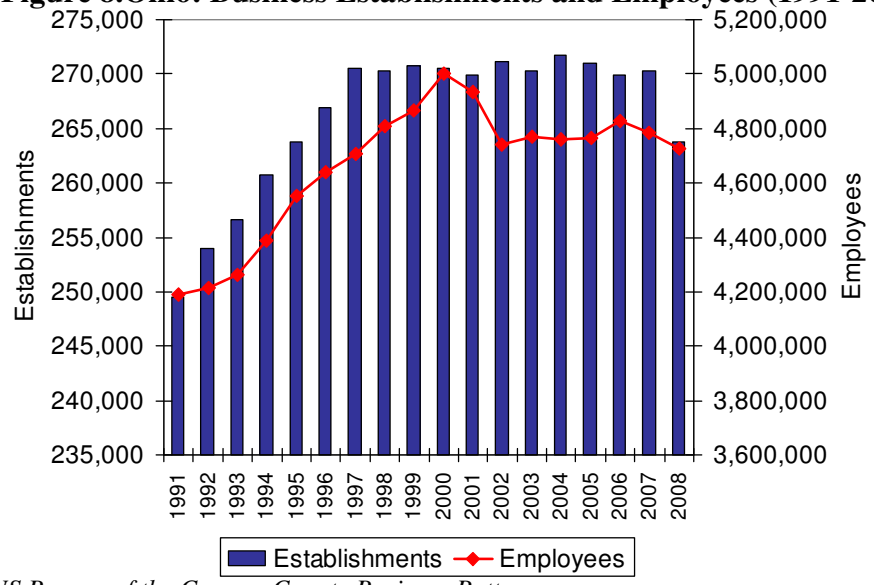


County Income is calculated as the number of employees multiplied by average income
Sources: Census Quarterly Workforce Indicators; analysis by the author

In 2008, there were 263,761 business establishments, employing 4,728,416 residents[56]. The number of employees has significantly declined since 2007 (see figure 8).

[54]Source: Bureau of Economic Analysis, US Department of Commerce.
[55] Source: 2010 Census; US Census Bureau, Population Division.
[56]Source: US Census County Business Patterns

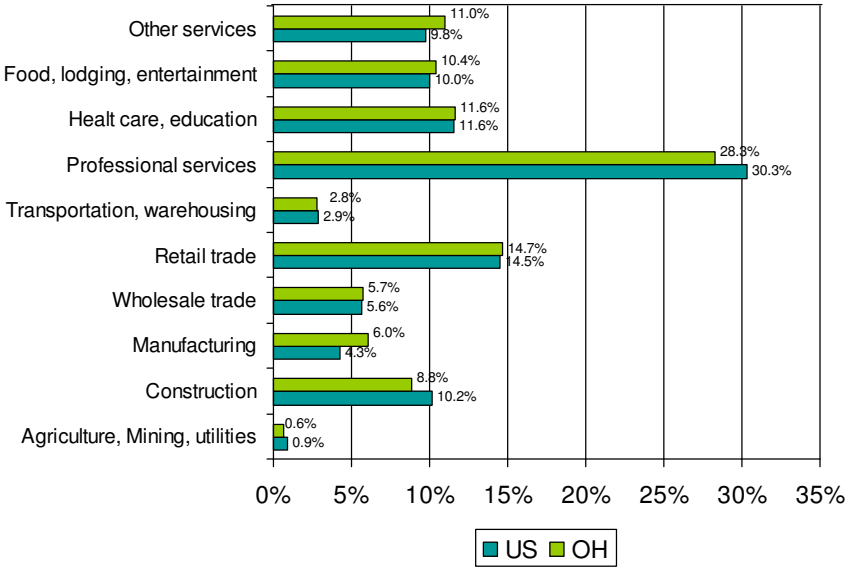
Figure 8.Ohio: Business Establishments and Employees (1991-2008)



Sources: US Bureau of the Census; County Business Patterns

According to these statistics, the average number of employees per establishment has remained relatively constant over the past decade. Though there has been some variation, it was 17.8 in 1998 to 17.9 in 2008. In 2008 roughly half, (48.6%), of all establishments in the state employed fewer than five employees and 2.9% employed more than 100 employees[57]. The sector decomposition of these establishments shows that professional services comprise the largest share (28.2%) of businesses, followed by retail trade (14.6%) (see figure 9).

Figure 9.Ohio: Number of establishments by Industry Sector (2008)



Source: US Census Bureau; County Business Patterns

[57] Source: US Census Bureau Country Business Patterns (2008).

Relative to the national breakdown, Ohio has a greater concentration of manufacturing (6.0 % to 4.3 %) and a lesser concentration of professional service businesses (28.2 % to 30.3 %).

Since the advent of the economic crisis, Ohio's already stagnant economy has further slowed. GDP grew by 1.30% from 2007-2008 and by -1.25% from 2008-2009. This is slightly below the US averages, which were 2.6% and -1.3%, respectively. Unemployment in Ohio has soared. In 2007 average seasonally adjusted monthly unemployment was 5.6%, but this figure grew to 6.8%, 10.3% and 10.5% in the following years. Unemployment began to grow (year over year) in January of 2008, reached its peak growth rate (69.5%) in July of 2009, and began to decline in June 2010. The highest unemployment rate (11.0%) was recorded in March of 2010, and as October 2010 there has been slight progress (the rate has decreased to 9.9%). Bankruptcies also drastically increased. The peak was in the second quarter of 2010 so it is difficult to say if they are now beginning to trend downwards. Totals for the 2007, 2008, 2009 and the first three quarters of 2010 are 50,728, 58.268, 70,779, and 55,092, respectively. During the first quarter of 2007 there were 11,415, but in the third quarter of 2010 the figure was 58% higher at 18,135.[58]

6.2. Broadband deployment in Ohio:

According to the FCC[59], there are 4.1 million of broadband lines in Ohio (see table 25).

Table 25. Ohio: Breakdown of Broadband Lines

Technology	Number of lines
DSL	1,109,000
FTTx	13,000
Cable modem	1,776,000
Satellite	---
Mobile broadband (WiMax, 3G, etc.)	1,209,000
Total	4,107,000

Source: FCC; Operator Reports

The growth of broadband lines has increased at an average rate of 34 % in the past ten years, reaching a penetration of 30 % of population, and 77 % of households in 2009[60] (see table 26).

[58]Source: American Bankruptcy Institute (2010)

[59]Source: FCC's report "Internet Access Services: Status as of June 30, 2009. (2010)

[60] The study recently published by the Economics and Statistics Administration and National Telecommunications and Information Administration (2010) estimates broadband penetration at 61 %.

Table 26. Ohio: Growth in Broadband Lines and Household Penetration (2000-9)

Year	Total Lines	Residential	Business	Population	Households	Penetration per pop.	Household Penetration
1999	160,792						
2000	223,845	174,566 (*)	49,279	11,363,844	4,445,773	2%	4%
2001	436,766	371,141 (*)	65,625	11,396,874	4,458,183	3%	8%
2002	710,355	630,503 (*)	79,852	11,420,981	4,470,592	6%	14%
2003	977,886	892,936 (*)	84,950	11,445,180	4,483,002	8%	20%
2004	1,347,040	1,249,482 (*)	97,558	11,464,593	4,495,411	11%	28%
2005	1,889,878	1,623,586	266,292	11,475,262	4,507,821	14%	36%
2006	3,186,537	2,141,752	1,044,785	11,492,495	4,499,506	19%	48%
2007	4,612,073	2,634,429	1,977,644	11,520,815	4,505,995	23%	58%
2008	3,910,000	3,360,000	550,000	11,528,072	4,508,871	29%	75%
2009	4,107,000	3,452,000	655,000	11,542,645	4,495,000	30%	77%

* Includes Small Businesses
Source: FCC; American Community Survey

Fixed line coverage currently amounts to 97.9 % of households. The FCC estimates the underserved supply gap of broadband (<4 Mbps service) in Ohio to amount to 123,456 households (see data by county in table B.1. in appendix).

Based on the difference between broadband coverage and service purchasing, the demand gap amounts to 15.58 %. A number of variables explain this gap (see table 27).

Table 27.Ohio: Drivers of Demand Gap (2009)

Reasons Household does not have Broadband (*)	Percentage
No need for broadband	38%
Does not own a computer	34%
Too expensive	22%
No service in area (**)	16%
Can access somewhere else	10%
Concerns about fraud or identity theft	6%
Other	11%

(*)Percentages do not add up to 100% because respondents could give multiple responses.
(**) This should not be considered as part of the demand gap.
Source: Connect Ohio Residential Survey (2009)

In 2010, 67% of business (up to 59% in 2009) reported having access to broadband, up 14 % from 59 % in 2009. When converted to absolute terms, 182,000 business establishments have high-speed Internet access. Of this, the highest adoption was registered in companies with 50 or more employees (88%), while for companies with less than 5 employees the adoption level declines to 65%.

Broadband adoption is fairly homogeneous among industry sectors. In the last enterprise survey conducted in 2010, most sectors with the exception of Health Care relied on broadband for Internet access (53%).

It is interesting to acknowledge that the main reason why companies do not subscribe to broadband is because they do not recognize the benefits of this technology (See Table 28). This fact underlines the importance of the implementation of public/private programs that would help companies incorporate the internet into their functions.

Table 28. Ohio: Reasons for Enteprises not connecting to the Internet

Reasons Household does not have Broadband*	Percentage
No need for broadband/ Do not know why they do not subscribe	80%
No computer	16%
Too expensive	11%
Security risks	7%
Is not available in our area	5%
Broadband is too complicated	3%

Source: Connect Ohio, Business Technology Overview (2010)

6.3. Estimating the economic benefit of filling the broadband supply gap in Ohio:

In this section the impact of broadband availability on future economic growth and employment in Ohio is estimated. Because data for the panel regression was only available for Kentucky, projections for Ohio relied on the econometric estimates from the previous regressions. It is considered that these estimates are relatively reliable due to the rich set of controls and the inclusion of county fixed effects. The only effects that were not able to control for are state-fixed effects[61]. Therefore, the projections assume that, given the set of controls, (such as income, population density, etc.), rural counties in Ohio respond to broadband in a way that is similar to rural counties in Kentucky. The same assumption applies for metro counties in the two states.

According to the FCC, as of 2010, broadband was available to 97.6% of households, ranging from 39% in Monroe County to 100 % in Allen County and many others. On this basis, the benefit of closing this broadband gap by deploying wireless broadband, (i.e., reaching 100 % availability in all counties throughout the state) was estimated.

Based on the effects analyzed for Kentucky, (see section 5.3), the increase in broadband availability to 100 % will drive an augmentation in median income by county and could help reduce the growth rate of unemployment by creating or preserving jobs. According to the models, an increase in broadband availability of 1% would result in a decrease in unemployment of 0.1953 % for rural counties. Based on these coefficients and assuming

[61] In this regard, it should be taken into consideration that these states are spatially adjacent.

a full deployment in 2011[62], impact on the unemployment rate was estimated for the period 2012-2014. Though we believe that there is a muted impact of broadband in isolated rural counties we cannot be sure since the coefficient was not significant. Nevertheless, in order to estimate impact by type of rural county, these were classified according to the USDA continuum scale and the same coefficient for rural impact was applied. We also note that, though our model estimates the lagged impact of broadband on unemployment growth, there is obviously no data for the size of the 2011 labor force. Thus, in these estimates we use 2010 labor force, which is a conservative constraint since we expect the labor force to be larger in 2011.

This resulted in 5,744 jobs created or saved from effects of broadband on business expansion[63] (see Table 29).

Table 29. Ohio: Impact of Broadband Availability on Job Creation Key Figures

County Type	Total Jobs Saved/Created 2011-14	Number of Counties with Supply Gaps
Rural Isolated	4,817	38
Rural Adjacent to Metro Counties	927	7
Total	5,744	45

The number of jobs saved/created by achieving full broadband availability throughout the state is validated by the total number of job openings estimated by the Occupational Profile of Ohio, which project total annual openings to be 173,718. This means that broadband universal coverage will enable the creation, saving of 3 % of total annual job openings.

The total number of jobs is limited by the natural unemployment rate. We cannot expect to realize all these jobs if people are already employed. However, as of now the unemployment rate is at 10%, well above the natural rate of 4-5%. In order to account for this phenomenon, we also do not allow the impact of broadband on unemployment to exceed 5% in any year for any county. Table B.2 in appendix presents the detailed results of this analysis.

We utilized the projections of Ohio's Occupational Outlook 2018 which state that the structure of the change in employment would be 15% new positions and 85% replacement jobs. These numbers allow us to break total employment impact of broadband in two categories: new jobs created and jobs saved. According to this, it is estimated that of the 5,744 jobs saved or created in Ohio, 860 will be new jobs resulting from new economic activities triggered by wireless broadband deployment in rural counties. Conversely, 4,884 jobs will be saved as a result of the combined impact of economic growth and enhanced capabilities that will be provided to those workers as a result of wireless broadband.

[62] This assumption was made for purposes of the estimation of economic impact.

[63] We are also probably underestimating the effects by using the Kentucky coefficients because Ohio has more of the types of industries that are positively influenced by broadband.

Moving now to estimating impact on income, according to the econometric models, an increase in broadband availability of 1% causes an area-specific effect on income. In metro counties, rural counties adjacent to metro counties, and isolated metro counties, it causes income to grow by 0.0968%, 0.0704%, and 0.0800% respectively. Based on these coefficients and assuming a full deployment in 2011[64], impact on each county median income was estimated for 2012-2013. (Note that similarly to labor force above, we use current 2010 median income for our estimations, though the impact will be on 2011 median income.) This resulted in an average increase of $428, which represents 0.8% increase in the median income of Ohio, $52,047 (see table 30).

Table 30. Ohio: Impact of Broadband Availability on Median Income
Key Figures

County Type	Average Increase in Median Income 2011-2013	Number of Counties
All Counties	**$427.85**	**88**
With supply gaps	$588.30	64
Metro Counties	**$248.65**	**40**
With supply gaps	$523.48	19
Rural	**$577.18**	**48**
With supply gaps	$615.66	45
Rural Adjacent to Metro Counties	$531.17	41
With supply gaps	$573.10	38
Rural, Isolated from Metro Counties	$846.72	7
With supply gaps	$846.72	7

Though metro counties experience a greater impact per percentage point of broadband supplied, we expect rural counties to benefit more from universal coverage. Because the supply gap is so much larger in rural areas, the average growth in median income is $577 for rural counties, whereas it is only $248 in metro counties. However, the difference is much smaller between rural counties and metro counties with supply gaps ($615 to $523). Table B.3 in appendix presents the detailed results of this analysis by county.

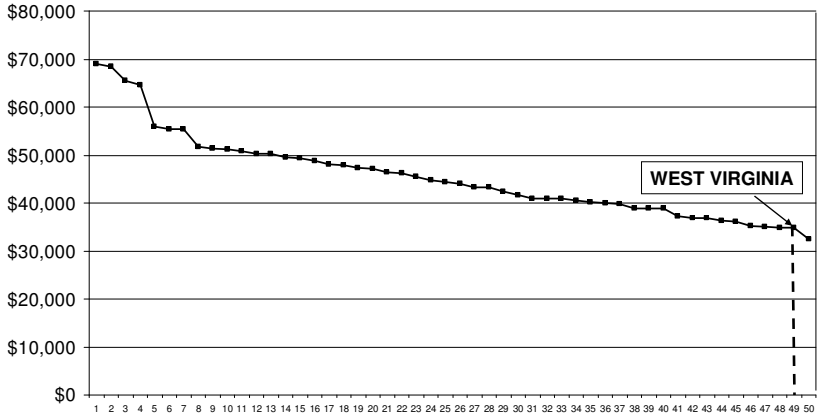
7. THE ECONOMIC IMPACT OF BROADBAND IN WEST VIRGINIA:

7.1. Economic profile of West Virginia:

The state of West Virginia ranks second to last in the United States in terms of GDP per capita (see figure 10).

[64] This assumption was made for purposes of the estimation of economic impact.

Figure 10. United States: States Ranking by GDP per Capita (2009)

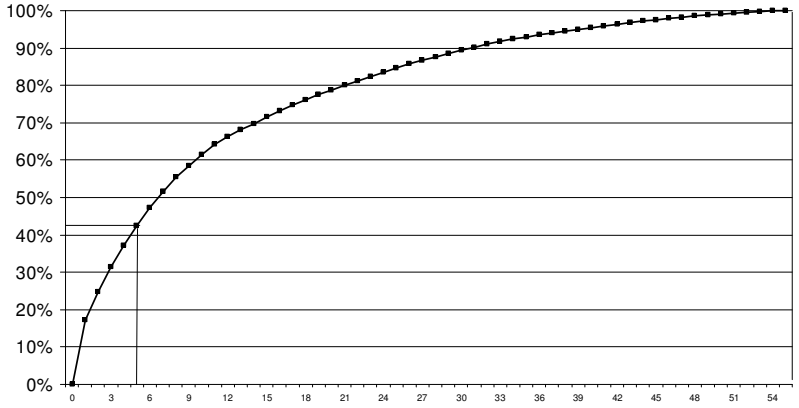


Source: Bureau of Economic Analysis, US Department of Commerce; US Census Bureau; analysis by the author

The growth of West Virginia's GDP since 2000 has averaged 4.8 %, which is somewhat higher than that of the United States, 4.1%[65]. It performed similarly in terms of GDP per capita, growing at an average rate of 4.8% since 2000, which is also significantly higher than the US average, 3.5%. In 2009, West Virginia's population was 1,806,962[66] and its income distribution, as measured by the GINI coefficient, was 0.463, which ranks it 35th among US states.

From a geographical standpoint, the state's economic activity is largely concentrated. Of 56 counties, five account for 42.38% of the state's income (see figure 11).

Figure 11. West Virginia: County Distribution of State Income (2009)

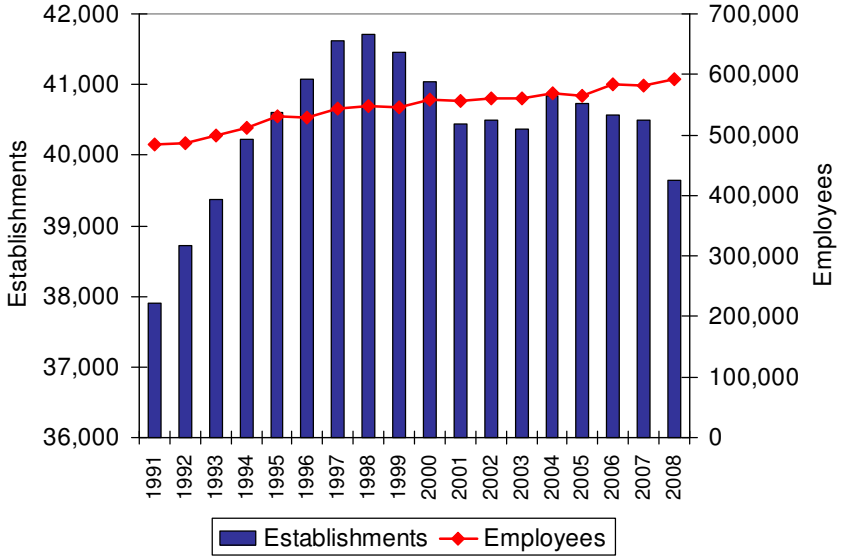


County Income is calculated as the number of employees multiplied by average income
Sources: Census Quarterly Workforce Indicators; analysis by the author

In 2008, there were 39,641 business establishments, employing 592,022 residents[67] (see figure 12).

[65] Source: Bureau of Economic Analysis, US Department of Commerce.
[66] Source: 2010 Census; US Census Bureau, Population Division.
[67] Source: US Census County Business Patterns

Figure 12.West Virginia: Business Establishments and Employees (1991-2008)

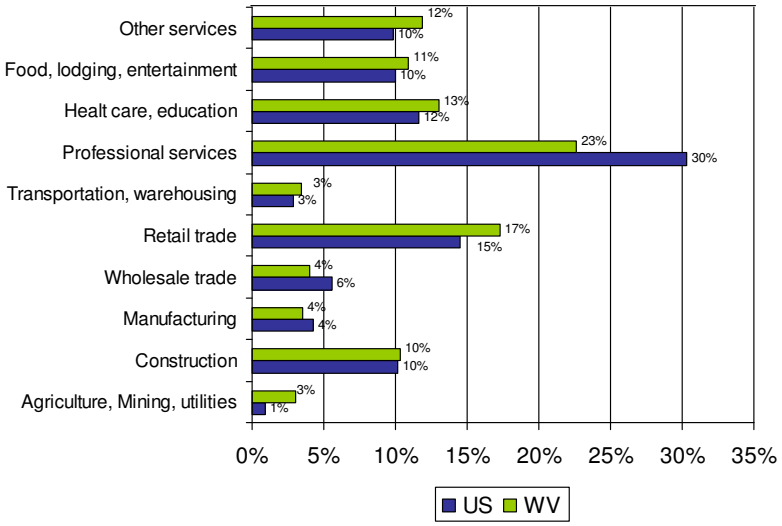


Sources: US Bureau of the Census; County Business Patterns

According to these statistics, the average number of employees per establishment increased gradually from 13 in 1998 to 15 in 2008. In 2008 half of all establishments in the state employed fewer than five employees and only 2% employed more than 100 employees[68].

The sector decomposition of these establishments shows that professional services comprise the largest share (22.5%) of businesses, followed by retail trade (17.3%) (see figure 13).

Figure 13.West Virginia: Number of establishments by Industry Sector (2008)



Source: US Census Bureau; County Business Patterns

[68] Source: US Census Bureau Country Business Patterns. (2008)

Relative to the national breakdown, West Virginia has a greater concentration of retail trade establishments (17.3 % to 14.5 %) and less concentration of professional service businesses (22.5 % to 30.3 %). It also has a higher concentration of businesses classified as agriculture, mining or utilizes than the national averages (3.1% to 0.9%).

Since the advent of the economic crisis, West Virginia's economy has stagnated, though it has done much better than other states. GDP grew by 6.18% from 2007-2008 and by 2.71% from 2008-2009. This is significantly better than the US averages, which were 2.6% and -1.3%, respectively. Unemployment in West Virginia has soared. In 2007 average seasonally adjusted monthly unemployment was 4.1%, but this figure grew to 4.4%, 8.0% and 9.1% in the following years. Unemployment began to grow (year over year) in September of 2008, reached its peak growth rate (102.3%) in July of 2009, and is still growing (albeit at rates closer to 10%). The highest unemployment rates (9.5%) were recorded in February and March of 2010, but as October 2010 there was little progress- the rate stood at 9.3%. Bankruptcies also drastically increased, but have begun to decrease since the first quarter of 2010. Totals for the 2007, 2008, 2009 and the first three quarters of 2010 are 4,498, 5,318, 6,660, and 4,815, respectively. During the first quarter of 2007 there were 1,103, but in the third quarter of 2010 the figure was 41% higher at 1,553.[69]

7.2. The State of Broadband in West Virginia:

According to the FCC[70], there are 518,000 broadband lines in West Virginia (see table 31).

Table 31. West Virginia: Breakdown of Broadband Lines

Technology	Number of lines
DSL	160,000
FTTx	13,000
Cable modem	215,000
Satellite	---
Mobile broadband (WiMax, 3G, etc.)	130,000
Total	518,000

Source: FCC; Operator Reports

The growth of broadband lines has increased at an average rate of 55 % in the past ten years, reaching a penetration of 24 % of population, and 59 % of households[71] (see table 32).

[69] Source: American Bankruptcy Institute (2010)

[70] Source: FCC's report "Internet Access Services: Status as of June 30, 2009. (2010)

[71] The study recently published by the Economics and Statistics Administration and National Telecommunications and Information Administration (2010) estimates broadband penetration at 52 %.

Table 32. West Virginia: Growth in Broadband Lines and Household Penetration (2000-2009)

Year	Total Lines	Residential	Business	Population	Households	Penetration per pop.	Household Penetration
2000	6,498	5,487 (*)	1,011	1,806,962	736,481	0%	1%
2001	32,848	31,160 (*)	1,688	1,798,582	736,599	2%	4%
2002	78,980	73,294 (*)	5,686	1,799,411	736,718	4%	10%
2003	100,937	97,802 (*)	3,135	1,802,238	736,836	5%	13%
2004	155,397	151,163 (*)	4,234	1,803,302	736,954	8%	21%
2005	205,984	192,910	13,074	1,803,920	740,702	11%	26%
2006	268,746	248,611	20,135	1,807,237	743,064	14%	33%
2007	336,283	297,852	38,431	1,811,198	733,849	16%	41%
2008	452,000	396,000	56,000	1,814,873	749,586	22%	53%
2009	518,000	442,000	76,000	1,819,777	748,517	24%	59%

* Includes Small Businesses

**FCC: "data withheld to maintain firm confidentiality".*

Source: FCC; American Community Survey

The FCC estimates the underserved supply gap of broadband in West Virginia to amount to 194,789 households (see data by county in table C.1. in appendix).

Based on the difference between broadband coverage and service purchasing, the demand gap amounts to 19%. In a survey administered in 2010 by the Future Generation Graduate School, the top three reasons respondents gave for not having a broadband service subscription are that it is too expensive, they already have free internet access, or there is no broadband connection currently available.

7.3. Estimating the economic benefit of filling the broadband supply gap in West Virginia

In this section the impact of broadband availability on future economic growth and employment in West Virginia is estimated. Because data for the panel regression was only available for Kentucky, the projections for West Virginia were performed using the econometric estimates from the previous models. As stated before, we believe that these estimates should be relatively reliable due to our rich set of controls and the inclusion of county fixed effects. The only effects that we are unable to control for are state-fixed effects[72]. Our projections assume that, given our set of controls, (such as income, population density, etc.), rural counties in West Virginia respond to broadband in a way that is similar to rural counties in Kentucky. The same assumption applies for metro counties in the two states. With this in mind, we believe that our projections are dependable estimates.

According to the FCC, as of 2010, broadband was available to 78.2% of households, ranging from 39% in Doddridge County to 100 % in Ohio County. Based on the effects

[72] In this regard, it should be taken into consideration that these states are spatially adjacent.

analyzed for Kentucky, (see section 5.3), the increase in broadband availability to 100 % will drive an augmentation in median income by county and could help reduce the growth rate of unemployment by creating or preserving jobs. According to the models, an increase in broadband availability of 1% would result in a decrease in unemployment of 0.1953 % for rural counties. Based on this coefficient and assuming a full deployment in 2011[73], impact on the unemployment rate was estimated for the period 2012-2014. Though we believe that there is a muted impact of broadband in isolated rural counties we cannot be sure since the coefficient was not significant. We also note that, though our model estimates the lagged impact of broadband on unemployment growth, there is obviously no data for the size of the 2011 labor force. Thus, in these estimates we use 2010 labor force, which is a conservative constraint since we expect the labor force to be larger in 2011.

This resulted in 4,793 jobs created or saved from effects of broadband on business expansion (see Table 33).

Table 33. West Virginia: Impact of Broadband Availability on Job Creation Key Figures

County Type	Total Jobs Saved / Created 2011-2013	Number of Counties with Supply Gaps
Rural isolated	3,042	19
Rural Adjacent to Metro Counties	1,751	15
Total	4,793	34

The number of jobs saved/created by achieving total broadband availability is fairly consistent with the Occupational Forecast of the State of West Virginia, which estimates annual job creation to be 21,090.

Our estimate is limited by the natural unemployment rate. We cannot expect to realize all these jobs if people are already employed. However, as of now the unemployment rate is at 10%, well above the natural rate of 4-5%. In order to account for this phenomenon, we also do not allow the impact of broadband on unemployment to exceed 5% in any year for any county. Table C.2 in appendix presents the detailed results of this analysis by county.

We utilized the projections of West Virginia's Occupational Forecast 2018 which state that the increase in employment would be a result of new (19%) and replacement (81%) jobs. These numbers allow us break total employment impact of broadband in two categories: new jobs created and jobs saved. According to this, it is estimated that of the 4,793 jobs saved or created in West Virginia, 910 will be new jobs resulting from new economic activities triggered by wireless broadband deployment in rural counties. Conversely, 3,883 jobs will be saved as a result of the combined impact of economic growth and enhanced capabilities that will be provided to those workers as a result of wireless broadband.

[73] This assumption was made for purposes of the estimation of economic impact.

According to the econometric models, an increase in broadband availability of 1% causes an area-specific effect on income. In metro counties, rural counties adjacent to metro counties, and isolated metro counties it causes income to grow by 0.0968%, 0.0704%, and 0.0800% respectively. Based on these coefficients and assuming a full deployment in 2011[74], impact on each county median income was estimated for 2012-2013. (Note that similarly to labor force above, we use current 2010 median income for our estimations, though the impact will be on 2011 median income.) This resulted in an average of $1,264, which represents 3.43% increase in the median income of West Virginia, $36,804 (see table 34).

Table 34. West Virginia: Impact of Broadband Availability on Median Income Key Figures

County Type	Average Increase in Median Income 2011-2013	Number of Counties
All Counties	**$1,263.71**	**55**
With supply gaps	$1,311.40	53
Metro Counties	**$1,144.50**	**21**
With supply gaps	$1,264.97	19
Rural	**$1,337.34**	**34**
With supply gaps	$1,337.34	34
Rural Adjacent to Metro Counties	$1,449.32	19
With supply gaps	$1,449.32	19
Rural, Isolated from Metro Counties	$1,195.51	15
With supply gaps	$1,195.51	15

Though metro counties experience a greater impact per percentage point of broadband supplied, we expect rural counties to benefit more from universal coverage. Because the supply gap is so much larger in rural areas, the average growth in median income is $1,337 for rural counties, whereas it is only $1,144 in metro counties,. Of the three states under consideration, West Virginia clearly has the most to gain, but it also necessitates the most deployment. Table C.3. in appendix presents the detailed results of this analysis by county.

8. ESTIMATING THE NATIONAL IMPACT IN RURAL STATES

The estimation of economic impact on a national scale was conducted for those states that exhibited the lowest broadband availability. For purposes of the analysis, states with accessibility lower than 90 % according to the National Broadband Plan were selected[75]. The 19 states considered for the analysis are included in table 35.

[74] This assumption was made for purposes of the estimation of economic impact.

[75] While we understand this to be an arbitrary number, his approach has the advantage of considering only those geographies that are facing major infrastructure access shortfalls, as opposed to a demand (penetration) problem.

Table 35. States identified as significantly lagging broadband accessibility

State	Percent of unserved or underserved	Number of Broadband lines	Households	Household penetration	Population	Population Penetration
W. Virginia	26.0 %	442,000	748,517	59%	1,819,777	24%
Arkansas	25.2 %	516,000	1,124,947	46%	2,889,450	18%
Mississippi	23.0 %	447,000	1,095,026	41%	2,951,996	15%
Alaska	20.7 %	162,000	236,597	68%	698,473	23%
S. Dakota	18.7 %	179,000	316,638	57%	812,383	22%
Montana	17.3 %	212,000	375,287	56%	974,989	22%
N. Dakota	16.5 %	155,000	279,014	56%	646,844	24%
Kentucky	15.7 %	876,000	1,694,197	52%	4,314,113	20%
N. Mexico	15.1 %	389,000	742,104	52%	2,009,671	19%
Missouri	13.6 %	1,269,000	2,339,684	54%	5,987,580	21%
Wyoming	13.5 %	122,000	213,571	57%	544,270	22%
Oklahoma	13.1 %	731,000	1,430,019	51%	3,687,050	20%
Louisiana	12.8 %	888,000	1,688,027	53%	4,492,076	20%
N. Carolina	12.3 %	2,172,000	3,646,095	60%	9,380,884	23%
Alabama	12.0 %	901,000	1,848,051	49%	4,708,708	19%
Kansas	11.6 %	659,000	1,104,976	60%	2,818,747	23%
Virginia	11.2 %	1,904,000	2,971,489	64%	7,882,590	24%
Tennessee	10.1 %	1,248,000	2,447,066	51%	6,296,254	20%
Maine	10.0 %	330,000	544,855	61%	1,318,301	25%
Total	14.1 %	13,602,000	24,846,160	55%	64,234,156	21%

Source: US Census Bureau; National Broadband Plan; FCC; analysis by the authors

As it can be seen, these states lag the national average broadband penetration: while broadband has been adopted on average by 55 % of households (or 21 % of the population) of these states, the US national average is 61 % (or 23 % of the population). Furthermore, while broadband is accessible on average by 93.8 % of US households, in the fourteen lowest availability states, the number drops to 85.9 %.

Based on the coefficients utilized in the evaluation of the three states studied in detail above, the impact on employment and median income was estimated for the 19 States (see table 36).

Table 36. Economic impact of full broadband accessibility

State	Jobs created/saved	Increase in median income Per county
W. Virginia	4,793	$ 1,273.61
Arkansas	8,960	$ 1,529.39
Mississippi	13,077	$ 1,222.21
Alaska	1,845	$ 2,427.42
S. Dakota	1,314	$ 1,525.99
Montana	2,280	$ 1,217.33
N. Dakota	660	$ 1,341.89
Kentucky	10,235	$ 911.09
N. Mexico	3,771	$ 1,141.53
Missouri	10,016	$ 1,385.28
Wyoming	996	$ 853.49
Oklahoma	5,855	$ 1,075.93
Louisiana	6,237	$ 954.72
N. Carolina	13,288	$ 1,073.90
Alabama	7,587	$ 905.61
Kansas	3,056	$1,484.67
Virginia	10,163	$1,143.15
Tennessee	11,192	$ 978.80
Maine	1,537	$ 517.98
Total	116,862	$ 1,201.11

Source: Analysis by the authors

In summary, by making broadband accessible to 100% of households in the states with lowest broadband availability, 116,862 jobs could be created and/or saved between 2011 and 2014. Furthermore, the average state median income could increase by $ 1,201.11.

We utilized the projections of each of the States' Occupational Outlook which break down new and replacement jobs to break total employment impact of broadband in two categories: new jobs created as a result of enhanced broadband accessibility in rural areas and jobs saved as a result of the combined effect of economic growth and broadband availability. According to this, it is estimated that of the 116,862 jobs saved or created in the 19 States with lowest broadband accessibility, 38,409 will be new jobs resulting from new economic activities triggered by wireless broadband deployment in rural counties. Conversely, 78,453 jobs will be saved as a result of the combined impact of economic growth and enhanced capabilities that will be provided to those workers as a result of wireless broadband (see table 37)

Table 37. Employment Impact broken down by New Jobs versus Saved Jobs

State	Jobs created/saved	Ratio of Jobs due to growth	New Jobs	Saved Jobs
Alabama	7,587	34.08%	2,585	5,002
Alaska	1,845	27.45%	507	1,338
Arkansas	8,960	41.67%	3,733	5,227
Kansas	3,056	36.45%	1,114	1,942
Kentucky	10,235	31.80%	3,254	6,981
Louisiana	6,237	28.40%	1,771	4,466
Maine	1,537	15.73%	242	1,295
Mississippi	13,077	26.23%	3,430	9,647
Missouri	10,016	19.61%	1,964	8,052
Montana	2,280	32.54%	742	1,538
N. Carolina	13,288	41.69%	5,540	7,748
N. Dakota	660	31.18%	206	454
N. Mexico	3,771	32.52%	1,226	2,545
Oklahoma	5,855	31.00%	1,815	4,040
S. Dakota	1,314	41.02%	539	775
Tennessee	11,192	37.42%	4,188	7,004
Virginia	10,163	40.75%	4,141	6,022
W. Virginia	4,793	18.98%	910	3,883
Wyoming	996	50.40%	502	494
Total	116,862		38,409	78,453

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9. SUMMARY OF FINDINGS AND POLICY IMPLICATIONS

The current broadband situation in Kentucky, Ohio and West Virginia indicates that there is still a portion of the population that is either unserved (cannot access broadband service) or underserved (could gain access to broadband service at download speeds under 4 Mbps, which is still the standard for universal service defined in the National Broadband Plan) (see table 38).

Table 38. Comparative Status of Broadband Adoption and Deployment

	Kentucky	Ohio	West Virginia
Number of Broadband Lines (1)	1,221,000	4,107,000	518,000
Broadband Penetration (2)	54 %	61 %	52 %
Broadband availability (>200 Kbps) (3)	95 %	98 %	88 %
Broadband availability (>4 Mbps) (4)	86 %	97 %	78 %

Sources:

(1) FCC's report "Internet Access Services: Status as of June 30, 2009. (2010)

(2) Economics and Statistics Administration and National Telecommunications and Information Administration (2010)

(3) Connect Kentucky (2009); Connect Ohio (2009); FCC

(4) National Broadband Plan (2010).

As expected, a large portion of the supply gap (unserved or underserved households) is concentrated in rural areas (see table 39).

Table 39. Regional Breakdown of Unserved and Underserved House Units

	Kentucky	Ohio	West Virginia
Total Housing Units	1,935,053	5,094,202	893,813
Unserved and Underserved Housing Units	14 %	2.5 %	22 %
Percent Rural Counties	8.8 %	1.7 %	13.6 %
Percent Metropolitan counties	5.2 %	0.8 %	8.4 %

Source: FCC (2010)

The econometric analysis of historical economic impact of broadband in Kentucky (the only state with robust statistical datasets collected between 2004 and 2009) indicates strong effects in terms of job creation and increase of median county income (see table 40).

Table 40. Kentucky: Impact of a 1 percentage point increase in Broadband Availability on Employment and Median Income

	Impact on Median Income	Impact on Employment
Metropolitan Counties	0.0968*	0.0303
Rural Counties Adjacent to Metro counties	0.0704*	-0.1953*
Rural Counties Isolated from Metro Counties	0.0800*	

*Significant at the 1% level

These coefficients were used to estimate the economic impact if broadband availability were to be increased to reach 100%[76]. In the three states analyzed in this study, filling up the supply gap (14 % in Kentucky, 2.5 % in Ohio, and 22 % in West Virginia) could result in 20,772 jobs created or saved resulting from business expansion between 2011 and 2014, and an increase in median income, ranging from $914 in Kentucky to $427 in Ohio, and $1,264 in West Virginia. (see table 41).

[76] Because data for the panel regression was only available for Kentucky, projections for Ohio and West Virginia relied on the econometric estimates from the former state. It is considered that Kentucky's estimates can be reliably applied to the other two states due to the rich set of controls and the inclusion of county fixed effects. The only effects not controlled for are state-fixed effects. Therefore, the projections assume that, given the set of controls, (such as income, population density, etc.), rural counties in Ohio and West Virginia respond to broadband in a way that is similar to rural counties in Kentucky. The same assumption applies for metro counties in the three states.

Table 41. Impact Analysis

	Kentucky	Ohio	West Virginia
Unemployment (October 2010)	10.0 %	9.9 %	9.3 %
Jobs created or preserved by broadband (2011-4)	10,235	5,744	4,793
Median income (2010)	$ 43,765	$ 52,047	$ 36,804
Increase in median income	$ 914.56	$ 427.85	$ 1,263.71

In conclusion, the opportunity cost of not increasing broadband availability to 100% of households in these three states is significant.

In order to estimate the national impact of providing full broadband availability through wireless technology, the economic impact was estimated for the nineteen states with lowest broadband availability. In this case, the total number of jobs to be created in these states would be 116,862.

In this context, it is critical to generate the policy incentives that will enable the private sector to invest to reach this target. In particular, allowing rural carriers to interoperate with national carriers across all bands at the 700 MHz band is a critical component of the policy framework. Service deployment in this band is the only choice for unserved and underserved households to gain access to broadband at the service speed stipulated in the National Broadband Plan. If this policy change were to be enacted, accessibility to service would have a significant economic impact.

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APPENDICES

A. KENTUCKY COUNTY DATA AND ESTIMATIONS

Table A.1. Kentucky Unserved Households

County	Unserved Households	Percent of Households
Adair	4633	58%
Allen	4847	57%
Anderson	2976	33%
Ballard	0	0%
Barren	3502	19%
Bath	0	0%
Bell	1887	14%
Boone	0	0%
Bourbon	0	0%
Boyd	551	2%
Boyle	0	0%
Bracken County	784	20%
Breathitt	4542	63%
Breckinridge	6663	63%
Bullitt	532	2%
Butler	3524	57%
Caldwell	646	10%
Calloway	4427	25%
Campbell	391	1%
Carlisle	484	18%
Carroll	397	9%
Carter	4004	32%
Casey	5342	70%
Christian	0	0%
Clark	1432	9%
Clay	3706	37%
Clinton	1236	24%
Crittenden	2342	51%
Cumberland	1005	28%
Daviess	4301	10%
Edmonson	996	15%
Elliott	2755	83%
Estill	1401	20%
Fayette	0	0%
Fleming	0	0%
Floyd	4209	21%
Franklin	1531	7%
Fulton	13	0%
Gallatin	0	0%
Garrard	1729	26%
Grant	1531	14%

Graves	5962	35%
Grayson	4661	35%
Green	1728	31%
Greenup	1494	9%
Hancock	2019	54%
Hardin	2175	5%
Harlan	3864	25%
Harrison	2053	25%
Hart	1828	22%
Henderson	897	4%
Henry	0	0%
Hickman	165	6%
Hopkins	2974	14%
Jackson	3717	58%
Jefferson	29103	9%
Jessamine	0	0%
Johnson	2190	21%
Kenton	159	0%
Knott	2770	34%
Knox	427	3%
Larue	671	10%
Laurel	3570	15%
Lawrence	3315	44%
Lee	2238	63%
Leslie	2930	50%
Letcher	0	0%
Lewis	2954	45%
Lincoln	2924	25%
Livingston	2030	40%
Logan	0	0%
Lyon	3663	81%
Madison	1788	5%
Magoffin	1629	28%
Marion	1892	25%
Marshall	2210	14%
Martin	1311	22%
Mason	348	4%
McCracken	1963	6%
McCreary	3294	43%
McLean	2455	53%
Meade	2730	24%
Menifee	2948	75%
Mercer	855	8%
Metcalfe	975	20%
Monroe	1337	24%
Montgomery	0	0%
Morgan	4600	78%
Muhlenberg	2641	18%

Nelson	2538	14%
Nicholas	616	19%
Ohio	5765	55%
Oldham	33	0%
Owen	2832	50%
Owsley	1588	67%
Pendleton	415	7%
Perry	4449	33%
Pike	8347	25%
Powell	838	14%
Pulaski	1388	5%
Robertson	716	66%
Rockcastle	1184	15%
Rowan	458	5%
Russell	3854	41%
Scott	317	2%
Shelby	1359	8%
Simpson	0	0%
Spencer	0	0%
Taylor	2044	20%
Todd	1319	25%
Trigg	3317	46%
Trimble	955	26%
Union	0	0%
Warren	2748	6%
Washington	1203	25%
Wayne	5933	59%
Webster	472	7%
Whitley	4327	27%
Wolfe	2344	67%
Woodford	905	8%
TOTAL	266,040	14%

Source: FCC (2010). National Broadband Plan

Table A.2. Kentucky: Impact of Broadband Availability on Job Creation Detailed Results

County	Percent Unserved	Unemp. growth due to complete coverage	Unemp. Rate Oct 2010	UnEmp 12	UnEmp 13	UnEmp 14	Labor Force	Jobs Saved / Created 2011-12	Jobs Saved / Created 2012-13	Jobs Saved / Created 2013-14	Total Jobs Saved/Created 2011-14
Adair	58%	-11%	9.2	8.2	7.2	6.4	9,130	95	84	75	254
Allen	56%	-11%	10.6	9.4	8.4	7.5	8,571	99	89	79	267
Anderson	32%	-6%	9.5	8.9	8.3	7.8	11,108	66	62	58	186
Ballard	0%	0%	9.1	9.1	9.1	9.1	4,236	0	0	0	0

Barren	19%	-4%	10.6	10.2	9.8	9.5	19,237	76	73	70	219
Bath	0%	0%	11	11.0	11.0	11.0	5,133	0	0	0	0
Bell	13%	-3%	11	10.7	10.4	10.2	10,059	28	27	27	82
Boone	0%	0%	9.1	9.1	9.1	9.1	63,934	0	0	0	0
Bourbon	0%	0%	8.5	8.5	8.5	8.5	9,787	0	0	0	0
Boyd	2%	0%	8.7	8.7	8.7	8.7	23,449	0	0	0	0
Boyle	0%	0%	11.1	11.1	11.1	11.1	13,058	0	0	0	0
Bracken	20%	0%	9.5	9.5	9.5	9.5	4,300	0	0	0	0
Breathitt	63%	-12%	10.6	9.3	8.2	7.1	5,831	76	67	58	201
Breckinridge	63%	-12%	9.9	8.7	7.6	6.7	9,519	116	102	89	307
Bullitt	2%	0%	9.3	9.3	9.3	9.3	40,085	0	0	0	0
Butler	57%	-11%	10.9	9.7	8.6	7.6	5,386	65	58	52	175
Caldwell	10%	-2%	7.8	7.6	7.5	7.4	6,895	11	10	10	31
Calloway	25%	-5%	7.4	7.0	6.7	6.4	18,154	66	62	59	187
Campbell	1%	0%	10	10.0	10.0	10.0	45,322	0	0	0	0
Carlisle	19%	-4%	7.3	7.0	6.8	6.5	2,347	6	6	6	18
Carroll	9%	-2%	11.9	11.7	11.5	11.3	5,486	11	11	11	33
Carter	33%	-6%	10.3	9.6	9.0	8.4	13,680	91	85	80	256
Casey	70%	-14%	9.4	8.1	7.0	6.0	7,155	92	79	69	240
Christian	0%	0%	10.3	10.3	10.3	10.3	29,929	0	0	0	0
Clark	9%	0%	9.7	9.7	9.7	9.7	17,628	0	0	0	0
Clay	38%	-7%	12.8	11.8	11.0	10.2	6,993	66	62	57	185
Clinton	24%	-5%	8.4	8.0	7.6	7.3	4,888	19	18	17	54
Crittenden	50%	-10%	8.6	7.8	7.0	6.3	4,141	35	31	28	94
Cumberland	28%	-5%	9.9	9.4	8.8	8.4	3,147	17	16	15	48
Daviess	10%	0%	8	8.0	8.0	8.0	48,858	0	0	0	0
Edmonson	15%	0%	9.6	9.6	9.6	9.6	5,427	0	0	0	0
Elliott	83%	-16%	10.2	8.5	7.2	6.0	3,220	53	45	37	135
Estill	20%	-4%	10.7	10.3	9.9	9.5	6,423	27	26	25	78
Fayette	0%	0%	7.2	7.2	7.2	7.2	152,842	0	0	0	0
Fleming	0%	0%	10.1	10.1	10.1	10.1	6,519	0	0	0	0
Floyd	21%	-4%	10.8	10.4	9.9	9.5	15,963	71	68	65	204
Franklin	7%	-1%	7.6	7.5	7.4	7.3	25,022	26	26	25	77
Fulton	0%	0%	12.1	12.1	12.1	12.1	2,749	0	0	0	0
Gallatin	0%	0%	10.2	10.2	10.2	10.2	4,005	0	0	0	0
Garrard	25%	-5%	10.3	9.8	9.3	8.9	7,744	39	37	35	111
Grant	14%	0%	10.2	10.2	10.2	10.2	13,024	0	0	0	0
Graves	35%	-7%	8.8	8.2	7.6	7.1	16,460	99	92	86	277

Grayson	36%	-7%	12.8	11.9	11.1	10.3	11,655	105	98	91	294
Green	31%	-6%	9.9	9.3	8.7	8.2	5,755	35	32	30	97
Greenup	9%	0%	9.3	9.3	9.3	9.3	18,133	0	0	0	0
Hancock	54%	0%	8.1	8.1	8.1	8.1	4,347	0	0	0	0
Hardin	5%	0%	8.5	8.5	8.5	8.5	48,892	0	0	0	0
Harlan	24%	-5%	10.9	10.4	9.9	9.4	10,780	55	53	50	158
Harrison	27%	-5%	9.7	9.2	8.7	8.2	9,447	48	46	43	137
Hart	22%	-4%	9.3	8.9	8.5	8.2	8,459	34	32	31	97
Henderson	4%	0%	9.2	9.2	9.2	9.2	23,580	0	0	0	0
Henry	0%	0%	8.9	8.9	8.9	8.9	7,912	0	0	0	0
Hickman	6%	-1%	8.3	8.2	8.1	8.0	2,125	2	2	2	6
Hopkins	14%	-3%	7.9	7.7	7.5	7.3	23,461	51	49	48	148
Jackson	58%	-11%	14.9	13.2	11.7	10.4	4,300	73	64	57	194
Jefferson	9%	0%	9.7	9.7	9.7	9.7	364,271	0	0	0	0
Jessamine	0%	0%	8.3	8.3	8.3	8.3	23,575	0	0	0	0
Johnson	21%	-4%	9.9	9.5	9.1	8.7	10,174	41	40	38	119
Kenton	0%	0%	9.7	9.7	9.7	9.7	85,344	0	0	0	0
Knott	34%	-7%	10.8	10.1	9.4	8.8	6,883	49	46	43	138
Knox	3%	-1%	10.6	10.5	10.5	10.4	12,764	8	8	8	24
Larue	10%	0%	7.5	7.5	7.5	7.5	7,160	0	0	0	0
Laurel	15%	-3%	9.8	9.5	9.2	9.0	26,907	77	75	73	225
Lawrence	44%	-9%	11.1	10.1	9.3	8.5	6,314	60	55	50	165
Lee	64%	-13%	11	9.6	8.4	7.4	2,846	39	34	30	103
Leslie	50%	-10%	12.2	11.0	9.9	9.0	3,661	44	39	36	119
Letcher	0%	0%	10.1	10.1	10.1	10.1	8,869	0	0	0	0
Lewis	42%	-8%	12	11.0	10.1	9.3	5,615	55	51	47	153
Lincoln	25%	-5%	11	10.5	10.0	9.5	10,798	58	55	52	165
Livingston	40%	-8%	7.2	6.6	6.1	5.6	4,887	27	25	23	75
Logan	0%	0%	9.7	9.7	9.7	9.7	12,303	0	0	0	0
Lyon	81%	-16%	9	7.6	6.4	5.4	3,451	49	41	35	125
McCracken	6%	-1%	8.2	8.1	8.0	7.9	31,687	30	30	30	90
McCreary	44%	-9%	13.4	12.2	11.2	10.2	5,859	67	62	56	185
McLean	53%	0%	8.4	8.4	8.4	8.4	4,696	0	0	0	0
Madison	5%	-1%	7.9	7.8	7.7	7.7	42,650	33	33	32	98
Magoffin	28%	-5%	16.8	15.9	15.0	14.2	4,562	42	40	37	119
Marion	25%	-5%	9.9	9.4	9.0	8.5	9,983	48	46	44	138
Marshall	14%	-3%	9.4	9.1	8.9	8.6	15,027	39	38	37	114
Martin	24%	-5%	10	9.5	9.1	8.7	3,790	18	17	16	51

Mason	4%	-1%	9	8.9	8.9	8.8	8,859	6	6	6	18
Meade	24%	0%	11.9	11.9	11.9	11.9	11,905	0	0	0	0
Menifee	79%	-15%	13.9	11.8	9.9	8.4	2,707	58	49	42	149
Mercer	8%	-2%	10.1	9.9	9.8	9.6	10,566	17	16	16	49
Metcalfe	20%	-4%	10.2	9.8	9.4	9.1	4,444	18	17	16	51
Monroe	24%	-5%	9.8	9.3	8.9	8.5	4,624	21	20	19	60
Montgomery	0%	0%	10.7	10.7	10.7	10.7	12,367	0	0	0	0
Morgan	78%	-15%	12.1	10.3	8.7	7.4	5,210	96	81	69	246
Muhlenberg	18%	-4%	9.3	9.0	8.7	8.4	13,915	46	44	42	132
Nelson	15%	0%	9.9	9.9	9.9	9.9	22,086	0	0	0	0
Nicholas	19%	-4%	10.2	9.8	9.5	9.1	3,147	12	11	11	34
Ohio	55%	-11%	8	7.1	6.4	5.7	12,674	109	97	87	293
Oldham	0%	0%	7.4	7.4	7.4	7.4	28,029	0	0	0	0
Owen	50%	-10%	8.1	7.3	6.6	6.0	5,545	44	40	36	120
Owsley	67%	-13%	10.1	8.8	7.6	6.6	1,596	21	18	16	55
Pendleton	7%	0%	10.6	10.6	10.6	10.6	7,495	0	0	0	0
Perry	33%	-6%	10.2	9.5	8.9	8.4	11,884	78	73	68	219
Pike	25%	-5%	8.8	8.4	8.0	7.6	26,514	114	108	103	325
Powell	14%	-3%	12.9	12.5	12.2	11.9	5,843	21	20	20	61
Pulaski	5%	-1%	9.6	9.5	9.4	9.3	28,063	26	26	26	78
Robertson	66%	-13%	8.2	7.1	6.2	5.4	1,081	11	10	9	30
Rockcastle	15%	-3%	8.4	8.2	7.9	7.7	7,247	18	17	17	52
Rowan	5%	-1%	7.8	7.7	7.6	7.6	12,558	10	9	9	28
Russell	41%	-8%	10.1	9.3	8.5	7.9	8,417	68	63	58	189
Scott	2%	0%	8.5	8.5	8.5	8.5	23,397	0	0	0	0
Shelby	8%	0%	7.8	7.8	7.8	7.8	21,765	0	0	0	0
Simpson	0%	0%	11	11.0	11.0	11.0	9,144	0	0	0	0
Spencer	0%	0%	9.1	9.1	9.1	9.1	9,278	0	0	0	0
Taylor	20%	-4%	9.5	9.1	8.8	8.4	13,587	50	48	47	145
Todd	25%	-5%	9.5	9.0	8.6	8.2	5,279	24	23	22	69
Trigg	46%	0%	9.2	9.2	9.2	9.2	6,540	0	0	0	0
Trimble	26%	0%	10.2	10.2	10.2	10.2	4,517	0	0	0	0
Union	0%	0%	9	9.0	9.0	9.0	7,685	0	0	0	0
Warren	6%	0%	8.8	8.8	8.8	8.8	57,807	0	0	0	0
Washington	25%	-5%	10	9.5	9.0	8.6	5,336	26	25	24	75
Wayne	59%	-12%	12.5	11.1	9.8	8.7	8,867	128	113	100	341
Webster	7%	0%	7	7.0	7.0	7.0	6,536	0	0	0	0
Whitley	27%	-5%	10.7	10.1	9.6	9.1	16,004	90	86	81	257

Wolfe	67%	-13%	12.4	10.8	9.4	8.1	2,429	39	34	30	103
Woodford	8%	0%	6.6	6.6	6.6	6.6	13,391	0	0	0	0
Total							**2,078,096**	**3,688**	**3,401**	**3,146**	**10,235**

Table A.3. Kentucky: Impact of Broadband Availability on County Median Income Detailed Results

Name	Percent Unserved	Median Income	Income GR Impact	2012 Median Income Increase	2013 Median Income Increase	2012-2013 Median Income Increase
Adair	42%	$29,220	5%	$678	$1,356	$2,034
Allen	44%	$38,402	4%	$757	$1,514	$2,271
Anderson	68%	$55,297	2%	$623	$1,246	$1,869
Ballard	100%	$39,815	0%	$0	$0	$0
Barren	81%	$39,593	1%	$265	$530	$794
Bath	100%	$31,514	0%	$0	$0	$0
Bell	87%	$23,008	1%	$120	$239	$359
Boone	100%	$73,399	0%	$0	$0	$0
Bourbon	100%	$44,648	0%	$0	$0	$0
Boyd	98%	$41,277	0%	$40	$80	$120
Boyle	100%	$44,078	0%	$0	$0	$0
Bracken	80%	$42,430	2%	$411	$821	$1,232
Breathitt	37%	$22,891	5%	$577	$1,154	$1,731
Breckinridge	37%	$36,971	4%	$820	$1,640	$2,460
Bullitt	98%	$55,758	0%	$54	$108	$162
Butler	43%	$37,054	4%	$743	$1,487	$2,230
Caldwell	90%	$34,981	1%	$123	$246	$369
Calloway	75%	$38,908	2%	$389	$778	$1,167
Campbell	99%	$55,245	0%	$27	$53	$80
Carlisle	81%	$36,471	2%	$277	$554	$832
Carroll	91%	$44,859	1%	$142	$284	$426
Carter	67%	$32,298	2%	$375	$750	$1,126
Casey	30%	$26,577	6%	$744	$1,488	$2,232
Christian	100%	$40,091	0%	$0	$0	$0
Clark	91%	$51,355	1%	$224	$447	$671
Clay	62%	$19,465	3%	$296	$592	$888
Clinton	76%	$24,207	2%	$232	$465	$697
Crittenden	50%	$35,693	4%	$628	$1,256	$1,885
Cumberland	72%	$26,747	2%	$300	$599	$899
Daviess	90%	$47,172	1%	$228	$457	$685
Edmonson	85%	$31,508	1%	$229	$457	$686
Elliott	17%	$24,684	7%	$820	$1,639	$2,459
Estill	80%	$28,422	1%	$200	$400	$600

Fayette	100%	$53,763	0%	$0	$0	$0
Fleming	100%	$35,177	0%	$0	$0	$0
Floyd	79%	$25,595	2%	$215	$430	$645
Franklin	93%	$51,843	0%	$128	$255	$383
Fulton	100%	$30,674	0%	$0	$0	$0
Gallatin	100%	$44,492	0%	$0	$0	$0
Garrard	75%	$43,089	2%	$379	$758	$1,138
Grant	86%	$49,846	1%	$338	$676	$1,013
Graves	65%	$38,567	3%	$540	$1,080	$1,620
Grayson	64%	$34,555	3%	$438	$876	$1,314
Green	69%	$30,850	2%	$337	$673	$1,010
Greenup	91%	$40,848	1%	$178	$356	$534
Hancock	46%	$45,807	5%	$1,197	$2,394	$3,592
Hardin	95%	$48,530	0%	$117	$235	$352
Harlan	76%	$22,384	2%	$215	$430	$645
Harrison	73%	$44,610	2%	$424	$848	$1,272
Hart	78%	$31,097	2%	$241	$482	$722
Henderson	96%	$45,504	0%	$88	$176	$264
Henry	100%	$46,332	0%	$0	$0	$0
Hickman	94%	$39,108	0%	$94	$188	$282
Hopkins	86%	$39,150	1%	$193	$386	$579
Jackson	42%	$24,466	5%	$568	$1,135	$1,703
Jefferson	91%	$53,341	1%	$232	$465	$697
Jessamine	100%	$52,736	0%	$0	$0	$0
Johnson	79%	$30,166	2%	$253	$507	$760
Kenton	100%	$60,939	0%	$0	$0	$0
Knott	66%	$24,096	3%	$328	$655	$983
Knox	97%	$22,052	0%	$26	$53	$79
Larue	90%	$40,255	1%	$195	$390	$585
Laurel	85%	$34,058	1%	$204	$409	$613
Lawrence	56%	$25,790	3%	$399	$799	$1,198
Lee	36%	$22,486	5%	$576	$1,151	$1,727
Leslie	50%	$21,606	4%	$432	$864	$1,296
Letcher	100%	$24,565	0%	$0	$0	$0
Lewis	58%	$27,229	3%	$403	$805	$1,208
Lincoln	75%	$32,834	2%	$328	$657	$985
Livingston	60%	$39,021	3%	$624	$1,249	$1,873
Logan	100%	$40,162	0%	$0	$0	$0
Lyon	19%	$39,954	6%	$1,139	$2,278	$3,418
McCracken	94%	$42,625	0%	$102	$205	$307
McCreary	56%	$22,953	4%	$404	$808	$1,212

McLean	47%	$36,248	5%	$930	$1,860	$2,790
Madison	95%	$41,774	0%	$74	$147	$221
Magoffin	72%	$23,007	2%	$258	$515	$773
Marion	75%	$37,888	2%	$333	$667	$1,000
Marshall	86%	$43,237	1%	$242	$484	$726
Martin	76%	$21,731	2%	$184	$367	$551
Mason	96%	$37,012	0%	$52	$104	$156
Meade	76%	$46,105	2%	$535.55	$1071.11	$1,606
Menifee	21%	$27,491	6%	$869	$1,737	$2,606
Mercer	92%	$43,442	1%	$122	$245	$367
Metcalfe	80%	$29,007	2%	$232	$464	$696
Monroe	76%	$27,399	2%	$263	$526	$789
Montgomery	100%	$40,748	0%	$0	$0	$0
Morgan	22%	$26,867	6%	$838	$1,677	$2,515
Muhlenberg	82%	$35,112	1%	$222	$444	$667
Nelson	85%	$48,984	1%	$356	$711	$1,067
Nicholas	81%	$36,389	1%	$243	$487	$730
Ohio	45%	$36,328	4%	$703	$1,407	$2,110
Oldham	100%	$85,094	0%	$0	$0	$0
Owen	50%	$40,556	4%	$714	$1,428	$2,141
Owsley	33%	$18,540	5%	$497	$994	$1,491
Pendleton	93%	$47,232	1%	$160	$320	$480
Perry	67%	$26,505	3%	$350	$700	$1,050
Pike	75%	$29,042	2%	$290	$581	$871
Powell	86%	$31,265	1%	$154	$308	$462
Pulaski	95%	$34,074	0%	$68	$136	$204
Robertson	34%	$36,844	5%	$856	$1,712	$2,568
Rockcastle	85%	$28,458	1%	$171	$341	$512
Rowan	95%	$34,809	0%	$70	$139	$209
Russell	59%	$26,883	3%	$441	$882	$1,323
Scott	98%	$63,353	0%	$61	$123	$184
Shelby	92%	$59,521	1%	$230	$461	$691
Simpson	100%	$45,905	0%	$0	$0	$0
Spencer	100%	$57,942	0%	$0	$0	$0
Taylor	80%	$34,581	2%	$277	$553	$830
Todd	75%	$35,927	2%	$316	$632	$948
Trigg	54%	$40,645	4%	$905	$1,810	$2,715
Trimble	74%	$44,414	3%	$559	$1,118	$1,677
Union	100%	$44,089	0%	$0	$0	$0
Warren	94%	$47,081	1%	$137	$273	$410
Washington	75%	$40,414	2%	$356	$711	$1,067

Wayne	41%	$25,218	5%	$595	$1,190	$1,785
Webster	93%	$38,736	1%	$131	$262	$394
Whitley	73%	$27,297	2%	$295	$590	$884
Wolfe	33%	$22,172	5%	$594	$1,188	$1,783
Woodford	92%	$62,592	1%	$242	$485	$727

B. OHIO COUNTY DATA AND ESTIMATIONS

Table B.1.Ohio Unserved Households

County	Unserved Households	Percent of Households
Adams	1950	16.21%
Allen (*)	0	0.00%
Ashland	989	4.49%
Ashtabula	5556	12.18%
Athens	586	2.33%
Auglaize	571	2.93%
Belmont	1077	3.44%
Brown	1474	7.67%
Butler (*)	0	0.00%
Carroll	2008	15.39%
Champaign	1333	7.92%
Clark (*)	0	0.00%
Clermont (*)	0	0.00%
Clinton	331	1.84%
Columbiana	702	1.50%
Coshocton	3141	19.43%
Crawford	345	1.67%
Cuyahoga (*)	0	0.00%
Darke	1410	6.32%
Defiance	1820	10.78%
Delaware	3	0.00%
Erie	3	0.01%
Fairfield	6	0.01%
Fayette	388	3.07%
Franklin (*)	0	0.00%
Fulton	540	3.13%
Gallia	6400	48.02%
Geauga	1953	5.51%
Greene (*)	0	0.00%
Guernsey	900	4.60%
Hamilton (*)	0	0.00%
Hancock	689	2.05%
Hardin	561	4.26%
Harrison	3597	46.48%
Henry	446	3.65%
Highland	701	3.84%
Hocking	3601	28.72%

Holmes	2692	21.28%
Huron (*)	0	0.00%
Jackson	2233	15.26%
Jefferson	5461	16.31%
Knox	1510	6.28%
Lake (*)	0	0.00%
Lawrence	4922	18.01%
Licking	1175	1.78%
Logan (*)	0	0.00%
Lorain	24	0.02%
Lucas (*)	0	0.00%
Madison	742	4.81%
Mahoning	1480	1.30%
Marion	452	1.64%
Medina	17	0.03%
Meigs	4788	44.22%
Mercer	1711	10.22%
Miami (*)	0	0.00%
Monroe	4437	61.39%
Montgomery	225	0.09%
Morgan	2739	33.61%
Morrow	558	4.24%
Muskingum	719	2.03%
Noble	2490	43.68%
Ottawa	408	1.51%
Paulding	2036	23.02%
Perry	3001	21.04%
Pickaway	2865	14.49%
Pike	2574	20.82%
Portage (*)	0	0.00%
Preble	3033	16.84%
Putnam	862	6.40%
Richland (*)	0	0.00%
Ross	2676	8.86%
Sandusky	483	1.85%
Scioto	3650	10.51%
Seneca (*)	0	0.00%
Shelby	315	1.57%
Stark (*)	0	0.00%
Summit (*)	0	0.00%
Trumbull	1064	1.10%
Tuscarawas	3685	9.46%
Union	1443	7.74%
Van Wert	473	3.72%
Vinton	2275	39.75%
Warren	868	1.15%
Washington	6705	23.98%
Wayne	753	1.65%

Williams	1920	11.32%
Wood	467	0.90%
Wyandot	444	4.58%
TOTAL	123,456	2.42%

NOTE: This number is underestimated because the counties marked with (*) have not reported availability

Source: FCC (2010). National Broadband Plan

Table B.2. Ohio: Impact of Broadband Availability on Job Creation Detailed Results

County	Percent Unserved	Unemp. Growth due to complete coverage	Unemp. Rate Oct 2010	UnEmp 12	UnEmp 13	UnEmp 14	Labor Force	Jobs Saved / Created 2011-12	Jobs Saved / Created 2012-13	Jobs Saved / Created 2013-14	Total Jobs Saved /Created 2011-14
Adams	16%	-3%	12.8	12.4	12.0	11.6	13,209	53	51	50	154
Allen	0%	0%	10.1	10.1	10.1	10.1	51,662	0	0	0	0
Ashland	5%	-1%	10.6	10.5	10.4	10.3	27,689	29	28	28	85
Ashtabula	12%	-2%	11.7	11.4	11.2	10.9	49,195	135	132	129	396
Athens	2%	0%	8.7	8.7	8.6	8.6	31,829	11	11	11	33
Auglaize	3%	-1%	8.9	8.8	8.8	8.7	26,698	14	14	14	42
Belmont	3%	0%	9.3	9.3	9.3	9.3	34,307	0	0	0	0
Brown	8%	0%	10.5	10.5	10.5	10.5	21,949	0	0	0	0
Butler	0%	0%	9.2	9.2	9.2	9.2	190,967	0	0	0	0
Carroll	15%	0%	11.1	11.1	11.1	11.1	13,938	0	0	0	0
Champaign	8%	-2%	10.8	10.6	10.5	10.3	20,369	34	34	33	101
Clark	0%	0%	10.2	10.2	10.2	10.2	70,857	0	0	0	0
Clermont	0%	0%	9.2	9.2	9.2	9.2	106,898	0	0	0	0
Clinton	2%	0%	15.8	15.7	15.7	15.6	19,829	12	12	12	36
Columbiana	1%	0%	11.3	11.3	11.3	11.2	53,713	12	12	12	36
Coshocton	19%	-4%	11.5	11.1	10.7	10.3	17,329	74	71	69	214
Crawford	2%	0%	11.3	11.3	11.2	11.2	22,041	10	10	10	30
Cuyahoga	0%	0%	9.0	9.0	9.0	9.0	641,200	0	0	0	0
Darke	7%	-1%	9.5	9.4	9.2	9.1	28,420	37	36	36	109
Defiance	11%	-2%	10.7	10.5	10.2	10.0	20,236	47	46	45	138
Delaware	0%	0%	7.0	7.0	7.0	7.0	91,756	0	0	0	0
Erie	0%	0%	9.3	9.3	9.3	9.3	43,985	0	0	0	0
Fairfield	0%	0%	8.2	8.2	8.2	8.2	75,747	0	0	0	0
Fayette	3%	-1%	10.4	10.3	10.3	10.2	17,058	10	10	10	30
Franklin	0%	0%	8.4	8.4	8.4	8.4	625,847	0	0	0	0
Fulton	3%	0%	9.7	9.7	9.7	9.7	22,720	0	0	0	0

Gallia	47%	-9%	10.7	9.7	8.8	8.0	14,327	141	128	116	385
Geauga	5%	0%	6.8	6.8	6.8	6.8	50,650	0	0	0	0
Greene	0%	0%	9.6	9.6	9.6	9.6	80,178	0	0	0	0
Guernsey	5%	-1%	10.6	10.5	10.4	10.3	19,863	21	20	20	61
Hamilton	0%	0%	9.2	9.2	9.2	9.2	438,827	0	0	0	0
Hancock	2%	0%	8.5	8.5	8.4	8.4	39,865	13	13	13	39
Hardin	4%	-1%	10.9	10.8	10.7	10.6	15,340	13	13	13	39
Harrison	46%	-9%	11.7	10.6	9.7	8.8	7,459	78	71	65	214
Henry	4%	-1%	10.2	10.1	10.0	10.0	15,974	13	13	13	39
Highland	4%	-1%	14.4	14.3	14.2	14.1	20,722	23	23	23	69
Hocking	28%	-5%	10.1	9.5	9.0	8.5	14,505	80	76	72	228
Holmes	21%	-4%	6.8	6.5	6.3	6.0	19,453	54	52	50	156
Huron	0%	0%	11.7	11.7	11.7	11.7	29,132	0	0	0	0
Jackson	15%	-3%	12.3	11.9	11.6	11.3	15,749	57	55	53	165
Jefferson	16%	0%	13.2	13.2	13.2	13.2	33,143	0	0	0	0
Knox	6%	-1%	9.1	9.0	8.9	8.8	30,390	32	32	32	96
Lake	0%	0%	7.5	7.5	7.5	7.5	132,624	0	0	0	0
Lawrence	18%	0%	8.4	8.4	8.4	8.4	29,904	0	0	0	0
Licking	2%	0%	9.0	9.0	9.0	9.0	84,075	0	0	0	0
Logan	0%	0%	10.5	10.5	10.5	10.5	24,667	0	0	0	0
Lorain	0%	0%	8.8	8.8	8.8	8.8	159,670	0	0	0	0
Lucas	0%	0%	10.8	10.8	10.8	10.8	216,490	0	0	0	0
Madison	5%	0%	9.0	9.0	9.0	9.0	20,291	0	0	0	0
Mahoning	1%	0%	10.7	10.7	10.7	10.7	115,109	0	0	0	0
Marion	2%	0%	10.3	10.3	10.2	10.2	31,487	13	13	13	39
Medina	0%	0%	7.5	7.5	7.5	7.5	95,515	0	0	0	0
Meigs	44%	-9%	13.5	12.3	11.3	10.3	9,640	112	102	93	307
Mercer	10%	-2%	7.1	7.0	6.8	6.7	24,575	34	33	33	100
Miami	0%	0%	9.8	9.8	9.8	9.8	54,409	0	0	0	0
Monroe	61%	-12%	13.0	11.5	10.1	8.9	5,741	89	78	69	236
Montgomery	0%	0%	10.9	10.9	10.9	10.9	264,410	0	0	0	0
Morgan	34%	-7%	12.5	11.7	10.9	10.2	6,209	52	48	45	145
Morrow	4%	0%	9.6	9.6	9.6	9.6	18,047	0	0	0	0
Muskingum	2%	0%	11.9	11.9	11.8	11.8	39,754	18	18	18	54
Noble	44%	-9%	13.4	12.2	11.2	10.2	6,044	70	64	58	192
Ottawa	1%	0%	12.1	12.1	12.1	12.1	21,278	0	0	0	0
Paulding	23%	-4%	10.5	10.0	9.6	9.1	10,545	50	48	45	143
Perry	21%	-4%	11.7	11.2	10.8	10.3	16,770	80	77	74	231

Pickaway	14%	0%	9.9	9.9	9.9	9.9	25,127	0	0	0	0
Pike	20%	-4%	14.3	13.7	13.2	12.7	11,340	63	61	59	183
Portage	0%	0%	9.0	9.0	9.0	9.0	90,880	0	0	0	0
Preble	17%	0%	9.7	9.7	9.7	9.7	21,273	0	0	0	0
Putnam	6%	-1%	8.5	8.4	8.3	8.2	18,724	19	18	18	55
Richland	0%	0%	10.9	10.9	10.9	10.9	62,417	0	0	0	0
Ross	9%	-2%	10.8	10.6	10.4	10.2	35,601	68	66	65	199
Sandusky	2%	0%	9.5	9.5	9.4	9.4	33,506	12	12	12	36
Scioto	10%	-2%	12.1	11.9	11.6	11.4	33,467	79	78	76	233
Seneca	0%	0%	10.3	10.3	10.3	10.3	30,883	0	0	0	0
Shelby	2%	0%	11.1	11.1	11.0	11.0	25,982	11	11	11	33
Stark	0%	0%	10.6	10.6	10.6	10.6	190,192	0	0	0	0
Summit	0%	0%	9.4	9.4	9.4	9.4	293,011	0	0	0	0
Trumbull	1%	0%	11.0	11.0	11.0	11.0	105,051	0	0	0	0
Tuscarawas	9%	-2%	9.8	9.6	9.5	9.3	47,456	82	80	79	241
Union	7%	0%	8.0	8.0	8.0	8.0	25,976	0	0	0	0
Van Wert	4%	-1%	11.2	11.1	11.0	10.9	15,021	13	13	13	39
Vinton	39%	-8%	12.0	11.1	10.2	9.5	5,816	53	49	45	147
Warren	1%	0%	8.5	8.5	8.5	8.5	108,883	0	0	0	0
Washington	24%	0%	8.3	8.3	8.3	8.3	33,636	0	0	0	0
Wayne	2%	0%	8.9	8.9	8.8	8.8	58,015	20	20	20	60
Williams	11%	-2%	11.7	11.4	11.2	11.0	20,013	50	49	48	147
Wood	1%	0%	9.1	9.1	9.1	9.1	67,048	0	0	0	0
Wyandot	4%	-1%	11.0	10.9	10.8	10.7	11,160	10	10	9	29
Total							5,942,755	2,001	1,911	1,832	5,744

Table B.3. Ohio: Impact of Broadband Availability on County Median Income
Detailed Results

Name	Percent Unserved	Median Income	Income GR Impact	2012 Median Income Increase	2013 Median Income Increase	2012-2013 Median Income Increase
Adams	16%	$35,720	1%	$201	$402	$604
Allen	0%	$45,851	0%	$0	$0	$0
Ashland	5%	$47,935	0%	$84	$169	$253
Ashtabula	12%	$43,779	1%	$185	$370	$555
Athens	2%	$33,737	0%	$24	$48	$71
Auglaize	3%	$53,915	0%	$57	$114	$171
Belmont	3%	$36,353	0%	$53	$106	$158
Brown	8%	$47,677	1%	$185	$369	$554

Butler	0%	$62,042	0%	$0	$0	$0
Carroll	15%	$42,411	1%	$308	$616	$924
Champaign	8%	$52,787	1%	$149	$297	$446
Clark	0%	$51,123	0%	$0	$0	$0
Clermont	0%	$62,712	0%	$0	$0	$0
Clinton	2%	$50,454	0%	$36	$71	$107
Columbiana	1%	$41,483	0%	$15	$29	$44
Coshocton	19%	$41,880	1%	$280	$560	$840
Crawford	2%	$44,787	0%	$32	$63	$95
Cuyahoga	0%	$49,019	0%	$0	$0	$0
Darke	7%	$47,266	0%	$116	$233	$349
Defiance	11%	$54,385	1%	$211	$421	$632
Delaware	0%	$92,271	0%	$0	$0	$0
Erie	0%	$53,645	0%	$0	$0	$0
Fairfield	0%	$61,337	0%	$0	$0	$0
Fayette	3%	$44,887	0%	$47	$95	$142
Franklin	0%	$55,046	0%	$0	$0	$0
Fulton	3%	$53,226	0%	$77	$155	$232
Gallia	47%	$36,830	3%	$609	$1,219	$1,828
Geauga	5%	$76,686	0%	$186	$371	$557
Greene	0%	$61,491	0%	$0	$0	$0
Guernsey	5%	$36,757	0%	$65	$129	$194
Hamilton	0%	$51,866	0%	$0	$0	$0
Hancock	2%	$53,815	0%	$38	$76	$114
Hardin	4%	$41,576	0%	$59	$117	$176
Harrison	46%	$37,140	3%	$601	$1,203	$1,804
Henry	4%	$50,978	0%	$72	$144	$215
Highland	4%	$42,193	0%	$59	$119	$178
Hocking	28%	$41,196	2%	$406	$812	$1,218
Holmes	21%	$45,278	2%	$380	$761	$1,141
Huron	0%	$50,402	0%	$0	$0	$0
Jackson	15%	$37,534	1%	$225	$450	$676
Jefferson	16%	$37,627	2%	$291	$583	$874
Knox	6%	$47,931	0%	$101	$202	$304
Lake	0%	$61,129	0%	$0	$0	$0
Lawrence	18%	$35,431	2%	$309	$617	$926
Licking	2%	$56,119	0%	$54	$109	$163
Logan	0%	$50,810	0%	$0	$0	$0
Lorain	0%	$56,033	0%	$0	$0	$0
Lucas	0%	$48,075	0%	$0	$0	$0
Madison	5%	$55,194	0%	$134	$267	$401

Mahoning	1%	$44,280	0%	$21	$43	$64
Marion	2%	$47,752	0%	$34	$67	$101
Medina	0%	$72,071	0%	$0	$0	$0
Meigs	44%	$32,530	3%	$504	$1,008	$1,511
Mercer	10%	$52,069	1%	$208	$417	$625
Miami	0%	$54,987	0%	$0	$0	$0
Monroe	61%	$37,303	4%	$801	$1,602	$2,403
Montgomery	0%	$50,685	0%	$0	$0	$0
Morgan	34%	$35,405	2%	$424	$847	$1,271
Morrow	4%	$49,272	0%	$95	$190	$286
Muskingum	2%	$43,142	0%	$30	$61	$91
Noble	44%	$40,062	3%	$620	$1,241	$1,861
Ottawa	1%	$54,750	0%	$26	$53	$79
Paulding	23%	$48,422	2%	$392	$784	$1,176
Perry	21%	$42,081	1%	$311	$622	$933
Pickaway	14%	$53,571	1%	$363	$726	$1,089
Pike	20%	$38,871	2%	$311	$622	$933
Portage	0%	$55,251	0%	$0	$0	$0
Preble	17%	$50,986	2%	$420	$839	$1,259
Putnam	6%	$54,719	0%	$116	$231	$347
Richland	0%	$46,527	0%	$0	$0	$0
Ross	9%	$45,811	1%	$145	$290	$435
Sandusky	2%	$50,592	0%	$36	$71	$107
Scioto	10%	$34,658	1%	$122	$244	$366
Seneca	0%	$46,100	0%	$0	$0	$0
Shelby	2%	$54,144	0%	$38	$76	$114
Stark	0%	$49,739	0%	$0	$0	$0
Summit	0%	$53,693	0%	$0	$0	$0
Trumbull	1%	$48,718	0%	$24	$47	$71
Tuscarawas	9%	$43,237	1%	$137	$274	$411
Union	7%	$66,143	1%	$224	$448	$672
Van Wert	4%	$48,262	0%	$68	$136	$204
Vinton	39%	$35,584	3%	$555	$1,110	$1,665
Warren	1%	$76,749	0%	$37	$74	$111
Washington	24%	$41,508	2%	$482	$964	$1,446
Wayne	2%	$50,696	0%	$36	$71	$107
Williams	11%	$49,892	1%	$220	$439	$659
Wood	1%	$54,729	0%	$26	$53	$79
Wyandot	4%	$47,664	0%	$76	$153	$229

C. WEST VIRGINIA COUNTY DATA AND ESTIMATIONS

Table C.1.West VirginiaUnserved Households

County	Unserved Households	Percent of Households
Barbour	4,287	56%
Berkeley	8,181	18%
Boone	4,585	38%
Braxton	4,509	58%
Brooke	0	0%
Cabell	5,856	13%
Calhoun	2,196	54%
Clay	3,263	65%
Doddridge	2,873	75%
Fayette	4,618	21%
Gilmer	1,305	35%
Grant	3,733	55%
Greenbrier	5,745	30%
Hampshire	6,143	48%
Hancock	2,058	14%
Hardy	4,228	52%
Harrison	2,330	7%
Jackson	5,620	44%
Jefferson	710	3%
Kanawha	6,622	7%
Lewis	2,469	30%
Lincoln	3,713	36%
Logan	6,695	38%
Marion	2,556	9%
Marshall	2,616	16%
Mason	5,163	41%
McDowell	2,361	17%
Mercer	8,724	29%
Mineral	1,841	14%
Mingo	4,813	36%
Monongalia	4,817	12%
Monroe	3,392	45%
Morgan	4,828	50%
Nicholas	6,967	53%
Ohio	0	0%
Pendleton	4,062	75%
Pleasants	1,165	36%
Pocahontas	3,048	38%
Preston	4,450	32%
Putnam	827	3%
Raleigh	3,400	9%
Randolph	2,432	17%
Ritchie	2,071	36%
Roane	4,254	54%

Summers	4,922	65%
Taylor	2,311	31%
Tucker	715	15%
Tyler	2,466	50%
Upshur	3,654	32%
Wayne	4,491	23%
Webster	1,940	35%
Wetzel	2,488	30%
Wirt	1,288	37%
Wood	1,586	4%
Wyoming	3,402	28%
TOTAL	194,789	22%

Source: FCC (2010). National Broadband Plan

Table C.2. West Virginia: Impact of Broadband Availability on Job Creation Detailed Results

County	Percent Unserved	Unemp. Growth due to complete coverage	Unemp, Rate Oct 2010	UnEmp 12	UnEmp 13	UnEmp 14	Labor Force	Jobs Saved / Created 2011-12	Jobs Saved / Created 2012-13	Jobs Saved / Created 2013-14	Total Jobs Saved/ Created 2011-14
Barbour	56%	-11%	9.4	8.4	7.5	6.6	6,806	70	62	56	188
Berkeley	18%	0%	9.1	9.1	9.1	9.1	44,169	0	0	0	0
Boone	38%	0%	8.1	8.1	8.1	8.1	8,973	0	0	0	0
Braxton	59%	-12%	10.1	8.9	7.9	7.0	5,803	68	60	53	181
Brooke	0%	0%	11.5	11.5	11.5	11.5	10,569	0	0	0	0
Cabell	13%	0%	7.3	7.3	7.3	7.3	43,484	0	0	0	0
Calhoun	55%	-11%	12.5	11.2	10.0	8.9	2,672	36	32	29	97
Clay	65%	0%	14.2	14.2	14.2	14.2	3,516	0	0	0	0
Doddridge	75%	-15%	8.3	7.1	6.0	5.2	2,774	34	29	25	88
Fayette	20%	-4%	9.0	8.6	8.3	8.0	17,733	62	60	58	180
Gilmer	36%	-7%	6.9	6.4	6.0	5.5	3,118	15	14	13	42
Grant	55%	-11%	11.0	9.8	8.8	7.8	4,761	56	50	45	151
Greenbrier	31%	-6%	8.7	8.2	7.7	7.2	14,533	77	72	68	217
Hampshire	49%	0%	8.2	8.2	8.2	8.2	9,000	0	0	0	0
Hancock	14%	0%	11.6	11.6	11.6	11.6	13,969	0	0	0	0
Hardy	58%	-11%	9.2	8.2	7.2	6.4	6,431	67	59	53	179
Harrison	7%	-1%	7.5	7.4	7.3	7.2	30,602	31	31	31	93
Jackson	44%	-9%	11.2	10.2	9.4	8.6	11,021	106	97	89	292
Jefferson	3%	0%	6.7	6.7	6.7	6.7	24,041	0	0	0	0
Kanawha	7%	0%	7.7	7.7	7.7	7.7	88,474	0	0	0	0
Lewis	30%	-6%	7.8	7.3	6.9	6.5	7,447	34	32	30	96

Lincoln	36%	0%	10.1	10.1	10.1	10.1	7,930	0	0	0	0
Logan	38%	-7%	9.6	8.9	8.2	7.6	12,664	90	84	77	251
McDowell	17%	-3%	11.9	11.5	11.1	10.8	7,122	28	27	26	81
Marion	9%	-2%	7.3	7.2	7.0	6.9	25,517	33	32	32	97
Marshall	16%	0%	9.6	9.6	9.6	9.6	14,496	0	0	0	0
Mason	41%	-8%	11.8	10.9	10.0	9.2	9,850	93	86	79	258
Mercer	21%	-4%	7.8	7.5	7.2	6.9	24,137	77	74	71	222
Mineral	14%	0%	8.3	8.3	8.3	8.3	12,894	0	0	0	0
Mingo	36%	-7%	10.4	9.7	9.0	8.4	8,444	62	57	53	172
Monongalia	13%	0%	5.7	5.7	5.7	5.7	47,846	0	0	0	0
Monroe	45%	-9%	6.6	6.0	5.5	5.0	5,537	32	29	27	88
Morgan	49%	0%	9.4	9.4	9.4	9.4	6,633	0	0	0	0
Nicholas	53%	-10%	9.9	8.9	8.0	7.1	10,293	106	95	85	286
Ohio	0%	0%	8.7	8.7	8.7	8.7	20,594	0	0	0	0
Pendleton	75%	-15%	7.1	6.1	5.2	4.4	3,530	37	31	27	95
Pleasants	36%	0%	9.1	9.1	9.1	9.1	3,036	0	0	0	0
Pocahontas	38%	-7%	11.0	10.2	9.4	8.7	3,482	28	26	24	78
Preston	32%	0%	7.0	7.0	7.0	7.0	15,113	0	0	0	0
Putnam	3%	0%	7.1	7.1	7.1	7.1	26,694	0	0	0	0
Raleigh	9%	-2%	8.3	8.2	8.0	7.9	31,702	46	45	45	136
Randolph	17%	-3%	9.4	9.1	8.8	8.5	12,355	39	37	36	112
Ritchie	36%	-7%	8.8	8.2	7.6	7.1	4,215	26	24	23	73
Roane	55%	-11%	13.0	11.6	10.4	9.2	5,284	74	66	59	199
Summers	65%	-13%	9.0	7.9	6.9	6.0	4,556	52	45	40	137
Taylor	31%	-6%	8.1	7.6	7.1	6.7	6,844	34	32	30	96
Tucker	15%	-3%	11.8	11.5	11.1	10.8	2,785	10	9	9	28
Tyler	50%	-10%	9.9	8.9	8.1	7.3	3,544	34	31	28	93
Upshur	32%	-6%	9.1	8.5	8.0	7.5	10,289	59	55	51	165
Wayne	23%	0%	9.0	9.0	9.0	9.0	16,972	0	0	0	0
Webster	35%	-7%	11.1	10.3	9.6	9.0	3,105	24	22	20	66
Wetzel	30%	-6%	11.6	10.9	10.3	9.7	6,134	42	39	37	118
Wirt	37%	0%	9.3	9.3	9.3	9.3	2,414	0	0	0	0
Wood	4%	0%	8.4	8.4	8.4	8.4	39,565	0	0	0	0
Wyoming	29%	-6%	10.8	10.2	9.6	9.1	7,941	49	46	43	138
Total							783,410	1,731	1,590	**1,472**	**4,793**

Table C.3. West Virginia: Impact of Broadband Availability on County Median Income

Name	Percent Unserved	Median Income	Income GR Impact	2012 Median Income Increase	2013 Median Income Increase	2012-2013 Median Income Increase
Barbour	56%	$29,101	4.48%	$652	$1,304	$1,956
Berkeley	18%	$47,363	1.74%	$413	$825	$1,238
Boone	38%	$30,215	3.68%	$556	$1,111	$1,667
Braxton	59%	$29,046	4.15%	$603	$1,206	$1,810
Brooke	0%	$40,867	0.00%	$0	$0	$0
Cabell	13%	$36,157	1.26%	$227	$455	$682
Calhoun	55%	$25,553	3.87%	$495	$989	$1,484
Clay	65%	$26,271	6.29%	$826	$1,653	$2,479
Doddridge	75%	$31,615	6.00%	$948	$1,897	$2,845
Fayette	20%	$30,104	1.41%	$212	$424	$636
Gilmer	36%	$26,855	2.88%	$387	$773	$1,160
Grant	55%	$33,896	3.87%	$656	$1,312	$1,969
Greenbrier	31%	$32,848	2.48%	$407	$815	$1,222
Hampshire	49%	$37,294	4.74%	$884	$1,769	$2,653
Hancock	14%	$41,892	1.36%	$284	$568	$852
Hardy	58%	$37,698	4.08%	$770	$1,539	$2,309
Harrison	7%	$38,213	0.56%	$107	$214	$321
Jackson	44%	$39,361	3.10%	$610	$1,219	$1,829
Jefferson	3%	$57,814	0.29%	$84	$168	$252
Kanawha	7%	$43,554	0.68%	$148	$295	$443
Lewis	30%	$33,328	2.40%	$400	$800	$1,200
Lincoln	36%	$26,705	3.48%	$465	$931	$1,396
Logan	38%	$29,355	2.68%	$393	$785	$1,178
McDowell	17%	$19,260	1.36%	$131	$262	$393
Marion	9%	$36,404	0.63%	$115	$231	$346
Marshall	16%	$38,686	1.55%	$300	$599	$899
Mason	41%	$32,760	2.89%	$473	$946	$1,418
Mercer	21%	$32,917	1.68%	$277	$553	$830
Mineral	14%	$37,560	1.36%	$255	$509	$764
Mingo	36%	$25,219	2.53%	$320	$639	$959
Monongalia	13%	$35,847	1.26%	$226	$451	$677
Monroe	45%	$32,807	3.17%	$520	$1,039	$1,559
Morgan	49%	$41,724	4.74%	$990	$1,979	$2,969
Nicholas	53%	$32,251	3.73%	$602	$1,203	$1,805
Ohio	0%	$38,214	0.00%	$0	$0	$0
Pendleton	75%	$35,604	5.28%	$940	$1,880	$2,820

Pleasants	36%	$39,099	3.48%	$681	$1,363	$2,044
Pocahontas	38%	$31,699	3.04%	$482	$964	$1,445
Preston	32%	$32,836	3.10%	$509	$1,017	$1,526
Putnam	3%	$53,462	0.29%	$78	$155	$233
Raleigh	9%	$34,956	0.63%	$111	$221	$332
Randolph	17%	$33,778	1.36%	$230	$459	$689
Ritchie	36%	$33,445	2.53%	$424	$848	$1,271
Roane	55%	$29,210	3.87%	$566	$1,131	$1,697
Summers	65%	$25,627	5.20%	$666	$1,333	$1,999
Taylor	31%	$32,664	2.18%	$356	$713	$1,069
Tucker	15%	$32,257	1.20%	$194	$387	$581
Tyler	50%	$35,137	3.52%	$618	$1,237	$1,855
Upshur	32%	$32,967	2.56%	$422	$844	$1,266
Wayne	23%	$32,980	2.23%	$367	$734	$1,101
Webster	35%	$24,633	2.80%	$345	$690	$1,035
Wetzel	30%	$37,606	2.11%	$397	$794	$1,191
Wirt	37%	$35,791	3.58%	$641	$1,282	$1,923
Wood	4%	$40,970	0.39%	$79	$159	$238
Wyoming	29%	$28,501	2.32%	$331	$661	$992