

Prospects for Innovative Rural Firms in an Era of Broadband Expansion

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Access to reliable broadband (often referred to as “high-speed internet”) is rapidly becoming a necessity for the everyday lives of Americans. However, the availability of broadband technologies and subsequent adoption has not been uniform across regions in the United States. Historically, rural areas have had lower levels of broadband availability (Grubestic and Murray, 2004), lower speeds (Lee and Leonard, 2023), and lower household adoption rates (Whitacre, 2008) compared to urban areas. To remedy this rural–urban digital divide, the U.S. federal government allocated billions of dollars to improve broadband infrastructure in unserved and underserved areas. Most recently, the Biden–Harris Administration has continued these efforts, announcing over \$40 billion to connect every household and small business to reliable broadband by 2030 (The White House, 2023).

An active field of research explores the ways in which broadband access affects local economies (Mack et al., 2023). One of the more understudied subtopics investigates broadband’s effect on rural innovation networks. Innovation—the process of introducing new or improving upon established knowledge, materials, or methods—also suffers from rural–urban disparities (Keene et al., 2023). Using traditional measures of innovation, such as patent citations, researchers found that innovation creation is concentrated in urban areas and dissipates as one travels toward more rural areas.

Reliable connections to broadband could improve the ability for rural businesses and innovators to engage in innovative activities. Information that was once difficult to obtain due to distance can now be sent and received with the click of a button. But how will these connections change the way rural firms innovate? In this article, we summarize recent U.S. broadband policy and the literature on how broadband affects rural areas, then outline differences in innovation incidence and innovation processes between urban and rural firms. Finally, we offer informed predictions on how rural firms may change their innovative activities with improved

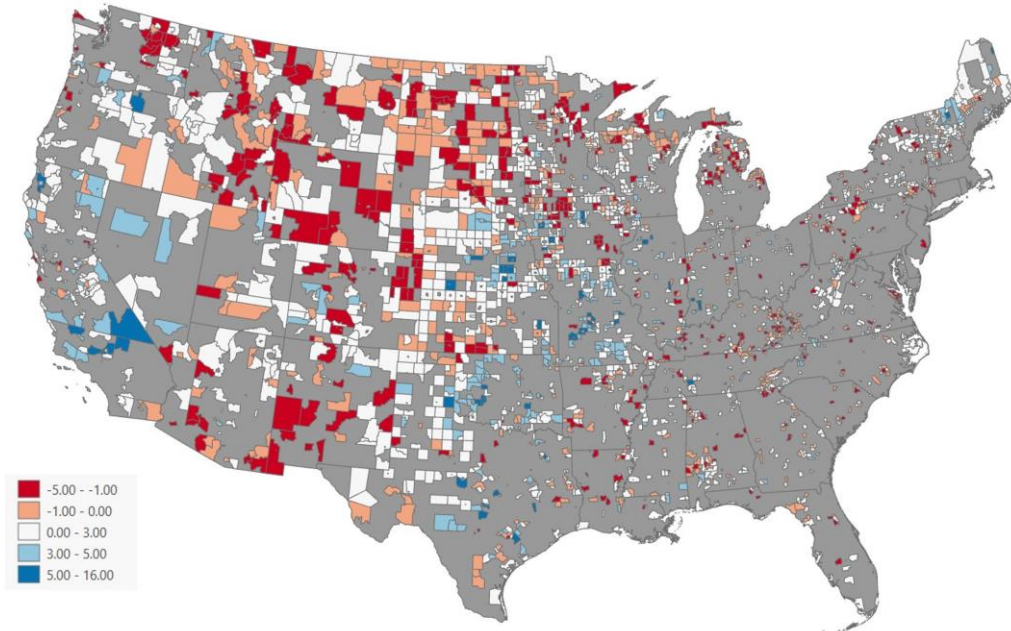
access to broadband and offer policy recommendations aimed at supporting them in their changing competitive environment.

United States Pours Billions into Rural Internet Access

The U.S. federal government regularly engages in initiatives aimed at improving access to reliable broadband. These efforts accelerated during the recovery from the global financial crisis of the late 2000s. In the American Recovery and Reinvestment Act of 2009 (ARRA), the federal government appropriated \$7.2 billion to two programs designed to improve broadband infrastructure and adoption in underserved and unserved areas (Kruger, 2010). Researchers found that these programs, along with others initiated both at the federal and state levels, improved affordable access in targeted areas (Whitacre and Gallardo, 2020; Bai, Wang, and Jayakar, 2022; Pender, Goldstein, and Mahoney-Nair, 2022).

Despite improvements in access, the gap in urban–rural broadband access persists. Figure 1 displays the change in the number of internet providers in rural census tracts from 2014 to 2020. While the underlying data and interpretation of internet provision counts suffers from issues (Mack et al., 2021; Sanders et al., 2022), these counts can be used to approximate internet availability. For the most part, internet provision counts rose in rural tracts over the late 2010s, showing that federal infrastructure investment may have improved availability. However, some tracts experienced drops in provision counts, indicating fewer providers are servicing these areas. While it is difficult to say whether the drop in providers reflects exit because of low profitability or industry consolidation, reductions in providers could indicate less favorable conditions for consumers in terms of provider choice, platform choice (such as fiber, DSL, cable), and higher prices (Reed and Watts, 2018).

Figure 1. Change in Internet Provision for Rural Tracts, 2014-2020



Source: Mack et al. (2021), Federal Communications Commission (FCC) Form 477.

Note: Rural areas are defined as tracts with a RUCA code of 10 (primary flow to a tract outside an Urbanized Area or an Urban Cluster).

On the other side of the broadband market are consumers. Figure 2 shows the percentage of rural and urban households subscribing to broadband plans from 2016 to 2022. While overall adoption rates are high and increasing for both types of households, adoption in rural areas still lags compared to adoption in urban areas—about 87% of rural households subscribed to broadband in 2022, while 92% subscribed in urban areas. Potential explanations for this adoption gap could be affordability issues or differences in preferences between urban and rural households. Research related to the adoption gap is ongoing at this time (see Gallardo, 2023).

In 2023, the Biden–Harris Administration announced an array of programs to ameliorate broadband access issues. The most ambitious of these programs is the Broadband Equity, Access, and Deployment (BEAD), which aims to give every American affordable access to reliable broadband by 2030. Figure 3 provides a map of state-level allocations for the contiguous United States. Each state will receive at least \$107 million to improve broadband infrastructure, with 19 receiving more than \$1 billion. Texas, California, Missouri, Michigan, and North Carolina will each receive more than \$1.5 billion.

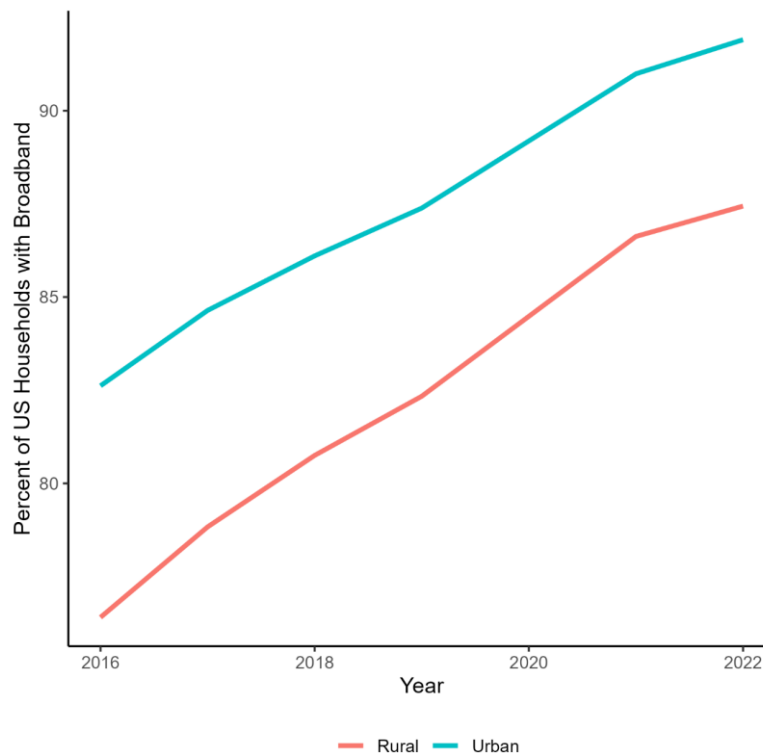
The federal government has several more broadband initiatives in the bipartisan infrastructure law aimed at improving broadband adoption. The Affordable Connectivity Program (ACP) provides subsidies to households for their monthly internet bill and to buy computers. The Digital Equity Act uses grants to fund skill acquisition in using the internet. There are several

initiatives aimed at improving broadband access for specific rural and tribal communities across the United States (U.S. Department of Agriculture, n.d.; National Telecommunications and Information Administration, n.d.). For example, the \$3 billion Tribal Broadband Connectivity Program, administered by the National Telecommunications and Information Administration, is designed to help tribal governments with an array of broadband-related initiatives including infrastructure deployment, telehealth, and online learning (National Telecommunications and Information Administration, n.d.).

Broadband Benefits Are Uneven

Broadband access has expanded dramatically since the ARRA (Pender, Goldstein, and Mahoney-Nair, 2022), and researchers found that the internet improved rural economies. Broadband drives local unemployment rates down, improves local median incomes, and on average improves entrepreneurship and business activity. Unfortunately, the effects of broadband are not the same across industries. Researchers have found that some industries, such as service industries, benefit from access but that others, such as manufacturing, are not affected. An interesting example is the agricultural sector: Some researchers have found that broadband access does not affect its productivity, while others have found that it is the impetus for farmers to adopt labor-saving technologies. For a literature review on broadband's effect on rural economies, see Mack et al. (2023).

Figure 2. Percentage of Urban and Rural Households with Broadband Access, 2016–2022



Source: American Community Survey 1-Year Estimates, 2016–2019, 2021–2022.

Will Broadband Help Innovative Rural Firms?

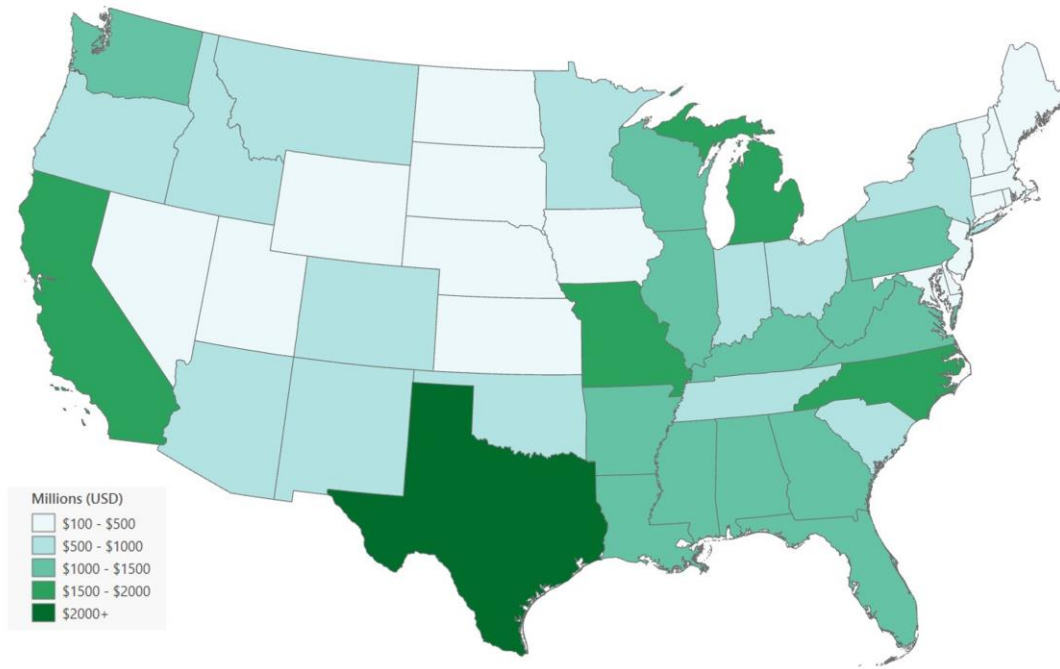
Because the effects of broadband access on rural businesses differ based on industrial classification (Hjort and Poulsen, 2019; DeStefano, Kneller, and Timmis, 2023), it is unclear in what ways it will affect rural innovation. As mentioned previously, innovation favors urban over rural areas. This bias is often attributed to benefits associated with urban areas, such as proximity to larger labor market pools and the exchange of industrial knowledge between workers and businesses close to one another. As a result, rural innovative businesses face challenges competing with their urban rivals.

Despite these hurdles, rural firms still innovate. After controlling for the size of the local “inventive class,” Wojan, Dotzel, and Low (2015) find that the urban–rural patent gap is about half as small compared to using patents per capita, with some rural regions exhibiting higher rates of patenting than regions with global cities (such as New York City, Minneapolis, and Miami). Innovation not only exists but thrives in rural areas of the United States.

Rural firms also innovate in differently than their urban counterparts. For example, using 40 measures of innovation, ranging from patent applications to new methods that measure improvements in worker satisfaction, Mann and Loveridge (2022) found that urban firms dominate rural firms in traditional measures such as investments in research and development and trademarks of intellectual property. However, rural firms engage more frequently in other forms of innovation, such as creating new services and making new processes that reduce labor and material costs. Rural firms also tend to innovate in different industries than urban ones. Manufacturing, which has edged toward rural areas over time, has more rural innovative activity than urban (Mann and Miller, 2022).

If rural firms innovate in different ways than urban ones, then there is no reason to believe that urban and rural areas compete with one another in a zero-sum game. Rural innovation may focus more on improving knowledge and processes for rural contexts. For example, Aghion and Jaravel (2015) argue that there are two types of innovation: those that push the technological frontier of our economy and those that pull local lagging economies to that frontier. The innovation that rural areas engage in could be closer to the latter,

Figure 3: State BEAD Allocation, Millions of Dollars



Source: The White House (2023).

Note: Alaska, Hawaii, and U.S. Territories received allocations but are not pictured.

and better access to information and networking through broadband may help rural innovators get to the frontier faster. As a result, one should not think that rural innovation is worse or noncompetitive with urban innovation. They may complement one another!

How does broadband come into the picture? Several studies have found that improved broadband access translated to better outcomes for innovative firms in rural areas (Keene et al., 2023; Chen and Ye 2021; Xu, Watts, and Reed, 2019). Firms with broadband access may have the ability to engage in larger labor markets with many skilled workers due to work-from-home opportunities and online job posting websites such as LinkedIn or Indeed. They may have access to information that improves their innovative processes like search engines and email. Additionally, they may be able to expand sales on the global market because they have their own website.

Broadband does not come without costs. While the Biden–Harris Administration’s plan may bring subscription costs in rural areas closer to costs in urban areas, rural firms are still at a disadvantage in other ways. Beginner internet users in rural areas may not know how to leverage fully the internet for their business. Researchers found that rural residents are less likely to understand the benefits of internet use in their own lives, leading to lower adoption rates (LaRose et al., 2007;

Thomas and Finn, 2018). As a result, rural businesses may find that broadband subscriptions and online marketing to local customers are not worth the cost.

More importantly, increased broadband access may intensify competition from urban firms based on their ability to market products and services to rural residents over the Internet. Additionally, urban businesses are often much bigger than rural ones, allowing them to take advantage of producing at higher volumes for lower price-per-unit of output (often referred to as economies of scale). In the past, rural firms were prone to this type of competition from expanding urban companies, such as Walmart (Artz and Stone, 2006; Neumark, Zhang, and Ciccarella, 2006), automobile dealerships (Luetkemeyer, 2009), and online retail (Chun et al., 2023). If broadband encourages urban innovative firms to compete directly with rural firms, rural innovation may become a thing of the past with improved broadband access.

Is an innovative rural firm more likely to survive? It is hard to say. If innovative rural firms do create knowledge that helps lagging regions catch up with firms on the frontier, there is no question that their role in society is valuable to local and national economies. Whether that activity remains profitable under universal, affordable access to broadband remains to be seen. If urban firms do not find it profitable to market to rural customers, rural

firms are safe. In addition, if rural firms can capture all the benefits of broadband access and drive down their research and development costs, they may be even more successful than before. The trajectory of rural innovation depends on the realized revenues, costs, government support in adopting broadband, and, of course, firms' readiness to adapt.

How Should Policy Be Structured for Rural Innovation in the Age of Broadband?

While the fate of rural innovation is unclear, policy can support it. In particular, the Small Business Administration (SBA) and its Small Business Innovation Research (SBIR) program assist rural innovative firms and in turn rural economies. Researchers found that SBIR enhanced rural innovation using a suite of measures (Mann, Miller, and Malone, 2022) and that improved internet availability is associated with a rural firm's success in the program (Keene et al., 2023). As innovation is a catalyst for economic growth, support for applied research and moving research outputs to market offerings is integral to helping rural communities thrive. In addition, research and commercialization support can help rural firms develop an advantage over urban market entrants, due to better information and efficiency in rural contexts. Policy makers and economists need to continue to acknowledge the unique benefits of rural innovation programs in their contexts rather than comparing them to their urban peers.

To create good policy, policy makers must understand the incentives of the agents affected. How firms use broadband is understudied outside of case studies. This is especially true for rural innovative firms. If policy makers and researchers have better data on broadband use in development and dissemination of innovations, they will be able to better support rural innovative networks. More research to maintain an understanding the rural innovation process, which is likely evolving with technical change, should be a component of policy formulation.

We can conjecture about what support rural innovative firms may need based on the wealth of research about encouraging broadband use and adoption in rural areas (Mack et al., 2023). Once rural firms have the infrastructure needed for reliable broadband, programs to educate business owners and employees on how best to use broadband for their business are needed. These programs should also present ways in which broadband can be used to augment or improve industry-specific tasks.

In summary, policy for rural innovation should work in tandem with broadband policy. Innovation policy should stress the importance of innovation in rural contexts and continue to offer support from the research stage to the commercialization stage. Broadband policy, on the other hand, should include innovative firms as stakeholders,

leveraging those connections to better understand how firms use broadband for innovation as an input. Based on that information, both innovation and broadband policy should help rural firms identify the benefits of broadband through programs centered on education, adoption, and use. They should also stay flexible as rural innovation is a dynamic and distinct phenomenon.

A Role for States

While much innovation policy occurs at the national level, under the current federal initiatives, states have a major role to play. To provide a recent example, the Michigan High-Speed Internet (MIHI) office recently shared a public draft of their proposal for using BEAD funds. While most of the funds will be awarded to improve broadband infrastructure to the 30% of Michigan households that lack affordable and reliable broadband, they have devoted a portion for nondeployment grants aimed at digital inclusion efforts. These efforts range from basic workforce upskill programs to more industry-specific programs, such as sessions on coding skills and smart technology adoption for agriculture (Michigan High-Speed Internet Office, 2023). However, none of the outlined programs specifically target rural innovative firms and rural innovators.

While the population of rural innovative agents is likely a small subpopulation of Michigan residents and businesses, the MIHI and similar programs in other states might benefit from finding ways to improve their skill sets. For example, rural firms often innovate in the manufacturing sector. The MIHI may want to provide programs that highlight how broadband can improve connections with consumers and producers along the manufacturing supply chain. MIHI has created a "robust and innovative community and stakeholder process" that may align the incentives of rural innovation networks with the program's goals (MIHI, 2023). It is important for states like Michigan to better incorporate innovation stakeholders into their broadband policies to capture more opportunities for rural economic growth.

Conclusions

Improved penetration of broadband infrastructure and adoption in rural areas provides new opportunities for rural innovative firms. The BEAD program's dual initiative of improving access to broadband resources and investing in training may help rural firms not only improve efficiency but create new market niches to stay competitive in the U.S. economy. It is important to support rural innovative networks, which can be a catalyst for improved economic outcomes in rural areas. While there is scope for stronger rural firms and communities due to the large federal investments in broadband infrastructure, there is also a strong possibility that broadband can open rural firms to new competitors. Complementary investments to make sure firms can take full advantage of the new infrastructure are needed for sustained rural growth.

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