Objective analysis. Constructive dialogue. Innovative ideas.

Issue Report

Economic Returns to Rural Infrastructure Investment

Authors:

Mark Burton
is a Professor at the University of Tennessee and Director of Transportation Economics at the University of Tennessee's Center for Transportation Research

Wesley W. Wilson
is a Professor in the Department of Economics at the University of Oregon

Farm Foundation®

Commissioned papers: This paper was one of six commissioned as part of the workshop, *Economic Returns to Rural Infrastructure Investment*, organized by Farm Foundation and USDA's Economic Research Service (ERS). The workshop took place April 10–11, 2018, in Washington, D.C. A seventh paper, which had already been published, was also presented at the workshop because of its high relevance to the topic. All seven full papers are available on the Farm Foundation website, *https://farmfoundation.org*. Farm Foundation gratefully acknowledges BNSF Railway for its support of the commissioned papers.

The Economically-Efficient Composition of Rural Infrastructure Investment

There is a widely-held view that public-sector investments, while necessary everywhere, are particularly important in rural areas. Perhaps because the need for public-sector investment in rural communities is so readily accepted, discussions of these investments skip immediately to the form and effect of spending, with few questions about why the public sector often provides resources that would, in other settings, be supplied privately.

The explanation lies in two basic economic realities. First, even in urban settings most publicly-provided infrastructures are tied to services that are provided over networks—things like highways, railroads, electricity distribution grids, water supply systems, or telecommunications networks. Network industries require service providers to incur high sunk costs, i.e. costs that can't be recovered if the seller decides to leave. Moreover, in the case of rural communities, smaller populations make it hard to spread these fixed and sunk network costs across a sufficient number of buyers to keep costs low.

The result is that new network services emerge slower in rural areas and, when they do arrive, there is often only sufficient demand to support a single seller. This *natural* monopolist, if left alone, will throttle output to yield monopoly prices. Historically, the policy response has been to encourage entry through subsidies, then regulate the prices that the new entrant can charge once service is established. Unfortunately, this sort of oversight is often cumbersome and clumsy.

Low population densities cause other problems. For example, in some cases, it is difficult to exclude consumer access to a good or service, particularly when those would-be buyers are thinly spread over large areas. If sellers can't exclude consumption, they can't enforce prices and generate revenues. Without revenues there will be no private-sector entry. This is precisely the reason that the public sector provides virtually all highway infrastructure, particularly in rural areas. The public sector does not need to impose prices to generate revenues; it can fund the necessary infrastructure through compulsory user fees, such as fuel taxes and registration fees.

Historically, at full build out and with mature technologies, rural areas have eventually acquired the same suite of services that are available to their urban counterparts, albeit with a very frustrating lag. However, as the 21st century continues to unfold, some important changes are raising the stakes and the challenges for rural communities.

First, the public sector's ability to fully meet infrastructure needs *anywhere* seems questionable. Urban communities hope to address this by attracting private-sector investment in publicly-directed infrastructure initiatives. The resulting public-private partnerships hold significant funding potential but come with their own set of difficulties. It is unclear if public-private partnerships are well suited to rural settings.

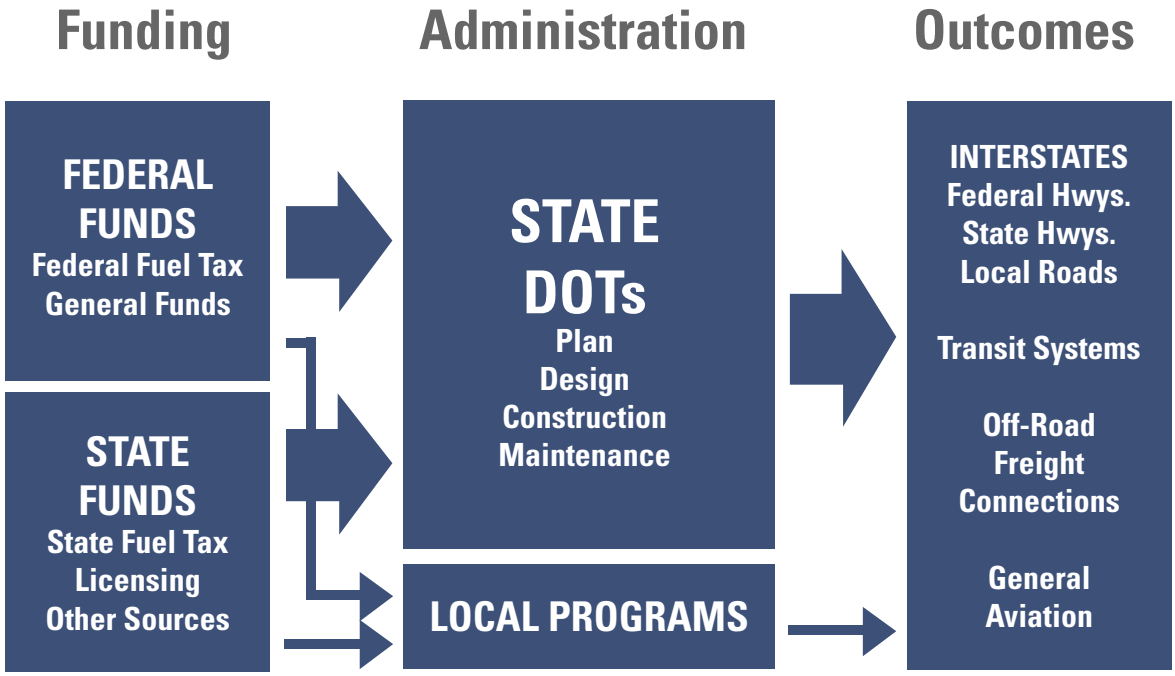
In addition, where infrastructure access was once primarily linked to quality of life, it is now critical to rural commerce. Global markets and sophisticated technologies have assured this. Finally, because networks of all types are increasingly tied to rapidly-changing technologies, forward-looking infrastructure needs to be flexible and at least a little visionary.

Looking forward

Efficiently functioning rural economies are important to all Americans. Urban inhabitants are inexorably dependent on the resources nurtured and harvested in rural America.[1] Similarly, without the demands from urban populations, rural economies would have few viable outlets for their outputs. Therefore, assuring efficient rural production capacity, including necessary infrastructure, is a national priority that transcends the urban-rural distinction.

In March 2018 Senate testimony, U.S. Agriculture Secretary Sonny Perdue, stressed seven "core" rural infrastructures. These include:[2]

- Highways and highway bridges;
- Railroads;
- Navigable waterways;
- Airports;
- Water supply and waste water treatment facilities;
- Electric utilities; and
- Telecommunications, including broadband access.



Major highways are traditionally funded largely through federal funds, with lesser highways and streets the responsibility of state and local jurisdictions. Actual funding is more convoluted. Federal funds for construction and maintenance of major roads generally requires state matching funds. At the same time, a modest share of federal highway funding goes through states to local jurisdictions.

Each of these infrastructure elements relies on network production technologies and each has traditionally attracted public-sector involvement or, at least, oversight, particularly in rural environments. Still the forward-looking public role depends both on the characteristics of new technologies and the magnitude of rural demands for these infrastructures. Thus, each of these infrastructure elements is worthy of a closer look.

Highways: Nearly all highways and local roads are treated as public goods, with no attempt to control, monitor or directly charge for use. These assets are funded through a combination of federal, state and local funds primarily derived through user fees, such as fuel taxes, vehicle registration fees, sales taxes on vehicles or driver licensing fees.

Future rural roadway needs are tied inexorably to future land uses. Usually, rural highways see less traffic per lane-mile than those in urban areas and can be designed and built to lower standards. However, this generalization doesn't always apply. For example, rural areas that border urban regions often require reliable connectivity to the urban center(s). Similarly, regions that rely on extractive industries may require more robust roads. Terrain and climate can also affect the form and extent of needed highways. Finally, both agriculture and tourism-related traffic can place differential seasonal demands on specific rural roads.

Perhaps the greatest uncertainty affecting rural roadway demands is the probable introduction of autonomous vehicles. Advocates promise faster speeds, improved safety, and the ability to substitute autonomous vehicles for the traditional forms of transit that are scarce in most rural settings. These potential outcomes are exciting. On the other hand, vehicle automation technologies require roads with uniform surfaces and consistent, well-maintained pavement markings. Affording this higher quality of highway infrastructure will be hard in urban areas and may prove even more difficult in rural areas.

Railroads: Some rail markets are most efficiently served by a single provider. Thus, many such markets constitute natural monopolies. For this reason, private railroad pricing and operations are closely monitored by federal regulators.

That oversight changed dramatically in the 1970s and 1980s, when regulatory reforms increased the flexibility that the largest freight railroads have both in setting rates and in offering or abandoning services. As a result, the larger railroads "rationalized" their networks by eliminating unprofitable, low-density route segments. In many instances, less-profitable branch-lines were sold to short-line railroads. The number of short-lines has grown to more than 550 in 2018, from roughly 200 in 1980. But not all unneeded Class I routes were attractive to short-line operators, so many rural communities lost freight-rail access.

The regulatory changes affected in the last half of the 20th century have produced a 21st century railroad industry that is financially healthy and in better physical condition than ever before. At the same time, the general movement away from coal as a fuel source in electricity generation has already reduced overall rail-freight volumes and promises further declines. Together, vehicle automation and declining coal volumes may, perhaps, threaten rail industry viability, particularly in rural communities.

Navigable Waterways: There are 12,000 miles of inland navigable waterways in the United States that collectively move roughly 550 million tons of freight each year, as well as provide a meaningful source of competition to rail-served shippers on or near the waterway.

Though by no means ubiquitous, the inland navigation system is a tremendous resource for the agricultural commerce that is vital to rural America. For example, each year approximately 10 million tons of corn and soybeans move south from the upper reaches of the Mississippi River for export over the Louisiana Gulf, and a similar amount of export corn and soybeans move south from origins on the Illinois River.[3]

Commercial navigation is sustained by approximately 175 navigation lock and dam projects that are federally owned and operated by the U.S. Army Corps of Engineers.[4] Actual freight services are provided by private-sector waterway operators.

Like railroads, locks and dams are not public goods. They are, however, unquestionably natural monopolies, so some form of public-sector involvement is required. There is a desire by some to replace direct public-sector involvement with publicly-supervised, private-sector operations, or to parse out Corps of Engineer functions to other federal agencies, such as the U.S. Department of Transportation or the U.S. Environmental Protection Agency. However, the fact that inland waterways also support residential and commercial water supply, flood control, hydroelectric generation, irrigation, and recreation served by lock

and dam projects makes these alternatives problematic.[5]

While inland navigation has ample capacity, system reliability and maintenance costs are problems. Most of the navigation locks have served past their design lives. Safe operation is possible, but the locks are increasingly prone to unscheduled outages that delay system traffic. As the locks age, they are increasingly expensive to maintain.

Like motor carriers, towing companies pay fuel taxes, with revenues accruing to the Inland Waterways Trust Fund. By statute, these tax revenues are expected to fund 50% of new lock construction costs but are currently insufficient to fund a growing backlog of lock projects.

General Aviation: General aviation and airport access are almost always necessary to—but rarely a catalyst for—economic development. In rural settings, general aviation airports also can be important to agricultural production and the recruitment of non-agricultural commerce.

Regarding the future of rural aviation, the most salient issue has little to do with infrastructure and much to do with aviation policy. Unmanned aerial vehicles (UAVs), more commonly called drones, have the potential to improve both productivity and access in rural settings. There are innumerable agricultural applications—from crop and livestock inspections to chemical applications. Drones can also be used to efficiently inspect infrastructure in remote locations. There are even plans for drone transport in rural medicine, where UAVs would be used to transport pharmaceuticals or diagnostic samples necessary to the treatment of humans and livestock.

Drones do, however, have an increasing potential to conflict with manned aircraft. The challenge for policy-makers is to identify policies that ensure public safety, without unnecessarily limiting the productivity of unmanned aircraft.

Rural Water and Wastewater Infrastructures: Few issues are more critical to commerce and the quality of life in rural America than the quality and availability of water. Providing this resource requires the long-run, responsible stewardship of ground water, the efficient delivery of water for agricultural, residential, commercial and industrial uses, and the provision of efficient and environmentally responsible wastewater treatment.

Given the importance of water it is not surprising that it receives tremendous attention from myriad state and federal agencies. At the federal level, 10 distinct entities are responsible for various aspects of water quality management. The U.S. Department of Agriculture (USDA) alone has 13 Rural Development Water and Environmental Programs.

While the economic resources available for the provision of rural water supplies and waste water treatment have not always been as plentiful as some would advocate, there has rarely been descent regarding the public-sector's dominant role developing, operating and regulating the associated infrastructures.

Electricity Generation and Distribution: Ensuring a reliable and affordable electricity supply to rural communities has long been a policy priority at both the federal and state levels. However, the magnitude of public-sector intervention and its effects on the generation and distribution of electricity vary considerably between regions.

Looking toward the future, rural commerce and quality of life are already influenced by two emerging patterns: the movement toward renewable fuels, and distributed electricity generation. While closely related, these trends are distinct and likely to attract markedly different policy responses at both the local and federal levels.

Renewables generally include hydroelectric, solar and wind-powered electricity generation. These energy sources avoid carbon emissions and the environmental degradation associated with fuel extraction, thus producing benefits that extend far beyond the power produced. For this reason, renewables continue to receive significant subsidies. Importantly, a 2011 USDA study observes that the expanded use of renewables is most easily accomplished in rural areas.[6] Thus, it is likely the renewables will confer a continually increasing advantage to rural America.

From a policy perspective, distributed generation is more complicated. While definitions vary, distributed generation typically involves electric utility users who self-supply some or all of their electricity needs, but who are allowed to draw power from the grid if necessary. Distributed generation producers are also allowed to feed surplus electricity into the incumbent power system and are paid for doing so.

Distributed generation often relies on renewable fuels and, as such, produces the same external benefits associated with any renewables use. At the same time, however, distributed generation poses serious equity issues. By self-supplying power, distributed generation reduces incumbent utility revenues, but does nothing to reduce the extent of the utility's required network.[7] As a result, non-distributed generation utility customers are required to shoulder a larger share of the fixed network costs. Given that there are often income differences between distributed generation and non-distributed generation customers, policies that support distributed generation are sometimes viewed as regressive.

Broadband Communications: As wireline telecommunications expanded during the 20th century, the physical and demographic characteristics of rural communities led to higher service costs and correspondingly lower penetration rates. Recognizing benefits attendant to wider network participation, federal programs eventually sought to bring about universal service in both rural and urban areas through a variety of subsidy programs. In the case of rural wireline service, increased penetration rates were achieved by direct federal payments to higher-cost rural local providers.[8]

As broadband telecommunications grew in the 1980s and 1990s, the same arguments centered on network externalities were used to justify subsidies that promoted the nascent technology's extension and adoption within rural settings. Added to the traditional motivation for subsidizing were pressures to accelerate broadband as a means of increasing agricultural productivity.

While broadband access is vital to precision farming and other forms of rural commerce, broadband capacity development continues to lag in rural communities. Quoting U.S. Telecom from 2017: "While broadband is widely deployed across the United States, availability continues to lag in rural areas compared to urban and suburban areas. There is variation across rural areas in terms of deployment, speeds, and competition. While there are gaps in rural broadband, there is no single 'rural broadband gap.' Rather, availability lags in targeted rural areas either where broadband is not yet available due to challenging geography or network costs or the economics do not support frequent upgrades of existing networks."[9]

The roll-out of higher capacity broadband in rural areas is not happening as quickly as many believe it should. At the same time, it is difficult to identify ways in which the markets for advanced telecommunications are failing to perform efficiently.

The markets for broadband access are not public goods. Issues surrounding competition are, perhaps, more relevant. While competition for patrons is robust in urban and suburban communities, there is probably room to question the extent of competition in rural settings. It is possible a lack of competition may, for now, keep prices unnecessarily high and, thereby, dampen adoption rates. Still, any competition-related lag in rural broadband develop is likely to be transitory.

That there is some amount of controversy surrounding the extent of the public-sector's promotion of rural broadband is not surprising. Every element of universal service programs has, at one time or another, endured considerable scrutiny. If nothing else, these controversies point to the importance of robust, defensible estimates of benefits (returns) to informed policy discussions.

Conclusions

The information gathered and presented here supports, at least, four conclusions. These include:

1. Market failures, or perhaps more accurately market *underperformance*, can lead to situations where economic outcomes may be measurably improved through public-sector intervention.
2. Addressing the opportunities to improve efficiency through public-sector investments in rural infrastructure is important to all U.S. citizens and should be a national priority.
3. Both the need for and nature of future public infrastructure investments are affected by rapidly changing technologies; simply replicating past policies without additional scrutiny is perilous, at best.
4. The limited resources available for public-sector infrastructure investments, compared with much greater wants and needs, means that developing the tools that facilitate appropriate comparisons is tremendously important to good policy.

Market characteristics continue to require a public-sector role in providing rural infrastructures, but executing this responsibility is both more difficult and more important than in the past.

End Notes:

[1] Another nine percent of the population lives in cities and towns with populations between 25,000 and 50,000. See "New Census Data Show Differences Between Urban and Rural Populations," U.S. Census Bureau, December 20016. https://www.census.gov/newsroom/press-releases/2016/cb16-210.html.

[2] See: "Secretary Perdue's Prepared Opening Statement on Rural Infrastructure," U.S. Department of Agriculture, Release No. 0056.18, March 14, 2018. https://www.usda.gov/media/press-releases/2018/03/14/secretary-perdues-prepared-opening-statement-rural-infrastructure.

[3] For a further discussion of export grain and soybean movements on the upper Mississippi and Illinois Rivers, along with a discussion of railroad capacity in this corridor, see Mark Burton and Craig Philip, "The Impact of Unscheduled Lock Outages," U.S. Maritime Administration and the National Waterway Foundation, October 2017.

[4] Lock and dam projects on the Tennessee and Cumberland Rivers are owned by the Tennessee Valley Authority.

[5] Locks and dams are also operated to provide flood control, irrigation, recreation, and hydroelectric generation. Operating practices a balanced to ensure that each of these purposes is fulfilled.

[6] See, "Renewable Power Opportunities for Rural Communities," USDA, Office of the Chief Economist, April 2011.

[7] In fact, accommodating any DG surplus power can actually increase network costs for the incumbent utility. See Mark Burton and Michael Hicks, "Distributed Generation in Indiana: A Preliminary Policy Discussion," Ball State University, Center for Business and Economic Research, January 2014.

[8] Originally titled the High-Cost Support program, more recent rural universal service efforts are undertaken as a part of the Connect America program. For a cursory summary of federal universal service programs see: https://www.fcc.gov/general/universal-service.

[9] https://www.ustelecom.org/blog/gaps-remain-broadband-availability-rural-vs-non-rural-areas.

Farm Foundation®

1301 West 22nd Street
Suite 906
Oak Brook, IL 60523
Tel 630.571.9393
Fax 630.571.9580
farmfoundation.org

facebook.com/thefarmfoundation
twitter.com/farmfoundation
AgChallenge2050.org
youtube.com/thefarmfoundation