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Issue Report

Economic Returns to Rural Infrastructure Investment

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Impacts of the USDA Broadband Loan and Grant Programs: Moving Toward Estimating a Rate of Return

The potential stimulative effect of publicly-funded infrastructure on local economic performance has long been a staple in the public discourse surrounding U.S. rural development policy.

An important rationale offered to justify public infrastructure investments argues that they can raise private-sector output directly as an intermediate input into private production processes, and indirectly by providing complementary inputs that raise the rate of return on private capital. At the same time, geographic remoteness and low population densities of many rural communities impose significant limits on the rate of return to private infrastructure provision—hence, the call for public infrastructure investment.

A salient example of this may be found in recent debates over the role and scope for federal investment in infrastructure to enable deployment of broadband technology in rural areas. Broadband technology delivers enhanced information and communications services at rapid transmission rates to end users. Increasing the availability of broadband in rural communities has been an explicit U.S. rural development policy goal for nearly two decades. Since 2000, federal broadband grant and loan programs authorized under consecutive Farm Bills have directed more than $1.8 billion to private telecommunications providers in 40 states with the explicit goal of making high-speed data transmission capacity available to rural residents and businesses. The American Recovery and Reinvestment Act of 2009 authorized $2.5 billion in federal funding for these same purposes.

Proponents of these programs point to research projecting large macroeconomic benefits from widespread broadband deployment. Research focused specifically on rural areas generally suggests positive impacts of broadband deployment on income per capita, local employment, number of business establishments, and firm location. Other work highlights broader community and social impacts of broadband deployment and adoption on migration, civic engagement, education, and healthcare.

An important finding of work that has been done on the impacts of broadband is that the distribution of economic benefits is not likely to be uniform, either spatially or across industries. Our work found evidence that USDA Broadband Loan Programs have created a range of impacts—some positive, some negative—that vary across industries and across the rural-to-urban continuum. We also found that while the loan programs have been effective in meeting their goal of creating more broadband availability in rural areas, it is by no means inevitable that this greater availability translates into improved economic outcomes.

Work to date on evaluating government broadband investments has not generated estimates of the rate of return or relative benefits and costs of those investments. Such information is clearly of significant value for two reasons. First, it provides a benchmark for gauging whether these investments pay for themselves. Key benefits of extending and expanding high-speed internet access into underserved areas—in areas such as telemedicine, distance education, social media and personal communication—typically go unmeasured in most assessments of benefits mediated through local economic activity. To the extent that those potentially large, but difficult-to-measure, benefits are deemed socially desirable—or even a social imperative—a positive cost-benefit ratio reflects the fact that securing those social benefits is being done via programs that pay for themselves.

Second, estimating a rate of return on broadband investments provides a reference point for comparison with alternative types of public investment. For example, cost-benefit analyses or return-on-investment studies exist for public health program interventions or road investments. Assembling comparable information for broadband investments thus has value for contributing to more efficient allocation of public resources across a more complete range of alternatives.

In this paper, we take a step toward understanding the rate of return to government efforts to promote broadband. Specifically, we evaluate the impact of USDA's Broadband Loan and Grant Programs on the average payroll per worker using zip code level data from the Zip Code Business Patterns for the period from 1997 to 2007. Using data on the size of the loans and grants, we produced a rough estimate of the return on such investments.

The programs

In December 2000, Congress authorized a pilot broadband loan program to help expand broadband access in geographically remote and underserved rural communities. Program eligibility criteria included: having a population of 20,000 or less, having no prior access to broadband, and loan recipients providing a minimum matching contribution of 15%. Loans were extended mainly to small telecommunications services firms at varying subsidized interest rates; most participating communities qualified for a "hardship rate" of 4% (Cowan 2008[1]).

Administered by the USDA's Rural Utilities Service (RUS), pilot loans totaling $180 million were made in 2002 and 2003 to broadband providers serving 98 communities in 13 states. Beginning with the 2002 Farm Bill, funding for the current (post-pilot) broadband loan program was expanded. Through 2007—the period covered by our analysis in this paper—these loans totaled $2.23 billion.

Since 2002 RUS has also operated a Community Connect Broadband Grant Program. This program appears to be targeted to the most under-served rural areas, as eligibility requirements specify that no high-speed internet is available in the community. By contrast, loan program eligibility only requires that at least 15% of households are unserved.

Begun at the time of the Pilot Broadband Loan Program, Community Connect Grants were designed to promote telemedicine and distance learning—"community-oriented connectivity"—in rural areas with no broadband service. Grantees are required to deploy free broadband service to community facilities for at least two years, as well as offering broadband to residential and business customers. Total authorizations for the Community Connect Grant Program between 2002 and 2007 were $66 million.

Data

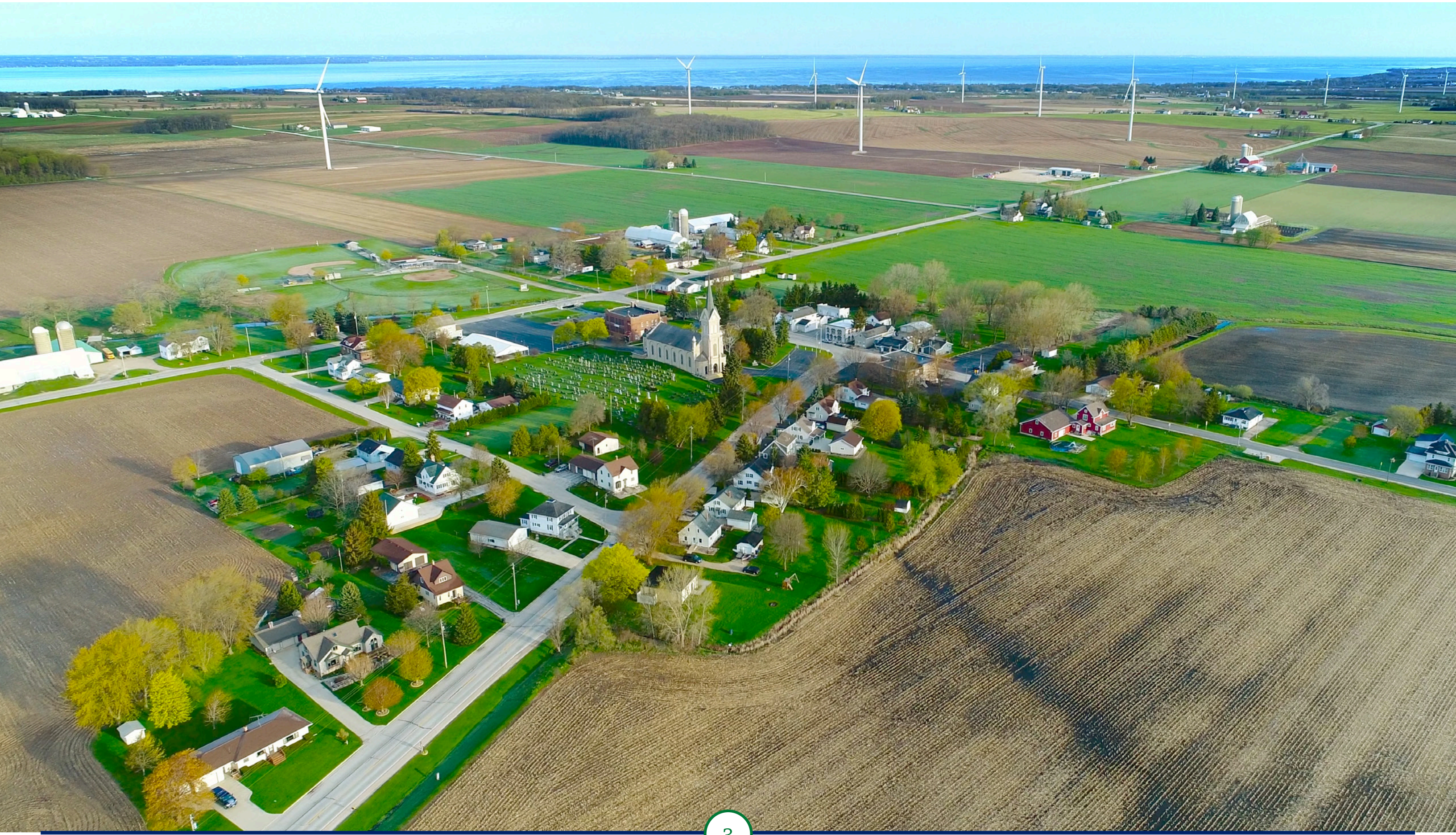
We analyzed the impacts of the broadband loan and grant programs using zip code level data for the 37 states that have received at least one loan or grant through 2007. Our sample includes only zip codes with population of 20,000 or less as of 2000—the year the Pilot Broadband Loan Program was authorized, and two years before the first pilot loans were made. We restricted the sample in this way because the broadband loans and grants were directed to small communities of 20,000 or less. The zip code is the smallest geographic area which resembles a community eligible for these loans and for which data on economic outcomes is publicly available.

In our empirical analysis, we investigated how payroll per employee, a measure related to the average wage rate, is affected by the broadband loan and grants. Data on annual payroll and employment at the five-digit zip code level were obtained from the Zip Code Business Patterns data set collected by the U.S. Census Bureau. The names of communities that received a Community Connect grant or a loan under the pilot or current broadband loan program were obtained via a FOIA request, which also provided information on the size and the timing of these grants and loans.

We manually matched the names of the communities that received the broadband loans or grants to the associated U.S. Postal Service zip codes, which were then matched to five-digit zip code tabulation areas (ZCTAs) reported in the Census Bureau's Zip Code Business Patterns dataset. Over the period considered:

- Community Connect Grants were disbursed to operators in 59 zip codes spread across 24 states;
- Pilot broadband loans were distributed for projects in 302 zip codes across 13 states; and
- Current broadband loans financed projects in 488 zip codes across 30 states.

Payroll per worker, a rough proxy for average wages, and population were both somewhat higher in zip codes receiving a current broadband loan than in zip codes receiving either pilot loans or Community Connect Grants. For zip codes that received current broadband loan, the average loan size was $196 per capita in 2007 dollars. Average loan size for pilot



loans was much smaller—$5 per capita—mainly due to the fact that many of these loans were spread over multiple zip codes. The average size of Community Connect Grants was $157 per capita.

Empirical Results

Our empirical analysis compares changes in annual payroll per worker in locations that received a broadband loan or grant (treated zip codes) with changes in payroll per worker in that locations that did not receive a grant or a loan (control zip codes). To control for the fact that communities that received broadband grants or loan were not randomly selected, we used propensity score matching. This involved first estimating the factors determining the likelihood of a locality successfully getting a loan, and then using that information to improve the statistical precision with which we can link loan receipt to an economic outcome—in our case, the effect of loans and grants on payroll per worker. We also controlled for time-invariant, zip code-specific characteristics that may bias the econometric estimates.

Our econometric results indicate that a $1 increase in zip code per capita broadband loan results in about a $1.08 increase in annual payroll per worker. A very similar number ($1.07) was estimated for the pilot loan program. These estimates of the marginal impact of receiving a broadband loan were statistically significant.

In contrast, we found no statistically significant impact of broadband grants received on the payroll per worker. The implication is that that grants did not affect the average zip code level payroll per worker. Given that these grants are awarded to the least connected unserved areas, it is possible that other community deficits render the provision of broadband alone insufficient to have generated substantial economic impact over the period analyzed.

Our estimates of the marginal impact of a loan on average payroll enable us to compute an estimate of the benefits and costs of the pilot and current loan programs, as shown in Table 1.[2] Applying those marginal effects to the average zip code loan size

Table 1. Benefits versus Costs for Pilot and Current Broadband Loan Programs

Variable	Pilot Loan Program	Current Loan Program
(1) Average employment per zip code	1,256	1,660
(2) Average loan per capita (2007 dollars)	$5.04	$195.81
(3) Marginal effect of loan per capita on payroll/worker	1.071	1.081
(4) Local annual benefit = (1) × (2) × (3)	$6,783	$351,387
(5) Total benefit per zip code (10% discount rate)	$67,831	$3,513,874
(6) Total benefit per zip code (5% discount rate)	$135,663	$7,027,749
(7) Average population per zip code	3,915	5,804
(8) Total loan cost per zip code = (7) × (2)	$20,828	$1,230,448
Benefit:Cost ratio at 10% discount rate = (5) ÷ (8)	**3.26**	**2.86**
Benefit:Cost ratio at 5% discount rate = (6) ÷ (8)	**6.51**	**5.71**

provides a sense of the average per-employee impulse to treated zip codes attributable to an average-sized loan. Multiplying this by the number of employees per zip code yields an estimate of annual benefit—essentially, our best estimate of the added increment to total payroll attributable to loan receipt.

This is an annual benefit, so we computed the net present value of the stream of these annual benefits at two discount rates, 10% and 5%—rows 5 and 6 in Table 1. Given that broadband loans were "last mile" loans justified based on the cost of provision of broadband services, we take the cost of broadband investment to be as large as the loan itself. Dividing annual benefits by these average total costs yields benefit cost ratios ranging from 3.46 to 6.51 for the pilot loan program, and between 2.86 and 5.71 for the current loan program.

Estimated benefit:cost ratios suggest that the net benefits of broadband loan programs have been substantial, very much in the same ballpark as benefit:cost estimates from a range of public health interventions. This is an important, policy-relevant finding.

Implications

We regard the foregoing analysis as encouraging, but preliminary. Our estimated benefit:cost ratios suggest that the net benefits of broadband loan programs have been substantial, very much in the same ballpark as benefit:cost estimates from a range of public health interventions. This is an important, policy-relevant finding.

That said, the incidence of those benefits—i.e., deciphering who the beneficiaries are and, in particular, where they live—is not discernable from the data at our disposal. We do know that generally only a small fraction of individuals in a particular zip code would also work in that zip code, so the benefits of increased payroll in one location would no doubt create significant spatial spillovers. Also, there would be labor market implications for nearby locations within the commuter shed. Clearly, attention to these sorts of spatial spillovers merits further attention.

Finally, our measures of benefits are likely under-estimates. Our analysis ignores positive impacts of broadband availability on property values—notably house prices, but also commercial or agricultural land values. Additionally, bringing enhanced access to high-speed internet to a community increases communication opportunities for residents of that community. An assessment of the value of such opportunities remains unaccounted, as well. Quantifying these additional benefits represents a fruitful area for future research.

End Notes:

[1] Cowan, T. 2008. "An Overview of USDA Rural Development Programs." CRS Report for Congress No. RL 31837. Washington, DC: Congressional Research Service.

[2] Because we detected no significant impact of Community Connect Grants, we did not compute benefit:cost ratios for that program.

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