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

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*"Broadband is a transformative technology. It allows rural communities to **dramatically enhance the quality of health care and education**. It gives every **rural business access to regional, national, and international markets**. It reduces barriers of time and distance, levels the playing field, and makes rural communities better places to live, work, and raise a family."* – **Thomas Dorr, former Undersecretary of Agriculture**

*"Access to affordable broadband is viewed as particularly important for the economic development of rural areas… Aside from enabling existing businesses to remain in their rural locations, **broadband access could attract new business enterprises drawn by lower costs and a more desirable lifestyle"** – **Lennard Kruger, Congressional Research Service**

About Broadband Technology

Early Broadband Technology

- First cable modem service introduced in 1996 by Rogers Communications
- Previous access through telephony, typically 56K modem
- "Always On"
- FCC defined broadband as connections faster than 200 kilo-bits per second in either download or upload speeds
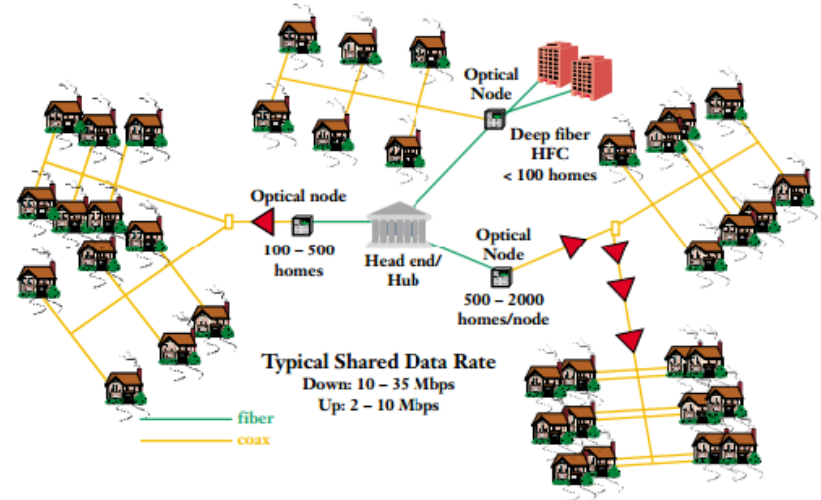
- Other technologies:
  - Digital Subscriber Line (DSL)
  - Wireless
  - Satellite
  - Broadband over Powerlines (BPL)

Broadband Diffusion over Time
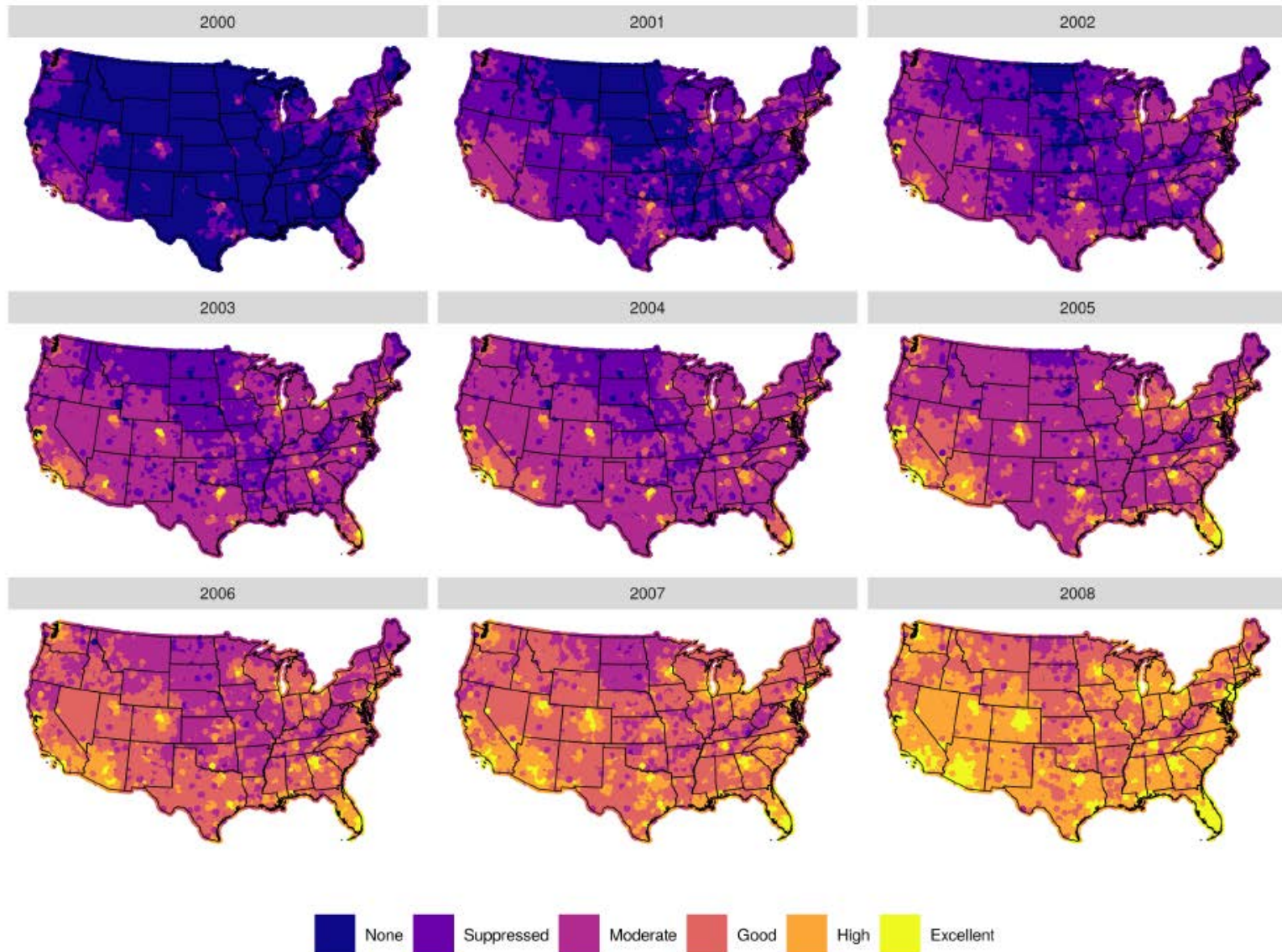
Rural-Urban Divide

Rural areas consistently lagged urban areas in terms of access to high-speed internet, which may put rural areas at a competitive disadvantage with respect to economic development in a changing US economy

- Differences in BB access between rural and urban areas (Norris 2001; DiMaggio, et al. 2001; Wade 2002; Antonelli 2003)

- Providers tend to first serve areas with higher expected profit via higher revenues and/or lower costs (Whitacre and Mills 2007; Whitacre 2010; Czernich et al. 2011)

- Considerable evidence that BB has positive economic impacts nationally (Crandall, et al. 2001; 2007) and locally (Stenberg 2009; Gillett et al. 2006; Shideler et al. 2007; Kolko 2014)

Federal Funding for Rural BB Deployment

- 2000-2009: **$1.8 billion** in subsidized loans to promote rural broadband deployment via the USDA's Broadband Loan Program

- 2009: ARRA authorizes **$2.5 billion** for Rural Utilities Service Broadband Loan and Grant programs

- 2018: Trump administration infrastructure plan includes $50 billion in rural block grants, some of which <u>may</u> be devoted to broadband

How sound are those investments?

USDA Broadband Loan Programs

Pilot program

- Authorized in December 2000

- Key eligibility requirements: (a) Population < 20,000; (b) No prior BB access; (c) Loan recipient ISP's couldn't serve > 2% of households nationally

- 2002 and 2003: $180 million in loans at subsidized rates (mostly 4%) to 98 communities in 13 states

- 25% default rate

USDA Broadband Loan Programs

Current program

- First authorized in 2002

- 2004-2007: $1.2 billion in loans to 1,263 communities located in 40 states

- Tightened equity & security provisions

- 2005 & 2008 Audits: Too many loans to suburban communities near big cities (e.g., 148 recipient communities located within 30 miles of cities with population > 200,000)
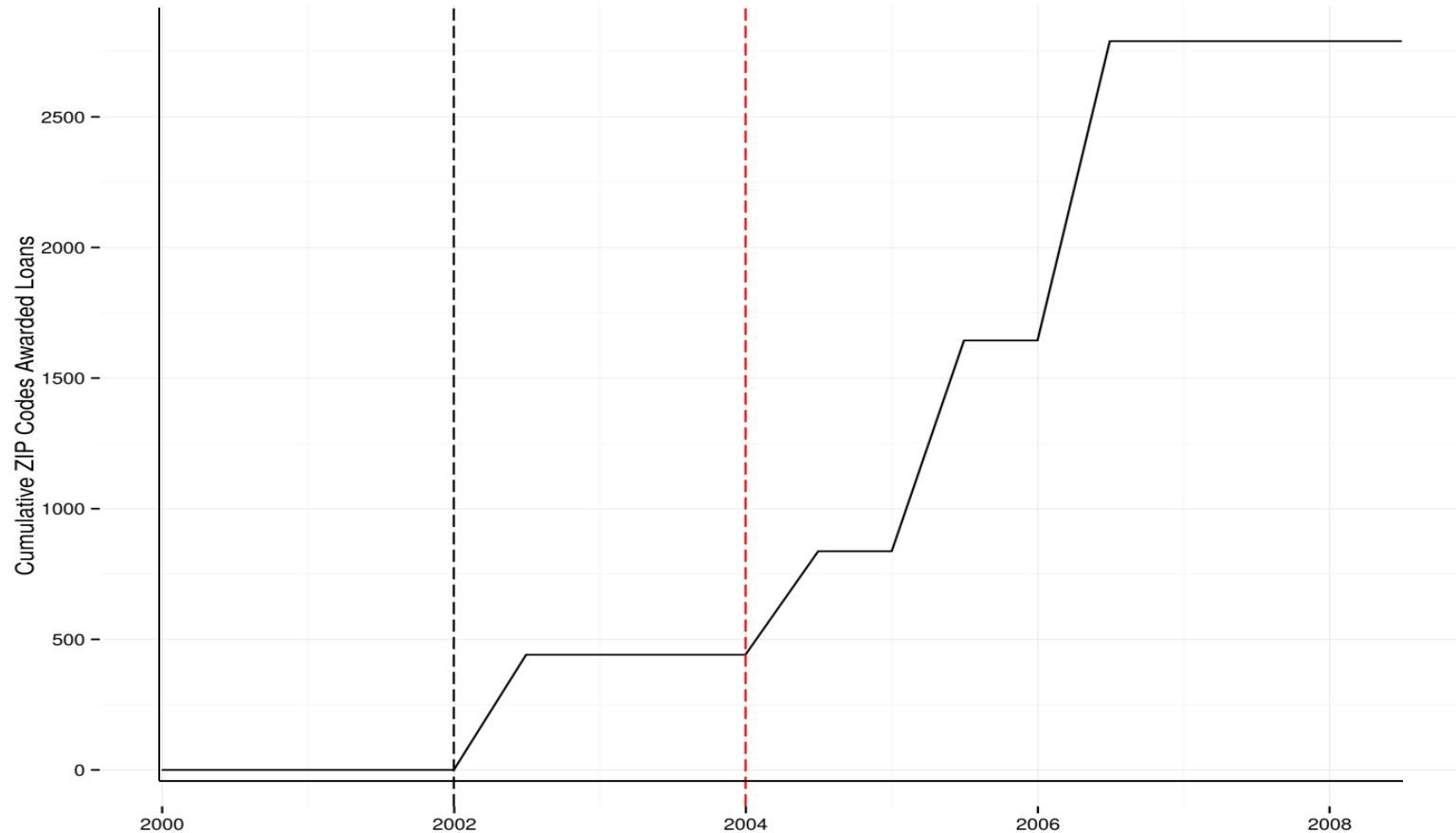
RUS Broadband Loans, 2002-2013

FY	No. of loans approved	Authorized value of loans ($ million)	Value of loans made ($ million)
2003	2	80	56.3
2004	33	602	574.6
2005	13	550	111.4
2006	15	500	329.2
2007	16	500	251.0
2008	13	3	421.3
2009	4	400	6.6
2010	0	400	0.0
2011	1	40	19.7
2012	1	212	68.9
2013	2	42	151.8
TOTAL	**100**	**3,329**	**1,990.8**

Source: GAO

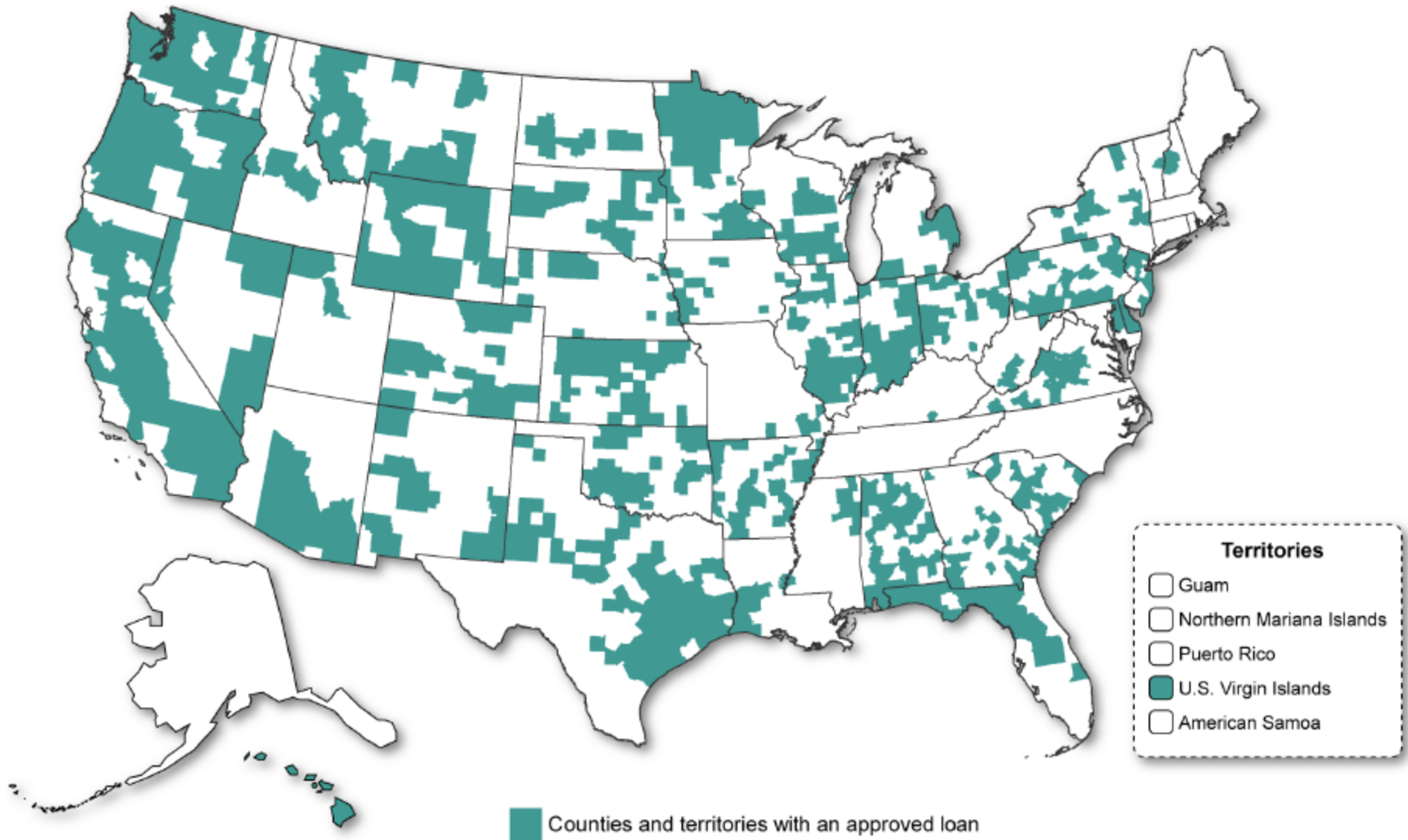# Disbursal of Broadband Loans

First (black) dashed line indicates initiation of the Pilot program;
Second (red) dashed line marks the initiation of the Farm Bill program.

US Counties Receiving Broadband Loans, 2002-2013 (Source: GAO)

Territories
- Guam
- Northern Mariana Islands
- Puerto Rico
- U.S. Virgin Islands
- American Samoa

Counties and territories with an approved loan

Community Connect Grants

- First authorized in 2002

- Targeted to unserved areas (zero prior high-speed internet service)

- $210 million authorized between 2002 and 2017

- Grantees required to deploy free broadband service to community facilities for at least two years (in addition to offering BB to residential and business customers

Findings from Kandilov & Renkow (2010)

- Pilot Broadband Loans: substantial positive impact on employm't, payroll, and # of estab's in communities; **<u>BUT</u>** positive impacts driven primarily by outcomes in communities located in metro counties (in contrast with stated program objectives)

- No evidence of significant positive economic impacts associated with the current Broadband Loan Program; possibly because not enough time had elapsed for positive impacts to have emerged

  ➔ **Mix of positive and negative impacts across different industries: Agriculture one of the positives**

Findings from Kandilov, et al. (2017)

- BB loan programs increased <u>availability</u> of high-speed internet in recipient communities (also found by Dinterman and Renkow)

- In the aggregate, BB loan programs had positive causal impacts on farm sales, expenditures, and profits. Average county net farm revenues increased by $24,000 for Pilot program, $9,000 for current program

- Positive impacts confined to rural counties that are adjacent to metropolitan counties; **no significant impact uncovered for other types of counties**.

Research Question

- What is the impact of the Broadband Loan and Grants on payroll per worker?
  - We find **positive effects** of **both Broadband Loan programs** (Pilot and current)
  - No significant impact of the Broadband grants program
- Can we construct a measure of rate of return?
  - Use data on the size of the loans and grants
  - Produce a rough measure of the rate of return
  - We find that **a $1 increase in zip code per capita broadband loan results in about a $1.08 increase in annual payroll per worker**, implying a rate of return of about 8 percent

Data

- Zip code level data on **annual payroll** and **employment** for the **37 states** that have received at least one broadband loan or grant during our sample period of 1997 to 2007 (Census Bureau's **Zip Code Business Patterns data** set)

- Zip codes with **population of 20,000 or less** as of 2000

- The **names of communities** that received a Community Connect grant or a loan under the Pilot Broadband Loan program or the current Broadband Loan program were **obtained via a FOIA request (unfortunately, information on rejected loan applications was not disclosed by the RUS, USDA)**

- **Manually match the names** of the communities that received the broadband loans or grants **to the associated zip codes**

Data

- Over the period considered, **Community Connect grants** were disbursed to operators in **66 zip codes spread across 24 states**; **Pilot broadband loans** were distributed for projects in **13 states (covering 412 zip codes)**; and **current broadband loans** financed projects in **30 states (488 zip codes)**

- Across zip codes that received these, the **average size** of a
  - **Pilot Loan** was about **$60 per cap.** (in 2007 $).
  - **Community Connect grant** was about **$660 per cap.**
  - **Current broadband loans** were about **$800 per cap.**
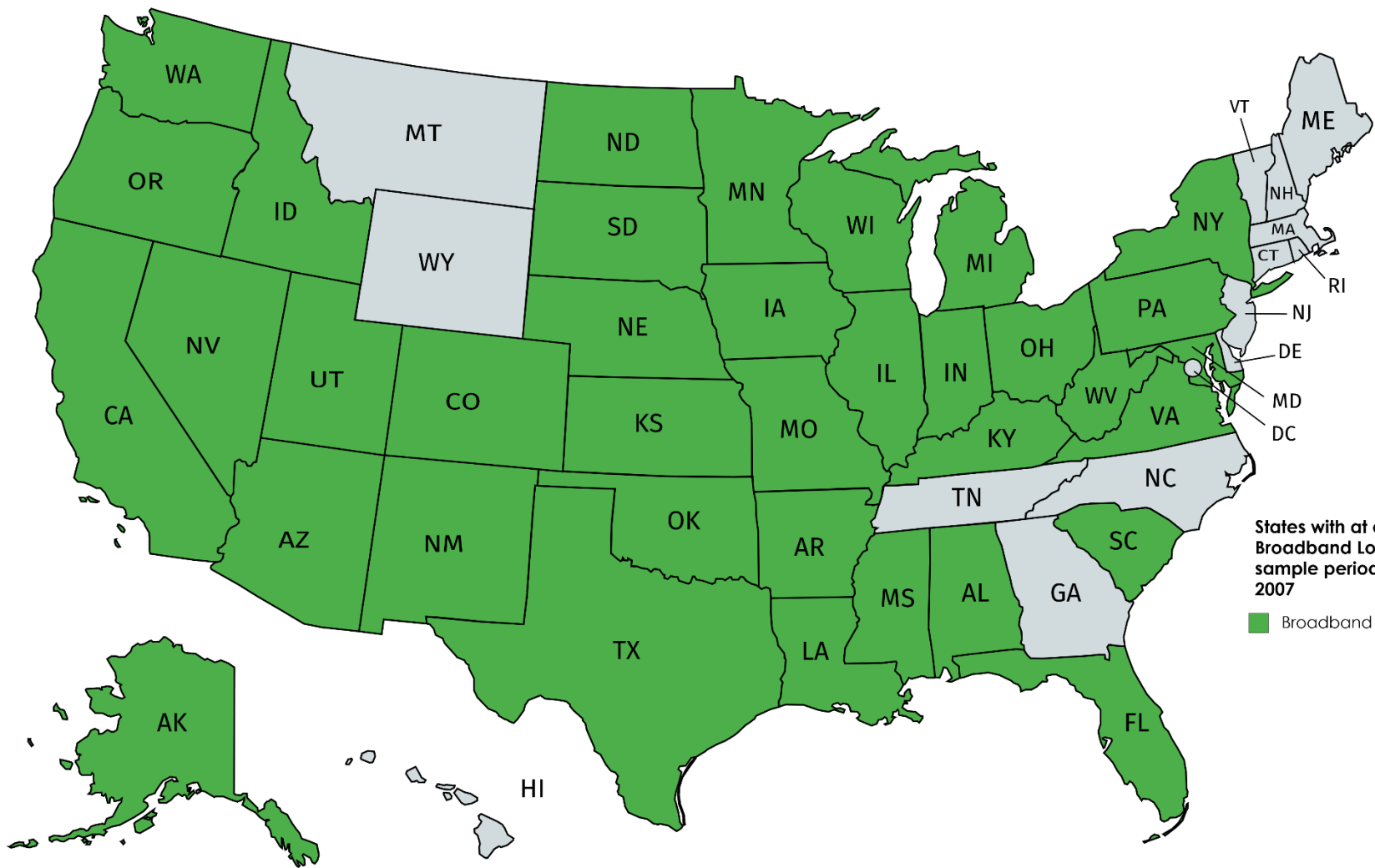
States with at at least one Broadband Loan or Grant during sample period from 1997 until 2007

■ Broadband Loan or Grant

Created with mapchart.net ©

Empirical Analysis

- **Compare 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 locations that did not receive a grant or a loan (control zip codes)**

- Important for the set of control zip codes to be as similar as possible to those that received a broadband loan or grant, then we can attribute changes in treated zip codes to the loans or grants

- Compare to zip codes that received a loan or grant to geographically adjacent zip codes that did not – spillover effects may this not as appealing

Empirical Analysis

- Use as control group the of zip codes, whose broadband operators applied for a loan or a grant but were turned down – **unfortunately, this information was not disclosed by the RUS, USDA**

- In our empirical work, we present estimates using as control group
  - (1) all zip codes from the entire sample of 37 states that did not receive a loan or a grant
  - (2) only zip codes in the same Census region as the community that received the loan or grant;
  - (3) **our preferred control group – only zip codes in the same Census division** (there are 9 Census divisions – Pacific, Mountain, West North Central, East North Central, West South Central, East South Central, South Atlantic, Middle Atlantic, and New England)

Empirical Analysis

- Finally, another issue in the empirical analysis is that the loans and grants are not randomly assigned across zip codes in the U.S., and this can lead to a bias

  - for example, communities with a provider who decides to apply may be different along both observable and unobservable dimensions (e.g. more entrepreneurial) from communities that qualify but whose providers do not apply for these loans or grants.

- To alleviate this issue, we use a technique called propensity score reweighting (Busso et al., 2014), which amounts to performing the empirical analysis in 2 steps. First, estimating a model explaining the likelihood of receiving a loan or a grant. Then we use the predicted probabilities as weights in the main model relating payroll per worker to loans or grants per capita at zip code level.

Table 2. The Determinants of Receiving a Broadband Loan (Current or Pilot) or a Community Connect Grant. Cross-sectional Logit model; the reported coefficients are elasticities.

Variables	Likelihood of Receiving a Loan (0/1 Ind. Var.)	
	(1)	(2)
% chg. in Annual Payroll, 1997-2000	-0.038***	-0.022*
	(0.012)	(0.013)
% chg. in Employment, 1997-2000	0.010	0.004
	(0.008)	(0.013)
% chg. in No. of Establishments, 1997-2000	-0.025**	-0.022**
	(0.012)	(0.010)
Population in year 2000	0.227	0.707***
	(0.147)	(0.214)
Number of Housing Units in year 2000	-0.087	-0.469**
	(0.146)	(0.215)
Land Area (Square Miles)	0.058***	0.096**
	(0.021)	(0.037)
Rural Adjacent		0.298***
		(0.085)
Rural Non-adjacent		0.157***
		(0.054)
State Dummy Variables	No	Yes
Pseudo R^2	0.01	0.18
No. Obs.	19,433	19,433

Omitted category from the Rural-Urban Continuum is Metropolitan. Heteroscedasticity adjusted standard errors that are clustered by state are presented in parenthesis below the estimated coefficients.
*** indicates statistical significance at the 1 percent level, ** indicates statistical significance at the 5 percent level, and * indicates statistical significance at the 10 percent level.

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Table 3. Summary Statistics

Variables	Mean	St Dev	Min	Median	Max
Annual Payroll per Worker (2007 dollars)	24,370	14,761	0	24,391	460,447
Value of Community Connect Grants per capita (2007 dollars)	0.41	25.39	0.00	0.00	5,314
Value of Current Broadband Loans per capita (2007 dollars)	4.20	58.61	0.00	0.00	822
Value of Pilot Broadband Loans per capita (2007 dollars)	0.07	7.17	0.00	0.00	2,454

Note: There are 213,078 observations (19,433 zip codes) over the sample period from 1997 to 2007. The sample consists of zip codes with population of 20,000 or less in 37 states where at least one providers has received a broadband loan or grant.

Table 4. The Impact of Broadband Loans and Grant Receipt on Payroll per Worker

Variables	Annual Payroll per Worker ($)		
	(1)	(2)	(3)
Community Connect Grant ($ per capita)	**0.506**	**-0.494**	**0.437**
	(0.830)	**(0.866)**	**(1.746)**
Current Broadband Loans ($ per capita)	**2.409***	**0.924****	**1.081****
	(0.563)	**(0.392)**	**(0.450)**
Pilot Broadband Loan ($ per capita)	**1.856***	**0.953***	**1.071****
	(0.558)	**(0.548)**	**(0.540)**
Zip Code Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
Census Region x Year Effects	No	Yes	No
Census Division x Year Effects	No	No	Yes
R^2	0.01	0.01	0.02
No. obs.	213,078	213,078	213,078
No. Zips	19,385	19,385	19,385

Note: Heteroscedasticity adjusted standard errors that are clustered by state are presented in parenthesis below the estimated coefficients.
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Table 5. The Impact of Broadband Programs across the Rural-Urban Continuum

Variables	Annual Payroll per Worker ($)		
	Metro	**Rural Adj.**	**Rural Non-adj.**
Community Connect Grant ($ per capita)	**19.427**	**-0.795****	**1.512****
	(18.892)	**(0.353)**	**(0.670)**
Current Broadband Loans ($ per capita)	**0.323**	**1.973*****	**1.140*****
	(0.837)	**(0.556)**	**(0.401)**
Pilot Broadband Loan ($ per capita)	**4.987****	**1.140*****	**-1.175**
	(2.431)	**(0.172)**	**(1.367)**
Zip Code Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
Census Division x Year Effects	Yes	Yes	Yes
R^2	0.11	0.05	0.01
No. obs.	100,978	67,202	44,898
No. Zips	9,188	6,112	4,085

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Conclusion

- 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**

- We employ a two-step empirical analysis to mitigate selection issues and reduce biases in the estimate effects

- Our 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, implying a rate of return of about 8 percent** in our preferred specification.

- We find **no statistically significant impact of broadband grants received on the payroll per worker**.