

# Measuring Efficacy of the Rural Broadband Initiatives: Evidence from the Housing Market

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# Introduction

- The US Federal Government has invested large amount of funds to address the rural-urban digital divide
  - ▶ 50\$ bln FY 2015-20
- Nevertheless, the digital divide between rural and urban areas is a continuing concern:
  - ▶ on only 53.6% of rural households had a broadband subscription according to ACS 2016-2020
- Empirical evidence on economic impacts of Federal Broadband Programs is limited

## Objective

This project investigates how the Federal Broadband Initiatives Program (BIP) has affected house sale prices

- Economic impacts of an access to a small amenity such as broadband should be reflected in house prices (Rosen 1974, Freeman, et al. 2014)

# Outline

- 1 Introduction
- 2 Background
- 3 Data
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- 5 Results
- 6 Conclusions

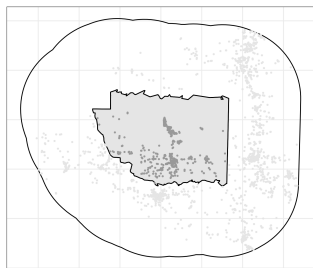
# Background: Broadband Initiatives Program

The Program aimed to facilitate broadband deployment in the US rural communities:

- established in 2009
- 299 projects approved by Sept 2010
- only **last** or middle mile projects
- \$2.2 bln in grants, \$1.2 bln in loans
- Criteria:
  - ▶ loan/grant combination (75/25)
    - ★ 75% of the area rural
    - ★ 90%/50% of HHs lack access to 768 Kbps downstream and 200 Kbps upstream
  - ▶ grant
    - ★ 100% are rural and  $\geq$  50 mi from non-rural area

# Data

- CoreLogic Real Estate Transaction Data
  - ▶ proprietary nationally representative dataset collected from counties property appraisers offices; consists of property information, and deed transactions
- Rural Utility Service (RUS) Broadband Initiatives Program (BIP) Data
  - ▶ GIS project geographies, project area and award characteristics
- Geo-connecting housing data to program data: 79 projects



*Figure 1.* - The Example of BIP Service Area in Oklahoma with an extended 20 mi border and property sales inside (dark grey) service area and outside (light grey)

# Mahalanobis Matching

- Properties covered by program may systematically differ from properties in the vicinity of program area in control group
  - ▶ use Mahalanobis matching and observed house characteristics to find the most similar houses for the control group

$$\delta(\mathbf{x}_i, \mathbf{x}_j) = \sqrt{(\mathbf{x}_i - \mathbf{x}_j)' S^{-1} (\mathbf{x}_i - \mathbf{x}_j)}$$

$\mathbf{x}$  is a vector of matching covariates: property age, number of bedrooms and bathrooms, living area sq. footage, land sq. footage, ratio of living sq. footage to total building area in sq. feet

$S$  is the pooled covariance matrix

- Matching was performed 1:1 nearest neighbor algorithm without replacement

# Difference-in-Difference

$$\log(P_{ijt}) = \alpha_0 + \alpha_1 BIP_i + \sum_{t=1}^{T=5} \beta_t \times Period_t + \\ + \sum_{t=1}^{T=5} \gamma_t BIP_i \times Period_t + Tract_j + \delta X_{ijt} + \varepsilon_{ijt}$$

where  $i$  indexes the property,  $t$  – time period, and  $j$  – census tract

$\log(P_{ijt})$  - natural logarithm of the property sale price

$BIP_i$  - the BIP indicator equals 1 if property  $i$  is located inside a BIP PSA

$Period_t$  - time periods dummies where  $t = 1$  corresponds to 2007-08 and  $t = 5$  indicates 2015+

$Tract_j$  - tract-level fixed effects

$X_i$  - property and program characteristics

## Results: Estimated Program Effects

	Estimate	Std. Error
BIP	-0.007	(0.009)
Year 2007-8	-0.008	(0.008)
Year 2009-10	-0.202	(0.009)
Year 2011-12	-0.268	(0.008)
Year 2013-14	-0.167	(0.008)
Year 2015+	-0.006	(0.007)
BIP x Year 2007-8	0.019	(0.011)
BIP x Year 2009-10	0.056	(0.011)
BIP x Year 2011-12	0.039	(0.010)
BIP x Year 2013-14	0.046	(0.009)
BIP x Year 2015+	0.03	(0.008)
Covariates	YES	
Tract FEs	YES	
Observations	190,838	

Table 1: Estimated ITT Effects of BIP: Main Results

Note. - Clustered at the matched pair robust standard errors are presented. The period of 2005-6 is the omitted period.



# Conclusion

- The results are confounded by the presence of upward pre-program trends: house prices in the program-affected areas were increasing several years prior to BIP
- The estimated impacts of new broadband infrastructure are initially positive and diminishing over time: the positive effects of the new broadband technology start fading in 2015-2018 period
- To further investigate the economic impacts of Federal broadband programs:
  - ▶ Immediate outcomes: Internet speed, broadband subscriptions etc.
  - ▶ More recent programs: Community Connect 2013-2019, ReConnect Programs 2019-2020
  - ▶ Business dynamics: business and employment growth, start-ups and home-owned businesses