State broadband policy: Impacts on availability

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STATE BROADBAND POLICY: IMPACTS ON AVAILABILITY

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Background

- Provision of broadband Internet is an increasingly important topic
  - Highlighted by COVID-19 pandemic

- Rural areas have continued to lag behind in terms of broadband availability

- Broadband is important for a host of rural (and urban) economic outcomes (Kim and Orazem, 2017; Kandilov et al. 2017; Whitacre et al. 2014)

- States have taken different approaches to broadband policy
  - Some have state broadband offices with full-time employees
  - Others have state-level funding mechanisms
  - Some restrict cooperatives / municipalities from providing broadband

- Little to no empirical evidence regarding which policies work
Previous Research on Broadband Policy

- Limited number of studies have examined U.S. broadband policy efforts
  - One early study concluded most state-level policies (tax incentives, universal service funds, municipal restrictions) were ineffective at promoting broadband penetration (Wallsten, 2005)
  - Another early study argued that policies focused on increasing demand were most effective (Falch, 2007)
  - Siefer (2015) lays out elements of “good” state broadband policy but stops short of empirically documenting their impacts.
  - Lack of research likely due to no clear source of information on state-level policies

Existing literature does not speak to effectiveness of state-level broadband policy in U.S.
Research Questions

- Do state-level broadband policies impact overall availability?
  - What about rural availability?

- Which broadband policies are most effective – and what is the magnitude of their impact?
  - Existence of state-level broadband office with full-time employees
  - Existence of state-level funding mechanism
  - Existence of state-level restrictions on cooperative / municipal broadband provision

Source: Broadbandnow.com
Data & Methods

- **Dependent Variable:** County % of Population with Access to 25/3
  - Aggregated from Census Block-level data
    - National Broadband Map (2010 – 2013)
    - Federal Communications Commission (2014 – 2018)
  - Other availability metrics of interest:
    - County % of Population with access to fiber
    - County % of Population with at least 2 providers offering 25/3 speeds
  - Also compiled “rural-only” metrics using Census Blocks classified as rural in 2010

- **Primary Independent Variables of Interest:** State Broadband Policies

- **Other county-level Control Variables**
  - Income
  - Education
  - Poverty Rates
  - Population Density
  - % Houses built after 2010
  - Topography

Sources:
- US Census American Community Survey
- US Census SAIPE
- BLS - LAUS
- USDA ERS Natural Amenities Scale

Panel Dataset from 2012 – 2018 (3,140 counties)
State Broadband Policies

- Initial Summary
  - Compiled by Pew Charitable Trusts
  - Initially available July 2019
  - Reviewed all state-level statutes, executive orders, and governing directives from terms dating to 1991
  - First comprehensive collection of broadband-related policies

- Ground-truthing
  - Statutes may establish funding for full-time employees
  - Several organizations (not captured in dataset)
  - Personalized emails sent to State Broadband Leaders Network (SBLN) for assessment
  - 31 of 50 states responded (62%)
## Data & Methods

### Table 1. Descriptive Statistics for Broadband Outcomes, Policy Variables, and Demographics, 2012 & 2018.

| Outcome Measures     | 2012     |        | 2018     |        |
|----------------------|----------|--------|----------|--------|
|                      | Mean     | S.D.   | Min      | Max    |
| 25/3_all (%)         | 31.93    | 37.93  | 0        | 100    |
| 25/3_rural (%)       | 24.43    | 31.46  | 0        | 100    |
| Fiber_all (%)        | 7.50     | 18.20  | 0        | 100    |
| Fiber_rural (%)      | 6.48     | 15.83  | 0        | 100    |
| 2+comp_all (%)       | 4.48     | 14.46  | 0        | 99.8   |
| 2+comp_rural (%)     | 2.37     | 2.83   | 0        | 100    |
| Broadband Policies   |          |        |          |        |
| State Funds (% with)| 9.86     | 29.82  | 0        | 100    |
| State Office (% with)| 6.01    | 23.77  | 0        | 100    |
| Muni Restrictions (% with)| 56.66 | 49.56  | 0        | 100    |

### Notes:
- The table provides descriptive statistics for broadband outcomes, policy variables, and demographics for the years 2012 and 2018.
- The data includes measures such as 25/3_all, 25/3_rural, Fiber_all, Fiber_rural, 2+comp_all, and 2+comp_rural.
- Broadband policies include State Funds, State Office, and Muni Restrictions.
- The statistics are presented as mean, standard deviation, minimum, and maximum values.
The Elephant in the Room…

Experts are furious over the FCC’s rosy picture of broadband access

The data the agency uses has been criticized as flawed

FCC data fails to count 21 million people without broadband, study finds

Congress Tells FCC to Fix Broadband Maps Now

• Major problems with FCC broadband data
  • Coverage of any part of census block = service in entire block
  • Max advertised speeds, not actual
  • No cost data
  • Incorrect submissions by providers

AT&T gave FCC false broadband-coverage data in parts of 20 states

AT&T corrects mistake, admitting it offers no broadband in 3,600 census blocks.
Broadband Availability, 2012-2018

Figure 1. Broadband Availability Averages for U.S. Counties, 2012-2018.

- **FCC Population-Based Availability Estimates**
  
  |        | 2017   | 2018   |
  |--------|--------|--------|
  | All    | 93.5%  | 94.4%  |
  | Rural  | 73.7%  | 77.7%  |

Source: FCC Form 477 data, 2012-2018 (author’s calculations)
State Broadband Policies, 2012 & 2018

Figure 2. State Broadband Offices, 2012 (left) and 2018 (right)

Figure 4. State Broadband Funding, 2012 (left) and 2018 (right)

Figure 3. Municipal Broadband Restrictions, 2012 (left) and 2018 (right)

SBLN contacts: Pew State Broadband Policy Explorer
Data & Methods (cont’d)

Table 1. Descriptive Statistics for Broadband Outcomes, Policy Variables, and Demographics, 2012 & 2018.

| Demographics | 2012 |  |  |  | 2018 |  |  |  |
|--------------|------|---|---|---|------|---|---|---|
|               | Mean | S.D. | Min | Max | Mean | S.D. | Min | Max |
| **All County** |      |      |     |     |      |      |     |     |
| Population   | 98,447 | 313,839 | 66 | 9,840,024 | 102,769 | 329,907 | 75 | 10,152,600 |
| Median HH Income | 45,644 | 11,900 | 19,624 | 122,844 | 51,583 | 13,703 | 20,188 | 136,268 |
| Population Density | 259.35 | 1725.37 | 0.03 | 69,423 | 269.75 | 1783.49 | 0.037 | 70,977 |
| % with Bach or more | 19.50 | 8.75 | 3.72 | 72.81 | 21.57 | 9.43 | 0 | 78.58 |
| % in Poverty | 16.30 | 6.43 | 0 | 47.70 | 15.60 | 6.48 | 2.30 | 55.10 |
| % Housing after 2010 | 0.31 | 0.44 | 0 | 5.60 | 3.59 | 2.64 | 0 | 36.00 |
| Rural % of population | 56.75 | 33.74 | 0 | 100.00 | 56.71 | 33.80 | 0 | 100.00 |
| Topography | 8.93 | 6.61 | 1 | 21.00 | 8.93 | 6.61 | 1 | 21.00 |
| **Rural Portion of County Only** |      |      |     |     |      |      |     |     |
| Population | 17,358 | 15,512 | 0 | 123,887 | 17,579 | 15,993 | 0 | 128,275 |
| Median HH Income | 25,468 | 14,858 | 0 | 91,571 | 28,919 | 17,003 | 0 | 102,156 |
| % with Bach or more | 17.35 | 8.64 | 0 | 73.65 | 19.45 | 9.24 | 0 | 73.64 |
| % in Poverty | 13.92 | 7.42 | 0 | 86.00 | 13.25 | 7.17 | 0 | 76.40 |
| % Housing after 2010 | 0.30 | 0.49 | 0 | 4.80 | 3.72 | 3.11 | 0 | 38.80 |
| **Instrumental Variables (State level)** |      |      |     |     |      |      |     |     |
| Conservative Adv. | 20.56 | 7.93 | -20.33 | 36.57 | 16.72 | 9.45 | -30.34 | 38.24 |
| % Repub. Legislators | 58.99 | 12.21 | 0 | 84.28 | 62.53 | 12.82 | 0 | 87.20 |
| **# Obs** | 3,143 |      |     |     | 3,143 |      |     |     |
Empirical Specification (Insert Glossy Eyes Here)

**Dynamic Panel Regression**

**Dependent Variable:**
% of Population with 25/3 access in county \( i \) at time \( t \)

\[
(1) \quad Availability_{it} = \rho Availability_{it-1} + \beta X_{it-1} + \gamma BBPolicy_{it-1} + \delta_t + v_i + \epsilon_{it}
\]

**Control Variables:**
- Poverty Rates
- Education
- Population Density
- Rural % of Population
- Topography

**Problem:** Strict Exogeneity of Regressors Does Not Hold

“Nickell Bias”

**County Fixed Effects**

**Variables of Interest**

**Year Fixed Effects**
But, endogeneity is still an issue for other variables (Policy_{it-1}). Do states leading / lagging in availability enact more broadband-related legislation?

Solve with Instrumental Variables

A Commonly-used Approach:
Difference (or System) Generalized Method of Moments (GMM)

\[
\Delta \text{Availability}_{it} = \rho \Delta \text{Availability}_{it-1} + \beta \Delta X_{it-1} + \gamma \Delta BBPolicy_{it-1} + \Delta \delta_t + \Delta \epsilon_{it}
\]
Results

Municipal restrictions lower availability 2-3%

State funds increase availability 1-2%

Intuitive results for controls

Some evidence of state office effectiveness

### Table 2. System GMM Estimates for Broadband Availability

|                      | 25_3_All (1) | Fiber_All (2) | 2_Competitors (3) |
|----------------------|--------------|---------------|-------------------|
| Lag (availability)   | 0.433        | 0.755         | 0.574             |
| % Bachelor’s Degree or More | 0.141         | 0.204         | 0.139             |
| % Poverty            | -0.351       | -0.128        | -0.068            |
| % Housing after 2010 | -0.320       | 0.496         | 0.358             |
| In(Median Household Income) | -0.008       | 0.016         | 0.062             |
| In(Population Density) | 0.032       | 0.000         | 0.020             |
| Rural % of Population | -0.112      | -0.015        | -0.093            |
| Topography           | 0.000        | 0.000         | 0.000             |
| Year F.E.            | Yes          | Yes           | Yes               |
| Policy Variables     |              |               |                   |
| State funds          | 0.012        | 0.020         | 0.001             |
| State office         | -0.003       | 0.009         | 0.016             |
| Municipal restrictions | -0.031     | -0.022        | -0.018            |
| Constant             | 0.542        | 0.231         | 0.170             |
| Wald Chi Squared     | 14,568       | 5,705         | 18,455            |
| # Instruments        | 54           | 55            | 61                |
| # Groups             | 3,140        | 3,140         | 3,140             |
| Hansen J-test        | 0.261        | 0.332         | 0.258             |
| AR(1)                | 0.000        | 0.000         | 0.000             |
| AR(2)                | 0.336        | 0.231         | 0.150             |
| # Obs                | 18,883       | 18,883        | 18,883            |

*, **, and *** represent statistical significance at the p<0.10, 0.05, and 0.01 levels, respectively.

Hansen J-test represents p-values for the null hypothesis of valid instruments (overidentification).

AR(1) and AR(2) represent p-values for null hypotheses of no 1st and 2nd-order autocorrelation.
### Results - Rural

Intuitive results for controls

- Municipal restrictions lower availability 2-4%
- State funds increase availability 1-2%

#### Table 3. System GMM estimates for Rural Broadband Availability

|                           | 25/3_All_Rural (1) | Fiber_All_Rural (2) | 2+_Competitors_Rural (3) |
|---------------------------|--------------------|---------------------|--------------------------|
| Lag (availability) - Rural | 0.448              | 0.818               | 0.803                    |
| % Bachelor’s Degree or More – Rural | 0.264              | 0.095               | 0.104                    |
| % Poverty – Rural      | -0.401             | **-0.091**          | **-0.112**               |
| % Housing after 2010 - Rural | -0.152             | 0.382               | 0.059                    |
| In (Median Household Income – Rural) | -0.035             | **-0.099**          | **-0.016**               |
| In (Rural Population)  | 0.045              | **-0.010**          | 0.015                    |
| Rural % of Population   | 0.019              | 0.050               | 0.008                    |
| Topography              | -0.001             | 0.000               | 0.000                    |
| Year F.E.               | Yes                | Yes                 | Yes                      |
| Policy Variables        |                    |                     |                          |
| State funds             | 0.018              | 0.021               | 0.014                    |
| State office            | -0.007             | 0.015               | 0.003                    |
| Municipal restrictions  | -0.037             | 0.011               | 0.003                    |
| Constant                | 0.175              | 0.208               | 0.037                    |
| Wald Chi Squared        | 15.432             | **7.215**           | **17.635**               |
| # Instruments           | 54                 | 53                  | 52                       |
| # Groups                | 3,028              | 3,028               | 3,028                    |
| Hansen J-test           | 0.251              | 0.304               | 0.275                    |
| AR(1)                   | 0.000              | **0.000**           | **0.000**                |
| AR(2)                   | 0.201              | 0.621               | 0.042                    |
| # Obs                   | 18,159             | 18,159              | 18,159                   |

* *, **, and *** represent statistical significance at the p<.10, .05, and .01 levels, respectively.

Hansen J-test represents p-values for the null hypothesis of valid instruments (overidentification).
AR(1) and AR(2) represent p-values for null hypotheses of no 1st and 2nd-order autocorrelation.
Study Summary in 2 slides:

- 2012-2018
- County-level data
- 18,833 observations
- Dynamic panel regression

- FCC Form 477
- ACS 5-year
- Pew Charitable Trusts
Study Summary in 2 slides (cont’d):

| Do these state broadband policies matter? | State broadband office | State broadband funding | Municipal network restrictions |
|-----------------------------------------|------------------------|-------------------------|-------------------------------|
| Overall                                 |                        |                         |                               |
| 25/3 availability                       |                        | Yes (higher)            | Yes (lower)                   |
| Fiber availability                      |                        | Yes (higher)            | Yes (lower)                   |
| Two or more 25/3 providers              | Yes (higher)           |                         | Yes (lower)                   |
|                                        |                        |                         |                               |
| Rural                                   |                        |                         |                               |
| 25/3 availability                       |                        | Yes (higher)            | Yes (lower)                   |
| Fiber availability                      |                        | Yes (higher)            | Yes (higher)                  |
| Two or more 25/3 providers              |                        |                         | Yes (lower)                   |
Conclusions

- Strong argument that state broadband policies are having an impact
  - Existence of restrictions on municipal / cooperative broadband hinders overall availability
  - Broadband funding programs / offices have positive impact

- Magnitude of impacts:
  - Typical county in 2018: 71.5% rural broadband availability
    - Including state-level funding program: (+1.8%) 73.3%
    - Removing municipal restrictions: (+3.7%) 75.2%
    - Additive in nature: Do both 77.0%
Conclusions (and recent progress)

- **State Broadband Offices**
  - Positive impact shown for only 2 outcomes: % of residents with 2+ providers; rural-only fiber
  - But, many states only began investing in these relatively recently:
    - 8 in 2014
    - 25 by 2018
  - Benefits of these offices may take time to accrue
    - Stakeholder outreach
    - Planning / capacity building
  - Interplay between state offices / other policies?

- **Recent Momentum**
  - Pew’s update for 2019 legislative session:
    - 4 additional states set up broadband task forces
    - 7 states set up their own broadband funding structures
    - 5 states reduced restrictions for cooperative broadband provision
That’s all, folks!

- Questions?
- Comments?

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