

Policy Deterrence: Strategic Investment in U.S. Broadband

Karam Kang (University of Wisconsin-Madison)

Mo Xiao (University of Arizona)

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Market Power

- Government policies (anti-trust, subsidies/taxes, regulations, etc.) shape market competition, *which also shapes government policies*
- One channel of solidifying/increasing market power is firms' political influence
- Existing studies: Large firms spend more on politics than small ones do
 - Google's 2022 PAC contributions (\$1.5M)/lobbying (\$13M)
 - More spending after mergers (e.g., Cowgill et al, 2022)

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 - *"Too little" money?:* Google's 2022 R&D \$40B

- Large firms' *business decisions* affect voters and thus politicians more than small ones' decisions do
 - More consumers (e.g., 77% of households have an Amazon Prime membership)
 - More employees (e.g., Amazon hires 1% of registered voters)
 - Covered by the (social) media more frequently
- We provide theory & empirical evidence that large firms attempt to reduce competition by **detering procompetitive government policies via their strategic investment** in the context of broadband industry

Context: U.S. Broadband Internet Services

1. Highly oligopolistic: Comcast, AT&T, Spectrum, Verizon, Cox
2. Substantive sunk cost of wireline investment
 - o Average cost of laying fiber optic cable: \$27K per mile (DoT)
3. Recent strides in state policy initiatives (“digital divide”)
 - o 31 states enacted new pro-broadband legislation in 2020
4. Heterogeneous providers by existing investment and network
 - o Small firms tend to benefit from these policies
5. Firm investment and government policies are location-specific
 - Cross-sectional variation (in addition to variation over time)

What The Paper Finds

- **Theory:** Stackelberg model of two firms (leader & follower) choosing investment and politician choosing a policy supporting the follower
 - Establish conditions under which the leader invests in order to preempt the follower's investment both directly and indirectly by deterring the policy
- **Empirics:** Politically-motivated investment, especially by large firms
 - More broadband investment in electorally competitive counties
 - Policy-making responds to market capacity in these counties
 - Heterogeneity results consistent with policy-deterrence motive for this empirical pattern

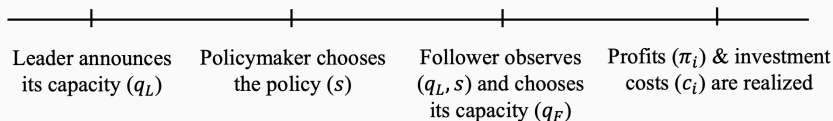
Intersection of Political Economy and IO

- Interaction btw market power and political power: Callander, Foarta & Sugaya, 2022; Cowgill, Prat & Valletti, 2022
- Empirical studies on entry deterrence: Ellison & Ellison, 2011; Goolsbee & Syverson, 2008; Seamans, 2012; Gil et al, 2021; Wilson et al, 2021
 - We exploit variation in political environments to detect strategic investment motive
- Firms' political influence by business activities: Carvalho, 2014; Bertrand et al, 2018; Delatte et al, 2022; Bisbee & You, 2022
 - We emphasize that firm benefits from policy influence by raising rivals' costs

Theoretical Framework

Government Policymaking and Firm Investment

- Players: Two firms (Leader L and Follower F) and a politician
- Firms choose capacity (q_i for $i \in \{L, F\}$) at a cost
- Politician chooses government policy $s \in \mathbb{R}_+$



Payoff and Preferences

- Firms: $\underbrace{\pi_i(q_L, q_F)}_{\text{operational profit}} - \underbrace{c_i(q_i, s)}_{\text{investment cost}}$
 - Capacity decisions are strategic substitutes
 - Government policy reduces marginal investment cost for the follower (s measures the level of **pro-competitiveness**)
- Politician: $u(q, s)$
 - Reflecting voters' preferences, electoral incentives, and politician's own policy preference
 - Increasing and concave in total capacity, $q = q_F + q_L$
 - Not necessarily increasing in policy s
 - **Appeal for policy diminishes as q increases:** $\frac{\partial^2 u}{\partial s \partial q} < 0$

Follower's Response

- Follower takes (q_L, s) as given and chooses its capacity:

$$\max_{q_F} \pi_F(q_L, q_F) - c_F(q_F, s)$$

- An increase in the leader's capacity deters the follower's investment: $\frac{dq_F}{dq_L} \leq 0$
- Policy encourages the follower's investment: $\frac{dq_F}{ds} \geq 0$

- Politician chooses policy s given the leader's capacity, anticipating the follower's response:

$$\max_s u(q_L + q_F(q_L, s), s)$$

- First order condition:

$$\underbrace{\frac{\partial}{\partial s} u(q, s)}_{\text{Direct MB}} + \underbrace{\frac{\partial}{\partial q} u(q, s) \frac{\partial}{\partial s} q_F(q_L, s)}_{\substack{\text{Indirect MB} \\ \text{via follower response}}} = 0$$

Policymaking (Cont'd)

- How does the leader's capacity influence policymaking?
- Less pro-investment policy as the leader's capacity increases:

$$\frac{ds}{dq_L} = \underbrace{\left(1 + \frac{dq_F}{dq_L}\right)}_{(+)} \underbrace{\left(\frac{\partial^2 u}{\partial q^2} \frac{dq_F}{ds} + \frac{\partial^2 u}{\partial q \partial s}\right)}_{(-)} \underbrace{P(q_L, s)}_{(+)} \leq 0$$

Effect of q_L on total capacity (q) Effect of q on MB of policy (s)

- o Leader's policy influence can come from politician's preference over (q, s) , (partially) representing voter preferences

Leader's Incentive to Deter Policy

- Leader chooses its capacity, anticipating politician and follower:

$$\max_{q_L} \pi_L(q_L, q_F(q_L, s(q_L))) - c_L(q_L, s(q_L))$$

- Leader's policy influence ($ds/dq_L < 0$)
 - This channel increases the leader's MB of capacity \Rightarrow More investment
 - As the leader builds up its capacity, the policy intervention is reduced, which indirectly reduces the follower's investment

$$MB(q_L) = \frac{\partial}{\partial q_L} \pi_L(q_L, q_F) + \left\{ \frac{dq_F}{dq_L} + \frac{dq_F}{ds} \frac{ds}{dq_L} \right\} \frac{\partial}{\partial q_F} \pi_L(q_L, q_F)$$

Effects of Politician Preferences on Capacity

- What if the politician cares more about broadband capacity?
 - γ represents political environment that increases politician's relative preferences on q : $\frac{\partial^2}{\partial q \partial \gamma} u(q, s; \gamma) > 0$
- The leader's response to a change in political environment γ :

$$\frac{dq_L}{d\gamma} = \underbrace{A(q_L, \gamma)}_{(-)} \underbrace{\frac{ds}{d\gamma}}_{(+)} + \underbrace{B(q_L, \gamma)}_{(+)} \underbrace{\left[\frac{\partial \pi_L}{\partial q_F} \frac{\partial q_F}{\partial s} - \frac{\partial c_L}{\partial s} \right]}_{\text{Leader's MB-MC of } s} \underbrace{\frac{d^2 s}{dq_L d\gamma}}_{(-)}$$

1. Higher γ induces more policy \rightarrow Anticipation of more competition from the follower reduces q_L
2. Higher γ amplifies leader's policy influence \rightarrow Unfavorable (lower profit $>$ lower cost) policy increases q_L

Effects of Politician Preferences on Capacity: An Extension

- Policies at the state level; two identical markets in a state, M_1 and M_2
- Governor cares more about M_1 's capacity than M_2 's
 - Perhaps, winning votes from M_1 is more beneficial?
- Leader invests more in M_1 than in M_2 , leveraging its larger policy influence in M_1
- Firm investment depends on politician's preferences on localities

Institutional Background and Data

State Policies to Encourage Broadband Investment

- Provide **funding and tax incentives** for private firms
 - \$20–500M grants, tax refund/credit/exemptions
- Amend **right-of-way laws** and help infrastructure access
 - Telecommunication Act of 1996, 253(c): Mandates access to poles, conduits and rights of way on a neutral and non-discriminatory basis, but implementation lies with state/local governments
 - “Dig-once” to streamline fiber deployment in road projects
 - Regulations on pole attachment fees, legal disputes with a property owner, etc.
- Strategic plans, broadband offices, publicly-owned broadband
- Promote broadband adoption and address affordability

Heterogeneous Firm Interests on Policies

Small firms tend to benefit more than large ones

- Disadvantaged in navigating regulatory hurdles
 - Hurdles, big and small: Permission to build, compensation schemes, management of a public rights of way; disputes; review process ...
 - “Dig once” policy is stalled in Congress, in part due to large companies’ opposition
- Less likely own dark fiber (“potential” capacity, unused but available for use)
- More flexible to work with local communities
 - 90% of Connect Illinois grants awarded to local firms
 - Large firms challenged rural grants to competitors in LA

⇒ Broadband policies tend to be **procompetitive**

Broadband in Campaign Platform and Policy Agenda

- Broadband status (or the lack thereof) is a recurring theme in campaign platforms
 - Typically relate broadband accessibility to education, healthcare, and local businesses and economy growth
- Governors emphasize their strategies and policies that have been implemented
 - In 2021, 40 states discussed their broadband policy in the governors' state of the state speeches
 - Many specifically mentioned the state's cooperation with new entrants or small firms as a strategic plan

- Broadband deployment: Every service provider's entry, technology, and (advertised) maximum speed
 - Collected bi-annually, Census Block level
 - NTIA 2010–2014; FCC 2014–2019
- State broadband policies
 - Pew Charitable Trusts: State Broadband Policy Explorer
 - State government websites (by state broadband program offices), budget and tax expenditure documents, state laws and legislation, public statements, news articles
- State politics: Gubernatorial election results and term limits, state legislature party composition

Broadband Deployment: Stats

Variable	Rural Only		Urban or Mixed	
	Mean	SD	Mean	SD
<i>Coverage</i>				
% Census blocks with any service	54.1	26.5	65.3	20.5
% Census blocks with 2+ ISP's	9.9	12.9	35.3	21.5
% Population with any service	81.4	20.7	90.1	11.5
% Population with 2+ ISP's	24.1	20.7	64.6	25.2
<i>Speed</i>				
% Census blocks with ≥ 25 Mbps	27.3	27.7	45.6	27.1
% Census blocks with fiber	15.5	25.8	10.2	18.3
% Population with ≥ 25 Mbps	44.4	34.0	68.4	29.6
% Population with fiber	20.3	30.5	14.7	24.2
Average max download speed (Mbps)	146.8	190.0	206.9	198.1

Notes: 14,040 observations from rural counties (702 counties \times 20 semi-annual periods, 2010-2019) and 48,780 observations from urban or mixed counties (2,439 counties \times 20).

State Broadband Policies and Politics: Stats

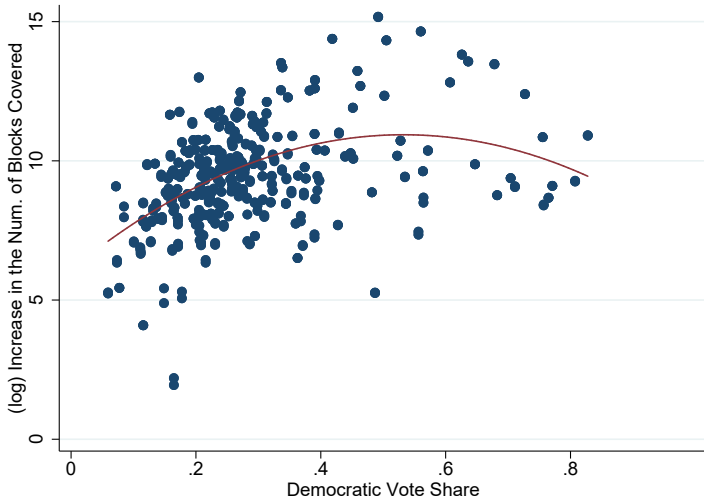
Variable	Mean	SD	Min	Max
<i>Panel A: Broadband investment policies</i>				
Rights of way accommodations	0.851	1.381	0	8
Tax incentives	0.204	0.481	0	2
Grant/loan programs	0.491	0.671	0	3
Office for broadband investment	0.210	0.408	0	1
Any pro-investment policy	1.545	1.810	0	11
<i>Panel B: Term limits, elections and politics</i>				
Democrat governor	0.415	0.493	0	1
Lame-duck governor	0.303	0.460	0	1
Governor's vote margin (% , most recent)	16.404	13.728	0.218	57.973
Governor's vote margin $\geq 10\%$	0.578	0.494	0	1
Divided branch	0.224	0.417	0	1
Split state legislature	0.093	0.290	0	1
Competitive state House or Senate	0.475	0.500	0	1

Notes: 550 observations (50 state \times 11 years, 2009–2019).

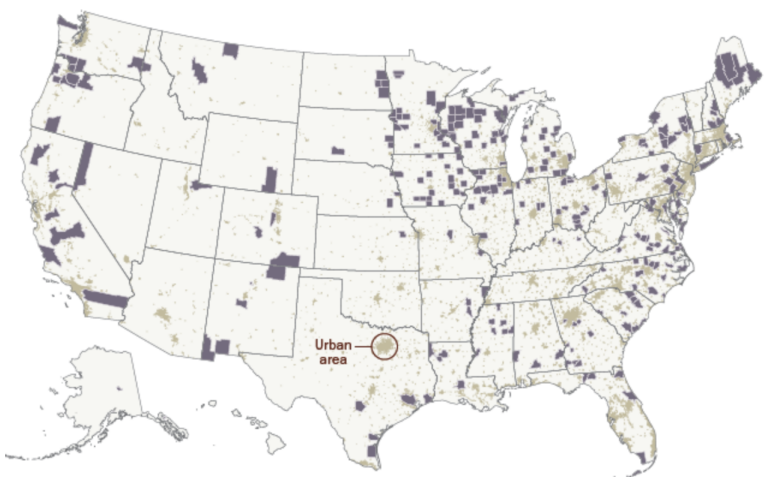
Empirical Evidence: Politically-motivated Investment

More Investment for Swing Counties

Texas, 2015



Swing Counties (2012 Presidential Election)

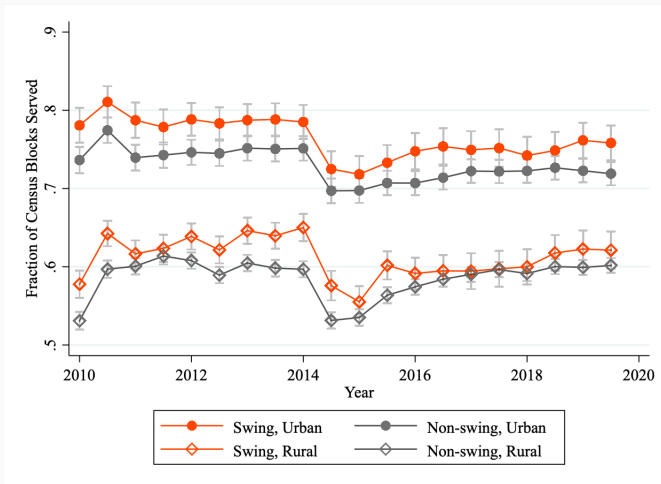


Note: For Alaska, state legislative districts are shown instead of counties.
Source: U.S. Census Bureau and Pew Research Center analysis of CQ Press data.

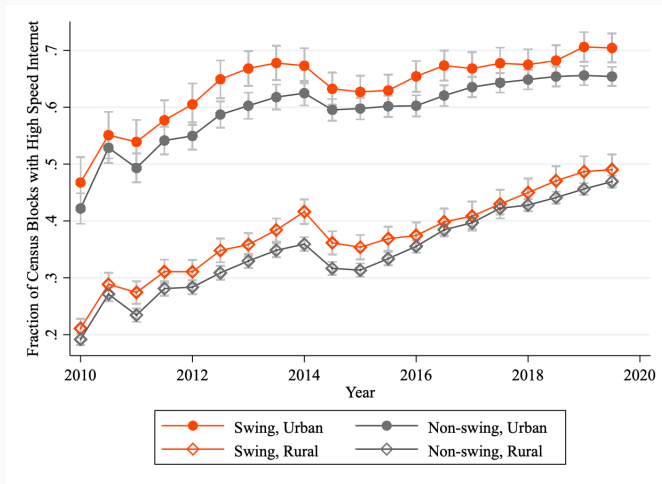
Swing Counties (2012 Presidential Election)

- Swing counties aren't predominantly in the swing states; they are scattered across the country
- Swing counties range widely in population
 - Harris county, TX (where Houston is): 4.5+ million
 - Kennedy county, TX: 407 residents

More Investment for Swing Counties: Revisited



More Investment for Swing Counties: Speed



Do Firms Strategically Invest for Political Reasons?

- Specifically: “All else equal, do firms invest more on locations that are electorally competitive?”
- For each county c and semi-annual period t :

$$Y_{ct} = \beta_1 DemShare_{ct} + \beta_2 (DemShare_{ct})^2 + X_{ct}\beta_x + \rho_{st} + \varepsilon_{ct}$$

- Y_{ct} : County-level broadband investment, measured by the (log) number of Census blocks
- $DemShare_{ct}$: Average vote share for a Democratic candidate in the state-wide elections in the past 8 years
- X_{ct} : Population size and density, their respective squared terms, age, gender and race compositions, income, work, education, ...

Politically Motivated Investment

$$Y_{ct} = \beta_1 Dem_{ct} + \beta_2 (Dem_{ct})^2 + X_{ct}\beta_x + \rho_{st} + \varepsilon_{ct}$$

	Investment in (log) number of blocks		
	(1)	(2)	(3)
Democratic vote share	9.895*** (1.011)	8.017*** (1.143)	5.145*** (1.215)
(Democratic vote share) ²	-9.478*** (1.118)	-8.651*** (1.190)	-5.321*** (1.304)
Time-varying county attributes	N	N	Y
State-period FE	N	Y	Y
Maximized at Democratic vote share	0.522 (0.015)	0.463 (0.015)	0.483 (0.038)
Fraction of counties with any investment	0.692	0.692	0.692
Median number of blocks invested (if invested)	46	46	46
Number of observations	49,784	49,784	49,661
Adjusted R ²	0.004	0.280	0.286

Notes: 3,140 counties \times 16 semi-annual periods (2010–2019). SEs are adjusted for clustering at the county level; *** $p < 0.01$.

Which Firms Strategically Invest for Political Reasons?

- Large firms: Broadband providers (ISPs) with services for at least 5% of the Census Blocks within a state, averaged across the time span of the study
 - e.g., Comcast, AT&T, Verizon, etc.
 - Typically 5 large firms, with minimum 2 (AK, HI, MD, NM, RI) and maximum 11 (IN)
- Large firms receive more public scrutiny and media attention
 - More influence on other firms' decisions and policymaking
 - Tend to be more politically active

Politically Motivated Investment by Large Firms

$$Y_{fct} = \beta_1 Dem_{ct} + \beta_2 (Dem_{ct})^2 + X_{ct}\beta_x + \mu_{fst} + \xi_c + \varepsilon_{fct}$$

	Investment in (log) number of blocks	
	(1) Large	(2) Small
Democratic vote share	3.431*** (1.130)	0.498 (1.563)
(Democratic vote share) ²	-3.781*** (1.269)	-1.178 (1.754)
Time-varying county attributes	Y	Y
Firm-state-period FE & County FE	Y	Y
Maximized at Dem. vote share	0.454 (0.077)	0.211 (0.434)
Number of firms	97	1,932
Number of observations	248,227	196,943
Adjusted R ²	0.350	0.366

Notes: SEs are adjusted for clustering within counties; *** $p < 0.01$.

Politically Motivated Investment: Robustness

Results are robust to

- Different measures of investment (speed instead of coverage; number of blocks vs. population)
- Capacity (instead of investment)
- Democratic vote share quantiles (as opposed to using the linear + quadratic terms)
- Variance of the Democratic vote share (as opposed to the average) to measure electoral competitiveness

Supporting Evidence for *Policy Deterrence*

Policy Responds to Broadband Status

$$Y_{s,y} = \beta_1 \text{SwingCap}_{s,y-1} + \beta_2 \text{PartisanCap}_{s,y-1} \\ + \beta_3 \text{SwingCap}_{s,y-1} \times \text{GovVote}_{sy} + X_{sy} \beta_x + \eta_s + \mu_y + \varepsilon_{sy}$$

- $Y_{s,y}$: State-level pro-investment broadband policies in year y
- Broadband capacity: SwingCap_{sy} and PartisanCap_{sy}
 - County-level capacity: Average fraction of population covered with broadband
 - Sum of capacities, multiplied by county-to-state population ratio, across swing counties and others, respectively
 - Lagged by one year (to rule out reverse causality + to reflect information flow in policymaking)
- Effects of broadband capacity may vary with governor's electoral incentives (recent vote margins, GovVote_{sy})

Policy Responds to Broadband in Swing Counties

	Any policy on		
	Tax/Grants (1)	ROW (2)	All (3)
Pop.-weighted capacity in swing counties (lag)	-0.122 (0.270)	-0.409*** (0.139)	-0.444*** (0.135)
Pop.-weighted capacity in swing counties (lag) × Governor's vote margin (in %)	0.015 (0.010)	0.020*** (0.006)	0.023*** (0.005)
Pop.-weighted in partisan counties (lag)	0.366 (0.229)	-0.192 (0.142)	-0.0680 (0.148)
Time-varying state attributes	Y	Y	Y
State FE, Year FE	Y	Y	Y
Mean of the dependent variable	0.180	0.462	0.687
Number of observations	450	450	450
Adjusted R ²	0.749	0.819	0.787

Notes: Standard errors are adjusted for clustering within states.

Policy Responds to Broadband in Swing Counties: Why?

- Swing voters are more responsive to politicians' performance
- Winning more (swing) votes is valuable:
 - More legislative seats for legislative agenda
 - Preferences of the median voter are uncertain
- Two potential channels: Investment in swing locations can
 1. Help politicians win elections → *Policy* rewards (**quid-pro-quo**)
 2. Affect voter demand → Less policy (**electoral accountability**)

Heterogeneity in Political Environment

Hump-shape more prominent for states without supermajority

	Investment in (log) number of Blocks	
	Not Supermajority	Supermajority
	(1)	(2)
Democratic vote share	5.177*** (1.482)	1.369 (1.762)
(Democratic vote share) ²	-6.488*** (1.691)	0.972 (1.771)
Time-varying county attributes	Y	Y
Firm-state-period FE, county FE	Y	Y
Number of observations	190,895	57,332
Adjusted R ²	0.340	0.387

Notes: Standard errors are adjusted for clustering within counties.

Heterogeneity in Market Structure

Hump-shape more prominent for markets with a few large firms
(less free riding)

	Investment in (log) number of Blocks	
	Fewer Firms (≤ 2.5)	More Firms (> 2.5)
	(1)	(2)
Democratic vote share	4.039*** (1.421)	4.693** (2.221)
(Democratic vote share) ²	-3.877** (1.724)	-2.467 (2.141)
Time-varying county attributes	Y	Y
Firm-state-period FE, county FE	Y	Y
Number of observations	107,983	109,269
Adjusted R ²	0.294	0.375

Notes: Standard errors are adjusted for clustering within counties.

Alternative Explanations: Omitted Variables

- Unobserved county attributes correlated with both electoral competitiveness and investment
 - State-level broadband policies tend not to be location-specific (perhaps rural areas—often not electorally competitive)
 - Local policies: Officials may be eager to help local investment (Slattery, 2020; Jensen et al, 2020), and perhaps more so in swing counties?
- Firms may be simply responding to these (unobserved) policies
- If so, why do we not observe more investment for swing counties by small firms?

Conclusion

Summary: Policy Deterrence

- Firms invest so as to deter pro-investment policies
 - More broadband investments in electorally competitive counties
 - Salient for large firms
 - Policymaking responds to market capacity in swing locations
- New, plausible mechanism: Firms gain competitive advantage by influencing government policies through their investment in local markets

Why Do We Care?

- Better Internet means less pro-investment broadband policy
 - Likely to be efficient
- A problem is the infrastructure of *certain locations* matters more than others to a policymaker
 - Inefficient investment allocation
 - Partially explaining the widening digital divide?
 - Weaker policy response to address positive externalities?
- Another issue is intensified market concentration (and higher price for consumers), strengthened by firms' enhanced ability to influence competitive policy

What's Next?

- Dynamic feedback loop between market power and political power: “Power begets power”
- Role of policy uncertainty in investment
- Room for structural analyses
 - Identify politicians' preferences over policy
 - Quantify welfare implications
 - Study effects of political reforms (e.g., term limits) or changes in the composition of swing voters
- What happens with new technology (e.g., Starlink)?