

Policy Deterrence: Strategic Investment in U.S. Broadband

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Market Concentration and Policymaking

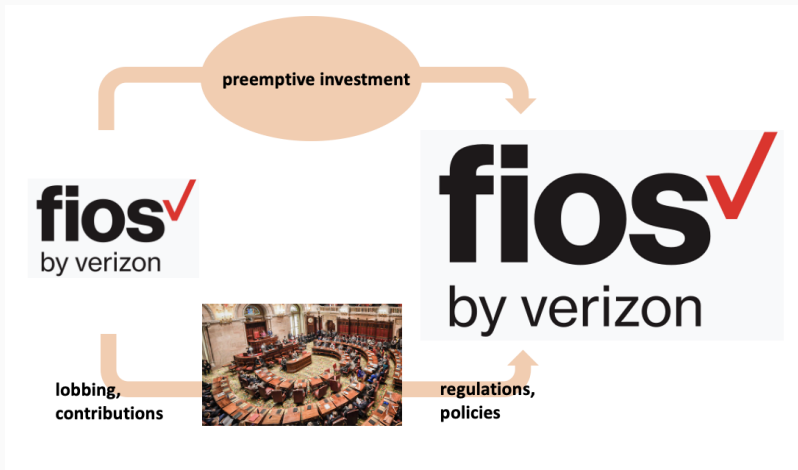
- Government policies affect market outcomes (prices, quantities, concentration, etc.)
- Policymaking also responds to market outcomes
 - Rise of monopolies and trusts → Antitrust laws
 - Pricing strategies of banks, airlines, etc. → Biden administration's taking on "junk fees"
 - High rents/housing prices → Subsidies for new development, changes in zoning, etc.
 - Possibly depending on policymakers' electoral incentives
- In a market with large incumbents, market outcomes hinges a lot on what they do

How Do Large Incumbents Reduce Competition?



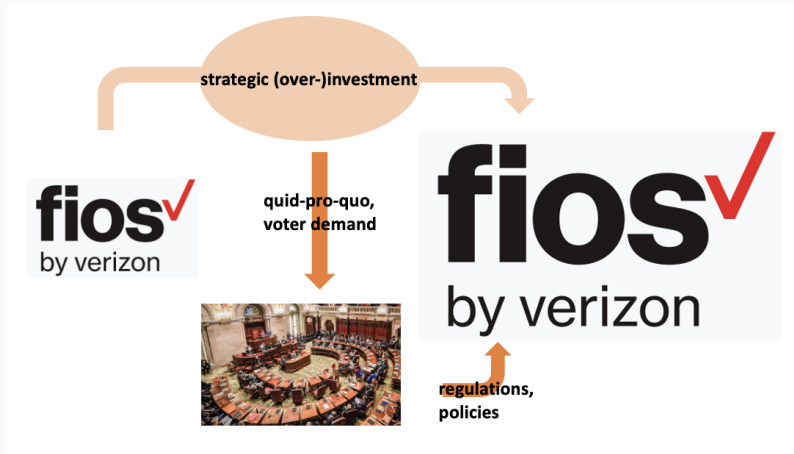
How Do Large Incumbents Reduce Competition?

Existing literature: Imperfect competition or political influence



How Do Large Incumbents Reduce Competition?

Our paper: Strategic interactions with the government & competitors



1. Do large incumbents *strategically* affect market outcomes in order to affect pro- or anti-competitive government policies?
 - o (Suggestive) empirical evidence that large incumbents in broadband industry invest to deter pro-competitive policies

1. Do large incumbents *strategically* affect market outcomes in order to affect pro- or anti-competitive government policies?
 - o (Suggestive) empirical evidence that large incumbents in broadband industry invest to deter pro-competitive policies
 - o More broadband investment in electorally competitive counties, controlling for various observed and unobserved attributes, especially by large firms
 - o Fewer pro-competitive broadband policies enacted in response to large firms' increased broadband capacity in electorally competitive areas
 - o This is a novel way of firms' influence on policymaking (as opposed to *quid-pro-quo* lobbying and donation)

This Paper

1. Do large incumbents *strategically* affect market outcomes in order to affect pro- or anti-competitive government policies?
2. If so, what are the welfare implications of “responsive” policymaking when the market is concentrated?
 - o Stackelberg model of two firms (leader & follower) choosing capacity and politician choosing a procompetitive policy
 - o Two cases: Policymakers commit to a policy regardless of firm behavior vs. make it contingent on the leader’s capacity
 - o Without policy commitment \Rightarrow Less procompetitive policies and intensified concentration

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 + do not rely on quid-pro-quo

Institutional Background and Data

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
 - o Panel variation in both policy and investment
4. Heterogeneous providers by existing investment and network
 - o Small firms tend to benefit from these policies

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

- 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

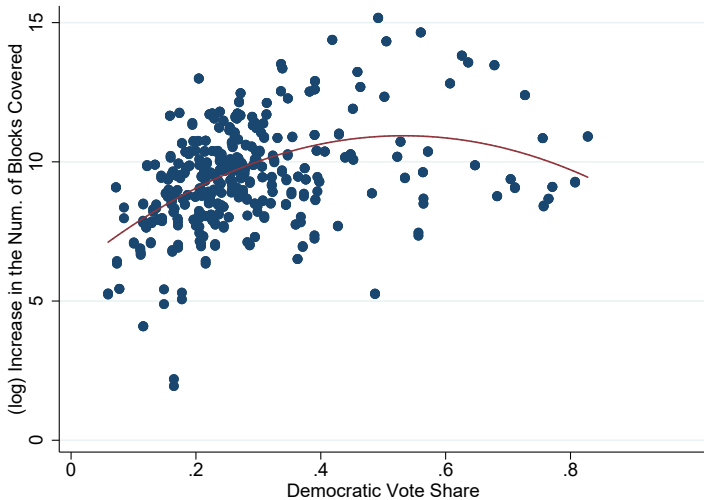
| Variable | Mean | SD | Min | Max |
|---|--------|--------|-------|--------|
| <i>Panel A: Broadband investment policies</i> | | | | |
| Rights of way accommodations | 0.851 | 1.381 | 0 | 8 |
| Tax incentives | 0.204 | 0.481 | 0 | 2 |
| Grant/loan programs | 0.491 | 0.671 | 0 | 3 |
| Office for broadband 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).

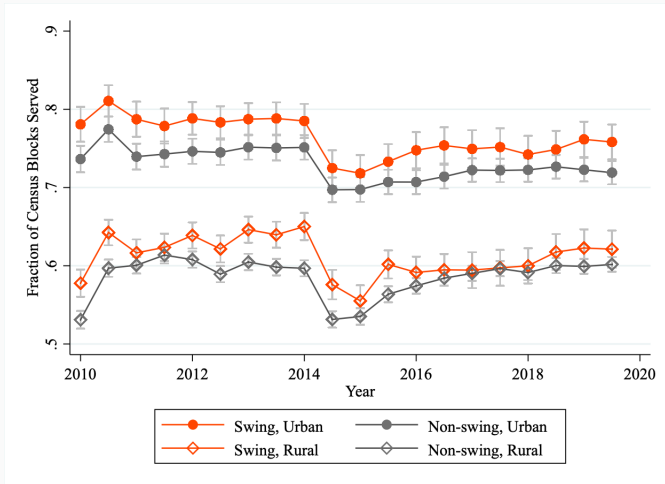
Empirical Pattern: Politics Matters for Investment

More Investment for Swing Counties

Texas, 2015



More Investment for Swing Counties: Revisited



Does Politics Matter for Investment?

- 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 × 16 semi-annual periods (2010–2019). SEs are adjusted for clustering at the county level; *** $p < 0.01$.

Which Firms Invest More in Swing Counties?

- 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)

Politically-driven 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-driven Investment: Robustness

Results are robust to

- Different measures of investment (speed instead of coverage; number of blocks vs. population)
- Capacity (instead of investment)
- Cross-sectional analysis
- Alternative functional forms: Democratic vote share spline function (as opposed to using the linear + quadratic terms)

Supporting Evidence for *Policy Deterrence*

Why More Investment in Swing Counties?

- o Local officials may help local investment (Slattery, 2020; Jensen et al, 2020), and perhaps more so in swing counties?
- o Swing counties may be more conducive to investment, even after controlling for observed local factors

Why More Investment in Swing Counties?

- o Local officials may help local investment (Slattery, 2020; Jensen et al, 2020), and perhaps more so in swing counties?
- o Swing counties may be more conducive to investment, even after controlling for observed local factors

If swing counties are in fact more conducive to investment, why are only large firms responsive, while small ones aren't?

In addition, large firm behavior depends on the market structure: Hump-shape more prominent for states with a few large firms

Large Firms May Benefit from Less Pro-broadband Policies

Small firms are

- Disadvantaged in navigating regulatory hurdles
 - Hurdles: 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” (unused but available capacity)
- 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**

Policy is Negatively Correlated with Broadband Status

$$Y_{s,y+2} = \beta_1 \text{SwingCap}_{s,y} + \beta_2 \text{PartisanCap}_{s,y} \\ + \beta_3 \text{SwingCap}_{s,y-1} \times \text{GovVote}_{sy} + X_{sy} \beta_x + \eta_s + \mu_y + \varepsilon_{sy}$$

- Y_{sy} : 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 two years
- Effects of broadband capacity may vary with governor's electoral incentives (recent vote margins, GovVote_{sy})

Policy “Responds to” Broadband in Swing Counties

| | Tax/Grants | | ROW | | All | |
|---|-------------------|------------------|---------------------|----------------------|-------------------|--------------------|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Capacity in swing counties (lag) ^a | -0.280 (0.712) | 0.015 (0.733) | -2.030** (0.973) | -3.160*** (1.112) | -1.692 (1.508) | -3.100* (1.576) |
| Capacity in swing counties (lag) × Governor’s vote margin (in %) | | 0.018 (0.021) | | 0.077** (0.035) | | 0.097** (0.045) |
| Capacity in partisan counties (lag) ^b | 0.567 (0.726) | 0.579 (0.722) | -1.660** (0.646) | -1.610** (0.611) | -1.005 (1.198) | -0.942 (1.151) |
| Governor vote margin (in %) ^c | 0.006 (0.005) | 0.011 (0.007) | 0.014 (0.008) | 0.002 (0.010) | -0.006 (0.012) | -0.007 (0.015) |
| Time-varying state attributes ^d | Y | Y | Y | Y | Y | Y |
| State FE, Year FE | Y | Y | Y | Y | Y | Y |
| Number of observations | 400 | 400 | 400 | 400 | 400 | 400 |
| Adjusted R ² | 0.791 | 0.791 | 0.836 | 0.842 | 0.823 | 0.827 |

Notes: Standard errors are adjusted for clustering within states.

Why Would Policymakers Be Responsive to Swing Counties?

- Electoral incentives may matter for broadband policy
 - Broadband status (or the lack thereof) is a recurring theme in campaign platforms
 - Governors emphasize their policies that promote broadband (e.g., in 2021, 40 states discussed their broadband policy in the governors' state of the state speeches)
- 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.

Taking stock

Two key patterns:

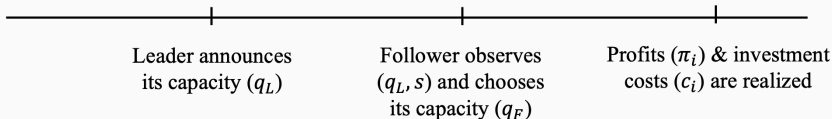
1. Controlling for various observed local factors affecting profitability of broadband investment (including county FE's), large firms invest more in swing counties
2. Large ISPs' capacity in swing counties is negatively correlated with pro-competitive state policies

These patterns may suggest that large firms **preemptively** invest in swing counties in order to deter pro-competitive state policies

Implications

Government Policymaking and Firm Investment

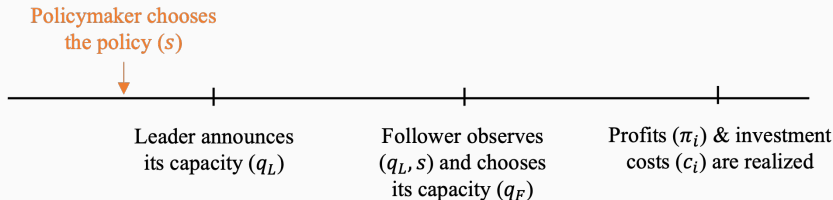
- Players: Two firms (Leader L and Follower F) and a politician
- Firms choose capacity (q_i for $i \in \{L, F\}$) at a cost



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 to adopt a pro-competitive or not $s \in \{0, 1\}$

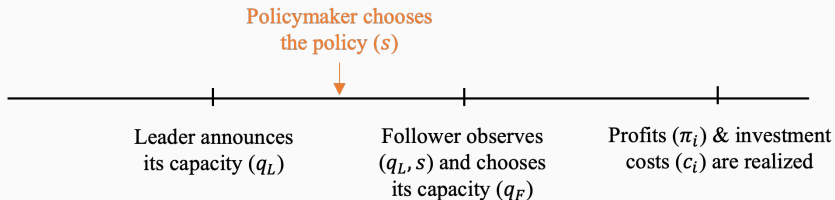
1. Case 1: Policy commitment



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 to adopt a pro-competitive or not $s \in \{0, 1\}$

2. Case 2: No policy commitment



Firms' Profits

- Government policy reduces marginal investment cost for the follower but not the leader

$$c_L(q_L) = 0, \text{ and } c_F(q_F, s) = \begin{cases} 0 & \text{if } s = 1 \\ c_F q & \text{if } s = 0 \end{cases}$$

- Market price is determined by the aggregate demand and market capacity $q \equiv q_L + q_F$:

$$p = A - bq,$$

- Firms' payoffs:

$$\pi_L(q_L, q_F, s) = [A - b(q_L + q_F)] q_L$$

$$\pi_F(q_L, q_F, s) = [A - b(q_L + q_F) - c_F(1 - s)] q_F$$

Politician's Payoff

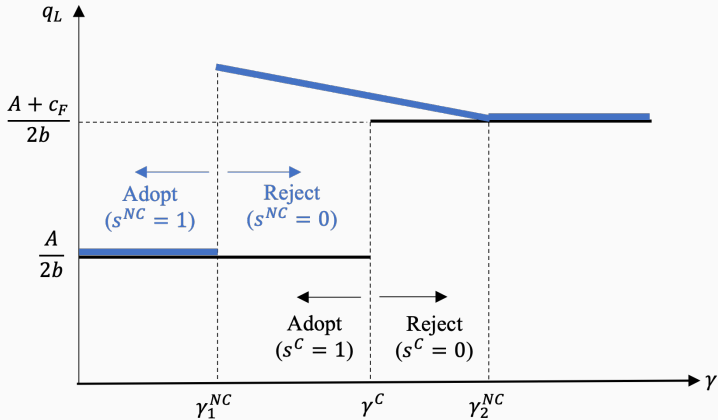
$$u(q, s) = \alpha q - \beta q^2 - \gamma s$$

- Reflecting voters' preferences, electoral incentives, and politician's own policy preference
- Increasing and **concave** in total capacity
- The fiscal or political costs of the policy is captured by $\gamma > 0$

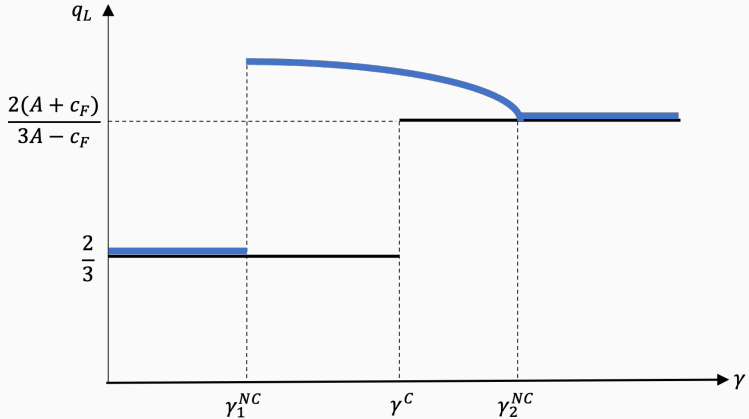
With vs. Without Policy Commitment

- Politician's trade-off:
 - Benefits from an increase in the equilibrium total capacity
 - Political/fiscal costs of carrying out the policy (γ)
- Without commitment:
 - Policymaking is contingent on the leader's capacity choice q_L :
 $s = 1$ iff $u[q_L + q_F(q_L, 1), 1] - u[q_L + q_F(q_L, 0), 0] < 0$
 - This is equivalent to $s = 1$ if $q_L < q^{cut}$ for some $q^{cut} \geq 0$
 - Given this, leader may choose q^{cut} to deter the policy adoption, although q^{cut} is higher than what he may have chosen absent the policy incentive

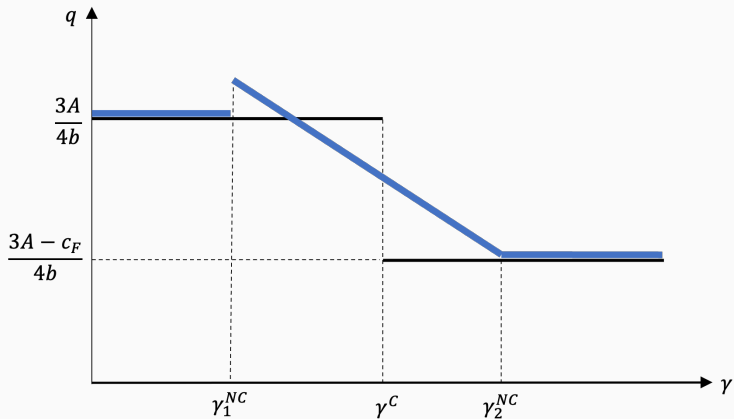
Lack of Commitment \rightarrow Less Policy, More Leader's Capacity



Lack of Commitment \rightarrow Higher Market Concentration



Lack of Commitment and Total Capacity



Why Do We Care?

- Weaker policy response to address positive externalities
 - Broadband access affects health, education, etc.
- Intensified market concentration, further strengthened by large firms' ability to influence policies
 - May lead to a lower total capacity and welfare
 - Implications for antitrust?
- Inefficient investment allocation across locations, when extending this framework to investment to multiple locations with heterogeneity in policy influence
 - Partially explaining the widening digital divide?

Broadband Price and Speed: Early 2015

Average prices conditional on the number of ISP

| No. of firms | No. of Markets | Price | | Mbps | | Unit Price | |
|--------------|----------------|-------|-------|-------|------|------------|------|
| | | mean | s.d. | mean | s.d. | mean | s.d. |
| $n = 0$ | 843 | - | - | - | - | - | - |
| $n = 2$ | 1,503 | 71.24 | 0 | 8.75 | 0 | 8.58 | 0 |
| $n = 3$ | 6,112 | 61.50 | 5.02 | 10.28 | 4.57 | 8.39 | .96 |
| $n = 4$ | 13,625 | 59.81 | 4.94 | 15.21 | 5.62 | 7.58 | .82 |
| $n = 5$ | 7,791 | 57.13 | 5.03 | 15.02 | 5.01 | 7.52 | .78 |
| $n = 6$ | 2,514 | 55.38 | 5.03 | 15.39 | 4.77 | 7.40 | .78 |
| $n = 7$ | 683 | 54.86 | 4.34 | 16.66 | 4.14 | 7.26 | .71 |
| $n = 8$ | 116 | 53.91 | 3.70 | 16.78 | 3.55 | 7.22 | .522 |
| $n = 9$ | 6 | 54.62 | .92 | 19.17 | 1.13 | 7.02 | .35 |
| Total | 33,193 | 58.12 | 10.94 | 13.62 | 5.87 | 7.55 | 1.50 |

Mbps: download speed

Unit Price = Price/Mbps