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 $\rightarrow$ Antitrust laws
  - Pricing strategies of banks, airlines, etc. $\rightarrow$ Biden administration's taking on "junk fees"
  - High rents/housing prices $\rightarrow$ 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

This Paper

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

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1. Do large incumbents *strategically* affect market outcomes in order to affect pro- or anti-competitive government policies?
    - (Suggestive) empirical evidence that large incumbents in broadband industry invest to deter pro-competitive government policies
    - Our starting point: More broadband investment in electorally competitive counties, controlling for various observed and unobserved attributes, especially by large firms
    - 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?
    - Stackelberg model of two firms (leader & follower) choosing capacity and politician choosing a procompetitive policy
        - Two cases: Policymakers commit to a policy regardless of firm behavior vs. make it contingent on the leader's capacity
        - Without policy commitment $\Rightarrow$ Less procompeitive policies, smaller market capacity, and intensified concentration
    - Work-in-progress: Empirical measurement and implications to antitrust policy (or policy-making process)?

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
    - Average cost of laying fiber optic cable: $27K per mile (DoT)
3. Recent strides in state policy initiatives ("digital divide")
    - 31 states enacted new pro-broadband legislation in 2020
    - Panel variation in both policy and investment
4. Heterogeneous providers by existing investment and network
    - 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

Data

- 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
Coverage				
% 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
Speed				
% Census blocks with $\geq$ 25 Mbps	27.3	27.7	45.6	27.1
% Census blocks with fiber	15.5	25.8	10.2	18.3
% Population with $\geq$ 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

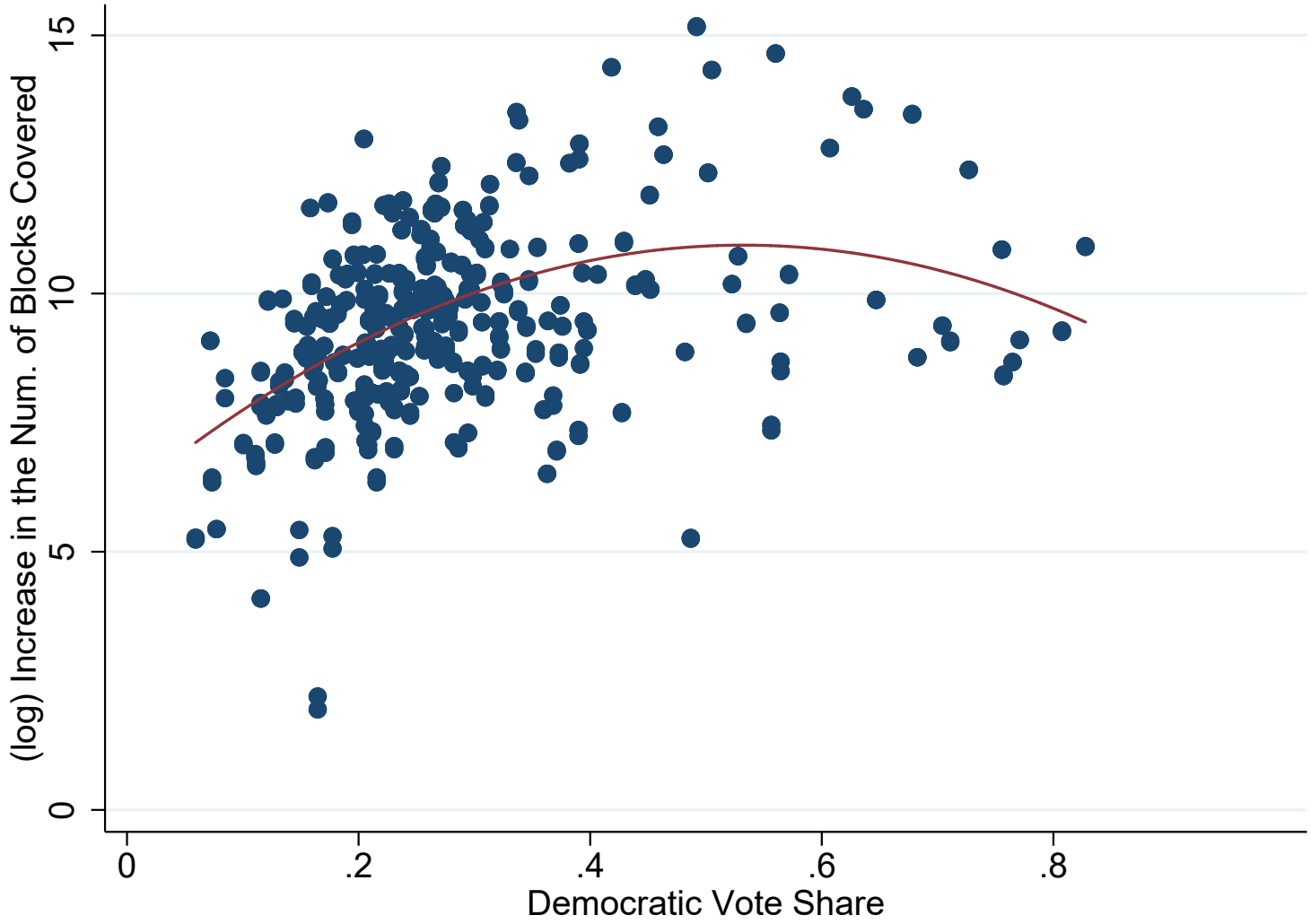
Variable	Mean	SD	Min	Max
Panel A: Broadband investment policies				
Rights of way accommodations	0.851	1.381	0	8
Tax incentives	0.204	0.481	0	2
Grant/loan programs	0.491	0.671	0	3
Office for broadband investment	0.210	0.408	0	1
Any pro-investment policy	1.545	1.810	0	11
Panel B: Term limits, elections and politics				
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).

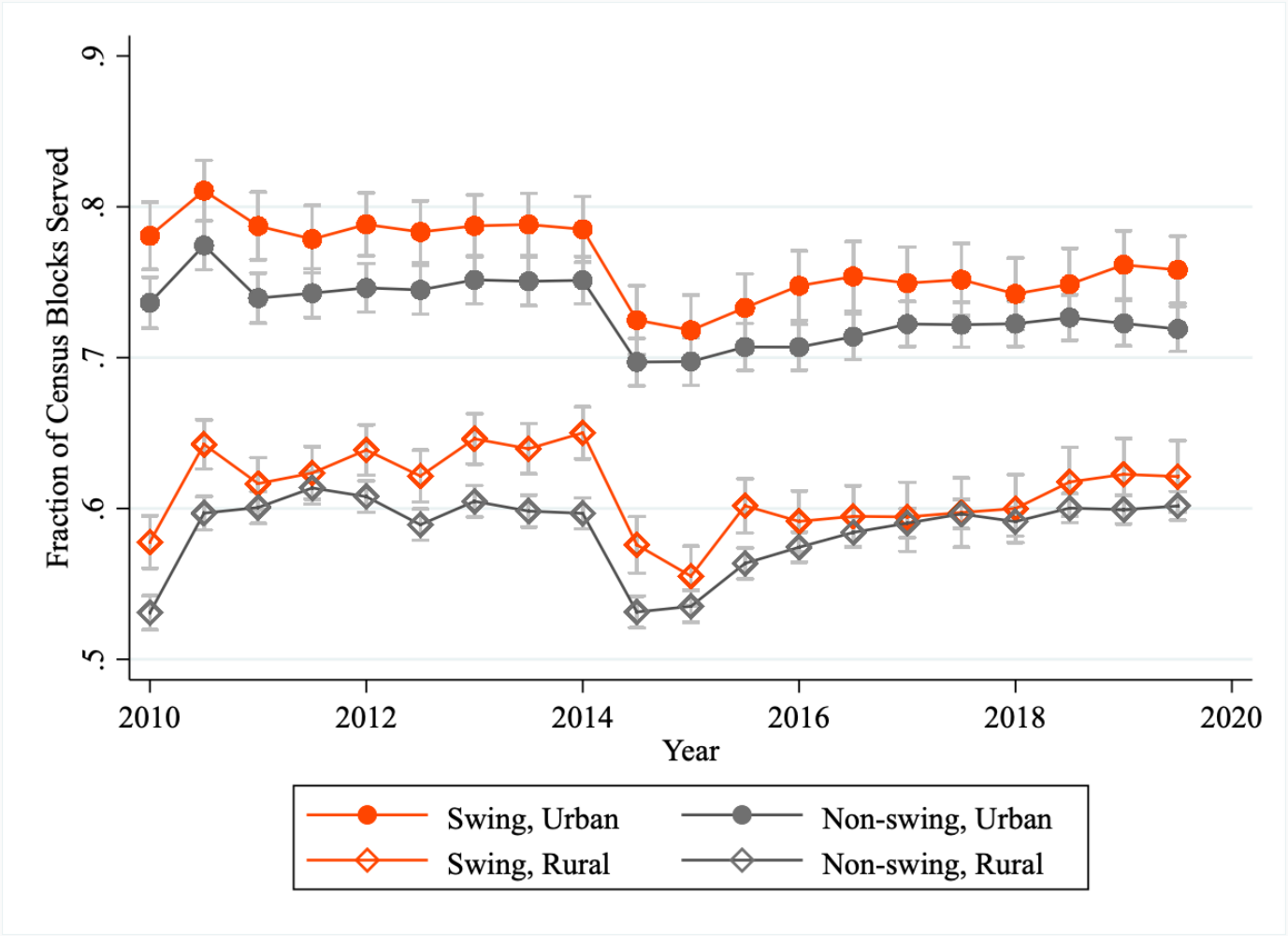
Empirical Pattern: Politics Matters for Investment

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:

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

  - 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-driven 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***	8.017***	5.145***
	(1.011)	(1.143)	(1.215)
(Democratic vote share)^2	-9.478***	-8.651***	-5.321***
	(1.118)	(1.190)	(1.304)
Time-varying county attributes	N	N	Y
State-period FE	N	Y	Y
Maximized at Democratic vote share	0.522	0.463	0.483
	(0.015)	(0.015)	(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 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***	0.498
	(1.130)	(1.563)
(Democratic vote share)^2	-3.781***	-1.178
	(1.269)	(1.754)
Time-varying county attributes	Y	Y
Firm-state-period FE & County FE	Y	Y
Maximized at Dem. vote share	0.454	0.211
	(0.077)	(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?

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

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- 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

Policy is Correlated with Broadband Status

$$
\begin{aligned}
Y_{s,y} \quad = \quad & \beta_1 SwingCap_{s,y-1} + \beta_2 PartisanCap_{s,y-1} \\
& + \beta_3 SwingCap_{s,y-1} \times GovVote_{sy} + X_{sy}\beta_x + \eta_s + \mu_y + \varepsilon_{sy}
\end{aligned}
$$

- 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 one year
- 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	ROW	All
	(1)	(2)	(3)
Pop.-weighted capacity in swing counties (lag)	-0.122	-0.409***	-0.444***
	(0.270)	(0.139)	(0.135)
Pop.-weighted capacity in swing counties (lag)	0.015	0.020***	0.023***
× Governor's vote margin (in %)	(0.010)	(0.006)	(0.005)
Pop.-weighted in partisan counties (lag)	0.366	-0.192	-0.0680
	(0.229)	(0.142)	(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.

Large Firms May Benefit from Less Pro-broadband Policies

Small firms are

- 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

$\Rightarrow$ Broadband policies tend to be procompetitive

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 $\rightarrow$ *Policy* rewards (quid-pro-quo)
  2. Affect voter demand $\rightarrow$ 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***	1.369
	(1.482)	(1.762)
(Democratic vote share)^2	-6.488***	0.972
	(1.691)	(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:

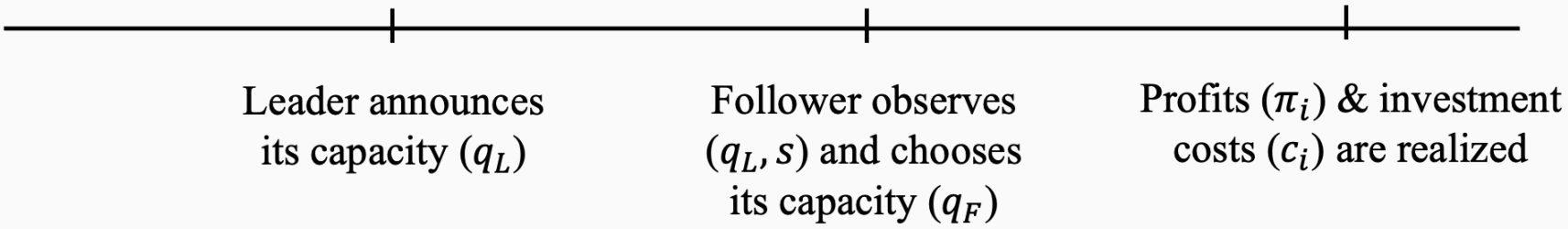
1. Controlling for various observed local factors affecting profitability of broadband investment (including county FE's), large firms invest more in swing counties
2. Investment in swing counties is correlated with less pro-competitive state policies

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

Welfare 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
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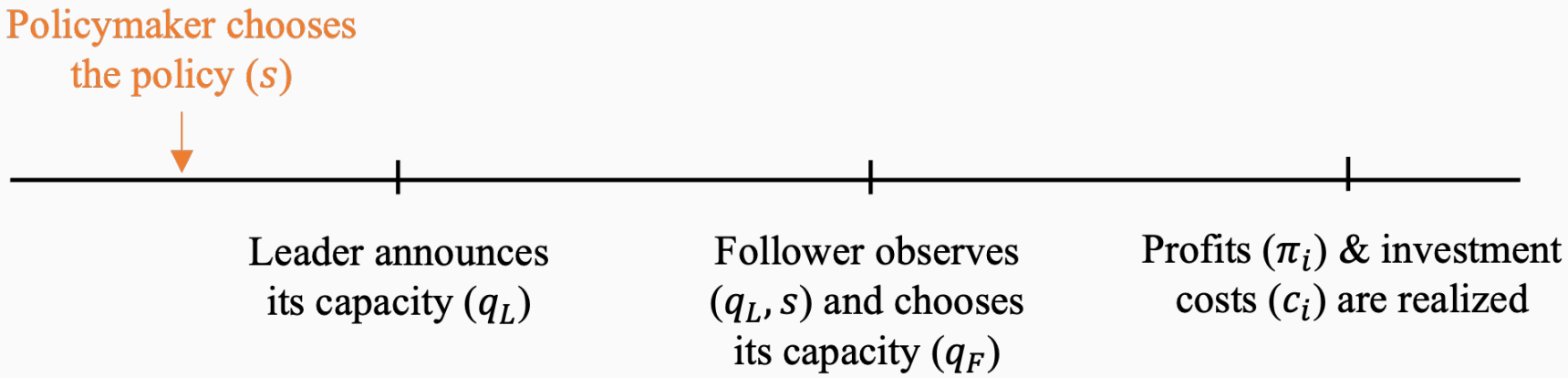
- Politician chooses to adopt a pro-competitive or not $s \in \{0, 1\}$
    1. Case 1: Policy commitment



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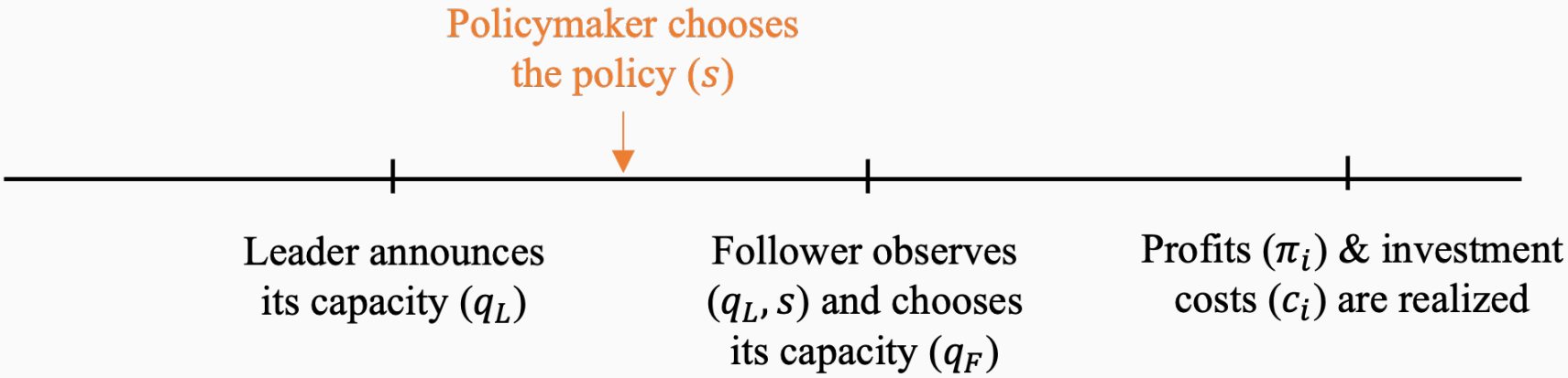
2. Case 2: No policy commitment



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 but not the leader
- Politician: $u(q, s)$
  - Reflecting voters' preferences, electoral incentives, and politician's own policy preference
  - Increasing and concave in total capacity, $q = q_F + q_L$
  - Appeal for policy diminishes as q increases: $\frac{\partial[u(q,1)-u(q,0)]}{\partial q} < 0$

Case 1: Policy Commitment

- Benefits of adopting the policy:
  - Reduces the equilibrium leader's capacity
  - Increases the equilibrium total capacity
  - Increases the market share of the leader
- Policymaker's problem: Trade-off between the above benefits vs. political or fiscal costs of carrying out the policy

Case 2: No Policy Commitment

- Policymaking is contingent on the leader's capacity choice q_L
- Policymaker chooses to adopt the policy $s = 1$ if and only if

$$\Delta(q_L) \equiv u[q_L + q_F(q_L, 1), 1] - u[q_L + q_F(q_L, 0), 0] < 0$$

- This is equivalent to $q_L < q^{cut}$ for some $q^{cut} \geq 0$

$$\frac{\partial \Delta(q_L)}{\partial q_L} \propto \underbrace{\left(1 + \frac{dq_F}{dq_L}\right)}_{(+)} \underbrace{\left(\frac{\partial^2 u}{\partial q^2}\frac{dq_F}{ds} + \frac{\partial^2 u}{\partial q \partial s}\right)}_{(-)} < 0$$

Case 2: No Policy Commitment

- Given the policy rule ($s = 0$ iff $q_L \geq q^{cut}$), leader may choose q^{cut} to deter the policy adoption although q^{cut} may be higher than what he may have chosen absent the policy incentive

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

- Suppose the policymaker prefers adopting the policy when she can commit; No commitment ability can result in
  - No adoption of the policy
  - Lower total capacity
  - Higher market share for the leader

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
  - 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

		Price		Mbps		Unit Price	
No. of firms	No. of Markets	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