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POLICY DETERRENCE: STRATEGIC INVESTMENT IN U.S. BROADBAND

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ABSTRACT

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Abstract. Can firms influence policy through investment? Using 2010–2019 U.S. broadband deployment and state policy data, we find that large internet service providers expand capacity more in electorally competitive counties. Greater large-provider capacity in swing counties is associated with fewer subsequent entry- and investment-facilitating policies, especially rights-of-way accommodations that reduce deployment barriers faced by smaller providers. To interpret these patterns, we develop a model in which a large firm's capacity can reduce the policymaker's gain from intervention. In the model, policy deterrence raises the large firm's market share and can reduce total deployment.

1. Introduction

Government policies can reshape market structure and industry performance, giving firms strong incentives to influence how those policies are designed and adopted. The existing literature has focused primarily on explicit political activities, such as lobbying and campaign contributions. One aspect that has received little attention is the possibility that firms can influence policies through their business investment. When policymakers intervene because market outcomes appear inadequate, firms can alter the perceived need for intervention by changing those outcomes themselves. In particular, a firm may invest in politically salient markets to discourage policies that would otherwise facilitate entry or expansion by its rivals. Such influence on policy may discourage potential entrants and rival firms from investing, which, in turn, safeguards the dominant positions of the investing firms.

This paper provides new empirical evidence that firms may invest strategically to deter government policies in U.S. residential broadband markets. We study local wireline deployment by internet service providers (ISPs) and state policies intended to promote broadband entry and expansion. Broadband investment is costly and largely irreversible, and occurs in an industry characterized by substantial economies of scale and persistent local market power. State governments adopt financial and regulatory policies that affect providers' entry

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and deployment costs.[1] Many of these policies, especially accommodations involving poles, conduits, permitting, and public rights-of-way, are particularly valuable to smaller providers that lack large firms' existing infrastructure, regulatory experience, and relationships with local governments. These policies can therefore intensify the competitive threat posed by smaller ISPs. These features allow us to exploit panel variation to study the strategic interaction between heterogeneous firms and policymakers within a single industry, complementing studies that exploit variation across industries.

We assemble a panel of firm investment, state broadband policies, and local political conditions from 2010 to 2019. Our data have three main components. First, we observe the broadband services that each ISP reports semiannually at the Census-block level, which allows us to measure provider-specific capacity and investment across local markets. Second, we construct an annual panel of state financial and regulatory broadband policies from the Pew Charitable Trusts' policy database, supplemented by state legislation and other official documents. Third, we measure the local political conditions using county-level outcomes in recent presidential, senatorial, and gubernatorial elections. We supplement these data with detailed county characteristics related to broadband demand and deployment costs and with information on the partisan composition of state governments.

We first document a robust relationship between electoral competitiveness and broadband investment. Controlling for state-by-period shocks and detailed time-varying county characteristics, broadband investment rises with a county's Democratic vote share up to roughly one-half and declines thereafter: investment tends to peak in counties with relatively balanced partisan support. The estimated peak is 0.47 for coverage and 0.42 for high-speed service. A flexible estimate using the binscatter methodology of Cattaneo et al. (2024), with 20 bins and the same covariates and fixed effects over Democratic vote shares between 0.2 and 0.7, supports this inverted-U pattern. The pattern holds for the stock of capacity as well as the flow of new deployment, across alternative measures of investment—population-weighted, restricted to high-speed service, measured over a two-year horizon, or defined on the extensive margin—and under alternative treatments of zero-investment observations, with implied peaks between 0.41 and 0.55 across these county-level specifications.

At the firm level, the inverted-U relationship is statistically significant for large ISPs but not for small ISPs. The large-provider result persists with provider-state-by-period and county fixed effects, so it is identified from changes in a county's own electoral competitiveness rather than only from fixed differences across locations. Differences in geographic reach and the ability to redirect investment could lead large and small providers to respond differently

[1]State governments issue certificates for new ISPs to enter and operate, provide financial incentives through tax and subsidy policies, allocate federal funds, and regulate siting and access to public rights-of-way. They also determine application procedures and mediate conflicts among providers, municipalities, and private landowners. See Section 2.2 for details.

to the same local conditions. Nevertheless, finding a statistically detectable pattern only among large ISPs provides suggestive evidence that their investment may reflect more than responses to local investment conditions common to all providers.

In addition, greater broadband capacity supplied by large ISPs in swing counties is associated with fewer subsequent state broadband policies, especially rights-of-way accommodations that reduce barriers involving poles, conduits, permitting, and access to public rights-of-way. Moving from the 10th to the 90th percentile of large-ISP capacity in swing counties—from 38% to 87% of Census blocks served by at least one large ISP—the linear-model prediction for adoption of a new entry- and investment-facilitating policy two years later falls from 33% to 9%, against a mean of 19%; for rights-of-way accommodations specifically, it falls from 21% to approximately zero across the same range, against a mean of 9%. These predictions illustrate magnitudes rather than precise adoption probabilities; the rights-of-way prediction at the upper endpoint is slightly negative. We find no statistically significant relationship for capacity in non-swing counties, and we find no statistically significant relationship for tax and grant policies. The pattern is consistent with the proposed mechanism: rights-of-way accommodations may be particularly valuable to smaller providers, whereas broad financial incentives may benefit large and small providers alike. However, the swing and non-swing coefficients differ significantly only for aggregate adoption, not for the rights-of-way outcomes. Taken together with the firm-level investment evidence, this evidence supports the interpretation that large firms' investment in politically important locations can discourage entry- and investment-facilitating policy.

We refer to this form of preemptive investment as *policy deterrence*: large firms expand capacity not only to compete directly with smaller firms, but also to reduce the likelihood of policies that facilitate small-firm investment and entry. We explore the implications of this mechanism using a stylized Stackelberg model with a leader, a follower, and a policymaker. The leader represents a large firm with an established market position, while the follower represents a smaller firm whose deployment cost is more sensitive to state policy. An entry- and investment-facilitating policy lowers the follower's marginal investment cost. Under policy commitment, the policymaker decides whether to intervene before firms invest, so the leader cannot affect the policy decision through its capacity choice. Without commitment, the policymaker observes the leader's capacity before deciding whether to adopt the policy.

Without policy commitment, greater leader capacity reduces the policymaker's gain from intervention through two related forces. First, it reduces the follower's residual demand, thereby limiting the additional investment induced by the policy. Second, it raises baseline broadband capacity, lowering the marginal political value of further deployment when the policymaker's payoff is increasing and concave in total capacity, potentially reflecting constituents' preferences. Anticipating this, the leader may strategically overinvest to deter a

policy that would otherwise be adopted. This mechanism does not require an explicit agreement between the firm and the policymaker: policy responds endogenously to the market conditions created by the firm's investment.

Policy deterrence has two implications for market structure and broadband deployment. First, it shifts capacity toward the leader. The leader expands capacity to discourage intervention, while the follower invests less because it faces both lower residual demand and the loss of the cost-reducing policy. The leader's market share therefore rises relative to the policy-commitment benchmark. Second, total broadband capacity may decline despite the leader's additional investment. The reduction in follower investment can exceed the leader's capacity expansion because the follower loses both market demand and policy support. Thus, investment that appears beneficial when considered in isolation may ultimately strengthen the large firm's market position and reduce aggregate deployment.

Our paper connects the political economy of corporate influence with the industrial-organization literature on strategic investment and entry deterrence. The theoretical entry-deterrence literature emphasizes that firms can preempt rivals by strengthening their own competitive positions or imposing costly commitments on potential entrants (Wilson, 1992). Empirical work has identified preemptive behavior through non-monotonic investment responses to market attractiveness (Ellison and Ellison, 2011; Gil, Houde, Sun, and Takahashi, 2026) or through changes in incumbent conduct following an entry threat (Goolsbee and Syverson, 2008; Seamans, 2012; Wilson, Xiao, and Orazem, 2021). We study a distinct channel of strategic investment: rather than deterring entry directly, an incumbent can deter policies that would strengthen its rivals. Investment affects not only rivals' residual demand but also the policymaker's incentive to support their expansion. We provide evidence consistent with this channel using variation in local political conditions within a single industry.

The paper also contributes to a growing empirical literature showing that firms can influence policymaking through their real economic activities, including employment expansion (Carvalho, 2014; Bertrand, Kramarz, Schoar, and Thesmar, 2018), bank lending (Delatte, Matray, and Pinardon-Touati, 2022), and the location of subsidiaries (Bisbee and You, 2024). These activities may influence politicians because voters value employment, credit, and local economic development (Nordhaus, 1975). We highlight a different mechanism through which economic activity shapes policy: by altering market outcomes that matter to policymakers, firms can reduce the incentive for interventions that would benefit their competitors.

In this respect, our paper is also related to Callander et al. (2022), who study the interaction between market competition and political influence when politicians have dynamic incentives to extract rents, and to Cowgill et al. (2024) and Moshary and Slattery (2026),

who examine how market concentration affects firms' political influence. We provide evidence consistent with a distinct mechanism linking the two: firms may allocate investment across locations according to their political importance, while the resulting capacity may affect incentives for subsequent policy intervention. By using investment to deter policies that would strengthen competitors, incumbent firms may reinforce their market power through the political process. This is one way market power can reinforce itself (Zingales, 2017).

2. Internet Service Providers and State Broadband Policies

An Internet Service Provider (ISP) provides internet access to consumers, offering varied speed, reliability, and customer support at different subscription rates. In general, a U.S. household spends $20 to $100 per month on internet services.[2] To deliver internet services, ISPs build a network infrastructure that connects to internet backbone through various technologies such as fiber optic cables, satellite links, or cellular networks. In this paper, we focus on wireline ISPs, a common type of ISP, which offer internet services through cable, Digital Subscriber Lines (DSL), or fiber-optic lines. Because these technologies enable data transmission at a higher speed than the traditional narrowband, dial-up services, this industry is often referred to as the "broadband" industry.

This industry is highly oligopolistic, with a handful of large firms dominating the market and a large set of fringe firms with limited geographic scope of services. In the United States, the dominant players include Comcast Xfinity, AT&T, Charter Spectrum, Verizon Fios, and Cox Communications. They typically span several telecommunications areas; for example, Comcast Xfinity and Charter Spectrum provide cable TV, internet, telephone and wireless services. These mega businesses often originated from a cable TV provider or an incumbent telephone provider, which was traditionally considered a local monopoly with substantial returns to scale.

The industry is regulated by both the federal and state governments. The Federal Communications Commission (FCC) is the main regulator of this industry, while the Department of Justice (DOJ) and the Federal Trade Commission (FTC) share the responsibility for evaluating anti-competitive conduct in this industry. While the federal government deals with big picture issues, such as net neutrality and internet privacy (Greenstein, Peitz, and Valletti, 2016), the state governments implement federal policies, allocate federal funds, and, most importantly, impose their own policies to directly affect ISPs' behavior.[3]

[2]Based on the FCC's Urban Rate Survey, the average monthly price of the most popular residential broadband tier offered by the 14 largest U.S. wireline providers was $48.42 in 2021; for their fastest tier, it was $74.80 (Menko, 2021).

[3]Within-state data transmission is considered a part of intrastate commerce and a state is the relevant regulatory body.

2.1. **Broadband Investment.** Throughout our 2010–2019 sample, we define high-speed service using a constant threshold of at least 25 megabits per second (Mbps) download speed. This empirical definition uses download speed alone. It differs from the FCC's benchmark for advanced telecommunications capability, adopted in 2015, which required both 25 Mbps download and 3 Mbps upload speeds (Federal Communications Commission, 2021).

The internet is structured like highways, with infrastructure organized into three levels: the backbone, middle mile and last mile. The backbone (a.k.a., tier 1 networks) consists of mostly fiber-optic cables that span continents and oceans. During the Clinton administration, the backbone internet, initially a government-funded project, was taken over by commercial firms. The largest backbone providers nowadays include Verizon, AT&T, CenturyLink, etc., which provide interconnection to lower level networks (tier 2 and tier 3 networks). The "middle mile" connects the backbone network to various local aggregation points. Internet traffic is then distributed at different aggregation points before it goes on the "last mile" to arrive at the end user (the local retail customer). In the U.S. most of the middle mile is privately owned, and owners charge fees for the usage of the part of infrastructure. Typically, tier 1 providers build an entire network from the backbone to the last mile, tier 2 providers invest in both the middle mile and last mile, and tier 3 providers only invest in the last mile.[4]

The last mile is typically the speed bottleneck; its bandwidth effectively limits the amount of data that can be delivered to the customer. The cost of building up the last-mile broadband infrastructure is substantial. For an industry example, it costs $20,000 for fiber infrastructure per mile and $600 per home to install service from the street, in addition to $32 average monthly cost for service delivery after installation. If there are 13 homes per mile and the monthly subscription fee is $65, it would take 5.4 years to break even on the investment in the best scenario that all 13 homes subscribe to the service. This calculation varies significantly across geographies and terrains, as the cost of laying out the network is much higher in rural, remote, sparsely-populated areas. The lack of the middle mile compounds this problem. To start serving a new market, an ISP with some middle-mile infrastructure may only need to build the last mile in urban areas, but may need to build its own middle mile or pay for wholesale middle-mile access in rural areas.

2.2. **State Policies and Regulatory Matters.** Beyond federal regulations, state governments have important jurisdiction over this industry. State policies and regulation, broadly speaking, include four categories: state grants and subsidies, tax incentives, rights-of-way accommodations, and municipality provision restrictions. The last category concerns whether municipal governments are allowed to provide public internet services, but such restrictions

[4]Tier 2 and 3 providers are difficult to distinguish because ISPs are reluctant to admit that they do not have control over parts of their network and, therefore, their ability to improve services may be limited.

had little variation in our period of study (2010–2019) so we do not include it in our analysis.[5] A range of miscellaneous policies and accommodations also exist, such as designating an office to allocate federal funding and oversee broadband deployment, or streamlining the bureaucratic process of providing internet services within the state.[6]

Grants and subsidies. Many states started active grant or loan programs during our data period and often set up an office to manage funds. States including New York, Massachusetts, Indiana and California provided grant programs ranging from $20 million to $500 million. Such programs were often targeted toward unserved or underserved areas; for example, Vermont established a Connectivity Initiative in 2015 to deploy high-speed internet to all service locations, and as a part of the initiative, the Public Service Department was required to publish a list of Census blocks eligible for funding on an annual basis and to solicit proposals from providers.

Tax incentives. An example is the 2014 policy in Colorado, allowing broadband providers to get a refund on state sales/use taxes paid for broadband equipment. Another example is the 6-percent excise tax credit for broadband providers purchasing new equipment, which was enacted in 2017 in Tennessee. Tax incentives often are not targeted, not discriminating between providers or locations, but with some exceptions. In 2017, Indiana enacted a policy to allow local governments to adopt an ordinance designating an area as an "infrastructure development zone" and to provide eligible infrastructure in the zone with an exemption from property tax.

Rights-of-way accommodation. When it comes to poles, conduits and rights-of-way, state and local governments go beyond just issuing a certificate for a new ISP to operate.[7] Section 253(c) of the Telecommunications Act of 1996 states: "Nothing in this section affects the authority of a State or local government to manage the public rights-of-way or to require fair and reasonable compensation from telecommunications providers, on a competitively neutral and nondiscriminatory basis."

[5]As of 2021, 21 states restrict electric cooperatives and municipalities from providing broadband services. For example, North Carolina requires a city to hold a special election on the question of whether it can provide a communications service before the city can incur debt for building such a system. Wilson (2025) evaluates a ban on municipality provision by estimating a structural model of consumer demand and a dynamic oligopoly model of investment by public and private ISPs.

[6]Florida, for example, requires local governments to treat telecommunications companies in a nondiscriminatory manner when exercising franchise authority. New York allows telephone companies to accept federal loans to expand broadband access without first obtaining approval from the Public Service Commission.

[7]Poles and conduits regulation refer to procedures, guidelines and requirements for communications attachments under high voltage power lines and access to underground pipes and tubes for protective electric wiring. Rights-of-way are pathways or corridors of access that ISPs need to secure to install their facilities and deliver their services.

The rights-of-way authority governs public infrastructure access for internet deployment. Major issues include permission to build, compensation in return for granting permission (in the form of cost recovery, rental fee, or a flat tax), and the management of a public rights-of-way, e.g., streets and roads.[8] Somewhat mundane, minor issues include mediation when an ISP conflicts with municipalities and private landowners, and even the time frame within which an ISP application gets reviewed.[9] In addition, remediation and maintenance laws dictate issues such as in what state of repair ISPs must maintain their facilities. For example, if a sidewalk is torn in order to lay cables, these laws determine to what extent the sidewalk would need to be restored to its original state and under what time frame.

Over time in our data period, states have eased regulations on permitting, access, pole attachments, and construction. Some accommodations were big strides, for example, California in 2016 required the Department of Transportation to notify ISPs during the planning phase of department-led highway construction projects suitable for broadband conduit installation. This is called "dig-once" policy, currently in place in eight states including Minnesota, Iowa, and Colorado. Some accommodations clearly tilt the playing field toward ISPs. For example, Alabama in 2019 specified the terms under which a property owner can sue a broadband provider for damages when the provider is using an existing electric easement for broadband. It stipulates that property owners cannot receive more in damages than the amount that their property lost in value because broadband facilities were installed.

2.3. **Broadband in Politicians' Campaign Platform and Policy Agenda.** The broadband status (or the lack thereof) has been a recurring theme in governor campaign platforms and policy agendas in the past decade, as represented in campaign website archives, governors' state of the state addresses, and news reports.[10] This motivates our framework where politicians consider the broadband status experienced by their constituents as an important policy issue, and have incentives to push for policies that encourage entry and investment if the status is deemed inadequate.

Examples span from Mark Dayton's 2010 gubernatorial campaign for Minnesota to Chris Jones's 2022 campaign for Arkansas. Political candidates often stress the lack of coverage in the state and the under-provision of high-speed internet. They typically relate broadband

[8]In some states, an ISP needs to get permission to build on a public rights-of-way from each municipality, whereas in other states, this is handled by a centralized authority.

[9]In Vermont, landowner complaints can be heard on a wide range of issues including aesthetics, and decisions can be appealed to the Vermont Supreme Court. On the other extreme is Texas, where most factors cannot be appealed and landowners must pay the ISPs legal expenses if the landowners lose in court.

[10]All 50 state constitutions mandate that the governor give an annual (or regular) report to the state legislature on the condition of the state. The speech also includes the governor's priorities and goals for the legislative session.

accessibility to education, healthcare, and local businesses and economic growth.[11] Many even developed concrete plans to implement their policy goals upon being elected.[12]

In addition, governors often actively pursue strategies and policies to improve the availability and affordability of broadband in the state. Similar to political candidates, incumbent politicians generally focus on the "unserved" and "underserved" areas, the first one about the coverage and the second about speed, as an inadequacy that needs to be fixed. In 2016, New York Governor Andrew Cuomo declared in his State of the State address "Upstate's roads and bridges, broadband and other infrastructure must be upgraded ... achieving parity with downstate." Different from election candidates, incumbent politicians emphasize their already implemented initiatives, strategies, and policies.[13] In 2021, 40 states discussed their broadband status and relevant policy fixes in the governors' state of the state speeches. Many of the speeches specifically mentioned the state's cooperation with entrants or small firms as a strategic plan.[14]

2.4. **Broadband Policies and Competition.** Entry- and investment-facilitating policies, particularly accommodations involving infrastructure access and rights-of-way, may be especially valuable to smaller providers and potential entrants. For example, Missouri in 2014 required pole attachment fees charged by local authorities to be nondiscriminatory and reasonable, and in 2017 Tennessee required electric cooperatives to allow other providers nondiscriminatory access to poles and other infrastructure. Such provisions can benefit new entrants that lack established relationships with local governments.

Even when the statutory language does not distinguish between providers, small firms appear to benefit more from these policies than their larger rivals. Without the political capital or regulatory experience of large incumbents, small firms face greater challenges in navigating state-level hurdles absent formal protections. They are also less likely to own dark fiber,[15] thus facing a higher barrier to entry. At the same time, small firms often

[11]Chris Jones, running for Arkansas Governor in 2022, states in his campaign website that "our families, our classrooms, and our small businesses need affordable broadband to connect to jobs and education opportunities, and support rural communities."

[12]For example, Janet Mills, running for Maine governor in 2018, put together a detailed broadband plan, as did Jared Polis for the Colorado governor race the same year.

[13]Georgia Governor Nathan Deal stated in 2011 "I have included $44.8M in the budgets to better connect every classroom in Georgia, including those in rural areas, to the internet and digital resources students need to thrive."

[14]Alabama governor Kay Ivey stated that "I partnered with C-Spire for their $500 million dollar investment in Alabama over the next three years." North Dakota governor Doug Burgum stated "The crews from Dakota Carrier Network, Midco and other broadband providers making thousands of connections to ensure that high-speed service to schools and homes to support distance learning, earning North Dakota national recognition for our broadband connectivity."

[15]Dark fiber refers to unused or underutilized fiber-optic cables that have not been activated, considered potential capacity by the industry. Telecommunications giants such as Comcast, AT&T, and CenturyLink own substantial amounts of dark fiber but generally refrain from leasing it to competitors to avoid cannibalization risks.

exhibit greater flexibility in partnering with local communities; for example, the first round of Connect Illinois broadband grants was awarded predominantly to local and regional internet service providers, rural cooperatives, nonprofits, and local governments rather than national carriers (Illinois Department of Commerce and Economic Opportunity, 2020).

State broadband policies can promote entry and competition by lowering deployment costs. Rights-of-way accommodations, for example, can facilitate expansion by smaller providers while also reducing incumbents' costs. Incumbents may oppose such policies when the competitive threat outweighs their own cost savings.

An interesting feature of broadband policy is that existing private deployment can itself reduce the scope for subsequent government intervention. State broadband-grant programs commonly allow existing providers to challenge proposed subsidies by demonstrating that they already serve the targeted area or have committed to deploy service there within a specified period. In Minnesota's 2019 grant program, for example, a credible commitment to complete qualifying deployment within 18 months could prevent a competing project from receiving state funding. More recently, Cable One challenged a Louisiana grant awarded to a smaller provider on the ground that its existing broadband service made public support unnecessary, arguing that grant funds should instead be directed to communities without broadband access. These examples concern awards under existing programs rather than the adoption of new policies, but illustrate the force we emphasize: private capacity can affect not only market competition, but also policymakers' perceived need to facilitate additional entry. Section 5 examines whether this relationship appears systematically in state broadband policy.

3. Data on Broadband Investment and Policymaking

We combine multiple data sources. First, data on each ISP's entry, technology, and internet speed at the Census block level are collected and reported semiannually by federal agencies, first by the National Telecommunications and Information Administration (NTIA) for the period of 2010 to the first half of 2014, and then by the Federal Communications Commission (FCC) since the second half of 2014. Second, we construct state broadband policy measures from the Pew Charitable Trusts' State Broadband Policy Explorer, supplemented by our review of state program websites, budget and tax expenditure documents, statutes, public statements, and news reports.[16] We manually classify financing and regulatory provisions and translate them into annual policy measures. The indicator for a state broadband office with full-time employees comes from Whitacre and Gallardo (2020). Appendix A describes the sources, coding rules, and construction of the policy outcomes. Third, gubernatorial election results are based on CQ Press Voting and Elections Collection. We

[16]Our archived Pew download, retrieved in June 2020, covers statutes as of January 1, 2020. Dated records range from 1991 through 2019; some records have no specified date.

TABLE 1. Broadband Coverage and Speed: Rural vs. Urban

Variable	Rural		Urban	
	Mean	SD	Mean	SD
Coverage				
% Census blocks with any service	59.2	22.4	73.8	18.7
% Census blocks with 2+ ISPs	22.3	17.8	51.7	20.8
% population with any service	85.5	15.0	93.7	6.6
% population with 2+ ISPs	46.2	27.9	82.4	16.5
Speed				
% Census blocks with $\geq$ 25 Mbps	35.3	26.1	60.5	25.7
% population with $\geq$ 25 Mbps	56.2	31.5	82.3	24.0
Average max upload speed (Mbps)†	71.2	123.2	107.3	130.3
Average max download speed (Mbps)†	175.3	190.3	249.3	209.4

Notes: 47,080 observations from rural counties (2,354 counties $\times$ 20 semiannual periods, 2010–2019) and 15,580 observations from urban counties (779 counties $\times$ 20). A county is classified as urban if at least 67% of its 2010 population resided in Census-defined urban areas. Coverage measures (Census-block shares) have slightly fewer observations owing to missing data. † : We take the average of the maximum upload/download speed of the residential broadband services advertised in a given county over provider-technology-block observations.

supplement these data with additional election results collected from online sources. Lastly, we employ various demographic information from the American Community Survey.

3.1. **Broadband Deployment and Investment.** Table 1 shows how broadband coverage and speed vary geographically across rural and urban counties during 2010–2019, focusing on residential services.[17] We classify a county as urban if at least 67% of its 2010 population resided in Census-defined urban areas, and as rural otherwise. Under this definition, 2,354 counties are rural and 779 are urban. During the ten years, the average fraction of the population with any service availability in rural counties is 85%, the fraction with service from at least two providers is 46%, and the fraction with download speed of at least 25 Mbps is 56%. These statistics contrast with those of urban counties—94%, 82%, and 82%, respectively—illustrating the persistence of the digital divide in the recent decade.[18]

Our analysis considers broadband investment at both the county level and the firm–county level. Table 2 summarizes investment patterns at the county–time level (Columns 1–2) and the firm–county–time level (Columns 3–4), where time is measured in six-month intervals.

[17]We focus on residential services because the political channel we study runs through voters: the broadband status that politicians emphasize, and that constituents experience, is primarily service available to households. The FCC data distinguish residential and business services, while the NTIA data do not. To focus on residential services, we exclude the observations by business-only ISPs from the NTIA data.

[18]The gap extends to the speeds advertised: the average maximum download speed is 175 Mbps in rural counties and 249 Mbps in urban counties, and the average maximum upload speed is 71 and 107 Mbps, respectively.

Our baseline measure defines investment in a given period as the increase in the number of Census blocks with residential broadband service between that period and 12 months later—a measure of net coverage expansion over one year, which we use as a proxy for investment.[19][20] We also check whether the results hold under alternative investment measures: (i) measuring the net increase in population in served Census blocks, so that coverage gains in more populous areas count for more; (ii) restricting attention to high-speed service (≥ 25 Mbps); (iii) distinguishing the *extensive* margin—an indicator for whether a county or firm recorded a positive net increase in served blocks—from the *intensive* margin—the size of that net increase; and (iv) measuring the *stock* of broadband capacity (the level of blocks, or population, served) rather than the *flow* of new investment. The summary statistics in Table 2 and in the regressions that follow use the baseline count measure unless noted otherwise. At the county level, investment was common during the study period: 65.4% of county-period observations recorded an expansion of overall coverage (Column 1), and 51.4% recorded increases in high-speed coverage of at least 25 Mbps (Column 2). Conditional on positive investment, the average and median increases were sizable—199 and 46 Census blocks, respectively—relative to the average county size of 3,469 blocks.

The broadband industry comprises highly heterogeneous providers, ranging from a small number of large firms with statewide or multistate footprints to thousands of smaller ISPs operating in localized markets. To capture this variation, we report firm-level statistics separately for large and small firms. Throughout, a "firm" denotes a *provider identifier–state* combination: an identifier appearing in multiple states is treated as a separate firm in each state, and its large/small status is fixed over the study period. We classify a provider–state combination as "large" if the provider identifier served at least 5% of Census blocks within the state at its first observation in that state; all others are classified as "small." The two groups are therefore mutually exclusive. Our sample comprises 3,741 provider–state combinations, of which 373 are large—spanning 87 provider identifiers—and 3,368 are small. By this criterion, a state has 7.5 large provider identifiers on average, ranging from a minimum of two (Rhode Island) to a maximum of sixteen (Indiana).

For the firm-level statistics in Columns 3–4 of Table 2, we define potential investment locations differently by firm size. For large firms, all counties in a state where the firm is present are treated as potential investment locations. For small firms, potential locations are

[19]Coverage changes do not measure capital spending or the gross number of newly served blocks. In the FCC data, a block is recorded as served if service is available at at least one location; population-weighted block coverage therefore does not imply service availability to every resident.

[20]We observe inconsistencies between NTIA and FCC reporting. Accordingly, when measuring investment as changes in broadband coverage over time, we exclude the transition periods between the two sources (December 2013 and June 2014, the last two periods of NTIA data collection) to avoid potential measurement error. A firm may occasionally miss reporting its presence; in such cases, we impute values by interpolating between reported years.

TABLE 2. Summary Statistics: Annual Broadband Investment

	County-level		Firm-level	
	(1) Any	(2) $\geq$ 25 Mbps	(3) Any, Large	(4) Any, Small
Any investment	0.654	0.514	0.301	0.296
Mean net increase in served blocks (if invested)	199.4	271.0	140.9	118.2
Median net increase in served blocks (if invested)	46	73	19	11
Number of counties	3,133	3,133	3,133	3,099
Number of provider–state combinations			373	3,368
Average (potential) counties per firm			64.7	6.5
Number of observations	50,128	50,128	218,952	214,013

Notes: The table reports broadband investment at the county–time level (Columns 1–2) and the firm–county–time level (Columns 3–4), where time is measured in six-month intervals. Investment is defined as the increase in the number of Census blocks served between a given period and 12 months later. In Column 2, "Any investment" refers to any investment in high-speed internet services; conditional mean and median additions are conditional on any high-speed investment. A provider–state combination is classified as large if the provider identifier served at least 5% of the state's Census blocks at its first observation in that state; for large firms, all counties in states where the firm is present are treated as potential investment locations. For small firms, potential locations are restricted to counties in which they were ever present during the study period. The row "Average (potential) counties per firm" reports the mean number of potential investment locations per firm.

restricted to counties in which the firm was ever observed during the study period. Under this definition, small firms have an average of 6.5 potential counties, whereas large firms—whose potential locations comprise every county in the states where they operate—average 64.7. Investment frequencies are broadly similar across firm size, though conditional on investing, large firms tend to expand coverage by a greater number of Census blocks.

3.2. **State Broadband Policies.** Panel A of Table 3 presents summary statistics on state broadband policies for each state and year. Rights-of-way and infrastructure-access accommodations were the largest policy category on average. Our broad entry- and investment-facilitating policy measure averaged just over two during our data span, with substantial variation across states and over time. Some states, such as Alaska, recorded no policies in this measure, while others, such as Colorado, adopted policies frequently and eventually reached a count of eleven. Policy adoption became more common in the latter half of our data span. Appendix A describes the construction of these measures, including the treatment of policy duration.

States also actively changed their policies within our window: over 2011–2019, 9.8% of state-years saw the adoption of a new financial-incentive (tax or grant) policy, 8.4% a new rights-of-way accommodation, and 17.3% at least one new entry- and investment-facilitating policy, as measured by positive annual changes in the respective policy counts. These policy

TABLE 3. State Broadband Policies and Politics

Variable	Mean	SD	Min	Max
Panel A: Broadband investment policies				
Grant/loan programs	0.514	0.683	0	3
Tax incentives	0.210	0.488	0	2
Rights-of-way accommodations	0.888	1.417	0	8
Office for broadband investment‡	0.231	0.422	0	1
Any entry- and investment-facilitating policy	2.004	2.093	0	11
Panel B: Electoral competitiveness				
% swing counties in state†	23.91	16.94	0	80.00
SD of county Democratic vote share (%)†	9.60	3.15	2.46	17.07
Governor's vote margin (pp, most recent)	15.94	13.58	0.22	57.97
Divided branch	0.216	0.412	0	1
Split state legislature	0.090	0.286	0	1
Competitive legislature	0.462	0.499	0	1

Notes: 500 observations (50 states × 10 years, 2010–2019), except as indicated. Panel A summarizes state broadband policy measures. "Any entry- and investment-facilitating policy" sums the grant/loan programs, tax incentives, rights-of-way and infrastructure-access accommodations, a demand-side assistance indicator, and miscellaneous accommodations. See Appendix A for coding and policy-duration conventions.
In Panel B, a county is classified as *swing* in a given year if its average Democratic vote share in gubernatorial, senatorial, and presidential general elections held during the preceding eight years lies within five percentage points of 50%. "% swing counties" is the percentage of a state's counties meeting this condition; "SD of county Democratic vote share" is the standard deviation, across the state's counties, of that same eight-year average vote share, in percentage points. Both are unweighted across counties. "Divided branch" equals one when the governor and the legislative majority belong to different parties, and "Split state legislature" when the two chambers are controlled by different parties. "Competitive legislature" equals one if at least one legislative chamber is closely divided, with neither major party holding more than 60% of the seats. † 490 observations: county-level election returns are not available for Alaska. ‡ 450 observations (2010–2018): office data from Whitacre and Gallardo (2020) are unavailable for 2019.

changes, together with the stock of policies in place, are the outcomes we relate to large ISPs' capacity in Section 5.

3.3. **Electoral Competitiveness.** Electoral competitiveness in state politics varies substantially along several dimensions. First, we measure local partisan competitiveness at the county-year level. For each county, we calculate the Democratic vote share in gubernatorial, senatorial, and presidential general elections held during the preceding eight years.[21] Counties with vote shares closer to 50% are more electorally competitive, or more "swing;" we classify a county as swing in a given year if this vote share lies within five percentage points of 50%. Because policy is set at the state level, we aggregate these county measures

[21]By taking the average vote share across multiple elections, we intend to capture the local voters' political preferences, as opposed to the popularity of particular candidates.

to the state-year. Panel B of Table 3 shows that the average state has 23.9% of its counties in the swing category, but that this share ranges from none to 80% across state-years.[22] States also differ in how internally divided their electorates are: the standard deviation of the Democratic vote share across a state's counties averages 9.6 percentage points, ranging from 2.5 to 17.1. The two dimensions are weakly correlated (correlation −0.22), so a state's stock of competitive counties is not simply a reflection of how politically homogeneous it is.

Second, the competitiveness of gubernatorial elections also varies considerably. Although these elections are typically decided by sizable margins—the average difference in vote share between the winner and the runner-up is 15.9 percentage points—some are effectively toss-ups. Examples of gubernatorial races decided by less than one percentage point during our sample period include: Minnesota in 2010 (0.4pp), Connecticut in 2010 (0.5pp), and Illinois in 2010 (0.9pp).

Third, states differ in the partisan composition of the governor's office and state legislature. In 22% of state-year observations, the governor and the legislative majority belong to different parties, a configuration we refer to as a "divided branch." In another 9%, partisan control is split across the two legislative chambers, which we call a "split legislature." Both configurations may make policy gridlock more likely. The balance of partisan control within legislative chambers also varies: in 46% of state-years, at least one chamber is closely divided, with neither majority party holding more than 60% of the seats, a configuration we refer to as a "competitive legislature."

4. Broadband Investment and Electoral Competitiveness

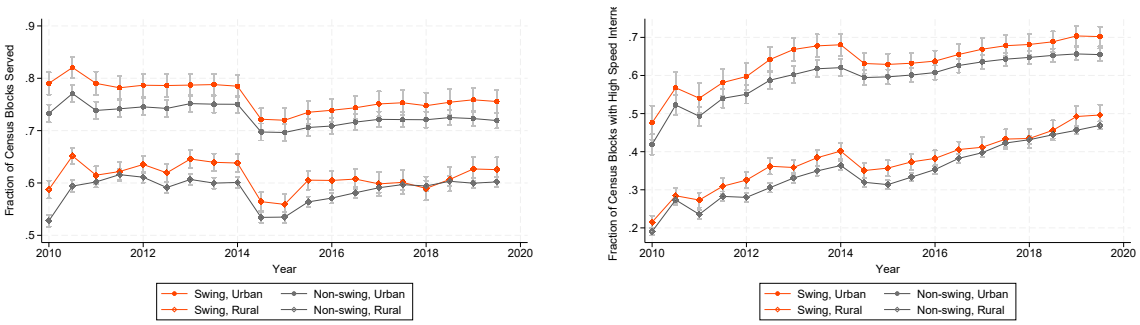
We document that local political environment matters for broadband investment, even after we control for a range of demographic and socioeconomic factors, as well as fixed effects, that may also affect investment. We find a novel and robust pattern: broadband investment increases as a county's Democratic vote share in state-wide (i.e., gubernatorial or senatorial) or presidential elections approaches 50%; put differently, investment is greater in electorally competitive, or *swing*, locations. In the firm-level analysis, this pattern is statistically significant for large providers, while we do not detect a comparable pattern for small providers.

4.1. **More Broadband Investment in Swing Counties.**

Figure 1 shows the average local broadband capacity, measured by the fraction of Census blocks with any residential broadband internet service (Panel (A)) and with high-speed service ($\geq$ 25 Mbps, Panel (B)), for four different groups of counties. There are two notable trends in the figure. First, the gap between rural and urban counties in broadband coverage and speed is persistent.

[22]Counties vary widely in population, so the share of a state's counties that are competitive need not track the share of its voters. Weighting counties by population, 27.1% of a state's residents live in swing counties on average, ranging from none to 88.8%.

FIGURE 1. Better Broadband in Electorally Competitive Areas



(A) Coverage (B) Speed

Notes: We group counties into four groups based on (i) whether the fraction of population living in urban area is above 67% in 2010 ("urban," in diamond) or not ("rural," in circle), and (ii) whether the average Democratic vote share in recent state or national elections is 45–55% ("swing," in orange) or not ("non-swing," in grey). Panel (A) shows the fraction of the Census blocks with any residential broadband internet service, averaged across the counties in each of the four different groups. Panel (B) presents the fraction of the Census blocks with residential broadband internet services featuring at least 25 Mbps maximum download speed. The error bars represent 95% confidence intervals. Note that the drop in broadband capacity in 2014 is due to the change of the data collection and reporting authorities (from NTIA to FCC).

This is the well-noted "digital divide" problem.[23] Second, electorally competitive counties consistently have better broadband capacity than non-swing (or partisan) counties, regardless of the urban/rural delineation. This suggests the relevance of local political environment to broadband investment. The overall political viewpoints in a local area, however, may also be correlated with demographic or socioeconomic factors that are relevant to broadband investment.

To control for potential confounding factors, we consider the following specification:

$$Y_{ct} = \beta_1 DemShare_{ct} + \beta_2 (DemShare_{ct})^2 + \mathbf{X}_{ct}\beta_{\mathbf{x}} + \mu_{s(c),t} + \epsilon_{ct}, \tag{1}$$

where Y_{ct} measures broadband investment in county c in each semiannual period t; and $DemShare_{ct}$ is the average vote share for a Democratic candidate in state-level or nationwide elections in the preceding eight years for county c. The vector X_{ct} consists of time-varying county attributes, including population size and density, their respective squared terms, and resident attributes such as demographics (age, gender, and racial composition), income, work, and education, as listed in Appendix Table A1. This specification includes state-time fixed

[23]The urban-rural disparity can be attributed to both demand- and supply-side economics in broadband deployment. In rural counties, residents tend to have lower income and are less educated than those in urban counties, resulting in lower willingness to pay for broadband services. At the same time, rural counties often have difficult terrains and low population density, increasing the cost of deploying broadband networks.

TABLE 4. Broadband Investment and Democratic Vote Share

	Investment in (log) number of blocks[a]			
	Any			≥ 25 Mbps
	(1)	(2)	(3)	(4)
Democratic vote share	9.269***	6.740***	4.163***	2.492**
	(0.848)	(0.945)	(0.997)	(1.082)
(Democratic vote share)^2	-9.098***	-7.284***	-4.463***	-2.993**
	(0.946)	(0.985)	(1.075)	(1.200)
Time-varying county attributes[b]	N	N	Y	Y
State-period FE	N	Y	Y	Y
Maximized at Dem. vote share	0.509	0.463	0.466	0.416
	(0.012)	(0.015)	(0.036)	(0.056)
Number of observations	49,696	49,696	49,579	49,579
Adjusted R^2	0.005	0.302	0.309	0.198

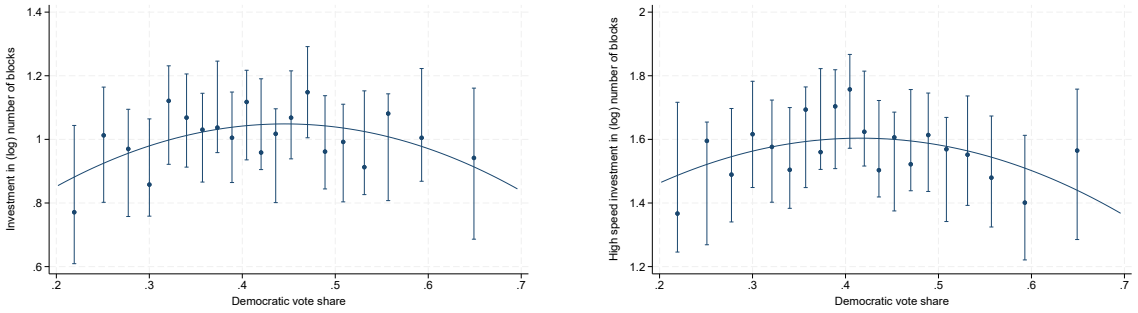
Notes: This table is based on 3,133 county × 16 semiannual periods. We cut 4 periods from the 20 periods in the time span of our data: we do not use the NTIA-to-FCC transitional periods, December 2013 and June 2014, due to inconsistent reporting; we lose June 2019 and December 2019 data due to 2-period forward calculation of investment. The number of observations slightly changes across the columns because time-varying county attributes based on the American Community Survey are not always available. Standard errors are adjusted for clustering within counties, and are provided in parentheses. Asterisks indicate the statistical significance at the 1% (***), 5% (**), and 10% (*) levels.
On variable construction: a. The outcome variable in Columns 1–3 is $\log\big(\max\{\Delta n_{ct}, 0.01\}\big)$, where Δn_{ct} is the one-year increase in the number of Census blocks in county c with any broadband service; the 0.01 floor retains county-periods with no increase. Column 4 uses the same definition but restricts attention to high-speed (≥ 25 Mbps) broadband. b. The time-varying county attributes include population size and density, their respective squared terms, as well as population characteristics on age, gender and race compositions, income, work, education and more (listed in Appendix Table A1).

effects, denoted by $\mu_{s(c),t}$, to account for, among other things, various state-level government policies. We allow county-time unobserved heterogeneity—ϵ_{ct}—to cluster within counties.

Table 4 reports the OLS results based on Equation (1). We focus on one outcome measure in this baseline table for Columns 1–3: we measure investment as $\log\big(\max\{\Delta n_{ct}, 0.01\}\big)$, where Δn_{ct} is the one-year increase in the number of Census blocks in county c with any broadband service.[24] In Column 4, we substitute n_{ct} with the number of Census blocks with high-speed service (at least 25 Mbps). In both measures, we floor the increase at 0.01 before taking logs, assigning log(0.01) to observations with no increase. This is a coding normalization that separates zero from positive deployment. The estimated inverted U and its peak near one-half persist with alternative floor values and a floor-free extensive-margin

[24]We measure investment in period t over the following year to allow for construction time. For the infrequent occasions of negative deployment growth, we code investment as zero.

FIGURE 2. Inverted U-Shape Relationship between Investment and Support for the Democratic Party



(A) Coverage (B) Speed

Notes: The figures display estimates based on the binscatter method of Cattaneo et al. (2024), where the main independent variable is each county's average Democratic vote share in recent state or national elections. The "dots" correspond to conditional means estimated under a piecewise constant specification, and the 95% confidence intervals are constructed using piecewise linear polynomials with continuity at bin breakpoints. We use 20 bins over Democratic vote shares between 0.2 and 0.7, controlling for county attributes and state-period fixed effects. For reference, we overlay a quadratic regression fit. The dependent variable in Panel (A) is $\log\big(\max\{\Delta n_{ct}, 0.01\}\big)$, the logged one-year increase in the number of Census blocks with any broadband service (floored at 0.01). Panel (B) uses the same transformation, restricted to high-speed broadband.

specification.[25] As Chen and Roth (2024) emphasize, log-with-zeros coefficient magnitudes depend on the floor. We therefore do not interpret $\hat{\beta}_1$ or $\hat{\beta}_2$ as percentage or semi-elasticity effects; our object of interest is the location of the peak, $-\hat{\beta}_1/2\hat{\beta}_2$.

In all four columns, there is a near symmetry between the coefficients for the Democratic vote share ($\hat{\beta}_1$) and its squared term ($\hat{\beta}_2$): they are almost equal, with the former positive and the latter negative. Based on $\hat{\beta}_1$ and $\hat{\beta}_2$, all columns present a clear inverted U-shaped relation between the electoral competitiveness of a county and broadband investment in the county. Using these estimates, we calculate the Democratic vote share that maximizes investment, which equals $-\hat{\beta}_1/2\hat{\beta}_2$, and the respective standard errors. As reported by the table, across the columns, broadband investment is maximized in counties with roughly 50% Democratic vote share. In short, all else equal, there has been more investment in electorally competitive counties.

A natural concern is that the inverted U-shaped pattern in Table 4 depends on imposing a quadratic functional form. We therefore use the binscatter methodology of Cattaneo et al. (2024), with 20 bins over Democratic vote shares between 0.2 and 0.7 and the same county controls and state-period fixed effects as the regression. The dots represent

[25]Recoding the floor from log(0.01) to −1, following Chen and Roth (2024), preserves the inverted U and its peak near one-half (Column (4) of Table A3), as does an extensive-margin linear probability model (Column (3) of the same table). Unreported results also use a floor of log(0.001) and yield a similar pattern.

a piecewise-constant fit; the pointwise confidence intervals use piecewise-linear polynomials with continuity at bin breakpoints.

Figure 2 presents the results for coverage (Panel A) and speed (Panel B), with a quadratic regression fit overlaid for reference. The flexible estimates support an interior-peaking relationship, although the confidence intervals are broad. This evidence supports the quadratic pattern and motivates the firm-level analysis that follows.

Our central result is also robust to a range of alternative outcome definitions and specifications, which we report in Appendix Tables A2 and A3. First, the pattern holds when we measure broadband *capacity*—the stock of Census blocks (or population) with service—rather than the flow of new investment (Table A2). Whether capacity is measured by the (log) number of served blocks or the (log) population served, and for both any service and high-speed ($\geq$ 25 Mbps) service, the coefficients on the Democratic vote share and its square retain their signs and statistical significance, and the implied capacity-maximizing vote share remains close to one-half (ranging from 0.486 to 0.547). Second, the inverted U survives a battery of alternative investment definitions (Table A3): measuring investment by the (log) net increase in population in served blocks, over a two-year rather than one-year horizon, by an extensive-margin indicator for any investment, and recoding the no-increase floor from $\log(0.01)$ to -1 following Chen and Roth (2024). In every case the estimated peak lies near a 50% Democratic vote share (0.410–0.542), supporting the stability of the county-level pattern across these treatments of zero investment and investment horizons.

4.2. **Large Providers Invest More in Swing Counties.** With Table 4 as a county-level overview, we focus on the decision-makers behind the novel investment pattern we document. Here, we construct a firm-county-period panel. For a large firm, every county in its state is a potential investment location; for a small firm, potential locations are limited to the counties in which it was ever present during the sample period. We then consider the following specification:

$$Y_{fct} = \beta_1^{\tau(f)} DemShare_{ct} + \beta_2^{\tau(f)} (DemShare_{ct})^2 + \mathbf{X}_{ct}\beta_{\mathbf{x}}^{\tau(f)} + \xi_{ft}^{\tau(f)} + \mu_c^{\tau(f)} + \epsilon_{fct}, \quad (2)$$

where $\tau(f)$ represents the type of the firm, either large or small, and Y_{fct} measures the investment of firm f in county c during period t. Here we control for time-varying county attributes (the same as those used in Equation (1)), firm-period fixed effects, and county fixed effects. As a firm in our panel is a provider-state combination, the firm-period fixed effects are in fact provider-state-period fixed effects. We cluster standard errors within counties.

Table 5 shows a statistically significant inverted-U relationship for large providers, while the linear and quadratic coefficients for small providers are individually insignificant. This

TABLE 5. Investment and Electoral Competitiveness by Firm Size

	Investment in (log) number of blocks[a]			
	(1) Large	(2) Small	(3) Large	(4) Small
Democratic vote share	3.213***	0.367	2.265**	1.028
	(0.625)	(0.670)	(1.103)	(1.332)
(Democratic vote share)^2	-3.028***	-0.902	-2.569**	-1.870
	(0.683)	(0.720)	(1.229)	(1.503)
Time-varying county attributes[b]	Y	Y	Y	Y
Firm-period FE	Y	Y	Y	Y
County FE	N	N	Y	Y
Maximized at Dem. vote share	0.531	0.203	0.441	0.275
	(0.040)	(0.223)	(0.106)	(0.202)
Number of observations	194,822	189,379	194,822	189,374
Adjusted R^2	0.347	0.389	0.386	0.426

Notes: This table presents the OLS results based on a firm-county-period panel. Same as in Table 4, we cut 4 periods: December 2013 and June 2014 for the NTIA-to-FCC inconsistent reporting, June 2019 and December 2019 for the 2-period forward calculation of investment. We also exclude each provider–state identifier's first observed period in the retained panel. Standard errors are adjusted for clustering within counties, and are provided in parentheses. Asterisks indicate the statistical significance at the 1% (***), 5% (**) and 10% (*) levels. *On variable construction*: a. The outcome variable is $\log\big(\max\{\Delta n_{fct}, 0.01\}\big)$, where Δn_{fct} is the one-year increase in the number of Census blocks served by firm f in county c; the 0.01 floor retains firm-county-periods with no investment. b. The (time-varying) county attributes are the same as in Table 4 and listed in Appendix Table A1.

pattern is suggestive of heterogeneity, but the separate regressions do not establish a statistically significant difference between the two groups.[26]

Across the four columns the control variables and firm-period fixed effects are identical; Columns 1 and 3 (large) and 2 and 4 (small) differ only in the inclusion of county fixed effects and that single difference changes the variation used to identify the vote-share coefficients. A natural concern is that a county's Democratic vote share is not random: it may proxy for other county characteristics, such as geography, density, income, or persistent political culture, that independently drive broadband investment. By adding county fixed effects (Columns 3 and 4 of Table 5), we control for time-invariant differences across counties and identify the coefficients only from within-county variation over time. We find that, even after controlling for county fixed effects, the large-firm inverted U remains statistically significant

[26]Appendix Table A4 reports a similar pattern of coefficient significance for three alternative outcome measures: the (log) net increase in the number of blocks with high-speed ($\geq$ 25 Mbps) service, the (log) net increase in population in served blocks, and the (log) net increase in the number of served blocks measured over a two-year horizon. The large-firm inverted U remains statistically significant under the high-speed and two-year measures and carries the expected, marginally significant signs under the population measure, whereas the corresponding coefficients for small firms are individually insignificant. The high-speed peak for large providers is 0.639, outside the designated swing interval.

and similar in shape, with the investment-maximizing vote share shifting only modestly (from 0.53 to 0.44), while the small-firm coefficients remain individually insignificant in both cases.

However, there may be unobserved time-varying county-firm attributes, represented as ϵ_{fct} in (2), that are correlated with both the Democratic vote share and the broadband investment. For example, mayors or other (elected) local officials may be eager to help broadband investment through various policies that boost the demand for broadband internet services or reduce the hurdles of investment especially if they face tough elections.[27] If so, firms may be simply responding to these policies, as opposed to making preemptive investment to influence policies. The absence of a statistically detectable inverted U for small firms does not rule out this explanation, since firms may respond differently to the same local conditions. Moreover, the different sets of potential investment locations limit the comparability of the two groups.

Why would investment in swing counties be especially valuable to large ISPs? Investment deters policy only insofar as policymakers value the outcomes it produces. Office-motivated politicians weight outcomes in places with many electorally responsive voters (Lindbeck and Weibull, 1987; Krasa and Polborn, 2010, 2014). Consistent with this, incumbents direct discretionary grants and campaign resources toward such places (Dahlberg and Johansson, 2002; Strömberg, 2008). Broadband outcomes in competitive counties may therefore carry greater direct electoral value, although balanced partisan vote shares need not imply more electorally responsive voters. They may also matter because such counties overlap with competitive legislative districts, where a few marginal seats can determine partisan control of a chamber (Appendix D). This second channel implies that the swing-county pattern should be strongest where legislative control is most contested. Appendix Table A5 is consistent with this: among states whose legislatures were frequently closely divided before our sample period, large-ISP investment peaks at a Democratic vote share of 0.42, whereas among the remaining states the peak is imprecisely estimated and does not lie near one-half. Because the comparison is imprecise, we treat it as consistent with, rather than as establishing, the mechanism.

5. Evidence on Policy Deterrence

The firm-level patterns in the preceding section motivate our examination of policy deterrence, but do not by themselves establish it. As the examples in Section 2.4 illustrate, existing private deployment can reduce policymakers' perceived need for further broadband intervention. We therefore examine whether greater large-ISP capacity in politically pivotal

[27]Relatedly, empirical evidence suggests that local politicians actively attract firm investment via tax incentives and subsidies (Jensen, Malesky, and Walsh, 2015; Mast, 2020; Slattery, 2024; Slattery and Zidar, 2020; Jensen, Findley, and Nielson, 2020).

counties is followed by fewer entry- and investment-facilitating broadband policies and a lower likelihood of new policy adoption.

We estimate

$$Y_{s,t+2} = \beta_1 \text{Swing Capacity}_{st} + \beta_2 \text{Non-Swing Capacity}_{st} + \mathbf{X}_{st}\beta_{\mathbf{x}} + \eta_s + \mu_t + \epsilon_{st}, \quad (3)$$

where t now indexes years rather than semiannual periods and $Y_{s,t+2}$ measures state broadband policy two years after year t. We consider two outcomes for each policy category: the number of recorded policies and an indicator for new policy adoption in year $t+2$. We identify adoption by an increase in the policy count from the preceding year; Appendix A provides the construction details. The vector $\mathbf{X}_{st}$ includes the time-varying controls from $\mathbf{X}_{ct}$ in (1), aggregated to the state level, along with measures of the governor's and legislature's political circumstances. All specifications include state and year fixed effects.

For each county, we measure large-ISP capacity as the fraction of Census blocks served by at least one large ISP; a block served by multiple large ISPs is counted only once. We then construct separate state-year measures for swing and non-swing counties. Swing Capacity$_{st}$ is the population-weighted average of county-level large-ISP capacity among counties whose average Democratic vote share lies between 45% and 55%, with weights proportional to county population within the set of swing counties. Non-Swing Capacity$_{st}$ is defined analogously for all remaining counties. Of the 400 potential state-year observations from 2012 to 2019, we exclude 23 that contain no swing counties.[28] We standardize each capacity measure using its mean and standard deviation over the 400 observations before these exclusions, with swing capacity set to zero when no swing counties are present.

Because broadband capacity is itself an equilibrium outcome, these regressions should be interpreted as mechanism-consistent evidence rather than as a standalone causal estimate. Lagging capacity and covariates by two years reflects the fact that policy decisions are likely to rely on prior information and mitigates mechanical reverse causality from contemporaneous policy to deployment. Earlier policies, unobserved state-level shocks, and firms' anticipation of future policy changes remain possible concerns. Policy levels include earlier adoptions, so the adoption outcomes speak more directly to subsequent decisions. Swing capacity can also change as counties enter or leave the swing category. We therefore view the results as complementary to the investment patterns documented above; they do not distinguish strategic deterrence from ordinary investment followed by reduced policy need.

Table 6 reports the results. We find no statistically significant relationship between large-ISP capacity in non-swing counties and subsequent broadband policy. By contrast, a one-standard-deviation increase in large-ISP capacity in swing counties is associated with 0.283

[28]These observations are concentrated in Alaska and Hawaii (all 8 each), followed by Oklahoma (3), Rhode Island (3), and Massachusetts (1). The results are robust to retaining these observations and setting Swing Capacity$_{st}$ equal to zero.

TABLE 6. Broadband Policies and Large ISPs' Capacity

	Number of policies[a]			New policy adoption[b]		
	Financial (1)	ROW (2)	All (3)	Financial (4)	ROW (5)	All (6)
Large-ISP capacity, swing counties[c]	-0.019	-0.283**	-0.336	-0.030	-0.102**	-0.118**
	(0.098)	(0.140)	(0.208)	(0.040)	(0.042)	(0.054)
Large-ISP capacity, non-swing[c]	0.016	0.040	0.071	0.027	-0.002	0.039
	(0.062)	(0.104)	(0.139)	(0.032)	(0.036)	(0.042)
Time-varying state attributes[d]	Y	Y	Y	Y	Y	Y
State FE, Year FE	Y	Y	Y	Y	Y	Y
Number of observations	377	377	377	377	377	377
Adjusted R^2	0.790	0.835	0.826	-0.012	0.100	0.181

Notes: OLS estimates for policy outcomes in 2012–2019, with capacity and controls measured two years earlier. The sample excludes 23 state-year observations with no swing counties. Standard errors in parentheses are clustered at the state level. Asterisks indicate statistical significance at the 1% (***), 5% (**), and 10% (*) levels.
On variable construction: *a.* "Financial" combines grant/loan programs and tax incentives. "ROW" combines rights-of-way and infrastructure-access accommodations. "All" additionally includes demand-side assistance and miscellaneous accommodations. *b.* New policy adoption is identified by an increase in the relevant policy count from the preceding year. Appendix A details the counting and policy-duration conventions. *c.* Capacity is the population-weighted average share of Census blocks served by at least one large ISP, calculated separately for swing counties (45–55% average Democratic vote share) and other counties. Both measures are standardized using the 400 observations before the no-swing exclusions, with swing capacity coded as zero where no swing counties are present. *d.* Controls include the time-varying county-level attributes from Table 4, aggregated to the state level, as well as political circumstances of the governor and legislature, such as governor's party and vote margin, and indicators for partisan composition of the state legislature (relative to the governor's party).

fewer recorded rights-of-way accommodations two years later and a 10.2 percentage-point lower probability of adopting a new rights-of-way policy in that year. To convey magnitudes, we report linear-model predictions at pooled percentiles of swing-county capacity, averaging over the observed values of other regressors and fixed effects. Moving from the 10th to the 90th percentile of that distribution—from 38% to 87% of Census blocks served by at least one large ISP—the fitted probability of adopting any new entry- and investment-facilitating policy two years later falls from 32.8% to 8.5%, relative to a mean adoption rate of 19% in the estimation sample. For rights-of-way adoption, the linear prediction falls from 20.8% to approximately zero (slightly negative) across the same range, against a mean of 9.0%. These fitted levels are illustrative and are reported without endpoint confidence intervals. We find no statistically significant relationship with tax or grant policies. The statistically significant associations concern rights-of-way accommodations, the class of policies most directly tied to entrants' deployment costs. The coefficients on swing- and non-swing-county capacity are not significantly different for the rights-of-way outcomes in Columns (2) and (5)

($p \approx 0.12$). These tests compare coefficients for one respective standard deviation of each capacity measure. The relationship also appears in the aggregate adoption measure: a one-standard-deviation increase in swing-county capacity is associated with an 11.8 percentage-point lower probability of adopting any new entry- and investment-facilitating policy two years later, and the difference between the swing- and non-swing-capacity coefficients is statistically significant in Column (6) ($p \approx 0.04$).

Together, the results suggest that greater large-ISP capacity in swing counties is followed by fewer state policies that would facilitate entry and expansion by smaller competitors. Combined with the firm-level investment evidence, these patterns support the interpretation that investment in swing counties can discourage entry- and investment-facilitating policy.

6. A Stylized Model of Policy Deterrence

We develop a stylized model in which greater broadband capacity lowers the policymaker's gain from intervention, allowing a leading firm to deter policies that would lower its rival's investment cost.[29]

The model considers a single market. Its interpretation across locations and policy categories relies on the institutional arguments above. Because the follower's capacity choice is interior, the model concerns expansion rather than an explicit entry decision.

6.1. **Setup.** There are two firms in a market, a leader (L) and a follower (F), denoted by $i \in \{L, F\}$.[30] Let industry demand be represented by an inverse demand function $P(Q)$, where $Q = q_L + q_F$ and $P'(Q) < 0$.[31] The leader and follower choose capacities q_L and q_F, respectively.[32]

The follower's investment cost depends on whether an entry- and investment-facilitating policy is in place ($s = 1$) or not ($s = 0$). Motivated by the institutional discussion in Section 2.4, we assume that the policy lowers the follower's marginal investment cost, while the leader's cost, $C_L(q_L)$, is unaffected. For simplicity, we abstract from any direct cost savings the policy may also provide to the leader and isolate the differential benefit to the

[29]The model could also accommodate a direct *quid pro quo* in which investment is exchanged for favorable policy treatment. Without observing explicit agreements, however, this channel is difficult to distinguish empirically from the indirect mechanism studied here, in which policy responds endogenously to the political value of broadband deployment. We focus on the indirect mechanism because it does not require an explicit or enforceable agreement; both channels share the key implication that a leading firm's investment can reduce the likelihood of policies that facilitate entry and investment by followers.

[30]Although several large ISPs may operate within a state, we model a single leader to isolate the mechanism. With multiple large incumbents, the benefits of policy deterrence may be shared across firms, creating a free-riding force that weakens individual incentives to overinvest.

[31]The model illustrates the investment–policy mechanism rather than providing a direct mapping to covered blocks, which our aggregate coverage measure counts only once regardless of the number of providers.

[32]We assume Cournot pricing rather than a two-stage capacity-then-price game (Kreps and Scheinkman, 1983; Davidson and Deneckere, 1986) to simplify the discussion.

follower emphasized in Section 2.4. Denoting the follower's cost by $C_F(q_F, s)$, we assume that

$$\Delta(q_F) \equiv \frac{\partial C_F(q_F, 0)}{\partial q_F} - \frac{\partial C_F(q_F, 1)}{\partial q_F} > 0 \tag{4}$$

for all $q_F > 0$. We further assume that demand is not excessively convex, i.e., $P'(Q) + QP''(Q) < 0$. This familiar sufficient condition implies that capacities are strategic substitutes: an increase in the leader's capacity lowers the follower's marginal return to capacity and therefore reduces the follower's best response.[33] We also assume that $C_F(\cdot, s)$ is twice continuously differentiable and weakly convex, and that, for each relevant value of q_L and s, the follower's optimum is interior. The demand and cost-curvature assumptions make the follower's objective strictly concave, so its best response is unique. We denote it by $BR_F(q_L, s)$. Under these conditions, the follower's best response is decreasing in the leader's capacity and increasing in the policy intervention.

The policymaker's payoff depends on total capacity and policy:

$$W(Q, s) = W_1(Q) + W_2(s), \tag{5}$$

where $W_1(\cdot)$ is increasing and strictly concave, and $W_2(1) < W_2(0)$. The dependence on broadband capacity can be motivated by electoral incentives: politicians seeking re-election have reason to respond to voter demand, and greater broadband capacity may benefit voters and thereby improve electoral prospects.[34] Thus, $W_1(\cdot)$ captures the policymaker's valuation of broadband deployment, while $W_2(\cdot)$ captures the fiscal or political cost of intervention. Define

$$\gamma \equiv W_2(0) - W_2(1) > 0 \tag{6}$$

as the cost of adopting the policy.

6.2. **Policymaker's Gain from Policy.** The following lemma establishes the key force behind policy deterrence. As incumbent capacity expands, the policy generates a smaller increase in follower investment and therefore a smaller increase in total broadband deployment. Consequently, the policymaker's gain from intervention declines.

Define the policymaker's gross gain from intervention given incumbent capacity by

$$G(q_L) \equiv W_1(q_L + BR_F(q_L, 1)) - W_1(q_L + BR_F(q_L, 0)). \tag{7}$$

[33]The condition holds, in particular, for linear and concave inverse demand.

[34]This interpretation does not require broadband to be a primary issue for voters. Even if broadband is secondary relative to "frontline" issues such as government spending or redistribution, secondary policy issues may still be shaped by electoral incentives (List and Sturm, 2006). More broadly, the reduced-form payoff ($W_1(Q)$) captures any political value of broadband deployment, including the possibility that visible private investment improves local service quality or brings local economic activity that benefits voters.

LEMMA 1. *Suppose that the incremental effect of the policy on the follower's capacity is decreasing in the leader's capacity:*

$$\frac{\partial}{\partial q_L}\left[BR_F(q_L,1) - BR_F(q_L,0)\right] < 0. \tag{8}$$

Suppose also that total capacity absent the policy is weakly increasing in the leader's capacity:

$$1 + \frac{\partial BR_F(q_L,0)}{\partial q_L} \geq 0. \tag{9}$$

Then $G'(q_L) < 0$.

The first condition states that the policy-induced increase in the follower's capacity becomes smaller as the leader's capacity rises. Intuitively, greater leader capacity reduces the follower's residual demand and lowers its equilibrium scale. The second condition ensures that, absent the policy, an increase in leader capacity is not more than offset by a reduction in follower capacity, so that baseline total capacity does not fall. These conditions reduce the policymaker's gain from intervention through two forces: the policy generates a smaller increase in capacity, and, because W_1 is concave, that increase is valued less when baseline capacity is higher. Appendix E.2 provides a sufficient set of primitives under which both conditions hold.

6.3. **Leader's Investment for Policy Deterrence.** We compare two policy regimes that differ in the timing of the policymaker's decision relative to the leader's capacity choice. In both regimes, the policymaker does not adopt the policy when indifferent. In the first regime, the policymaker chooses whether to adopt the policy before either firm invests. The leader then chooses its capacity, followed by the follower. Because the policy is fixed before investment occurs, we refer to this as the *policy-commitment regime*. In the second regime, the leader chooses its capacity first, after which the policymaker observes that choice and decides whether to adopt the policy; the follower then chooses its capacity. We refer to this as the *no-commitment regime*. In this regime, the leader may influence the policy decision through its capacity choice.

Consider first the policy-commitment regime. Let $Q^C(1)$ and $Q^C(0)$ denote the equilibrium industry capacities when the policy is adopted and not adopted, respectively. Define the policymaker's gross gain from intervention under commitment as

$$\Gamma^C \equiv W_1\big(Q^C(1)\big) - W_1\big(Q^C(0)\big). \tag{10}$$

The policymaker adopts the policy whenever $\Gamma^C > \gamma$. Because the policy decision is made before firms choose capacities, the leader cannot influence the policymaker's decision through its investment choice.

Consider next the no-commitment regime. After observing the leader's capacity q_L, the policymaker adopts the policy whenever $G(q_L) > \gamma$. Unlike under commitment, the leader now recognizes that its capacity affects not only the follower's subsequent investment decision, but also the policymaker's incentive to intervene. By Lemma 1, a larger incumbent capacity reduces the policymaker's gain from intervention. Therefore, a sufficiently large capacity expansion can move the policymaker from adopting the policy to not adopting it. Consequently, investment can be used strategically to discourage policy adoption.

We say that *policy deterrence through incumbent overinvestment* occurs when a policy that would be adopted under commitment is not adopted under no commitment. In the no-commitment regime, the leader chooses a higher capacity, reducing the policymaker's gain from intervention to or below the policy-adoption threshold.

PROPOSITION 1. *There exist primitives*

$$P(\cdot), \quad C_L(\cdot), \quad C_F(\cdot,\cdot), \quad W_1(\cdot),$$

and a nonempty interval of policy costs γ such that policy deterrence through incumbent overinvestment occurs.

Proposition 1 establishes that policy deterrence through incumbent overinvestment can arise as an equilibrium outcome. The proof, provided in Appendix E.3, constructs a linear-demand example in which the leader profitably expands capacity enough to deter intervention. For intermediate policy costs, the policy would be adopted if the policymaker could commit before firms invest, but is not adopted when the policymaker observes the leader's capacity before choosing policy.

6.4. **Implications of Policy Deterrence.**

PROPOSITION 2. *When policy deterrence occurs through incumbent overinvestment, the leader's market share is higher under no commitment than under commitment. Furthermore, total industry capacity can be lower despite the leader's greater investment.*

The proof is provided in Appendix E.4. The first implication concerns market structure. In the policy-deterrence equilibrium, the leader expands capacity to discourage intervention. At the same time, the follower loses access to the cost-reducing policy that would otherwise stimulate its investment. Both effects shift capacity toward the leader and increase its equilibrium market share relative to the commitment benchmark.

The second implication concerns aggregate deployment. Policy deterrence has two opposing effects on total capacity. The leader's additional investment weakly raises total capacity, even after accounting for the follower's strategic response.[35] At the same time, deterring the

[35]This is the second condition in Lemma 1.

policy eliminates the additional follower investment that the cost-reducing policy would otherwise have induced. If this lost policy-induced investment exceeds the net capacity added by the leader's expansion, total industry capacity is lower under no commitment despite the leader's greater investment. The example used to establish Proposition 1 shows that this case arises for a nonempty range of policy costs. Appendix Figure A2 illustrates these effects in the example.

7. Conclusion

This paper provides evidence for a new channel through which firms may gain competitive advantage: influencing government policy through their investment in local markets. We document a robust empirical pattern in which more broadband investment occurs in electorally competitive counties, and find that the pattern is statistically significant for large providers but not for small providers. We also find that greater large-firm capacity in those counties is associated with fewer subsequent rights-of-way accommodations. Taken together, these findings are consistent with large firms directing investment toward politically important locations in ways that may reduce policymakers' incentives to adopt entry- and investment-facilitating policies.

The proposed mechanism suggests several possible welfare implications, which we do not directly test or establish through a social-welfare analysis. First, if policy deterrence reduces competition, consumers could face higher prices or lower service quality, outcomes commonly associated with reduced competition. Second, policy-deterrence incentives may distort the geographic allocation of investment by directing capacity toward electorally competitive locations rather than those where its social return is greatest. To the extent that urban counties are more electorally competitive than rural counties, this mechanism could contribute to the "digital divide," the uneven access to high-speed internet across geographic areas and socioeconomic groups.

Finally, the policy-deterrence mechanism raises the possibility that government support for broadband entry and investment may be lower than under policy commitment. Our model shows that investment by a large firm can reduce the perceived need for intervention even when the resulting equilibrium shifts capacity toward that firm and may reduce total broadband deployment. The consequences could extend beyond the broadband industry, as access to reliable and affordable internet has become increasingly important for households' economic, political, and social well-being. The COVID-19 pandemic accelerated this trend by expanding the role of broadband in remote work, online education, telehealth and telemedicine, and the ability to self-isolate at home (Chiou and Tucker, 2020). More broadly, the issues highlighted in this paper—uneven competition, the politically influenced allocation

of investment, and the endogenous response of broadband policy—may have consequences for labor-market access, regional growth, and aggregate economic performance.

Appendix A. Construction of State Broadband Policy Measures

This appendix describes the policy measures summarized in Panel A of Table 3 and used as outcomes in Table 6. They capture the number or presence of coded policies.

A.1. **Sources.** Our principal source is the Pew Charitable Trusts' *State Broadband Policy Explorer*, downloaded in June 2020 and covering statutes as of January 1, 2020. Dated records range from 1991 through 2019; some provisions have no specified date. We manually classify financing and regulatory provisions using their descriptions and statutory text, supplemented by state program websites, budget and tax expenditure documents, award reports, public statements, and news reports. The coding records policy types, beginning and termination dates, and whether provisions facilitate or restrict broadband deployment. We treat provisions without a specified beginning date as predating the sample period.

The broadband-office indicator comes from Whitacre and Gallardo (2020) and identifies states with an office or task force with full-time employees. It covers 2010–2018, yielding 450 observations in Table 3; the other policy measures cover 2010–2019 and have 500 observations.

A.2. **Policy categories and annual measures.** We organize the coded provisions into financial incentives and regulatory accommodations, then construct annual measures for each state. The following describes which provisions enter each category and how we account for their duration.

A.2.1. *Financial incentives.* We construct separate counts of grant/loan programs and tax incentives. Qualifying economic-development grants are included when coded as relevant to broadband. Records classified as administrative changes, definitions, funding mechanisms, or other modifications to existing programs are not counted as additional programs. Tax-definition changes, reductions in tax incentives, and financing records concerning airports, studies, or voice-network providers are excluded.

We separate supply-side assistance from assistance directed toward consumers and institutions. The grant and tax counts exclude records classified as demand-side assistance. Records classified solely as school funding or other assistance do not enter automatically.

Within each supply-side category, records with identical state, beginning year, termination year, and rural/unserved targeting status are counted once. Each retained record contributes one from its coded beginning year through its termination year, inclusive. An unspecified termination date leaves it active thereafter. Program budgets, award amounts, and general state-government expenditures do not enter these counts.

A.2.2. *Regulatory accommodations.* We remove records marked as duplicates or as telephone-only or wireless policies. We then count provisions classified as favorable rights-of-way or infrastructure-access accommodations, combining them into the ROW measure. These include provisions concerning poles, conduits, permitting, and access to public rights-of-way. Restrictive provisions are excluded. A separate count captures miscellaneous accommodations, such as provisions facilitating infrastructure leasing or easing administrative requirements.

Regulatory accommodations enter from their coded beginning year. We carry regulatory accommodations forward without subtracting expirations. These measures therefore capture cumulative recorded accommodations rather than an exact inventory of provisions legally in force and may overstate the persistence of provisions with recorded expiration dates. Municipal-provision restrictions and regulatory-authority indicators are maintained separately and excluded from the broad entry- and investment-facilitating measure.

A.2.3. *Combined measures.* Table 6 uses three policy categories. "Financial" sums the counts of grant/loan programs and tax incentives. "ROW" combines the counts of rights-of-way and infrastructure-access accommodations. "All" adds these two categories, the demand-side assistance indicator, and the count of miscellaneous accommodations. This broad measure is reported as "Any entry- and investment-facilitating policy" in Table 3.

A.3. **Policy measures for Table 6.** Columns (1)–(3) of Table 6 relate each policy measure two years later to current broadband capacity and covariates. Columns (4)–(6) identify new policy adoption in that future year by an increase in the relevant measure from the preceding year. The adoption indicator is missing if either required value is unavailable.

The adoption indicator records whether the policy count rises in the year being studied, including when a state adds to its existing policies. For financial incentives, a new program may replace an expiring one without changing the count; our indicator would miss that adoption. For regulatory accommodations, each newly recorded provision increases the cumulative count, so the adoption indicator captures additions to that count.

Appendix B. County Attributes for Our Analyses

In our regression analyses, we include various time-varying county attributes, drawn from sources such as the American Community Survey, to represent the demographic and socioeconomic characteristics of a county's residents, as well as their political tendencies. These attributes are likely to be associated with the demand for broadband services and the costs of providing those services. Table A1 presents summary statistics on county demographics and political environment.

Table A1. County Attributes

Variable	Mean (SD)	Median	Variable	Mean (SD)	Median
Democratic vote share	0.410 (0.137)	0.406	Long-distance commuters	0.176 (0.088)	0.160
Population (millions)	0.100 (0.321)	0.026	Public transit users	0.009 (0.030)	0.003
Female	0.500 (0.024)	0.504	Household size	2.621 (0.313)	2.578
Children under 5	0.060 (0.012)	0.059	Log median household income	10.741 (0.253)	10.730
Seniors over 65	0.170 (0.045)	0.167	In poverty	0.161 (0.065)	0.153
White	0.836 (0.166)	0.901	Living in an old house	0.307 (0.152)	0.284
Black	0.090 (0.145)	0.022	Median year house built	1974.108 (11.212)	1976.000
American Indian/ Alaska Native	0.019 (0.073)	0.003	Living in rental property	0.280 (0.080)	0.268
Asian	0.013 (0.027)	0.005	Owning a phone	0.971 (0.021)	0.975
Hispanic	0.155 (0.250)	0.043	Population density	0.101 (0.678)	0.017
College-educated	0.191 (0.091)	0.170	Population growth rate	0.003 (0.020)	0.001
In labor force	0.594 (0.079)	0.601	Growth rate of college-educated share	0.071 (0.171)	0.022
Working at home	0.049 (0.033)	0.041	Rural	0.586 (0.315)	0.594

Notes: Summary statistics for county attributes, pooled across county–period observations over the sample period. Standard deviations appear in parentheses. The number of observations varies across variables because of data availability. Demographic, employment, housing, and rural shares are reported as fractions, not percentages. Population is measured in millions; population density is population per 1,000 square meters of land area.

Appendix C. Robustness Exercises

This appendix collects the robustness exercises referenced in the main text. Tables A2 and A3 probe the county-level inverted-U result of Table 4, and Table A4 revisits the firm-size result of Table 5.

Table A2 re-estimates the baseline county-level specification, Equation (1), using broadband *capacity*—the stock of served Census blocks—as the outcome rather than the flow of new investment. Columns (1) and (2) measure capacity by the (log) number of Census blocks with any service and with high-speed ($\geq$ 25 Mbps) service, respectively, while Columns (3) and (4) weight blocks by the population they contain. In all four columns the coefficient on the Democratic vote share is positive and that on its square is negative and statistically significant, and the implied capacity-maximizing vote share lies between 0.486 and 0.547—close to the value obtained for investment in the main text. The swing-county pattern therefore characterizes the broadband stock as well as the flow.

Table A3 examines the sensitivity of the baseline investment result to alternative outcomes. Column (1) measures investment by the (log) net increase in population in served blocks

TABLE A2. Broadband Capacity and Electoral Competitiveness

	Capacity by blocks with any service[a]			
	(log) number		(log) population	
	Any	≥ 25 Mbps	Any	≥ 25 Mbps
	(1)	(2)	(3)	(4)
Democratic vote share	1.183**	3.719***	2.889***	5.661***
	(0.497)	(1.117)	(0.573)	(1.379)
(Democratic vote share)^2	-1.218**	-3.483***	-2.719***	-5.175***
	(0.533)	(1.194)	(0.619)	(1.504)
Time-varying county attributes[b]	Y	Y	Y	Y
State-period FE	Y	Y	Y	Y
Maximized at Dem. vote share	0.486	0.534	0.531	0.547
	(0.055)	(0.053)	(0.034)	(0.051)
Number of observations	61,966	61,966	61,966	61,966
Adjusted R^2	0.680	0.429	0.841	0.474

Notes: This table is based on 3,133 county × 20 semiannual periods, with some observations dropped due to unavailability of certain variables from the American Community Survey. Standard errors are adjusted for clustering within counties, and are provided in parentheses. Asterisks indicate the statistical significance at the 1% (***), 5% (**), and 10% (*) levels. *On variable construction*: a. For Columns (1) and (2), the outcome variable is $\log(\max\{n, 0.01\})$, where n is the number of Census blocks with broadband service. The difference between (1) and (2) is that we consider any broadband service for (1) and high-speed service (at least 25 Mbps download speed) for (2). For Columns (3) and (4), we apply the same transformation to the population in served blocks, using the same 0.01 floor. b. The time-varying county attributes are as listed in Table A1.

rather than the count of blocks; Column (2) lengthens the investment horizon from 1 to 2 years; Column (3) replaces the outcome with an indicator for any investment, estimated as a linear probability model; and Column (4) recodes the baseline log-investment outcome's no-increase floor from $\log(0.01)$ to -1, following Chen and Roth (2024). Across all four variants the inverted U persists, with the estimated peak between 0.410 and 0.542 Democratic vote share, supporting the stability of the county-level pattern across these investment measures and treatments of zero-investment observations.

Table A4 re-estimates the firm-size specification of Table 5 using three alternative outcome measures: the (log) net increase in the number of blocks with high-speed (≥ 25 Mbps) service (Columns (1)–(2)), the (log) net increase in population in served blocks (Columns (3)–(4)), and the (log) net increase in the number of served blocks measured over a two-year horizon (Columns (5)–(6)). The qualitative pattern of coefficient significance is preserved. For large firms the inverted U is statistically significant under the high-speed and two-year measures (Columns (1) and (5)) and carries the expected, marginally significant signs under the population measure (Column (3)); the corresponding coefficients for small firms

TABLE A3. Investment and Electoral Competitiveness: Alternative Measures

	(log) population covered[a] (1)	(log) blocks (2-year horizon)[b] (2)	Any investment (0/1)[c] (3)	(log) blocks (CR transform)[d] (4)
Democratic vote share	4.810***	4.654***	0.448***	2.547***
	(1.283)	(1.467)	(0.117)	(0.621)
(Democratic vote share)^2	-4.973***	-5.680***	-0.414***	-2.971***
	(1.412)	(1.596)	(0.126)	(0.672)
County attributes[e]	Y	Y	Y	Y
State-period FE	Y	Y	Y	Y
Maximized at Dem. share	0.484	0.410	0.542	0.429
	(0.042)	(0.038)	(0.052)	(0.034)
Number of observations	49,579	37,201	49,579	49,579
Adjusted R^2	0.295	0.276	0.202	0.375

Notes: This table reports OLS estimates that probe the robustness of the baseline inverted-U result (Table 4) to alternative outcome definitions. All columns include time-varying county attributes and state-period fixed effects, with standard errors clustered within counties. Except for the longer-horizon measure in Column (2), the sample drops the NTIA–FCC transition periods (December 2013 and June 2014) and the last two periods lost to the forward differencing, as in Table 4. Asterisks indicate statistical significance at the 1% (***), 5% (**), and 10% (*) levels.
On variable construction: *a.* Column (1) measures investment by the log of one plus the net increase in population in served Census blocks, rather than by the net increase in the number of served blocks. *b.* Column (2) measures investment over a two-year (four-period) horizon instead of one year, which requires dropping additional periods (hence fewer observations). *c.* Column (3) replaces the outcome with an indicator equal to one if the county recorded a positive net increase in the number of served blocks, estimated as a linear probability model. *d.* Column (4) uses the baseline log-investment measure, $\log(\max\{\Delta, 0.01\})$, but recodes county-periods with no increase from the floor value $\log(0.01)$ to -1, following Chen and Roth (2024). *e.* The time-varying county attributes are as listed in Table A1.

are individually insignificant under every measure. The estimated large-firm peak for high-speed investment is 0.639, outside the designated swing interval, so the inverted-U shape is more stable than its precise location.

APPENDIX D. POLITICAL STAKES AND INVESTMENT IN SWING COUNTIES

Section 4.2 summarizes why swing counties may matter to state policymakers and cites the relevant theory and evidence. Here we elaborate on the two channels and describe the heterogeneity analysis. The first channel is direct electoral value. Even when broadband is not a primary campaign issue, improvements in local service may affect voters' evaluations of incumbents and candidates. Because policy responsiveness is driven by marginal voters whose support can shift between candidates rather than by committed partisans, and because counties with closely divided vote shares plausibly contain a larger share of such voters, broadband investment there may generate greater electoral returns than comparable investment in reliably partisan counties.

TABLE A4. Investment and Electoral Competitiveness by Firm Size: Alternative Measures

	Investment, alternative outcome measures					
	(log) blocks, $\geq$ 25 Mbps[a]		(log) population[b]		(log) blocks, 2-yr horizon[c]	
	(1) Large	(2) Small	(3) Large	(4) Small	(5) Large	(6) Small
Dem. vote share	5.352***	0.101	2.813*	-0.126	4.398***	-1.966
	(1.130)	(1.420)	(1.483)	(1.850)	(1.459)	(1.850)
(Dem. vote share)^2	-4.186***	-1.758	-2.985*	-1.022	-4.764***	0.786
	(1.211)	(1.577)	(1.627)	(2.118)	(1.583)	(2.092)
County attributes[d]	Y	Y	Y	Y	Y	Y
Firm-period FE	Y	Y	Y	Y	Y	Y
County FE	Y	Y	Y	Y	Y	Y
Turning point	0.639	0.029	0.471	-0.062	0.462	1.251
	(0.094)	(0.382)	(0.135)	(1.017)	(0.077)	(2.383)
Number of obs.	194,822	189,374	194,822	189,374	137,681	133,294
Adjusted R^2	0.394	0.416	0.354	0.383	0.399	0.433

Notes: This table presents OLS results on the constructed firm-county-period panel, estimated separately for large and small firms as in Table 5, using three alternative outcome measures. Standard errors are clustered within counties. Asterisks indicate statistical significance at the 1% (***), 5% (**) and 10% (*) levels.
On variable construction: *a.* Columns (1)–(2) use the (log) net increase in the number of blocks with high-speed ($\geq$ 25 Mbps) service. *b.* Columns (3)–(4) measure investment by the (log) net increase in population in Census blocks served by the firm. *c.* Columns (5)–(6) use the (log) net increase in the number of served blocks measured over a two-year (four-period) horizon. *d.* The time-varying county attributes are listed in Table A1. The turning point is $-\hat{\beta}_1/(2\hat{\beta}_2)$; in Column (6) it is a minimum outside the feasible vote-share range, and in Column (4) it is also outside that range.

Second, swing counties may matter because they contain or overlap with competitive legislative districts and can therefore affect partisan control of state government.[1] When a legislative chamber is closely divided, a small number of marginal seats may determine which party controls the chamber and accordingly, whether the governor can advance a broader policy agenda. In that setting, broadband outcomes in politically competitive areas should be especially valuable to state policymakers. Our heterogeneity analysis speaks primarily to this second channel: if large ISPs invest in swing counties to deter entry- and investment-facilitating policy, the swing-county investment pattern should be strongest where legislative control is most contested.

This argument predicts how the investment difference between swing and non-swing counties should vary across states. When one party comfortably controls the governorship and both legislative chambers, swing counties may still have direct electoral value, but outcomes

[1]County boundaries do not coincide exactly with legislative districts. We therefore interpret county-level electoral competitiveness as a reduced-form proxy for the political importance of local broadband outcomes.

TABLE A5. Investment and Electoral Competitiveness: State Politics

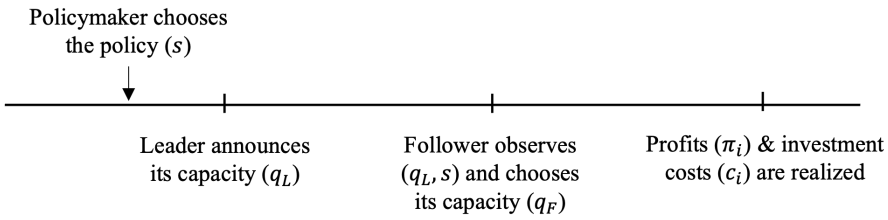
	Investment in (log) number of blocks			
	Split government[a]		Competitive legislature[b]	
	(1) Frequent	(2) Infrequent	(3) Frequent	(4) Infrequent
Democratic vote share	2.959*	2.119	2.684*	2.750*
	(1.726)	(1.399)	(1.506)	(1.617)
(Democratic vote share)^2	-2.602	-3.057*	-3.224*	-1.591
	(1.844)	(1.613)	(1.659)	(1.783)
Time-varying county attributes	Y	Y	Y	Y
Firm-period FE	Y	Y	Y	Y
County FE	Y	Y	Y	Y
Maximized at Dem. vote share	0.569	0.347	0.416	0.864
	(0.173)	(0.128)	(0.099)	(0.648)
Number of observations	91,224	103,598	133,910	60,912
Adjusted R^2	0.379	0.391	0.374	0.410

Notes: This table follows the same construction as Table 5 (identical outcome variable, controls, and fixed effects), restricted to large firms. The columns split states by their political environment during 2000–2009. *a*. For each state and year, we code a *split-government* dummy equal to one if the governorship and the legislative majority are held by different parties, or if the two legislative chambers are controlled by different parties. We average this dummy across 2000–2009 and classify a state as "Frequent" if the average exceeds 0.5 (split government in more than half of those years) and "Infrequent" otherwise. *b*. Analogously, for each state and year we code a *competitive-legislature* dummy equal to one if either chamber's majority-party seat share falls below 60%, average it across 2000–2009, and split states at the same 0.5 cutoff. Standard errors are clustered within counties. Asterisks indicate statistical significance at the 1% (***), 5% (**) and 10% (*) levels.

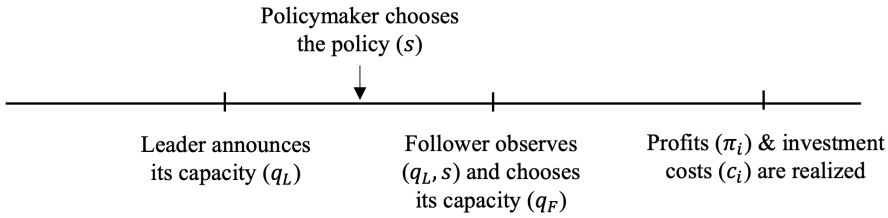
in a few competitive areas are less likely to alter control of the policy agenda. The incentive for large firms to favor swing counties over non-swing counties should therefore be relatively weak. When a legislative chamber is closely divided, by contrast, outcomes in competitive areas may affect marginal seats and thereby determine partisan control. The investment premium associated with swing counties should therefore be larger in states where legislative control is more contested. Split government provides a related but less sharp test: it may increase the political value of changing partisan control, while at the same time making new policy more difficult to enact.

We capture these features of a state's political environment using two measures, each constructed over 2000–2009, before our investment window. The first measures how frequently the state had a split or divided government, where the governor and the legislative majority belonged to different parties or the two legislative chambers were controlled by different parties. The second measures how often either legislative chamber was closely divided. For

FIGURE A1. Timeline with and without Policy Commitment



(A) Policy Commitment



(B) No Policy Commitment

each measure, we average the relevant indicator over 2000–2009 and classify a state as having experienced the condition frequently if it occurred in more than half of those years, and infrequently otherwise. We then re-estimate the large-firm specification of (2) within each group.

Table A5 provides suggestive evidence consistent with this prediction. The contrast is clearest for legislative competitiveness. In states where closely divided legislatures were frequent, the estimated investment curve has an inverted-U shape and peaks at a Democratic vote share of 0.416, near the swing point. In states where closely divided legislatures were infrequent, the location of the peak is poorly determined and does not lie near one-half. The split-government comparison is less sharp: the estimated peak is closer to one-half among states that frequently experienced split government, but the coefficient estimates do not produce as clear a contrast. Overall, the results provide suggestive support for the view that large firms place greater investment weight on swing counties when those counties are more likely to matter for partisan control of state government.

Appendix E. Proofs and Primitive Conditions for Section 6

This appendix collects formal derivations and proofs for the model in Section 6 of the main text. The setup, notation, and equilibrium expressions follow the main text without modification. For clarity, Figure A1 presents the timelines for the policy-commitment case (Panel A) and the no-commitment case (Panel B), respectively.

E.1. **Proof of Lemma 1.** Let

$$Q_0(q_L) \equiv q_L + BR_F(q_L, 0)$$

denote total capacity when the policy is not adopted, and let

$$D(q_L) \equiv BR_F(q_L, 1) - BR_F(q_L, 0) > 0$$

denote the increase in the follower's capacity induced by the policy. Then total capacity under the policy is

$$Q_1(q_L) = q_L + BR_F(q_L, 1) = Q_0(q_L) + D(q_L).$$

The policymaker's gross gain from adopting the policy is therefore

$$G(q_L) = W_1(Q_1(q_L)) - W_1(Q_0(q_L)) = W_1(Q_0(q_L) + D(q_L)) - W_1(Q_0(q_L)).$$

Differentiating with respect to q_L yields

$$G'(q_L) = [W_1'(Q_0(q_L) + D(q_L)) - W_1'(Q_0(q_L))]\, Q_0'(q_L) + W_1'(Q_0(q_L) + D(q_L))\, D'(q_L).$$

Because W_1 is strictly concave in capacity q,

$$W_1'(Q_0(q_L) + D(q_L)) - W_1'(Q_0(q_L)) < 0.$$

Moreover, W_1 is increasing in q, so

$$W_1'(Q_0(q_L) + D(q_L)) > 0.$$

Thus, if

$$Q_0'(q_L) = 1 + \frac{\partial BR_F(q_L, 0)}{\partial q_L} \geq 0$$

and

$$D'(q_L) = \frac{\partial}{\partial q_L}\left[BR_F(q_L, 1) - BR_F(q_L, 0)\right] < 0,$$

then both terms in the expression for $G'(q_L)$ are nonpositive, with the second strictly negative. Hence

$$G'(q_L) < 0.$$

■

E.2. **Primitive Conditions for Lemma 1.** We now provide a set of primitives under which the conditions used in Lemma 1 hold. Suppose inverse demand is linear,

$$P(Q) = A - bQ, \qquad b > 0,$$

and the follower's cost is

$$C_F(q_F, s) = \frac{k_s}{2} q_F^2,$$

where

$$k_0 > k_1 > 0.$$

Thus, the policy lowers the follower's marginal investment cost from $k_0 q_F$ to $k_1 q_F$.

The follower's best response under policy state s solves

$$A - bq_L - 2bq_F - k_s q_F = 0,$$

so

$$BR_F(q_L, s) = \frac{A - bq_L}{2b + k_s}.$$

Therefore,

$$\frac{\partial BR_F(q_L, s)}{\partial q_L} = -\frac{b}{2b + k_s} < 0.$$

Thus, the follower's best response is decreasing in the leader's capacity. Since $k_1 < k_0$, the policy increases the follower's capacity:

$$BR_F(q_L, 1) > BR_F(q_L, 0).$$

We first verify that total capacity absent the policy is increasing in incumbent capacity. Since

$$\frac{\partial BR_F(q_L, 0)}{\partial q_L} = -\frac{b}{2b + k_0},$$

we have

$$1 + \frac{\partial BR_F(q_L, 0)}{\partial q_L} = 1 - \frac{b}{2b + k_0} = \frac{b + k_0}{2b + k_0} > 0.$$

Next, define the policy-induced increase in follower capacity,

$$D(q_L) \equiv BR_F(q_L, 1) - BR_F(q_L, 0).$$

Then

$$D(q_L) = (A - bq_L)\left(\frac{1}{2b + k_1} - \frac{1}{2b + k_0}\right).$$

Differentiating with respect to q_L gives

$$D'(q_L) = -b\left(\frac{1}{2b + k_1} - \frac{1}{2b + k_0}\right) < 0,$$

because $k_1 < k_0$. Thus, the policy-induced increase in follower capacity is decreasing in incumbent capacity.

Therefore, both conditions of Lemma 1 hold under these primitives. By Lemma 1, the policymaker's gain from intervention is decreasing in incumbent capacity.

E.3. **Proof of Proposition 1.** We prove the proposition by example. Normalize $b = 1$, assume the leader's investment cost is zero, and let

$$W_1(Q) = \log Q.$$

Set

$$A = 10, \qquad k_0 = 2, \qquad k_1 = \frac{1}{2}.$$

The follower's best response is

$$BR_F(q_L, s) = \frac{10 - q_L}{2 + k_s}.$$

Under commitment, conditional on policy state s, the leader solves

$$\max_{q_L} \left(10 - q_L - \frac{10 - q_L}{2 + k_s}\right) q_L,$$

so

$$q_L^C(s) = 5.$$

Thus,

$$Q^C(1) = 5 + \frac{5}{5/2} = 7,$$

and

$$Q^C(0) = 5 + \frac{5}{4} = \frac{25}{4}.$$

The policymaker's gross gain from intervention under commitment is

$$\Gamma^C = \log\left(\frac{28}{25}\right).$$

Under no commitment, if the leader chooses q_L, the policymaker's gross gain from intervention is

$$G(q_L) = \log\left(q_L + \frac{10 - q_L}{5/2}\right) - \log\left(q_L + \frac{10 - q_L}{4}\right).$$

By Lemma 1, $G(q_L)$ is strictly decreasing in q_L. Under the tie-breaking convention that the policymaker does not adopt the policy when indifferent, the minimum deterrence capacity $\hat{q}_L(\gamma)$ satisfies

$$G(\hat{q}_L(\gamma)) = \gamma.$$

In the deterrence region, solving explicitly gives

$$\hat{q}_L(\gamma) = \frac{4 - \frac{5}{2}e^{\gamma}}{\frac{3}{4}e^{\gamma} - \frac{3}{5}}.$$

The leader's profit when the policy is adopted is

$$\pi_L(q_L, 1) = \left(10 - q_L - \frac{10 - q_L}{5/2}\right) q_L = \frac{3}{5}(10 - q_L)q_L,$$

which is maximized at $q_L = 5$, yielding

$$\pi_L(5, 1) = 15.$$

When the policy is not adopted,

$$\pi_L(q_L, 0) = \left(10 - q_L - \frac{10 - q_L}{4}\right) q_L = \frac{3}{4}(10 - q_L)q_L.$$

Solving

$$\pi_L(q_L, 0) = \pi_L(5, 1)$$

for the larger root gives

$$\bar{q}_L = 5 + \sqrt{5}.$$

Thus, for any $q_L \in (5, \bar{q}_L)$,

$$\pi_L(q_L, 0) > \pi_L(5, 1).$$

Since $G(5) = \Gamma^C$, $\bar{q}_L > 5$, and $G(q_L)$ is strictly decreasing,

$$G(\bar{q}_L) < \Gamma^C,$$

so the interval $(G(\bar{q}_L), \Gamma^C)$ is nonempty. For any $\gamma \in (G(\bar{q}_L), \Gamma^C)$, strict monotonicity of G implies

$$5 < \hat{q}_L(\gamma) < \bar{q}_L.$$

Hence,

$$\pi_L(\hat{q}_L(\gamma), 0) > \pi_L(5, 1).$$

Moreover, because $\pi_L(q_L, 0)$ is decreasing for $q_L > 5$, $\hat{q}_L(\gamma)$ is the most profitable capacity among those that deter the policy. The leader therefore chooses

$$q_L^{NC} = \hat{q}_L(\gamma) > 5 = q_L^C.$$

■

E.4. **Proof of Proposition 2.** Suppose policy deterrence occurs through incumbent overinvestment. That is, the policy is adopted under commitment but not under no commitment, and the leader's choice of capacity under no commitment, q_L^{NC}, is higher than that under commitment:

$$q_L^{NC} > q_L^C.$$

Under commitment, the policy is adopted, so the follower's equilibrium capacity is

$$q_F^C = BR_F(q_L^C, 1).$$

Under no commitment, the policy is deterred, so the follower's equilibrium capacity is

$$q_F^{NC} = BR_F(q_L^{NC}, 0).$$

Because the follower's best response is decreasing in the leader's capacity and increasing in the policy intervention,

$$BR_F(q_L^{NC}, 0) < BR_F(q_L^C, 1).$$

Hence,

$$q_F^{NC} < q_F^C.$$

We first compare market shares. The leader's market share under no commitment is

$$\frac{q_L^{NC}}{q_L^{NC} + q_F^{NC}},$$

whereas its market share under commitment is

$$\frac{q_L^C}{q_L^C + q_F^C}.$$

Since $q_L^{NC} > q_L^C$ and $q_F^{NC} < q_F^C$, it follows that

$$\frac{q_L^{NC}}{q_L^{NC} + q_F^{NC}} > \frac{q_L^C}{q_L^C + q_F^C}.$$

Thus, policy deterrence raises the leader's market share.

Next, compare total capacity:

$$Q^{NC} - Q^C = (q_L^{NC} - q_L^C) + (q_F^{NC} - q_F^C).$$

The first term is positive, while the second term is negative. Therefore, the sign of $Q^{NC} - Q^C$ is ambiguous. If the reduction in follower capacity is sufficiently large that

$$q_F^C - q_F^{NC} > q_L^{NC} - q_L^C,$$

then $Q^{NC} < Q^C$. To verify that the latter case can arise, consider the example used in the proof of Proposition 1. Under commitment, the policy is adopted and

$$Q^C = 7.$$

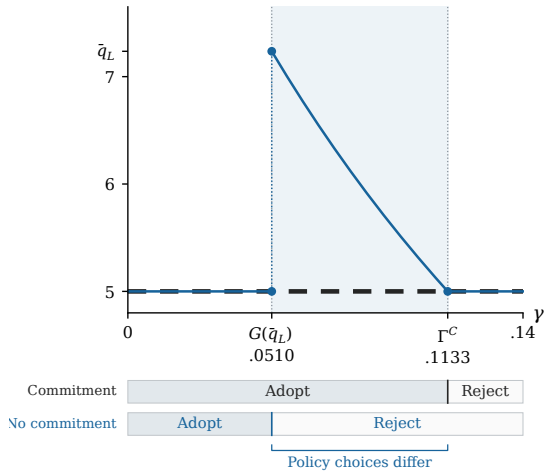
Under no commitment, when the policy is deterred,

$$Q^{NC} = q_L^{NC} + \frac{10 - q_L^{NC}}{4} = \frac{5}{2} + \frac{3q_L^{NC}}{4}.$$

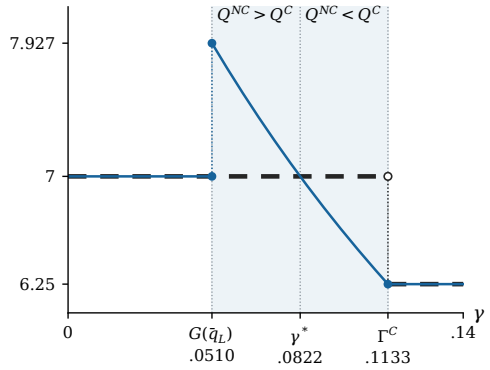
Hence $Q^{NC} < Q^C$ whenever $q_L^{NC} < 6$. Since $q_L^{NC} = \hat{q}_L(\gamma)$ approaches 5 as γ approaches Γ^C from below, there is a nonempty interval of policy costs for which policy deterrence occurs and $Q^{NC} < Q^C$. Thus, total industry capacity can be lower under no commitment despite greater investment by the leader. ■

Figure A2 illustrates Propositions 1 and 2 using the example from the proofs. Policy deterrence arises only for intermediate policy costs: when policy is sufficiently inexpensive, deterring it is too costly, while when policy is sufficiently expensive, deterrence is unnecessary. In the intermediate region, the leader expands capacity and its market share rises. Total capacity, however, can either rise or fall, depending on whether the leader's additional capacity exceeds the reduction in follower capacity caused by policy deterrence.

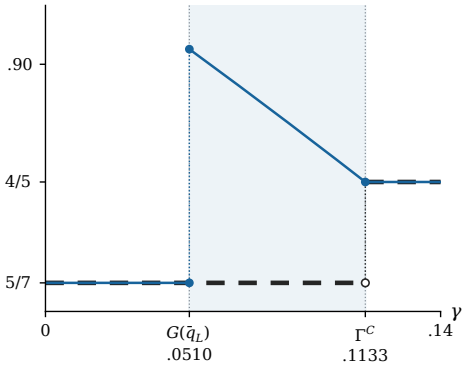
FIGURE A2. Policy Deterrence in the Parametric Example



(A) Leader's Capacity



(B) Total Capacity



(C) Leader's Market Share

Notes: The figure plots the exact equilibria in the example used to prove Proposition 1, with $A = 10$, $b = 1$, $k_0 = 2$, $k_1 = 1/2$, $C_L(q_L) = 0$, and $W_1(Q) = \log Q$. Black dashed lines denote policy commitment; blue solid lines denote no commitment. All panels use the same policy-cost scale; vertical axes have nonzero minima. The shaded interval is the deterrence region, in which the policy is adopted under commitment but rejected under no commitment. The rows below Panel (A) show policy choices under each regime. The largest capacity at which the leader is willing to deter the policy is $\bar{q}_L = 5 + \sqrt{5} \approx 7.236$. The policy-cost thresholds are

$$G(\bar{q}_L) \approx 0.0510, \qquad \gamma^* = G(6) = \log\left(\frac{38}{35}\right) \approx 0.0822, \qquad \Gamma^C = \log\left(\frac{28}{25}\right) \approx 0.1133.$$

Within the deterrence region, the leader's capacity and market share exceed their commitment levels. Total capacity is higher under no commitment for $\gamma < \gamma^*$ and lower for $\gamma > \gamma^*$. Dotted vertical connectors mark jumps. At $G(\bar{q}_L)$, the leader is indifferent between adoption and deterrence. The policymaker rejects when indifferent, so both regimes reject at Γ^C; open circles exclude the policy-adoption outcome at that threshold.

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