Lobbying, Innovation and Aggregate Productivity*

Nasir Hossein Dad
University of Toronto
[Job Market Paper]

Duc Nguyen
University of Toronto

October 31, 2024

[Click here for the latest version]

Abstract

We study the impact of firms lobbying activities on innovation and aggregate productivity in the United States. We build a quantitative model where firms make decisions about lobbying and R&D investments to grow. Lobbying can either complement R&D by increasing its returns or substitute for R&D as an alternative way to boost profits, making the net effect theoretically ambiguous. To determine which effect dominates on average, we use firm-level lobbying data and a shift-share instrumental variable strategy to estimate the causal effect of lobbying on R&D expenditure. We find that lobbying significantly reduces R&D expenditure at the firm level. We calibrate the model to the U.S. economy and find that eliminating lobbying would lead to a 3.5% increase in aggregate productivity. The gains are primarily driven by improvement in firm-level productivity distribution, through an increase in firm-level innovation. We then use the model to evaluate the impacts of U.S. Senator Elizabeth Warren's proposal to tax lobbying progressively and find that such a policy could increase aggregate productivity in the U.S. by 1.57%.

Keywords: Innovation, Lobbying, Productivity, Dynamic Misallocation
JEL classification: E10, E20, M20, O31, O32, O33, O41.

*We are grateful for the generous support and encouragement from Diego Restuccia, Laurent Cavenaile, Murat Alp Celik, Eugene Tan and useful comments from Ufuk Akcigit, Mark Rempel, Fatih Guvenen, Loren Brandt Lin Shao, Ashantha Ranasinghe, Ceren Baysan, Till Gross, Youngmin Park, Kurt See and MacDev group and audiences at Toronto, Carleton, Bank of Canada and Canadian Economic Association CEA 2024 in Toronto. All remaining errors are our own. Hossein Dad and Nguyen gratefully acknowledge the support from the Social Sciences and Humanities Research Council of Canada. We are thankful to In Song Kim and the team at Lobbyviews for detailed data access. The views expressed herein are those of the authors and should not be attributed to any other person or institution. Contact: nasir.hossein@mail.utoronto.ca and ducm.nguyen@mail.utoronto.ca.

1 Introduction

A large body of innovation literature (Aghion and Howitt, 1990; Grossman and Helpman, 1991) has emphasized that innovation is the driving force behind productivity growth, where unproductive incumbents are replaced by innovative new entrants. These models typically assume that firms increase their profits through investing in research and development (R&D) to innovate and expand their production technologies. Although R&D driven firm-growth is well studied in the literature, there exists other tools that firms may use to extract rents and create favorable distortions to grow.

A key intangible investment to influence policy outcomes is through corporate lobbying. Corporate lobbying allows firms to enhance profitability without relying on innovation. Lobbying enables firms to extract rents or create favorable distortions, potentially acting as a substitute for innovation. Alternatively, lobbying can increase a firm's profitability, which could enhance the returns on innovation. This increased profitability can motivate firms to invest more in R&D, as they stand to gain more from their innovations, making lobbying a potential complement to innovation.

How do firms utilize lobbying, and what are the consequences on innovation, aggregate productivity and social welfare in the economy? What are the implications for policy intervention and how should we govern lobbying in the United States? We study these questions, both empirically and quantitatively.

In this paper, we develop a general equilibrium model of innovation embedded with lobbying and estimate it with detailed firm-level financial and lobby data. Using a shift-share instrumental variable we establish a causal relationship between lobbying and R&D expenditure at the firm level, which is a key empirical target for the model. Empirically, we find that a 1% increase in lobby expenditure leads to a 0.81% decrease in R&D expenditure on average. We conduct a counterfactual experiment, where we shut down lobbying and find that aggregate productivity increases by 3.5%. Firm's productivity distribution is key to explaining the increase in aggregate productivity. Through shutting down lobbying, firm's substitute away from lobbying activities to increase their innovation efforts, hence improving the distribution of firms in equilibrium. We implement a real world policy, where we evaluate Elizabeth Warren's excess lobby tax, and find that aggregate productivity increases by 1.57%, which accounts for 45% of the productivity gains of the economy with no lobbying.

Our dataset includes firm's lobbying expenditure and assignment of politicians across congressional committees over time. We establish a causal relationship between lobbying and R&D expenditures at the firm level using an instrumental variable to address issues of endogenity. We exploit exogenous variation in the value of firm's connection with politicians by following the assignment of politicians to committees across time. Our identification strategy uses a shift-share design, where the shares are importance of committees to firms and the shift is movement of politicians across committees for which there is connection to firms. We find that at the firm level, lobbying and innovation are substitutes.

To address the quantitative role of lobbying on innovation, aggregate productivity and social welfare, we develop a model of production heterogeneity with innovation and lobbying decisions by firms building on (Hopenhayn, 1992; Celik et al., 2022). The quantitative framework allows firms to maintain their profitability by making production, innovation and lobbying decisions. We model innovation and lobbying as intangible expenditures which can improve a firm's profitability through alternative methods. Firms innovate through investing in costly R&D to maintain and improve their productivity over time. Alternatively, our model features endogenous lobbying decision where firms decide to lobby to gain policy benefits and improve their profits. We model lobbying as a profit-shifter: lobbying expenditures result in policy benefits at the cost of directly spending resources on lobbying. In theory, our framework allows innovation and lobbying to be substitutes or complements. Lobbying allows a firm to grow in size, which can amplify the returns from innovation— we term this as scale effect, where lobbying and innovation act as complements. Conversely, if a firm is not able to lobby, they may expend more resources into R&D, as it becomes their primary means to enhance profitability. In this scenario, lobbying and innovation are substitutes.

To quantify the impact of lobbying through the various channels, we calibrate the model to match key macroeconomic and firm-level moments in the United States. In particular, the model replicates key facts on R&D and lobbying activities observed in the data. We validate the model by replicating non-targeted firm-level moments on lobbying and innovation as well as aggregate moments on investment dynamics.

Our main counterfactual experiment is to compare the calibrated baseline economy to a counterfactual economy where we eliminate lobbying entirely. This experiment reveals the main implications of lobbying for macroeconomic aggregates. Shutting down lobbying in the economy increases firm level investments in R&D, which results in more aggregate innovation in the economy. Through an increase in firm-level investments in R&D, both sales and productivity growth rates of firms increase relative to the baseline economy. In equilibrium we find that R&D and lobbying are substitutes at the aggregate level.

We find that shutting down lobbying improves consumption-equivalent welfare in the economy through changes in the productivity distribution which is driven by the substitution effect between lobbying and innovation. In addition to our quantitative results on the aggregate effects of lobbying, we consider the implications for policy intervention. In particular, if it is not feasible to eradicate lobbying in the United States, then the question becomes "How should we regulate lobbying." To address policy questions, we implement an excessive lobbying tax proposal by senator Elizabeth Warren. Under Warren's lobbying tax proposal, companies that spend between \$500,000 and \$1 million per year on lobbying, calculated on a quarterly basis, will pay a 35% tax on those expenditures. For every dollar above \$1 million spent on lobbying, the rate increases to 60% – and for every dollar above \$5 million, it increases to 75%. We find that the policy increases aggregate productivity and consumption by 1.57% and 5.11% respectively, whereas the market value of firms will increase by 2.07%. We compare the proposal to a revenue-netural flat 4.8% lobby tax on all lobbying expenditure in the economy. The flat taxation under-performs Warren's proposal through increasing aggregate productivity and consumption by 1.30% and 4.19% respectively. The differential effect provides evidence that the distribution of firms impacted by the policy matters for macroeconomic aggregates.

Our paper contributes to three key strands of literature. First, it relates to the broad literature on resource misallocation (Restuccia and Rogerson, 2008; Hsieh and Klenow, 2009) and its dynamic consequences (Hsieh and Klenow, 2014; Bento and Restuccia, 2017; Akcigit et al., 2021; Ayerst et al., 2024). We advance this literature by providing a quantitative framework that endogenizes the choice to invest in distortions through lobbying. While previous studies have largely focused on the indirect effects of misallocation without addressing the sources of distortions, our paper offers a direct approach by micro-founding the sources of misallocation through firm-level lobbying. This connects to recent efforts in assessing the impact of lobbying on distorting firm-size distributions, which leads to factor misallocation (Huneeus and Kim, 2021; Choi, 2023).

Second, our paper contributes to the innovation literature by examining the relationship between lobbying and innovation, making two important contributions. First, our empirical analysis reveals that, at the firm level, lobbying and innovation act as substitutes. This finding connects to recent studies exploring interactions between innovation and other intangible investments, such as advertising (Cavenaile et al., 2019; Cavenaile and Roldan-Blanco, 2021; Cavenaile et al., 2022) and intellectual property rights (Abrams et al., 2019; Rempel, 2021). Second, based on this empirical result, we develop a quantitative model to evaluate the impact of lobbying on innovation. Our model includes policy interventions, specifically assessing the effects of Elizabeth Warren's proposed excessive lobbying tax. This analysis not only adds to the advertising literature by highlighting how policy interventions can enhance aggregate productivity and promote social welfare but also provides new insights into the regulation of lobbying. Our findings emphasize the significant implications of policy regulation on macroeconomic aggregates and social welfare.

Third, our paper is closely related to the empirical and quantitative literature on corporate lobbying in the United States, including studies such as (Bombardini, 2008; Bombardini and Trebbi, 2012; Kerr et al., 2014; Chen et al., 2015; De Figueiredo and Richter, 2014; Bombardini and Trebbi, 2020; Kang, 2016; Choi, 2023; Arayavechkit et al., 2018). These studies investigate various aspects of lobbying, such as the differential willingness of firms of different sizes to invest in lobbying, sector-specific analyses, and the role of lobbying associations or policy issues. For example, (Kang, 2016) uses a game-theoretic model to quantify the effect of lobbying on policy in the energy sector, while (Choi, 2023) examines how lobbying influences welfare gains from trade. Our contribution extends this literature by assessing firm-level trade-offs between lobbying and other intangible resources, particularly R&D investments, and analyzing the macroeconomic impact of lobbying across all sectors and congressional periods from 1999-2020. By exploring the broader economic consequences of corporate lobbying and its dynamic effects, our study provides new insights into the welfare implications of lobbying across the entire economy.

The closest paper to ours is (Huneeus and Kim, 2021), which examines the impact of firm-level lobbying activities on resource misallocation and the distortion of the firm-size distribution, focusing primarily on the static effects of lobbying on macroeconomic aggregates. In contrast, our study introduces a new dynamic mechanism by exploring the interplay between lobbying and innovation. While (Huneeus and Kim, 2021) demonstrate that eliminating lobbying can increase aggregate productivity by 6% through reducing static misallocation, our findings highlight that the dynamic channel can boost aggregate productivity by 50% more in the United States. Our paper is, to our knowledge, the first to analyze the implications of lobbying on innovation within a dynamic quantitative framework.

The paper proceeds as follows. In the next section we describe the data and present the main empirical findings using our micro-data. Section 3 describes the model and characterizes the equilibrium. In section 4, we calibrate a baseline model to micro and aggregate data for United States and quantify the effects of lobbying on macroeconomic aggregates. In section 5, we implement Elizabeth Warren's excessive lobbying tax proposal and compare it with a revenue-neutral flat-taxation system. We conclude in section 6.

2 Stylized Facts

We describe the micro-data, provide details of constructed variables and discuss our identification strategy. We then present our main facts on the interaction between lobbying and innovation at the firm-level.

2.1 Firm Balance Sheet and Lobby Data

We use firm-level balance sheet data from Compustat covering publicly traded firms in the United States. We integrate firm-level economic activities with detailed information on lobbying activities for all public firms between 1999-2020. In 1995, Congress enacted the Lobby Disclosure Act (LDA) which requires detailed documentation of lobbying activities between lobbyist and clients for all lobbying expenditures over $5000 in a quarter. The data contains information on the quarterly lobbying expenditure of firms, list of issues lobbied, whether the lobbying was in-house or outsourced and the precise legislative bill that is lobbied. The lobbying data is from one million filings available from the Senate Office of Public Records (SOPR) and the House of Representatives Legislative Resouce Center (LRC). In the literature the LDA reports are the gold standard as source of data for studying lobbying activity in the United States (Bombardini and Trebbi, 2012; Huneeus and Kim, 2021).

Table 1: Shares of Firm Types

Statistic	**Value**
Share of Innovative Firms	43.4%
Share of Lobby Firms	14.7%
Share of Innovative and Lobby firms	8.0%
Share of Sales by Innovative and Lobby firms	27.9%

Notes: The table reports the share of firms that are i) innovative, ii) lobby firms iii) both and the share of sales captured by innovative and lobby firms. We define a firm to be innovative if they have positive R&D expenditure in a given year. We define a firm to be actively lobbying if they have positive lobby expenditure in a given year.

Compustat is not representative of the entire distribution of firms in the economy, since publicly listed firms tend to be large. Given that our focus is on innovative and lobbying firms and both activities are largely conducted by large firms, Compustat data is complimentary to our analysis. We focus on firms that report positive R&D and lobbying expenditure. Compustat firms account for 40% of all lobbying activity in the economy from 1999-2020. In Table 1, we document the share of firm types (innovative, lobbying or both) in our sample. We define a firm to be innovative, if they have positive expenditure on R&D consistent with (Cavenaile and Roldan-Blanco, 2021). Similarly, a firm is defined to be engaged in lobbying, if they have positive expenditures towards lobbying activity. We find that 43.4% of firms are innovative, while only 14.7% engage in lobbying activity. Amongst our sample, 8% of all firms are both engaged in innovation and lobbying activities. However, the set of innovative and lobbying firms capture 27.9% of total sales our sample.

Table 2: Summary Statistics

	Lobby and R&D firms		**All firms**	
Variable	**Mean**	**St. dev.**	**Mean**	**St. dev.**
Sales (million U.S.D.)	16,252	40,323	3722	16,965
Age (years)	19.30	10.43	12.48	9.93
R&D (million U.S.D.)	790	2073	181	977
LOB (million U.S.D.)	1.48	3.83	1.24	3.96
# of Bills	39	71.76	45	103.02
Productivity Growth	0.65%	11.80	0.91%	67.81

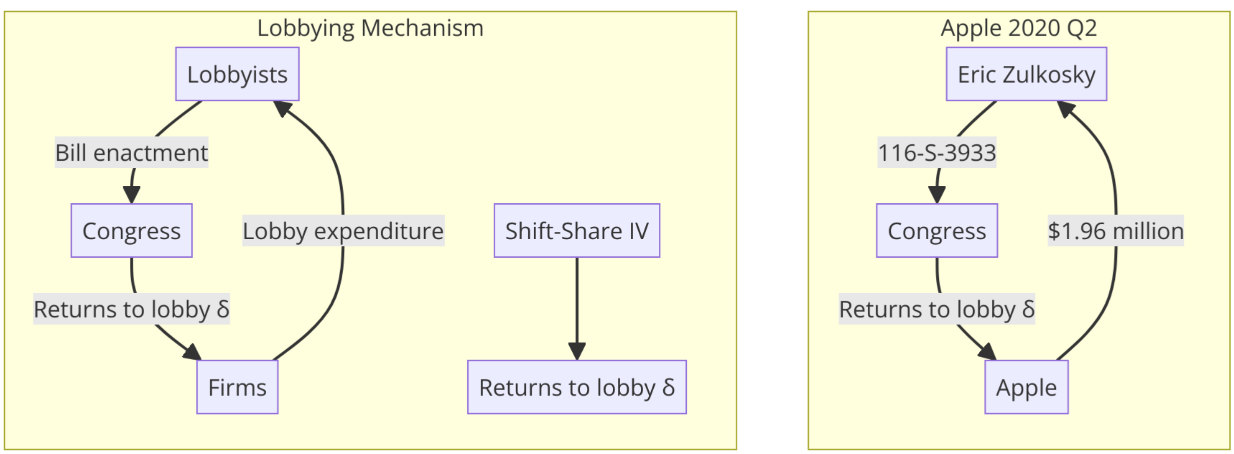
Notes: This table presents the mean and standard deviations of sales, firm age, R&D expenditure, lobby expenditure, number of bills lobbied, and productivity growth. We divide the sample into firms that have positive lobby and R&D expenditure in columns 2 and 3 and compare the mean and standard deviation of each moment with the entire sample of firms in columns 4 and 5.

In Table 2, we show that the firms who engage in lobbying and innovation tend to be larger, survive longer, spend more on innovation and lobbying and have lower productivity growth relative to the average firm in our sample. Conditional on lobbying, the firms that lobby more tend to survive longer in the industry (see Figure 10) and the industry tend to have weaken firm dynamics, consistent with studies on political connections and firm dynamics (Akcigit et al., 2023).

2.2 Identification Strategy

We supplement Compustat and lobby data with detailed information on politicians and congressional committees. We construct a complete history of bills that are lobbied by a firm, targeting a specific committee, which provides a measure of importance of that particular committee and firm. We have detailed information on the set of bills that firms lobby, which committee the set of bills are assigned to and the politicians that are assigned to that particular committee. In Figure 1, we provide an example of our mapping between firms, politicians, and committees. Apple spent 1.96 million dollars in quarter 2 of 2020 to lobby for CHIPS America Act which corresponds to Bill 116-S-3933. We observe the politician, Eric Zulkosky, who is politically connected to Apple and the sponsors of the bill (John Cornyn, Marsha Blackburn, Todd Young) and their assigned committee (Finance).

Figure 1: Identification Strategy



Notes: This figure summarizes the mechanism of lobbying (left panel) and a specific example (right panel) for the process. On the left panel, firms make lobby expenditures to motion bills, which go through congress where politicians can sponsor a specific bill. Once the bill circulates over the political system, firms can reap benefits in the form increased revenues from a particular bill. On the right panel, we provide an example of how we measure the returns to lobbying and trade-off between innovation. We match firms, lobbying expenditure, set of bills lobbied, political connections,political assignments across committees and exogenous movements across the committees as our identification strategy.

The relationship between lobbying expenditures and R&D expenditure is subject to endogenity concerns. The effect of lobbying expenditure on R&D expenditure needs to account for potential amplification effect due to firm's lobbying ability. Our goal is to exploit variation in lobbying expenditure which is exogenous to firm's lobbying ability. We follow (Bertrand et al., 2014; Huneeus and Kim, 2021) in proposing an instrument that captures changes in the marginal cost of lobbying, while maintaining the firm's primitives constant.

The instrument is comprised of three key ingredients that capture changes in the marginal value of firm's lobbying expenditure. First, we exploit changes in the assignment of politicians committee membership in Congress. Second, firms are heterogeneous in their exposure to particular committees. Third, firms and politicians may have mutual objectives, making them politically connected.

We define the instrument z_{it} for our endogenous variable as follows:

$$z_{it} = \sum_{j \in \Omega_i} \sum_{c} \underbrace{w_{ict-k}}_{Share} \underbrace{d_{jct}}_{Shift}.$$

1. Ω_i: Set of politicians that are connected to firm i

2. w_{ict-k}: Importance of committee c for firm i in period $t-k$

$$w_{ict-k} = \frac{b_{ict-k}}{\sum_h b_{iht-k}}.$$

3. $d_{jct} \in \{0,1\}$: Whether politician j is a member of committee c in period t

First, we define a firm i's set of political connection Ω_i as defined by the co-location of firm i's headquarter and the district where the politician is representing. For example, Apple and politician Don Edwards are considered to be politically connected as the headquarter and state representation are both orginated in California. Second, committee weights w_{ict-k}, represent how important a particular committee c is for firm i in period $t-k$. We capture the importance of committees to firms through measuring the share of bills b_{ict-k} lobbied that are assigned to that particular committee c in period $t-k$. Last, we exploit the identification from the shift d_{jct} of a politician j from committee c in period t. The key identification assumption is that firm's cannot influence the movement or timing of movements of politicians across committees. We confirm that this is not the case as movements across committees does not correlate with firms decisions and depends on factors such as inter-party negotiations and seniority. Note that the key identification is that movements of politicians across committees differently impacts the returns to lobbying for firms due to differences in exposure to committees and connections to politicians. We provide a detailed illustrative example of our shift-share design in figure 21 in our empirical appendix.

2.3 Empirical Results

Table 3 presents our main empirical findings of the relationship between innovation and lobbying at the firm-level. Column 1 and 2 presents the OLS and IV estimation of the elasticity of lobbying with respect to sales. While column 3 and 4 presents the estimation of the elasticity lobbying with respect to R&D. In particular, we estimate the OLS model as follows:

$$y_{jt} = \alpha + \beta L_{jt} + \gamma_j^F + \gamma_t^T + \gamma_{k(j)t}^S + \gamma_{l(j)t}^I + \epsilon_{jt},$$

where $y_{jt} \in \{Sales, R\&D\ expenditure\}$, L corresponds to the lobbying expenditure, γ_j^F corresponds to firm-fixed effects, γ_t^T corresponds to time-fixed effects, $\gamma_{k(j)t}^S$ corresponds to state-time fixed effects, $\gamma_{l(j)t}^I$ corresponds to sector-time fixed effect. Similarly, we estimate the IV regression model in column 2 and 4 as follows:

$$y_{jt} = \alpha + \beta Z_{jt} + \gamma_j^F + \gamma_t^T + \gamma_{k(j)t}^S + \gamma_{l(j)t}^I + \epsilon_{jt},$$

$$z_{it} = \sum_{j \in \Omega_i} \sum_{c} \underbrace{w_{ict-k}}_{Share} \underbrace{d_{jct}}_{Shift} .$$

The results in Table 3, Column 1 and 2 corresponds to elasticity of lobbying to sales. In particular we find that a 10 percentage increase in lobbying expenditure will result in a 2.16 percentage increase in sales. Our results are consistent with the estimates of returns

Table 3: Elasticity of Lobbying to Sales & Innovation

	Log Sales		**Log R&D**	
	(1)	**(2)**	**(3)**	**(4)**
Log Lobby	0.048***	0.216***	0.102***	−0.815**
	(0.012)	(0.045)	(0.029)	(0.421)
N	9180	9180	2345	2345
Firm and Year FE	✓	✓	✓	✓
State-Year FE	✓	✓	✓	✓
Sector-Year FE	✓	✓	✓	✓
Model	OLS	IV	OLS	IV
Sample Period	2005-2017	2005-2017	2005-2017	2005-2017
Weight Lag		*nBills, t-1*		*nBills, t-1*
F-Stat		19.7		9.6

Notes: Robust asymptotic standard errors reported in parentheses are clustered at the firm-year level. The sample period is from congress 109-115 at the annual frequency. All regression specifications, control for firm, year, state-year and sector-year fixed effects. We use the share of bills lobbied to a particular committee in period $t-1$ as weights for our IV. We measure the sector at the SIC3 classification. We denote the significance $^{***} = p < 0.01$, $^{**} = p < 0.05$, $^{*} = p < 0.1$

to lobbying found in the literature Huneeus and Kim (2021). Column 3 indicates a positive relationship between R&D and lobby expenditure, which is statistically significant and robust to inclusion of firm, year, state-year and sector-year fixed effects. Next column 4 shows findings based on the second stage of the IV estimation, which indicates a strong negative relationship between R&D and lobby expenditure.

We find a strong substitution effect at the firm-level between lobbying expenditure and R&D expenditure. In particular, we find that a 10% increase in lobbying expenditure results in a 8.1% decline in R&D expenditure. The difference between the OLS and IV estimates suggests that endogenity is significantly impacting our OLS reuslts and the IV provides a correction for the bias. In particular, there are two sources of endogenity issues that are corrected for by the IV. First, the problem of reverse causality which highlights that R&D expenditures may influence directly lobbying decisions of firms. Firms that invest heavily in R&D may have a larger incentive to lobby for policies that protect their innovations or to influence policies directly impacting R&D. To this extent, higher R&D expenditures could lead to higher lobbying expenditures. The positive feedback loop can bias our OLS estimate upward as it amplifies the effect of R&D on lobbying with the effect of lobbying on R&D. Second, firms make decisions about their R&D and lobbying expenditures simultaneously which may lead to endogenity in our OLS estimation. Given the strong causal relationship between lobbying and innovation at the firm level, we develop a quantitative model with firm-level structural estimation procedure to assess the importance of lobbying on innovation and macroeconomic aggregates.

3 Model

We develop a model of production heterogeneity embedded with costly innovation and lobbying decisions by firms building on Hopenhayn (1992) and Celik et al. (2022). Time is discrete and denoted by $t \in \{0, 1, 2, ..\}$. There is a continuum of firms, indexed by $i \in [0, 1]$, which are heterogeneous in their productivity z_{it} and lobbying ability s_{it}. Firms use capital to produce a homogeneous good. We extend this framework to allow for both productivity-enhancing investments and lobbying expenditure. A key feature of the model is that firms endogenously choose how much to spend on lobbying efforts. The benefits of lobbying expenditure are increased revenues and the costs are variable expenditures made on lobbying efforts and the opportunity cost of investing into innovation through R&D expenditures.

3.1 Economic Environment

Technologies. At each date, a homogeneous final consumption good is produced by firms. Firms have access to a decreasing-returns-to-scale technology and are heterogeneous in their productivity z_{it} and lobbying ability s_i,

$$y_i = [\theta(s_i l_{it})^{\kappa\omega} + (1-\theta) z_{it}^{\kappa}]^{\frac{1-\gamma}{\kappa}} k_{it}^{\gamma}, \quad \gamma \in (0, 1)$$

where y_i is output, k_i is the capital input, l_i is the lobbying expenditure, θ is the share of lobbying in the economy, ω governs the returns to lobbying. Total factor productivity at the firm-level is characterized as $[\theta(s_i l_{it})^{\kappa\delta} + (1-\theta)z_{it}^{\kappa}]^{\frac{1-\gamma}{\kappa}}$. The term containing z_i is the innovation component of total factor productivity, where firms make costly R&D expenditures to improve. Note that the firm produces output $z_{it}^{\gamma}k_{it}^{1-\gamma}$ of real output in terms of the final consumption good. The κ governs the elasticity of substitution between lobbying and innovation at the firm-level.

Innovation. Firm productivity z_{it} is stochastic and fluctuates over time. We follow Celik et al. (2022) in modelling the evolution of productivity z_{it} as a AR(1) process. In particular, productivity z_{it} evolves according to the following AR(1) process:

$$\log z_{it+1} = \mu_{it} + \rho \log z_{it} + \sigma\varepsilon_{it+1},$$

where μ_{it} is the productivity drift, ρ is the persistence of productivity, σ is the standard deviation of innovation and ϵ_{it} is a shock drawn from i.i.d standard normal distribution $N(0,\sigma)$. We assume that firm innovation directly impacts the long-run mean of productivity μ_{it}. This is consistent with the idea that innovation generates growth opportunities and expands firm's technological frontier (Aghion et al., 2018; Celik et al., 2022). Firms endogenously choose the drift of productivity, which requires Research and Development spending each period:

$$\Omega(\mu_{it}, z_{it}) = \chi(\mu_{it} - \underline{\mu})^2 z_{it},$$

where $\chi > 0$ is the scale parameter, $\underline{\mu}$ is the lower bound of μ_{it} which is analogous to free drift when firms optimal policy is not to innovate. A key feature of the innovation process is that R&D spending is linear in z_{it}, which ensures that costs and benefits of innovation jointly scale upwards.

Lobbying. A firm $(z_{i,t}, s_i)$ decides how much to spend on lobbying activity $l_i(z_i, s_i)$, given their state z and s. We focus on the intensive margin of lobbying and abstract from selection into lobbying. This is motivated due to the strong persistence of lobbying expenditure over time and lack of firm firm dynamics on the extensive margin. When making the decision to lobby, firms compare the benefits of lobbying which is in the form of extra revenue to the variable cost of spending l resources.

Entry and exit. Firms exit at an exogenous rate λ each period. We assume that firms enter with the lowest productivity type $\underline{z} \in Z$ into the economy. Upon entry, firms make their innovation and lobbying decisions simultaneously. We abstract from additional structure such as entry costs and focus on a unit mass of operating firms in each period. In this sense, our results will provide a lower bound in assessing the impact of lobbying only through a fixed mass of firms. In a stationary equilibrium, the entry rate of new firms will equal to the exit rate in the economy.

3.2 Equilibrium

We focus on the steady state equilibrium in which the distribution of firms across states s, z, allocations and prices are constant. We normalize the price of the output good and denote r as the risk free- discount rate.

Households problem. There is a representative household of measure one with time-separable preferences exhibiting constant relative-risk aversion. The preferences on consumption are represented by $U(C_t) = \beta^t \frac{C_t^{1-\theta}-1}{1-\theta}$, where $\beta_t \in (0,1)$ is the time discount rate. The household is endowed with capital each period which is supplied elastically to the market.

Given initial assets A_0, the households utility optimization problem can be stated as follows:

$$\max_{\{C_t,A_{t+1}\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t \frac{C_t^{1-\theta}-1}{1-\theta} \quad \text{subject to} \quad C_t + A_{t+1} \leq (1+r_t)A_t,\, \forall t$$

where they choose the set of consumption and assets to maximize their lifetime utility. The Euler equation implies that the risk free rate $r = \frac{1}{\beta} - 1$ in a stationary equilibrium.

Firm's problem. An operating firm is characterized by productivity $z_{i,t}$ and lobbying ability $s_{i,t}$. The firm chooses the optimal capital $k_{i,t}$ and lobbying effort $l_{i,t}$ to maximize expected per-period profits $\pi(z_i, s_i)$:

$$\Pi(z_{it}, s_i) = \max_{k_{it},\ell_{it}\geq 0} \left\{ [\theta(s_i l_{it})^{\kappa\omega} + (1-\theta) z_{it}^{\kappa}]^{\frac{1-\gamma}{\kappa}} k_{it}^{\gamma} - (r+\delta)k_{it} - \ell_{it} \right\},$$

We can characterize the optimal conditions for firm's problem as follows:

$$1 = (1-\gamma)\left(\frac{\gamma}{r+\delta}\right)^{\frac{\gamma}{1-\gamma}} (\theta(s\ell)^{\kappa\omega} + (1-\theta)z^{\kappa})^{\frac{1-\kappa}{\kappa}} \omega\theta s^{\omega\kappa} \ell^{\omega\kappa-1},$$

$$k(z,s) = \left(\frac{\gamma}{r+\delta}\right)^{\frac{1}{1-\gamma}} (\theta(s\ell^*)^{\kappa\omega} + (1-\theta)z^{\kappa})^{\frac{1}{\kappa}}.$$

The production function does not yield closed-form solutions, we use numerical methods to solve for optimal $l(z,s)$ then compute the corresponding optimal $k(z,s)$. Given the optimal policy functions, optimal output, the corresponding operating profits are equal to

$$\Pi(z_{it}, s_i) = y(z,s)^* - (r+\delta)k_{it}^* - \ell_{it}^*.$$

Innovation Decision. At the beginning of each period, a firm chooses its innovation policy $\mu_i(z,s)$ given their states z, s. Note that firms may choose not to innovate. Those firms obtain a "free drift", characterized through the parameter $\underline{\mu}$ to match the average firm growth in the economy.

The optimal decision of innovation is characterized as maximizing the present value of expected profits subject to the stochastic process governing innovation:

$$V(z_i, s_i) = \max_{\mu_z > \underline{\mu}} \left\{ \pi(z_i, s_i) - \chi(\mu_i - \underline{\mu})^2 z_i + \frac{1-\lambda}{1+r} E_z V(z_i', s_i) \right\},$$

$$\log z_{it+1} = \mu_{it} + \rho \log z_{it} + \sigma \varepsilon_{it+1},$$

where λ is the exogenous exit rate and the evolution of productivity z is governed by the AR(1) process.

Firm Distribution. The firm distribution is determined over the distribution of firm's productivity z and lobbying ability s. Note that in our setting, we abstract from endogenous entry and exit decisions and impose an exogenous exit rate λ at which firms die. To ensure a constant distribution over firm types, we allow for firms to enter with the lowest productivity z in our state space. Denote $\Lambda(z, s)$ as the transition probability density function from the current state (z, s) to the next period's state (z', s'),

$$\Lambda(z', s'|z, s) = (1-\lambda) I(s' = s) \Phi' \left(\frac{log(z') - \mu(z, s) - \rho log(z)}{\sigma} \right) + \lambda I(z' = \underline{z}) \Phi' \left(\frac{log(s')}{\sigma_s} \right),$$

where $I(s' = s)$ and $I(z' = \underline{z})$ are the indicator functions of whether $s' = s$ and $z' = \underline{z}$; and $\Phi(\cdot)$ denotes the cumulative density function of the standard normal distribution.

Definition of Equilibrium. A stationary competitive equilibrium is defined as allocations $\{C, Y, K, A, I, R, L, T\}$ which denotes aggregate consumption, output, capital stock, assets, R&D expenditure, lobby expenditure and transfers, prices $\{r\}$, policies $\{l(z, s)$, $k(z, s)$, $\mu(z, s)$, $\pi(z, s)$, $y(z, s)\}$ and firm distribution $F(z, s)$ such that:

1. Given the price, the households' decision $\{C, A\}$ maximizes their lifetime utility.

2. Given the price, the optimal policy functions $\{l(z, s), k(z, s)\}$ solve the firm's static problem, determining the per-period profits $\pi(z, s)$ and optimal output $y(z, s)$.

3. Given the price, the optimal policy function $\mu(z, s)$ solves the firm's dynamic problem, determining the value of a firm $V(z, s)$.

4. The lump-sum transfer T ensures government budget balance:

$$T = \int_s \int_z \ell(z, s) dF(z, s).$$

5. Final good market clears: $Y = C + I + R + T$ where

$$Y = \int_z \int_s y(z, s) dF(z, s),$$

$$I = \delta \int_z \int_s k(z, s) dF(z, s),$$

$$R = \int_z \int_s \chi \left[\mu(z, s) - \underline{\mu}\right]^2 z dF(z, s),$$

6. Asset market clears:

$$A = K + \int_z \int_s V(z, s) dF(z, s),$$

where

$$K \equiv \int_z \int_s k(z, s) dF(z, s).$$

7. Invariant distribution of firms $F(z, s)$ are consistent with firm decisions and are stationary:

$$F'(z', s') = \int_z \int_s \Lambda(z', s' | z, s) dF(z, s).$$

3.3 Implications.

In the empirical section, we emphasized the relationship between lobbying and innovation at the firm-level. We now discuss how the model relates with the elasticises derived from our empirical section and provide key implications of innovation and lobbying across the firm-size distribution.

Proposition 1. *The optimal choice of a firm's decision to innovative and improve their productivity drift μ is characterized by assessing the total impact of productivity on the value of a firm as follows*

$$\frac{\partial V(z_{it}, s_i)}{\partial z_{it}} = \underbrace{\frac{\partial \pi(z_{it}, s_i)}{\partial z_{it}}}_{\textit{Marginal profit effect}} - \underbrace{\chi(\mu_i - \underline{\mu})^2}_{\textit{Cost of productivity drift}} + \underbrace{\frac{1-\lambda}{1+r} \int \frac{\partial V(z_i', s_i)}{\partial z_i'} \frac{\partial z_i'}{\partial z_{it}} f(\varepsilon_{it+1}) d\varepsilon_{it+1}}_{\textit{Expected marginal future value}} . \tag{1}$$

Proposition 1 shows the total impact of productivity z on the value of firm $V(z_i, s_i)$. The first term captures the direct effect of current productivity z_{it} on the static profits, highlighting how changes in productivity impacts immediate profits. Second, firms endogenously choose the long run drift μ_i, this decision has direct implications on the costs of innovation. The last term captures the indirect effect of z_{it} on future value of a firm through the law of motion for productivity.

Note that, we are interested in characterizing how lobbying choice ℓ_{it} is affected by productivity z_{it} through the decision of μ_{it}. First, as outlined in the firm's problem, lobbying impacts the value of a firm through the first term, which captures the direct effect of lobbying ℓ_{it} on static profits. We can characterize the optimal condition for ℓ as a function of productivity z:

Proposition 2. *Conditional on lobbying, a firm's optimality with respect to lobbying is characterized as follows*

$$1 = (1-\gamma) \left(\frac{\gamma}{r+\delta} \right)^{\frac{\gamma}{1-\gamma}} \left[\theta (s\ell)^{\kappa\omega} + (1-\theta) z^{\kappa} \right]^{\frac{1-\kappa}{\kappa}} \omega \theta s^{\omega\kappa} \ell^{\omega\kappa - 1}. \tag{2}$$

Proposition 2 shows the optimal decision of lobbying can be characterized as a function of their lobbying ability, productivity and key parameters governing the relationship between lobbying and innovation. Importantly, the endogeneity issue illustrated in the empirical section is evident through the interdependence between lobbying expenditure ℓ and corresponding firm's primitives.

Proposition 3. *The elasticity of lobbying ℓ with respect to productivity z is given by:*

$$\epsilon_{\ell,z} = \frac{1-\kappa}{\kappa(1-\omega\kappa)} \cdot \frac{(1-\theta)\kappa z^{\kappa}}{\theta(s\ell)^{\kappa\omega} + (1-\theta)z^{\kappa}}. \tag{3}$$

Proposition 3 highlights the relationship between changes in lobbying with respect to changes in productivity. Using proposition 1 and 3, coupled with the empirical estimates in section 2, we numerically derive a relationship between lobbying and innovation consistent with the empirical counterpart in our quantitative model.

Proposition 4. *In the model without lobbying whereby $\theta \to 0$, z_{it} has linear sufficient statistic property for firm characteristics where:*

$$\begin{aligned} \Pi(z_{it}) &= \max_{k_{it}} \left\{ z_{it}^{1-\gamma} k_{it}^{\gamma} - (r+\delta)k_{it} \right\}, \\ &= z \left(\frac{\gamma}{r+\delta} \right)^{\frac{\gamma}{1-\gamma}} \left[1 - (r+\delta) \left(\frac{\gamma}{r+\delta} \right)^{\frac{1}{\gamma}} \right]. \end{aligned} \tag{4}$$

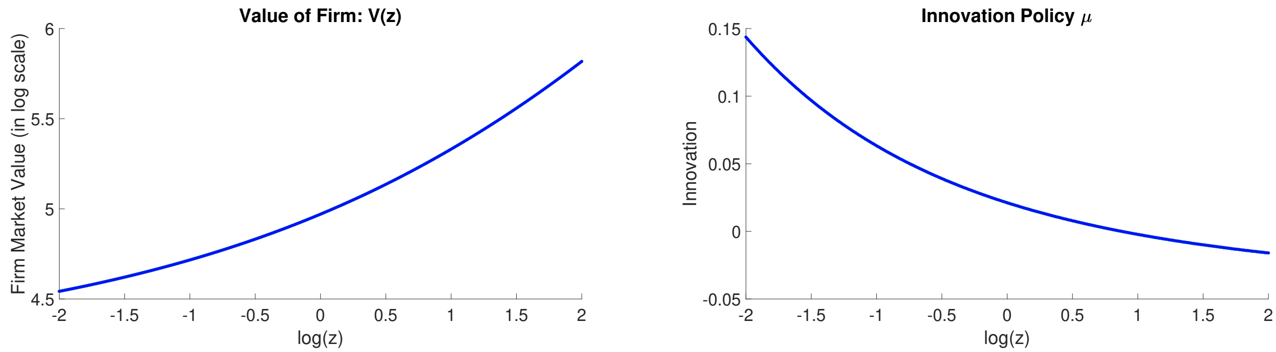
$$V(z_i) = \max_{\mu_z > \underline{\mu}} \left\{ \Pi(z_i) - \chi(\mu_i - \underline{\mu})^2 z_i + \frac{1-\lambda}{1+r} E_z V(z_i') \right\},$$

$$s.t. \quad \log z_{it+1} = \mu_{it} + \rho \log z_{it} + \sigma \varepsilon_{it+1}.$$

We characterize a firm with state z, where profits are linear in productivity and firm-size distribution can be characterized proportional to the distribution of productivity $F(z)$. Given the scaling of innovation with productivity z, the model will reject Gibrat's law as smaller firms will innovate more intensively and grow faster.

A key prediction of Proposition 4 can be shown in the innovation policy across the firm-size distribution approximated through state z in Figure 2. The baseline model is consistent with the empirical literature that reject Gibrat's law, smaller firms denoted by lower z innovate more intensively and grow faster than larger firms. The static profits combined

Economy without Lobbying: Market Value and Innovation Policies



(a) Market Value of Firm

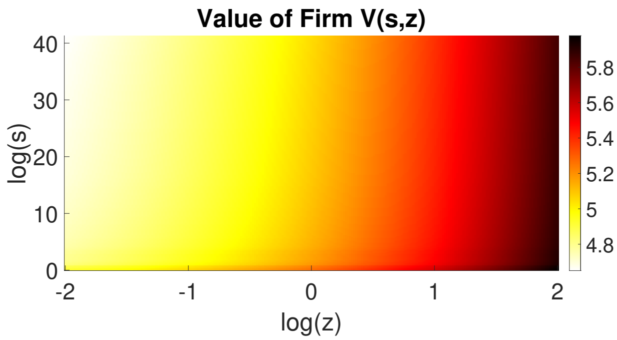
(b) Innovation Policy Function $\mu(z)$

Figure 2: Notes. The figure shows the optimal innovation policy function and the implied market value of firms with different productivity levels z in panel a) and b). Consistent with empirical literature, the baseline model rejects Gibrat's law as we observe the smaller firms innovate more intensively and grow faster.

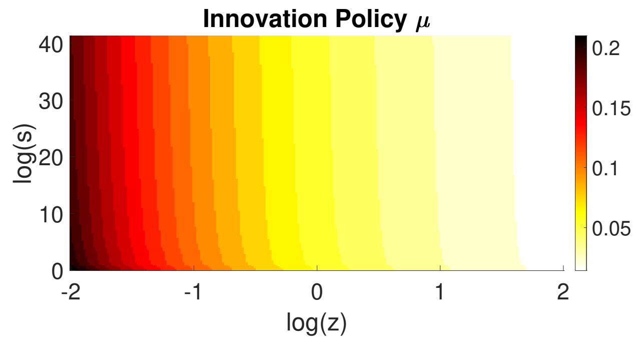
with the dynamics from the innovation policy imply that $V(z)$ is an increasing function of z.

In the baseline model with lobbying, the value of a firm $V(s,z)$ and innovation policy μ is a function of both productivity z and lobbying ability s. Figure 3 depicts the market value of a firm and optimal innovation policy across pairwise states s, z. First, from panel b) we observe that the optimal innovation policy is a decreasing function of both s and z. Note that in the model with lobbying, z is no longer a sufficient statistic for firm characteristics. Given the monotonic behavior of the optimal innovation policy, our model is consistent with figure 2, whereby innovation is most intensive for those firms with lower productivity z and lobbying ability s. The value of a firm $V(s,z)$ is monotonically increasing their productivity (z), but decreasing in their lobbying ability (s). The relationship between the value of a firm along the two dimension are non-linear and the differences along the lobbying ability is more prevalent for more productive firmss.

Baseline Economy with Lobbying: Market Value and Innovation Policies



(a) Market Value of Firm



(b) Innovation Policy Function $\mu(z)$

Figure 3: Notes. The figure shows the optimal innovation policy function and the implied market value of firms with different productivity levels and lobbying ability (s, z) in panel a) and b).

4 Quantitative Analysis

We proceed in three steps. First, we calibrate a benchmark economy with lobbying match key micro moments we established in our empirical section. Second, we show that a complete shutdown of lobbying has significant positive impact on macroeconomic aggregates. Third, we assess a policy intervention based on Elizabeth Warren's lobby tax proposal and compare it to an alternative revenue-neutral policy.

4.1 Calibration

We calibrate a benchmark economy to micro and aggregate data for United States. We parameterize the distribution of log z and log s to be normal with normalized means and standard deviations σ_z, σ_s. There are 12 parameters to calibrate in the model: the decreasing returns to scale γ, the discount factor β, the depreciation rate δ, the exogenous exit rate λ, the elasticity of substitution between lobbying and R&D κ, the returns to lobbying ω, the scale and lower bound of innovation parameters $\chi, \underline{\mu}$, the CES lobby share θ, the persistence and dispersion in AR(1) process of innovation ρ, σ_ϵ, and the dispersion in lobbying ability σ_s.

A set of six parameters are externally calibrated. We set the decreasing returns to scale to $\gamma = 0.67$ as commonly used in the literature Hsieh and Klenow (2009), Huneeus and Kim (2021), the discount factor $\beta = 0.96$ which implies a real interest rate of $r = 4\%$, the depreciation rate δ to 0.09 consistent with U.S NIPA, the exit rate to $\lambda = 0.02$ consistent with innovative and lobbying firms in Compustat, the elasticity of substitution between lobbying and R&D and returns to lobbying κ, ω are given by our estimates using our identification strategy in section 2.

The remaining six parameters $\chi, \underline{\mu}, \theta, \rho, \sigma_\epsilon, \sigma_s$ are jointly calibrated to match the following moments from United States- firm level data: (1) the average R&D intensity, (2) the average firm growth rate, (3) the average lobbying intensity, (4) the auto correlation of firm market value, (5) the coefficent of variation of firm market value, (6) the dispersion in lobby to sales ratio.

Table 4: Calibration of Benchmark Economy

Parameter	**Value**	**Target (Source)**	**Data**	**Model**
Externally identified				
Decreasing returns to scale (γ)	0.67	Huneeus and Kim (2021)		
Discount rate (β)	0.96	Interest rate $r = 0.04$		
Depreciation rate (δ_{dep})	0.09	U.S. NIPA		
Exit rate (ψ)	0.02	Compustat		
Internally identified				
Innovation cost (χ)	308	Average R&D intensity	3.96%	4.29%
Lower bound prod drift ($\underline{\mu}$)	-0.016	Average firm growth rate	0.65%	0.65%
Lobby CES share ($\hat{\theta}$)	0.042	Average lobby intensity	0.05%	0.05%
Productivity persistence (ρ)	0.86	Productivity autocorrelation	0.94	0.83
S.d of innovation (σ_ϵ)	0.12	Coefficient of variation	0.37	0.37
S.d of lobby efficiency (σ_s)	4.86	S.D. log (lobby/sales)	0.90	0.90
Elasticity of substitution (κ)	0.64	Elasticity of lobby-innovation	0.81	0.81
Returns to lobbying (ω)	0.23	Sales-lobby elasticity	0.21	0.22

Table 4 reports the calibrated parameter values with the data and model implied moments. First, we find that the calibrated parameters for innovation $(\rho, \sigma_\epsilon, \underline{\mu})$ imply values that are consistent with other studies Celik et al. (2022) Second, our calibration implies a relatively small share of lobbying in economy but large dispersion in firms ability distribution consistent with other studies in the literature Huneeus and Kim (2021). Our model is able to replicate the key moments on innovation and lobbying dynamics in the United States. Note that our model is highly non-linear in that each moment responds to all parameters in the model.

In Table 5, we provide further identification of model parameters by reporting the model-implied sensitivity of moments with respect to parameter values. The Jacobian matrix further highlights how the calibration provides identification for model parameters. We report the result changes in the model implied moments from a 1 percent increase in each calibrated parameter.

Table 5: Sensitivity of Moments to Parameters

	χ	$\underline{\mu}$	θ	ρ	σ_ϵ	σ_s
Average R&D intensity	0.001	0.001	0.000	0.001	0.003	0.000
Average firm growth rate	0.003	0.012	0.001	-0.006	0.003	0.001
Average lobby intensity	0.000	0.000	0.000	0.000	0.001	0.000
Autocorrelation	-0.009	-0.015	-0.001	0.002	-0.003	0.001
Coefficient of Variation	0.023	0.089	0.006	-0.003	0.024	0.003
Std. lobby/sales	0.000	0.000	-0.001	0.001	0.000	0.004

Notes: The values indicate the percentage changes in the moment when the indicated parameter is increased by 1 percent relative to the benchmark value and all other parameters are fixed at the benchmark values. The diagonal of the Jacobian matrix corresponds to the identification of model parameters to the moments, respecitvely.

Table 5 highlights the interactions between the parameters and model implied moments. The R&D intensity is sensitive to the scale parameter of the R&D function χ, which determines the amount of resources spent on innovation as well as the parameters governing the evolution of firm-level productivity ρ, σ_ϵ. The average firm growth rate, depends on the innovation parameters $\chi, \underline{\mu}, \rho, \sigma_\epsilon$ directly through productivity investment decisions, but is also impacted by the lobby-productivity dispersion through the substitution channel between lobbying and innovation. The dispersion in log lobby-to-sales is most sensitive to the parameter σ_s, which governs the dispersion in lobbying-ability in the model. The lobby intensity is most sensitive to θ, as it governs the share of lobbying in the model, but indirectly it is also impacted by the standard deviation of innovation σ.

Model Fit. To validate the baseline calibration, we evaluate the model's performance on a set of non-targeted moments. The interaction between R&D and lobbying is a key object in our quantitative exercises. Table 6 presents the untargeted firm-level and aggregate moments. First the model captures the correlation between R&D intensity and lobbying intensity even though we did not calibrate to match this dimension of the data. The model generates endogenously a correlation between R&D and lobby intensity that is of magnitute 0.69 which is close to the data counterpart of 0.59. Second, our model is able to other dimensions of growth at the firm-level, such as sales and productivity weighted measures.

Table 6: Untargeted Moments: Data vs Model

	Data	Model
Firm-level Moments		
corr(R&D intensity, Lob intensity)	0.5853	0.6924
sales(growth rate)	0.35%	0.20%
Aggregate Moments		
Capital-Output Ratio	3.96	4.95
Investment-Output Ratio	0.24	0.44

Notes: The table presents the untargeted moments in the model and data. We provide 3 key firm-level moments: correlation of R&D and lobby intensity, skewness and kurtosis of R&D to lobby ratio. We evaluate two key aggregate moments, the capital-output ratio in the data is consistent with Auerbach and Kotlikoff (2023). The investment-output ratio is consistent with U.S. Bureau of Economic Analysis (2024).

In addition to the model's ability to match non-targeted firm-level moments, we provide further validation through assessing the model's performance in predicting aggregate moments. First, in the model beside the substitution between R&D and lobbying expenditures, firms have the ability to use capital, therefore assessing the model's ability to match aggregate investment dynamics is important for the quantitative exercises. The model predicts a capital-output ratio and investment-output ratio which are consistent with the empirical counterparts (Auerbach and Kotlikoff, 2023; U.S. Bureau of Economic Analysis, 2024).

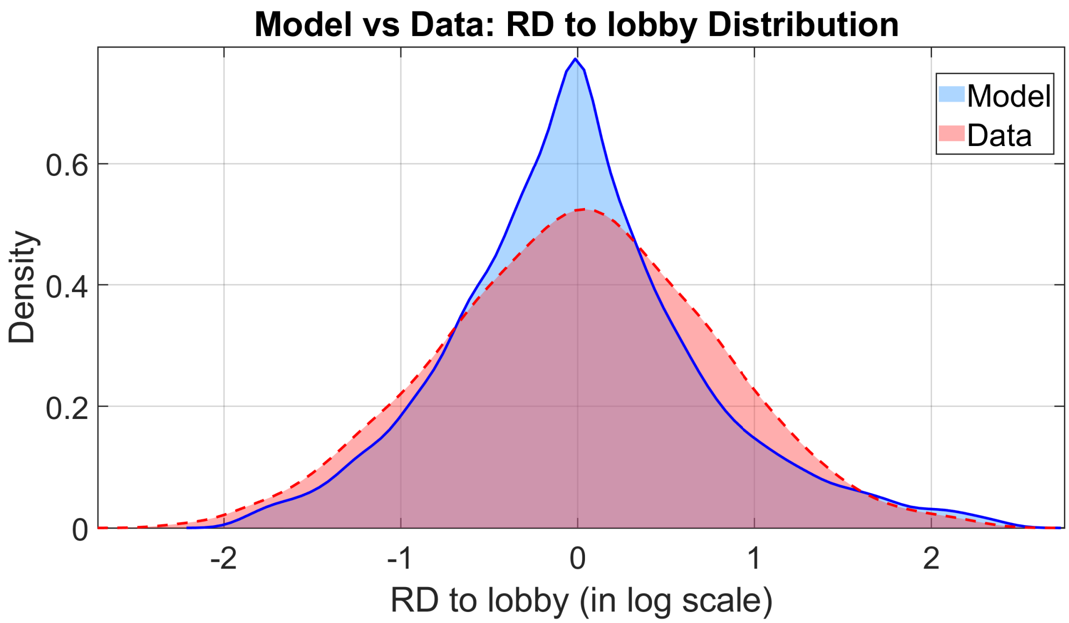


Figure 4: **Notes:** This figure shows the data (red) and model-implied (blue) distributions of RD to lobby expenditures. We target other dimensions of innovation and lobbying, but the distribution of Rd to lobbying remains untargeted and serves as a validation exercise of our model.

4.2 Counterfactual Experiments

We have calibrated the model to match key features of micro and aggregate data for United States. We now use the calibrated model as a laboratory to tackle the central question of our paper: how does lobbying impact innovation, social welfare and macroeconomic aggregates? To address the question, we conduct a counterfactual experiment in which we shutdown lobbying completely then compare our baseline calibration with a stationary equilibrium with no lobbying. Now suppose that eradicating lobbying in the United States is not feasible, then we ask: how should we regulate lobby in in the United States? To shed light to the question, we consider a policy intervention using Warren's lobbying tax proposal and compare it with an alternative revenue-neutral policy.

The Macroeconomic Effects of Lobbying

Table 6 reports how macroeconomic aggregates and firm moments are impacted as a result of a complete shutdown of lobbying as an institution. We shutdown lobbying in the economy by setting $\theta = 0$, which collapses our model to the economy without lobbying as in Proposition 4. First, the R&D as a share of GDP and growth rate of firms increase when lobbying is shut down. There are two forces governing the relationship between lobbying and R&D. First, lobbying allows firms to grow and increase their size which increases the incentive to perform R&D, a scale effect. From this perspective, lobbying and innovation are complimentary. Second, when firms cannot engage in lobbying activity, they might invest more in the R&D, which allows lobbying and innovation to be substitutes. Our result shows that the substitution effect dominates, where lobbying and innovation are substitutes at the aggregate level in general equilibrium. At the firm level, on average the innovation policy function increases by 3.5% absent of lobbying. This result is consistent with our empirical finding on the relationship between lobbying and innovation. Absent of lobbying, the average market value of firms increase by 10.5%, specifically through the innovation channel.

Table 7: Macroeconomic Impact of Lobbying Shutdown

Eliminating Lobbying	Baseline	No Lobbying	% Change
Aggregate Outcomes			
Output	1.00	1.15	15.2%
TFP	1.00	1.035	3.5%
CEWC	1.00	1.133	13.3%
Firm-level Outcomes			
Avg. R&D intensity	4.29%	4.31%	0.47%
Market Value	1.00	1.105	10.5%
Avg. Innovation	0.045	0.047	3.5%
Productivity Growth	0.65%	0.70%	7.69%

Notes: This table presents the changes in the relevant macroeconomic aggregates under the lobbying shut down whereby $\theta = 0$, stationary equilibrium compared to the baseline economy.

Lobbying also has consequences for macroeconomic aggregates. When lobbying is shutdown, aggregate output increases by 15.2% and aggregate productivity increases by 3.5%. This is due to the substitution effect, whereby firms invest more in R&D absent of lobbying, resulting in increase in average firm productivity. Note that our counterfactual experiment does not account for static misallocation and only considers the dynamic implications of lobbying. Huneeus and Kim (2021) find that the static misallocation lowers aggregate productivity by 6%, which is sizable given the dynamic response. The increase in aggregate output and productivity is also reflected as a benefit to the representative consumer in our model. We find that consumption-equivalent welfare increases by 13.3%, highlighting substantial gains for society when we eliminate lobbying. Note that there is no aggregate growth in our model, so we define consumption-equivalent welfare gain as the difference between the benchmark stationary aggregate consumption level C^{BE} and the no-lobby aggregate consumption level $C^{NoLobby}$.

The model allows for an analytical decomposition of the change in welfare, $\Delta W \equiv W^A - W^B$ between any two stationary equilibria A and B as follows:

$$\sum_{t=0}^{\infty} \beta^t \frac{((1+\Delta W)C_A)^{1-\theta} - 1}{1-\theta} = \sum_{t=0}^{\infty} \beta^t \frac{C_B^{1-\theta} - 1}{1-\theta}$$

Given the stationarity of the model and no aggregate growth we can simplify the consumption equivalent welfare change between two equilibria A and B as follows:

$$\Delta W = \frac{C^B}{C^A} - 1$$

Decomposition of channels. What are the channels in which lobbying impacts the macroeconomy? To address this question, we decompose the results discussed above into three components. First, the static and capital contribution attributes changes to the economy, whereby only capital endogenously responds holding fixed the the distribution over firm-types $F(z, s)$ and innovation policies $\mu(z, s)$. Second, we hold fixed the capital policies $k(z, s)$, but allow the distribution $F(z, s)$ and innovation policies $\mu(z, s)$ to respond endogenously. Last, the full dynamic effect is due to complete endogenous response of firms in terms of R&D investments when lobbying is shut down and capital policies, which also translates to a change in the entire distribution of firm-types.

Table 8 shows how each of the three margins impact the macro economy through a shutdown in lobbying. The first column in table 8 reports the static and capital effect of lobbying, whereby we fix the distribution over firm states $F(z, s)$, the innovation policies $\mu(z, s)$ and the level of R&D to their baseline levels. Statically, shutting down lobbying results in a welfare gain of 2.51%, which comes from the increase in capital stock and output of firms. The second column, displays what happens to welfare if we only allow the distribution of firms to adjust but keep capital policies fixed. In this case, the welfare gain from shutting down lobbying is larger, at 11.46%. This is due to the fact that the distribution of firms shift towards those firms who are more productive and produce relatively more. As a result, the total output of firms increase which translate directly to the welfare gains. In column 3 of table 8, we show the results including the dynamic effects due to changes in R&D investment. Shutting down lobbying raise the output and capital stock as a result of changes in total R&D and lobbying expenditures. In addition, the average firm value increases. Overall, the dynamic effects are large and quantitatively important. The static effects account for 2.51% welfare increase where as the dynamic gains account for a total of 13.38% in consumption equivalent terms when lobbying is shut down.

Table 8: Lobbying shutdown: Decomposition of channels

	Change $k(s, z)$ only	Change $F(s, z)$ only	Full Dynamic
	Δ %	Δ %	Δ %
Output: Y	3.84%	10.96%	15.27%
Capital: K	5.78%	10.93%	17.43%
CEWC: Λ	2.51%	11.46%	13.38%

Notes: This table shows the decomposition of the changes in aggregate and firm-level moments in the counterfactual economy without lobbying relative to the benchmark economy. All of the percentage changes are relative to the calibrated benchmark economy. The first column is changes when we fix $F(z, s), \mu(z, s)$ and aggregate R&D expenses, but allow for capital to endogenously respond. Column 2 allows for changes in the distribution of firm states $F(z, s)$, holding fixed the innovation and capital policies. The last column is the full dynamic response of the economy to a shut down in lobbying.

Aggregate output, aggregate capital and consumption are computed as follows:

$$Y = \int_{s=0}^{\infty}\int_{z=0}^{\infty} z^{\gamma} k(z,s)^{1-\gamma} dF(z,s),$$

$$K = \int_{s=0}^{\infty}\int_{z=0}^{\infty} k(z,s) dF(z,s),$$

$$\int_{s=0}^{\infty}\int_{z=0}^{\infty} z^{\gamma} k(z,s)^{1-\gamma}\, dF(z,s) - \delta \int_{s=0}^{\infty}\int_{z=0}^{\infty} k(z,s)\, dF(z,s) - \int_{s=0}^{\infty}\int_{z=0}^{\infty} \chi\left[\mu(z,s) - \underline{\mu}\right]^2 z\, dF(z,s)$$

where the first column shows the effect of an endogenous response in $k(z,s)$ to the counterfactual with $\theta = 0$ and keeping $F(z,s)$ fixed to the baseline economy. The second column shows the effect of an endogenous response of $F(z,s)$ to the counterfactual with $\theta = 0$ and keeping $k(z,s)$ fixed to the baseline economy. The last column shows the impact of allowing both policies $k(z,s)$, $\mu(z,s)$ and distribution of firms $F(z,s)$ to endogenously respond to the economy without lobbying. The response of firm types through the productivity distribution accounts for a large bulk of the effect of lobbying on aggregate outcomes. The changes in distribution of firm types in response to shut of lobbying accounts for 85% of the impact on consumption equivalent welfare.

In Figure 5, we plot the changes in the distribution of firm-types between the benchmark calibrated economy and the counterfactual no lobby economy denoted as $F^{CF}(z,s) - F^{BE}(z,s)$. Conditional on firm's lobbying ability, we find that the mass of firms have shifted towards more productive types (higher z) in the counterfactual economy. Therefore, validating our de-compositional effects, whereby in response to a shutdown to lobbying, firm-productivity distribution improves through more investments toward innovation. Shutting down lobbying results in firms substituting towards capital which improves macroeconomic outcomes, but the effects on the firm-type distribution dominates and accounts for bulk of the effects on the macro-economy.

Distributional consequences. To address the question of who are the winners and who are the losers of a shutdown in lobbying, we assess the changes in market value of firms. In

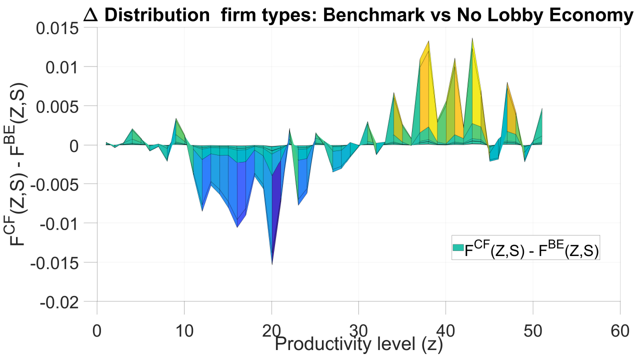


Figure 5: Divergent Benchmark and Counterfactual Distribution

Notes: The figure plots the changes in the distribution of firm types across (z,s) space between the benchmark economy and the counterfactual economy without lobbying. Key insight from the figure is to show that the distribution of firm types across the productivity distribution is more concentrated on the upper tail, which increases the average productivity type firms in the counterfactual economy conditional on lobbying productivity.

Figure 5, we show the percentage change in market value of firms across states (s,z) between the baseline and no lobby economy. Formally, we compute the percentage change in the value of firms across the two economies as follows:

$$\left(\frac{V^{\text{No Lobby}}(s,z) - V^{\text{BE}}(s,z)}{V^{\text{BE}}(s,z)}\right) \times 100$$

There are two key takeaways from Figure 6. First, the losers of policies that eliminate lobbying are the high lobby ability and low productivity types. These firms achieve large surplus from actively engaging in lobbying to improve their profits. Second, the firms that win from eradicating lobby are the low lobbying ability but highly efficient firms. Given the low lobby ability of these firms, a shut-down to lobbying will not impact their static profits or their dynamic returns relative to the high lobby ability firms.

Overall, we find that that shutting down lobbying will have net-positive impact both at the firm-level and macroeconomic aggregates. However, can a complete shutdown of lobbying in the United States be implemented or even plausible? This raises questions for policy intervention: How should we regulate lobbying in the United States?

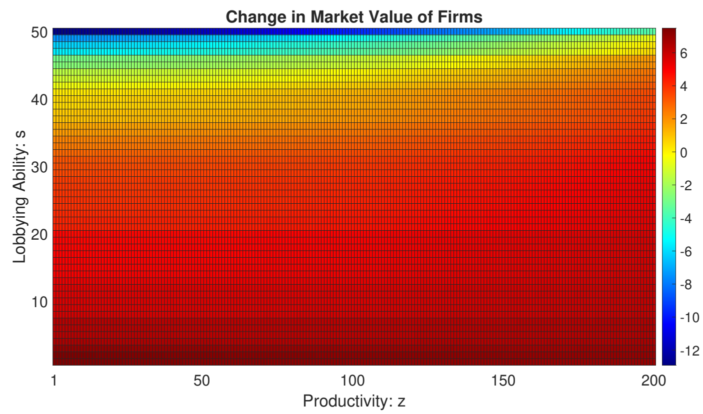
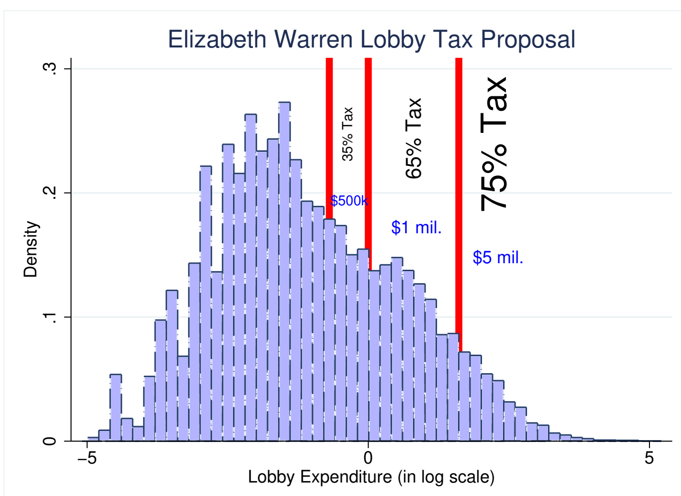


Figure 6: **Notes:** The figure shows the percentage change in market value of firms between the benchmark and no lobby economy across (s,z) firm states.

Policy interventions. Our main result is that a complete shutdown of lobbying has a net positive quantitative impact on the macro economy through improvements in the productivity distribution. This raises the question on how to regulate lobbying, if eliminating lobbying altogether is not feasible in the United States. In this section, we assess a progressive lobbying tax proposed by senator Elizabeth Warren and compare it to a revenue-neutral alternative policy.

Figure 7: Lobby Expenditure with Proposed Tax Rates



Notes: This figure shows the empirical distribution of lobby expenditure (blue density) with Senator Elizabeth Warren's lobby tax proposal. The red lines on the distribution indicate where the 75%, 60%, and 35% marginal tax rates will be applicable, corresponding to lobby expenditures of 5 million, 1 million, and 500,000, respectively.

To address these policy questions, we implement a lobbying tax proposal introduced through Elizabeth Warren. Under Warren's lobbying tax proposal, companies that spend between $500,000 and $1 million per year on lobbying, calculated on a quarterly basis, would pay a 35% tax on those expenditures. For every dollar above $1 million spent on lobbying, the rate increases to 60% – and for every dollar above $5 million, it increases to 75%. Figure 9, shows the empirical distribution corresponding to lobby expenditure and the distributional consequences of the progressive taxation. In particular, 5.9 of lobby expenditure are taxable at 75%, 16.7% at 60% and 3.69% at 35% tax rate. Note that a large fraction of expenditure are exempt of taxes, precisely 73.71% will be tax-free under Warren's policy.

Table 9: Empirical Distribution of Lobbying Expenditure

Warren Tax Cutoffs	**Value**
Share > 5 mil.	5.9%
Share 1 mil. > 5 mil.	16.7%
Share 500,000 > 1 mil.	3.69%
Share 500,000 > 0	73.71%

Notes: The table presents the share of lobby expenditure that are within each of the marginal tax brackets. 73.71% of lobby expenditure is in the non-taxable region, where as 3.69% is at the 35% marginal tax rate and 16.7% and 5.9% are at the 60% and 75% marginal tax rates, respectively.

We compare Warren's policy with a simple flat taxation of 4.8% on all lobbying expenditure, which is revenue-neutral. Table 10 show the impact of policy structure on macroeconomic aggregates. First, with a simple flat tax policy, aggregate R&D expenditure and TFP increases by 3.3% and 1.3% relative to the benchmark economy. Under Warren's revenue neutral progressive taxation, R&D expenditure increases by 4.03%, resulting in a TFP boost of 1.57% relative to the benchmark. This is due to the fact that how regulate lobbying has distributional consequences, impacting the productivity distribution deferentially. For instance, under the Warren's policy, firms that are most lobby intensive are disproportionately impacted and as a result the extent to which firms substitute between R&D and lobbying differs across firm types. Under the flat taxation, firms do not have the same size-dependent impact of lobbying on R&D and hence dampening the effect on the productivity distribution.

Second, our results show that the representative consumer is better of under the Warren

Table 10: Elizabeth Warren vs Flat Taxation

	Flat Tax	Warren Tax	No Lobby
Output	4.19%	5.14%	15.2%
TFP	1.30%	1.57%	3.5%
Consumption	4.19%	5.11%	13.3%
Market Value	1.63%	2.07%	10.5%

Notes: This table presents aggregate and firm-level moments in three altenrative economies, relative to the baseline calibrated economy. First column 2 presents the impact of a 4.8% flat taxation on all lobby expenditure, relative to the baseline economy. Column 3 presents the economy which a progressive taxation as in Warren's proposal is implemented relative to baseline. Column 4 presents the economy where lobbying is completely shutdown relative to the baseline economy.

Tax reform, which has a consumption-equivalent welfare gain of 5.11% compared to the 4.19% under flat taxation relative to the benchmark economy. This is due to the fact that the substitution effect dominates scale effects relatively more in an economy with size-dependent lobbying taxation policy. This is further present in the differential impact on the average market value of firms in the economy. Warren's policy improves the average market value of firms by 2.07%, relative to the 1.63% achieved under flat taxation.

Warren's size-dependent lobbying tax imposes strong incentive to eliminate excessive lobbying by large firms such as Amazon, Meta, Boeing, Alphabet and General Motors. The average lobby tax-rate that large firms face under this schedule spans from 69% for Amazon to 66% for General Motors. Under Warren's policy large firms have greater incentive to substitute from lobbying to innovation relative to the flat taxation, given the large differences in tax schedule along the size distribution.

The flat taxation would discourage firms on the entire lobby distribution. In particular, lobby passive firms would be disproportionately impacted by the flat policy. Under Warren's policy, the emphasis is on excessive lobbying above $ 500,000 USD, whereas the flat-taxation focuses on all lobbying activities. In the model, small lobby firms will substitute lobbying with R&D more intensively in the flat-taxation scheme, relative to Warren's policy. Therefore, the impact of lobbying on innovation differs across the lobby distribution under both taxation schemes. Overall, the substitution effect from the mega-lobby firms in Warren's

Table 11: Top 5 Lobbying Firms in 2023

Top Lob Firms (2023)	$ (in Mil.)	Flat (in Mil.)	Warren (in Mil.)
Amazon	19.9	0.955	13.75
Meta	19.3	0.926	13.30
Boeing	14.5	0.696	9.70
Alphabet	14.45	0.693	9.66
General Motors	14.42	0.692	9.64

Notes: Top 5 Lobbying Firms in 2023 with total lobby expenditure taxation under flat taxation and Warren taxation schedule. The second column shows the total lobby expenditure in 2023 in millions. The third column shows the amount of taxes firms would pay under the flat taxation scheme. The fourth column demonstrates the amount of taxes firms would pay under Warren's tax schedule.

policy dominates the substitution by the small-lobby firms in the flat policy, resulting in improved welfare under Warren's progressive tax schedule.

5 Conclusion

Firms use both innovation and lobbying to enhance their profits, yet these strategies have different macroeconomic consequences. We study the interaction between innovation and lobbying and their implications for aggregate productivity and social welfare. We find that, at the firm level, innovation and lobbying are substitutes, with a 1% increase in lobbying expenditures leading to a 0.81% reduction in R&D investments. Motivated by this empirical evidence, we develop a quantitative model to assess the interaction between lobbying and innovation and quantify their macroeconomic impact.

Our model is calibrated to match key micro and macro-level data from the United States and serves as a laboratory for conducting counterfactual experiments. When we shutdown lobbying in the model,aggregate productivity increases by 3.5%. The shutdown of lobbying reduces the returns to innovation through scale effects, leading to lower R&D investment. However, without lobbying as a tool to boost revenues, firms increase their R&D investments. Overall, eliminating lobbying results in a 13.3% increase in consumption for the representative household.

For policy considerations, we implement senator Elizabeth Warren's progressive lobbying tax schedule and compare it with a revenue-neutral flat taxation. We find that Warren's size dependent taxation is welfare improving and favorable to the flat taxation. On net, the progressive scheme increases aggregate productivity by 1.57% relative to the baseline calibrated economy. Our results provide justification for recent efforts by policy makers to impose regulations towards corporate lobbying. Our policy analysis demonstrates how we regulate and implement policies has significant implications for macroeconomic aggregates and social welfare.

References

Abrams, D. S., Akcigit, U., Oz, G., and Pearce, J. G. (2019). The patent troll: Benign middleman or stick-up artist? Technical report, National Bureau of Economic Research.

Aghion, L., Howitt, P., and Levine, R. (2018). Financial development and innovation-led growth. In *Handbook of finance and development*, pages 3–30. Edward Elgar Publishing.

Aghion, P. and Howitt, P. (1990). A model of growth through creative destruction.

Akcigit, U., Alp, H., and Peters, M. (2021). Lack of selection and limits to delegation: firm dynamics in developing countries. *American Economic Review*, 111(1):231–275.

Akcigit, U., Baslandze, S., and Lotti, F. (2023). Connecting to power: political connections, innovation, and firm dynamics. *Econometrica*, 91(2):529–564.

Arayavechkit, T., Saffie, F., and Shin, M. (2018). Capital-based corporate tax benefits: Endogenous misallocation through lobbying. Technical report, Working paper.

Auerbach, A. and Kotlikoff, L. (2023). The us capital glut and other myths.

Ayerst, S., Nguyen, D. M., and Restuccia, D. (2024). The micro and macro productivity of nations. Technical report, National Bureau of Economic Research.

Bento, P. and Restuccia, D. (2017). Misallocation, establishment size, and productivity. *American Economic Journal: Macroeconomics*, 9(3):267–303.

Bertrand, M., Bombardini, M., and Trebbi, F. (2014). Is it whom you know or what you know? an empirical assessment of the lobbying process. *American Economic Review*, 104(12):3885–3920.

Bombardini, M. (2008). Firm heterogeneity and lobby participation. *Journal of International Economics*, 75(2):329–348.

Bombardini, M. and Trebbi, F. (2012). Competition and political organization: Together or alone in lobbying for trade policy? *Journal of International Economics*, 87(1):18–26.

Bombardini, M. and Trebbi, F. (2020). Empirical models of lobbying. *Annual Review of Economics*, 12(1):391–413.

Cavenaile, L., Celik, M. A., Roldan-Blanco, P., and Tian, X. (2022). Style over substance? advertising, innovation, and endogenous market structure. *Advertising, Innovation, and Endogenous Market Structure (April 29, 2022)*.

Cavenaile, L., Celik, M. A., and Tian, X. (2019). Are markups too high? competition, strategic innovation, and industry dynamics. *Competition, Strategic Innovation, and Industry Dynamics (August 1, 2019).*

Cavenaile, L. and Roldan-Blanco, P. (2021). Advertising, innovation, and economic growth. *American Economic Journal: Macroeconomics*, 13(3):251–303.

Celik, M. A., Tian, X., and Wang, W. (2022). Acquiring innovation under information frictions. *The Review of Financial Studies*, 35(10):4474–4517.

Chen, H., Parsley, D., and Yang, Y.-W. (2015). Corporate lobbying and firm performance. *Journal of Business Finance & Accounting*, 42(3-4):444–481.

Choi, J. (2023). Lobbying, trade, and misallocation. *Available at SSRN 4618166*.

De Figueiredo, J. M. and Richter, B. K. (2014). Advancing the empirical research on lobbying. *Annual review of political science*, 17(1):163–185.

Grossman, G. M. and Helpman, E. (1991). Trade, knowledge spillovers, and growth. *European economic review*, 35(2-3):517–526.

Hopenhayn, H. A. (1992). Entry, exit, and firm dynamics in long run equilibrium. *Econometrica: Journal of the Econometric Society*, pages 1127–1150.

Hsieh, C.-T. and Klenow, P. J. (2009). Misallocation and manufacturing tfp in china and india. *The Quarterly journal of economics*, 124(4):1403–1448.

Hsieh, C.-T. and Klenow, P. J. (2014). The life cycle of plants in india and mexico. *The Quarterly Journal of Economics*, 129(3):1035–1084.

Huneeus, F. and Kim, I. S. (2021). The effects of firms' lobbying on resource misallocation.

Kang, K. (2016). Policy influence and private returns from lobbying in the energy sector. *The Review of Economic Studies*, 83(1):269–305.

Kerr, W. R., Lincoln, W. F., and Mishra, P. (2014). The dynamics of firm lobbying. *American Economic Journal: Economic Policy*, 6(4):343–379.

Rempel, M. (2021). Innovation and firm dynamics with patent wars.

Restuccia, D. and Rogerson, R. (2008). Policy distortions and aggregate productivity with heterogeneous establishments. *Review of Economic dynamics*, 11(4):707–720.

U.S. Bureau of Economic Analysis (2024). Shares of Gross Domestic Product: Gross Private Domestic Investment [A006RE1Q156NBEA]. retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/A006RE1Q156NBEA, August 25, 2024.

Appendix

A Empirical Extensions

In this section, we provide details on data sets, variable construction, large language model (LLM) implementations and provide additional facts on lobbying and innovation for public firms in the United States.

A.1 Variable Construction

Data Sources: We use the Compustat North American Fundamentals for financial statement information of US-listed firms for the years 1998-2020, which includes R&D expenditure (xrd). We only include variables with no missing values. Our results are qualitatively robust to replacing values with zeros. We use lobby data from lobbying reports provided by the Lobbying Disclosure act, available at: https://lda.senate.gov/system/public/, which includes lobbying registartions (LD-1), quarterly activity reports (LD-2) and contribution reports (LD-203) for all firms that have lobby expenditure larger than $5000 in a given quarter. We use the lobbying expenditure reported in the lobby reports to measure lobbying. It should be noted that this measure includes both in-house spending and outsourced expenditure on lobbying. We capture both the impact of lobbying conduced by firms and outsourced to lobbying firms.

R&D Expenditure: We use R&D expenditure as a measure of an input to the innovation process. We use R&D expenditure reported in Compustat, notably coded as (XRD). We keep only variables with positive expenditure. We define a firm to be innovative, conditional on spending positive resources on R&D activities.

Lobby Expenditure: We use lobby expenditure as measure of input into the lobby process. We use lobby expenditure self-reported by firms under the Lobby Disclosure Act (LDA) mandate. We keep only variables with positive expenditure. We define a firm to be engaged in lobbying, conditional on spending positive resources on lobbying activities.

Table 12: Elasticity of Lobbying to Patents & Innovation

	Patents (Flow)		**Patents (Stock)**	
	(1)	**(2)**	**(3)**	**(4)**
Panel A:				
Log Lobby	0.209*	0.118**	0.102**	0.184
	(0.211)	(0.045)	(0.083)	(0.256)
N	3343	3343	1350	1350
Firm and Year FE	✓	✓	✓	✓
State-Year FE	✓	✓	✓	✓
Sector-Year FE	✓	✓	✓	✓
Model	OLS	IV	OLS	IV
Sample	109-115	109-115	109-115	109-115
Weight Lag		*nBills, t-1*		*nBills, t-1*
F-stat		10.2		5.5

Notes: Robust asymptotic standard errors reported in parentheses are clustered at the firm-year level. The sample period is from congress 109-115 at the annual frequency. All regression specifications, control for firm, year, state-year and sector-year fixed effects. We use the share of bills lobbied to a particular committee in period $t-1$ as weights for our IV. We measure the flow of innovation as the flow of patents in a given period for a firm. We use the stock of innovation as the stock of patents in the history of the firms existence. We measure the sector at the SIC3 classification. We denote the significance $^{***} = p < 0.01$, $^{**} = p < 0.05$, $^{*} = p < 0.1$

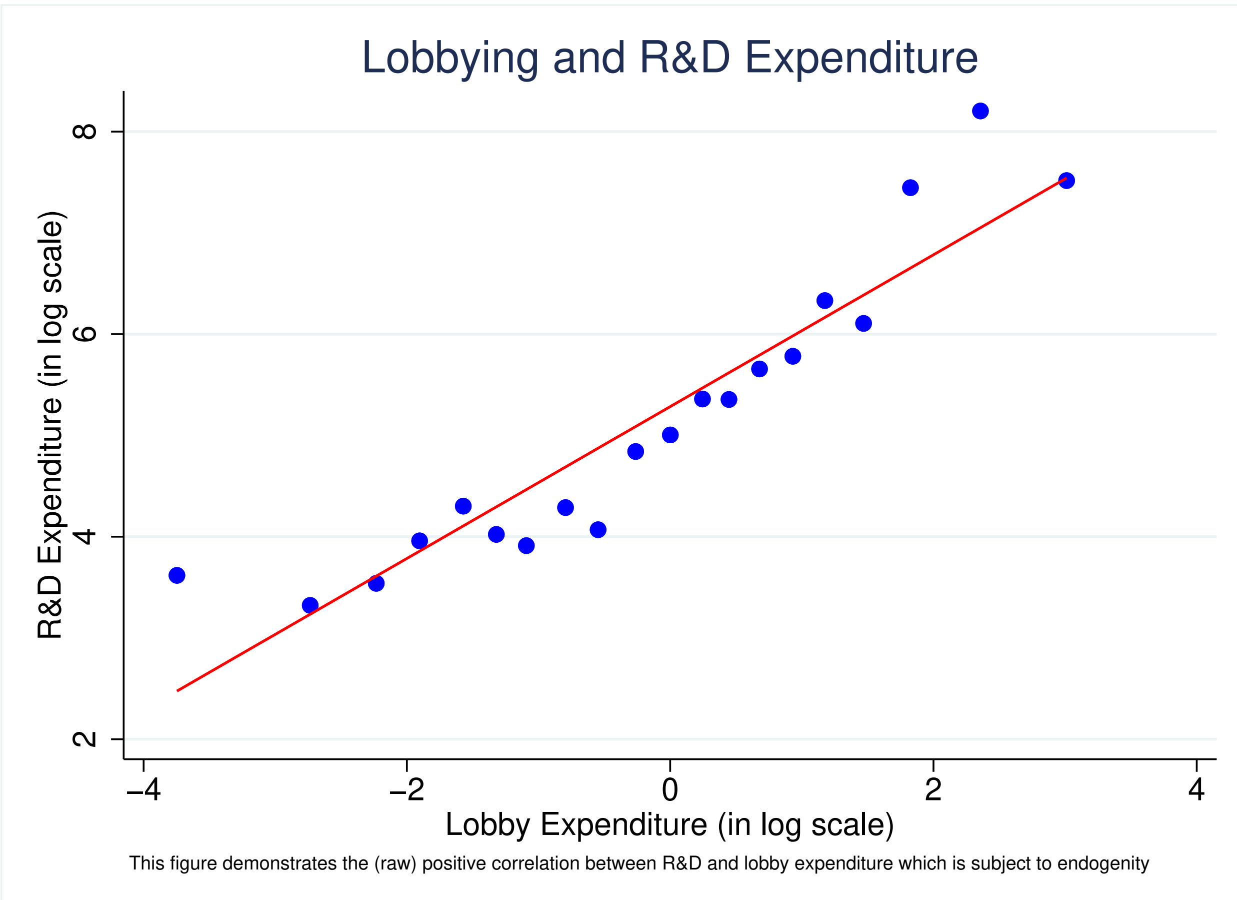


Figure 8: Lobbying and R&D expenditure

Notes: The figure plots a bin-scatter of the elasticity between R&D expenditure and lobby expenditure. This elasticity does not control for co-variates such as size, time or industry and thus is the raw relationship. The raw elasticity shows a positive relationship with a strong positive elasticity of R&D to lobby expenditure, which is subject to endogenity.

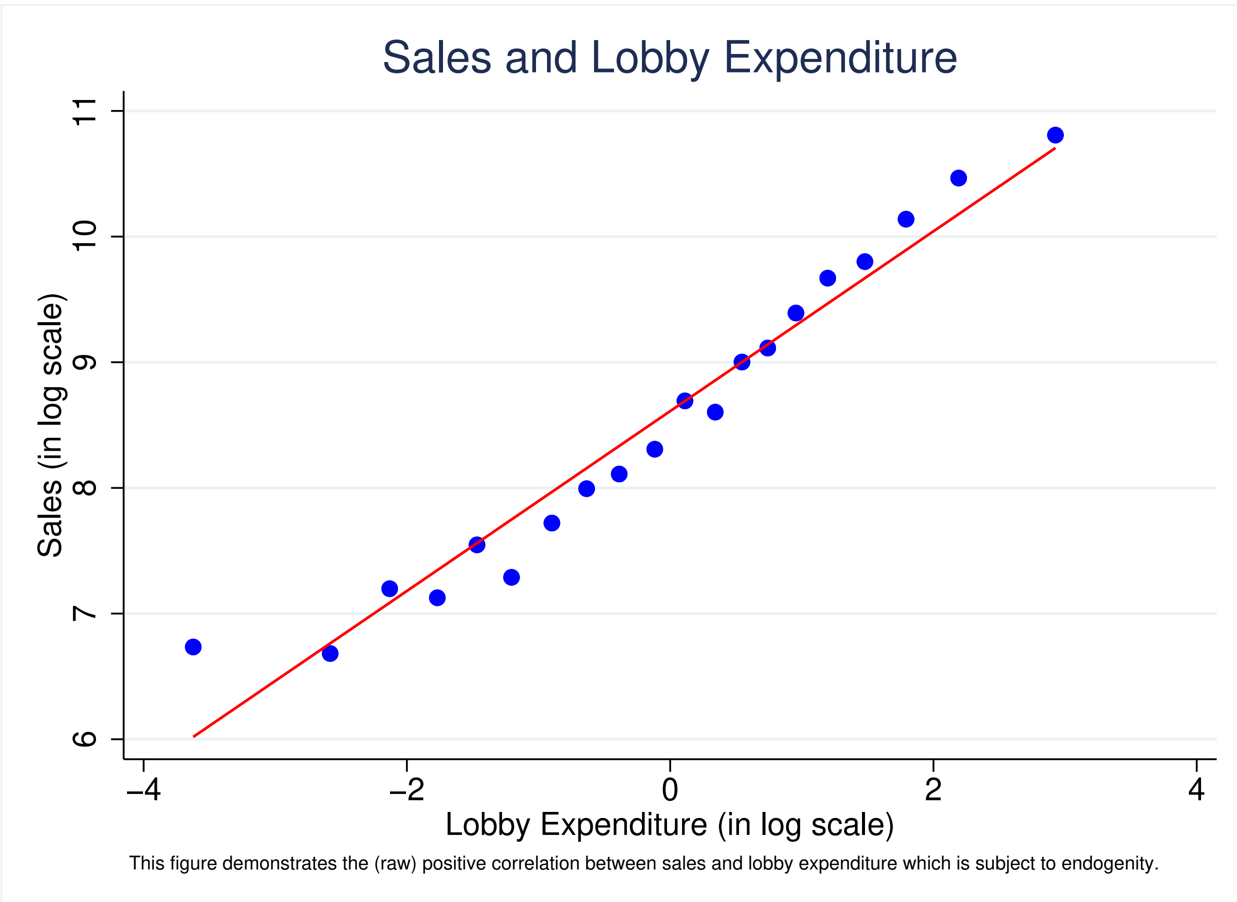


Figure 9: Lobbying and Sales

Notes: The figure plots a bin-scatter of the elasticity between sales and lobby expenditure. This elasticity does not control for co-variates such as size, time or industry and thus is the raw relationship. The raw elasticity shows a positive relationship with a strong positive elasticity of sales to lobby expenditure, which is subject to endogenity.

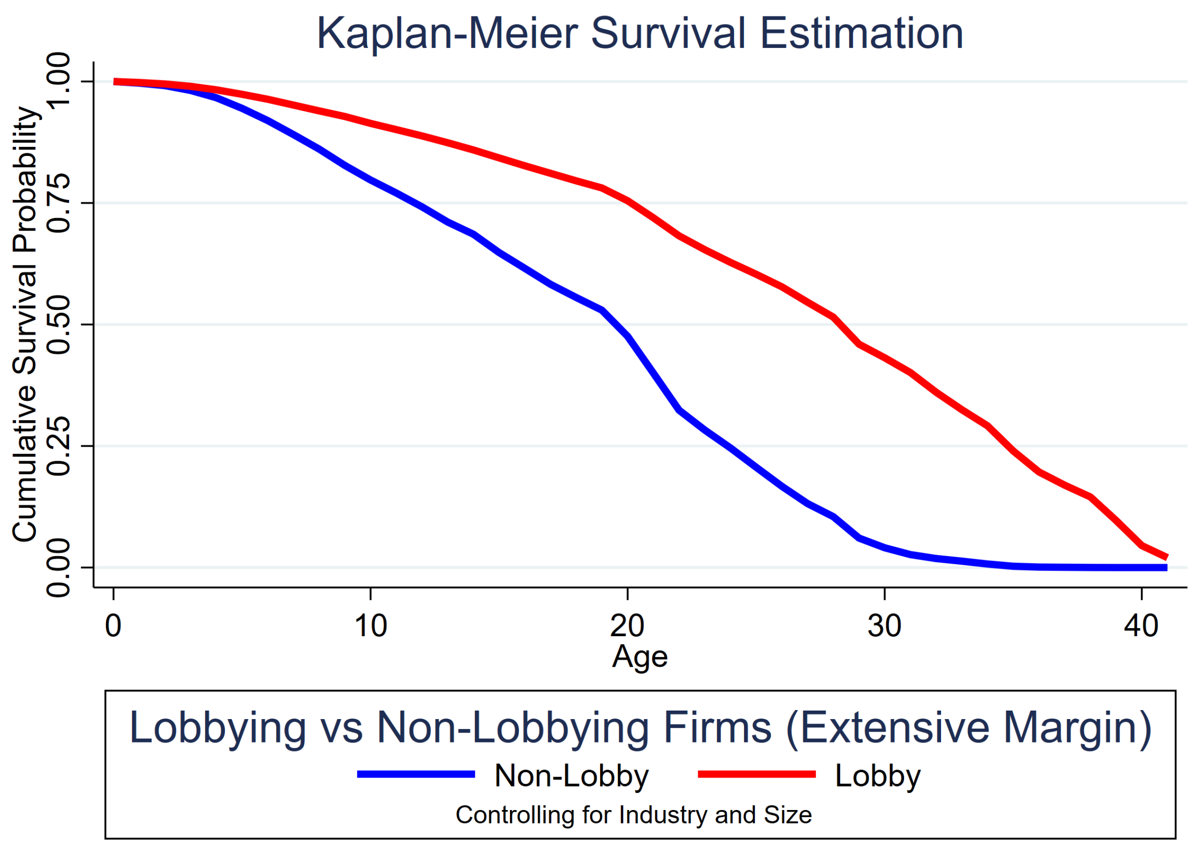


Figure 10: Kaplan-Meier Surival Estimation

Notes: In the data, differences in survival probabilities of lobbying firms and non-lobby firms large. This figure presents Kaplan-Meyer survival estimates splitting the sample of firms based on their lobby participation over the life-cycle. Different curves plot cumulative survival probabilities of firms that have never lobbied and have lobbied at some point in their life. The blue curve is the cumulative survival probability of non-lobby firms; the red curve is the cumulative survival probability of lobby firms. We observe that the lobby firms stochastically dominates the non-lobby firms over the life-cycle. The estimates control for industry (SIC 3-digit) and size defined as sales of firms. On average, the lobby firms have a higher probability of survival over the life-cycle.

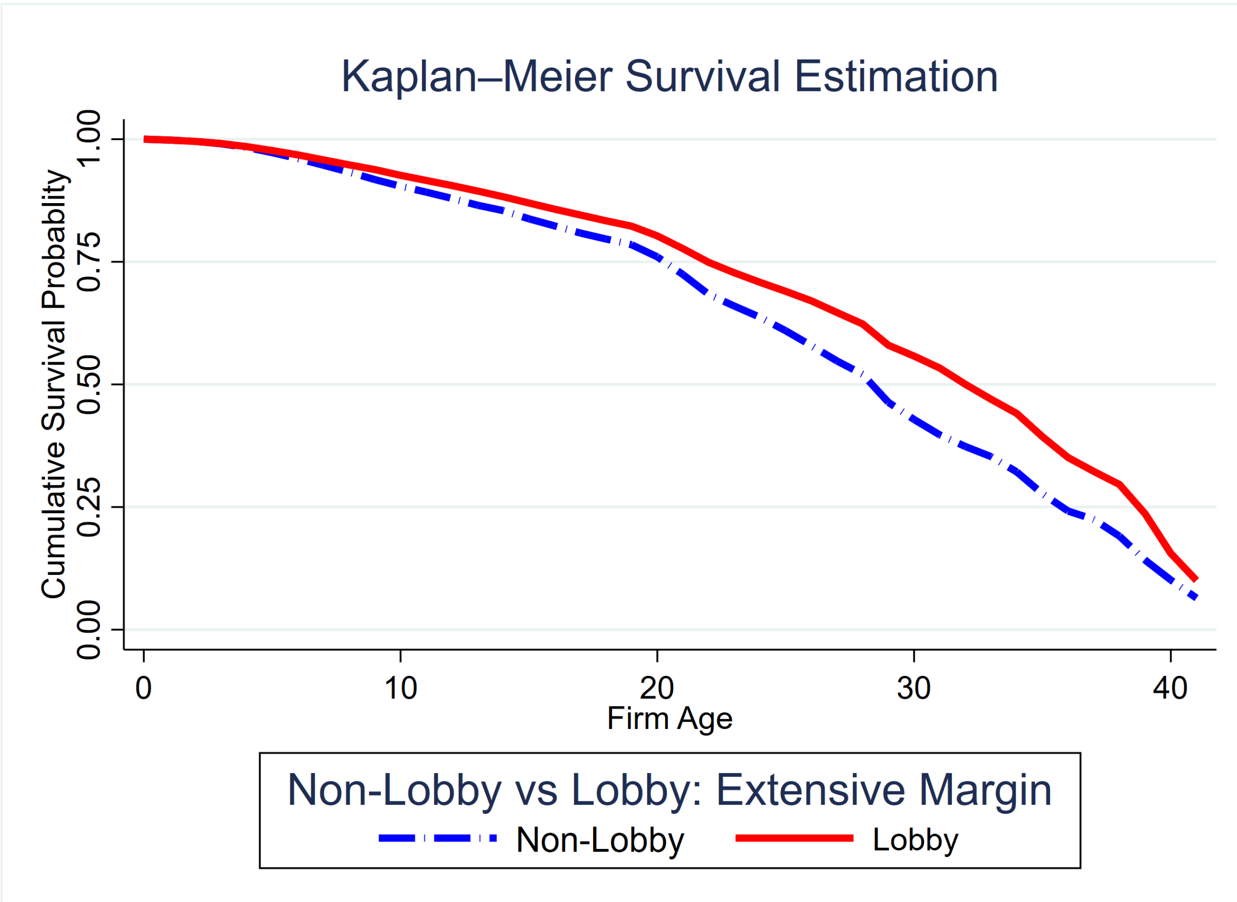


Figure 11: Kaplan-Meier Surival Estimation (No Controls)

Notes: In the data, differences in survival probabilities of lobbying firms and non-lobby firms large. This figure presents Kaplan-Meyer survival estimates splitting the sample of firms based on their lobby participation over the life-cycle. Different curves plot cumulative survival probabilities of firms that have never lobbied and have lobbied at some point in their life. The blue curve is the cumulative survival probability of non-lobby firms; the red curve is the cumulative survival probability of lobby firms. We observe that the lobby firms stochastically dominates the non-lobby firms over the life-cycle. The estimates control for industry (SIC 3-digit) and size defined as sales of firms. On average, the lobby firms have a higher probability of survival over the life-cycle. Note that this is the raw survival estimation without controls.

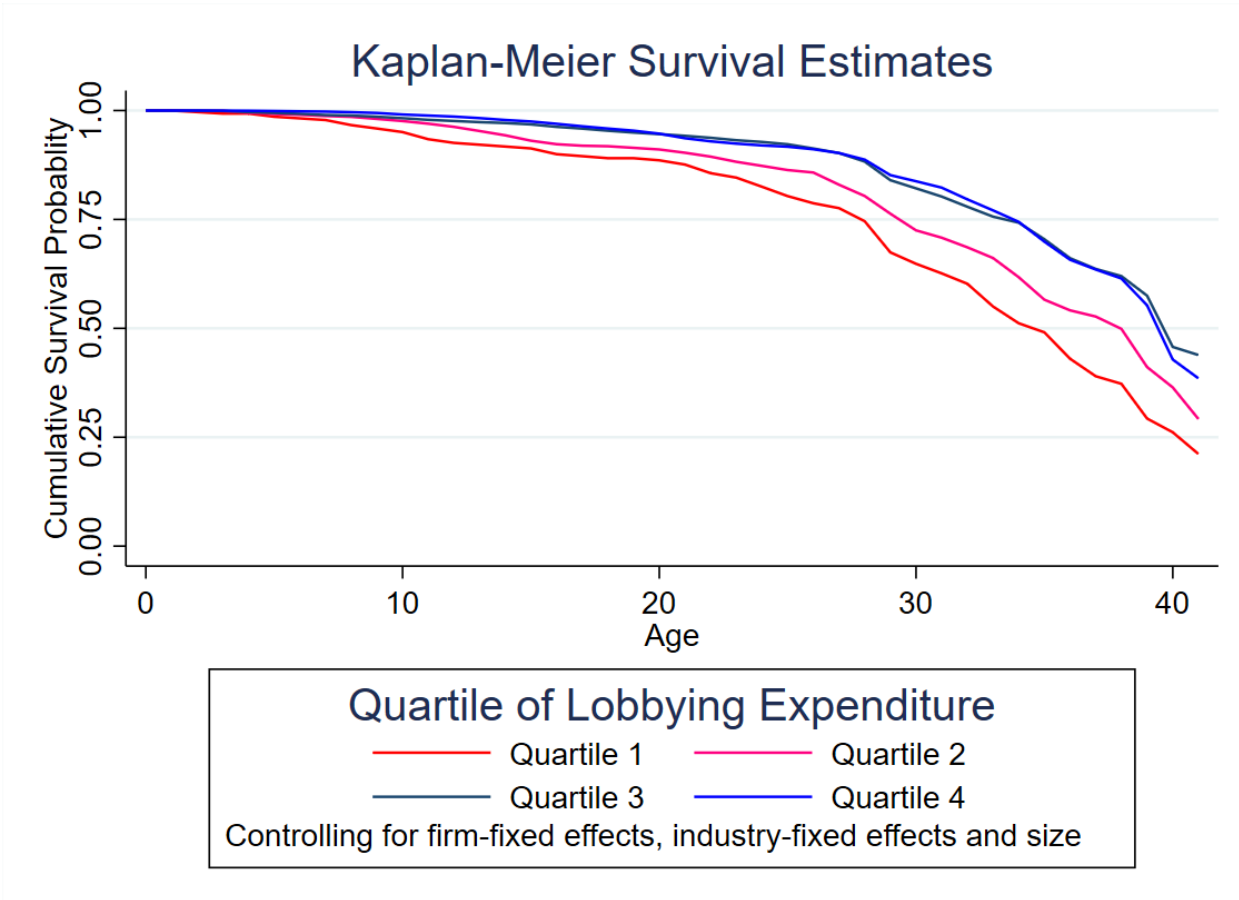


Figure 12: Kaplan Meier Survival Analysis: Intensive Margin

Notes: In the data, differences in survival probabilities of lobbying firms with varying degrees of intensity are large. This figure presents Kaplan-Meyer survival estimates splitting the sample of firms into 4 quartiles based on their lobbying expenditure. Different curves plot cumulative survival probabilities of firms that are in different quartile of lobby expenditure. The red curve is the cumulative survival probability of firms in the quartile 1, which is the lowest lobby intensity; the pink curve is the cumulative survival probability of lobby firms in quartile 2, the second least lobby intensity.The blue and green curves represent firms in the top 2 quartiles of lobbying expenditure. We observe that the more intensive lobby firms stochastically dominates the least lobby intensive firms over the life-cycle. The estimates control for industry (SIC 3-digit), firm-fixed effects and size defined as sales of firms. On average, the lobby firms with more lobby expenditure tend to have a higher probability of survival over the life-cycle.

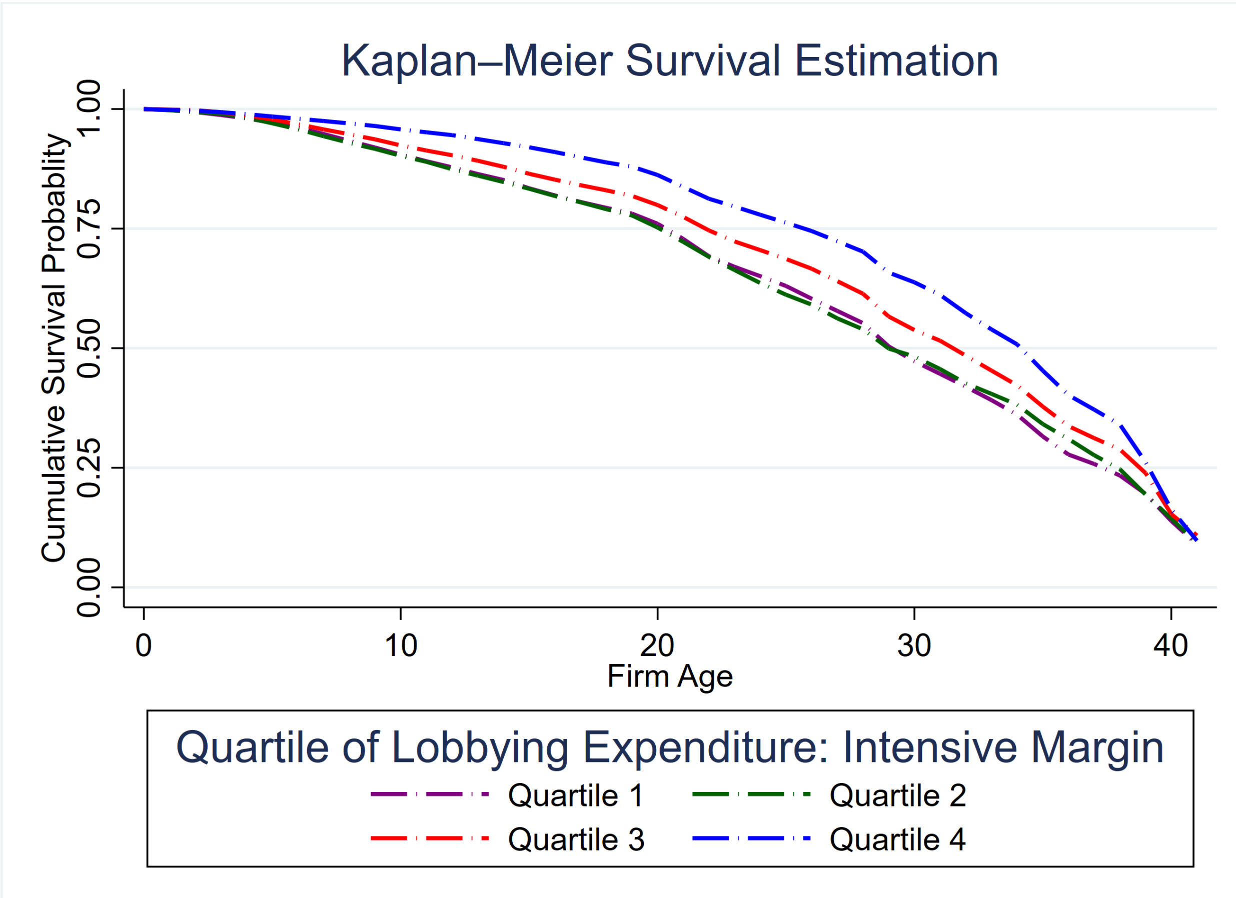


Figure 13: Kaplan Meier Survival Analysis: Intensive Margin (No Controls)

Notes: In the data, differences in survival probabilities of lobbying firms with varying degrees of intensity are large. This figure presents Kaplan-Meyer survival estimates splitting the sample of firms into 4 quartiles based on their lobbying expenditure. Different curves plot cumulative survival probabilities of firms that are in different quartile of lobby expenditure. The brown curve is the cumulative survival probability of firms in the quartile 1, which is the lowest lobby intensity; the green curve is the cumulative survival probability of lobby firms in quartile 2, the second least lobby intensity.The blue and red curves represent firms in the top 2 quartiles of lobbying expenditure. We observe that the more intensive lobby firms stochastically dominates the least lobby intensive firms over the life-cycle. The estimates control for industry (SIC 3-digit), firm-fixed effects and size defined as sales of firms. On average, the lobby firms with more lobby expenditure tend to have a higher probability of survival over the life-cycle. Note that this is the raw survival estimation without controls

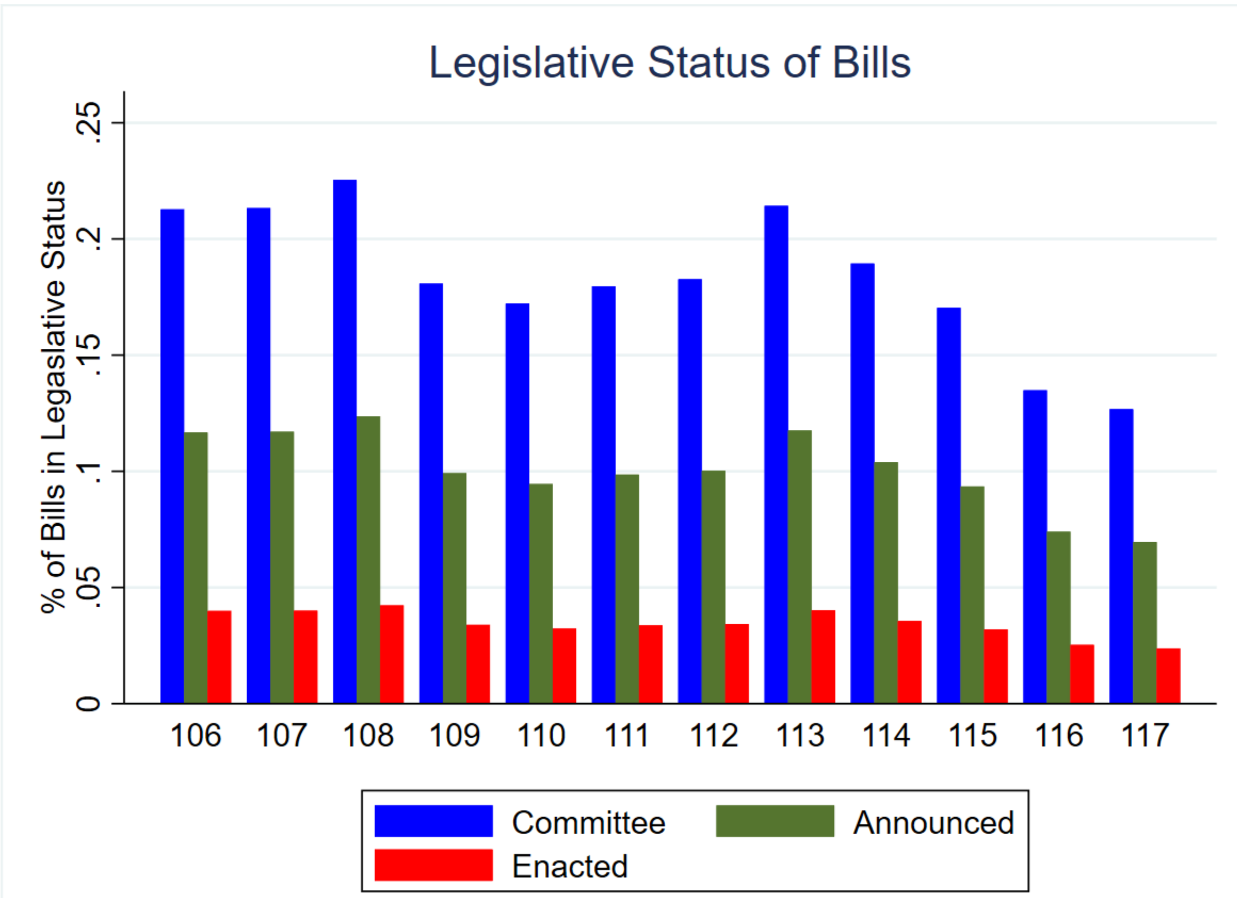


Figure 14: Legislative Status of Bills

Notes: The figure demonstrates the fraction of bills in each legislative status over the congressional period of 106-117. The green bar shows the fraction of bills that are announced in each congressional period. The blue bar shows the fraction of bills that are sent to a particular committee. The red bar shows the fraction of bills that are enacted and thus are a law in the United States.

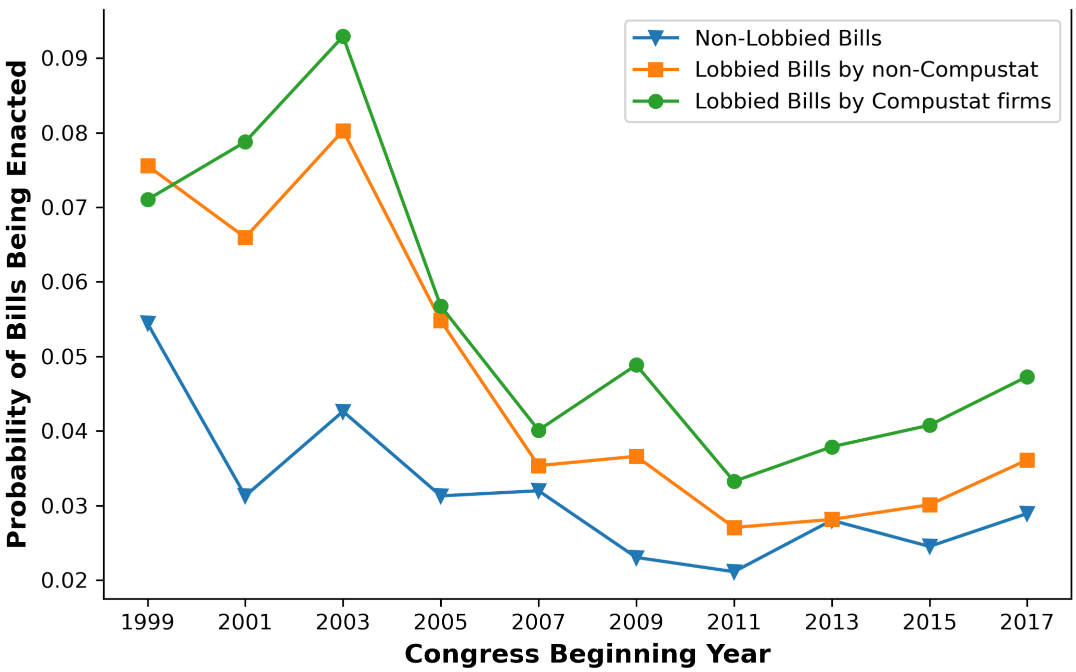


Figure 15: Probablity of Bill being Elected

Notes: The figure demonstrates the probability of a bill being enacted conditional on being lobbied or not lobbied. First, the blue curve is the probablity of a bill being enacted, conditional on not being lobbied by any firm. The yellow line is the probability of a particular bill being enacted conditional on being lobbied by a non-compustat firm. The green curve is the probablity of a bill being enacted conditional on the bill being lobbied by a compustat firm. The probablity distribution is from 1998 to 2017.

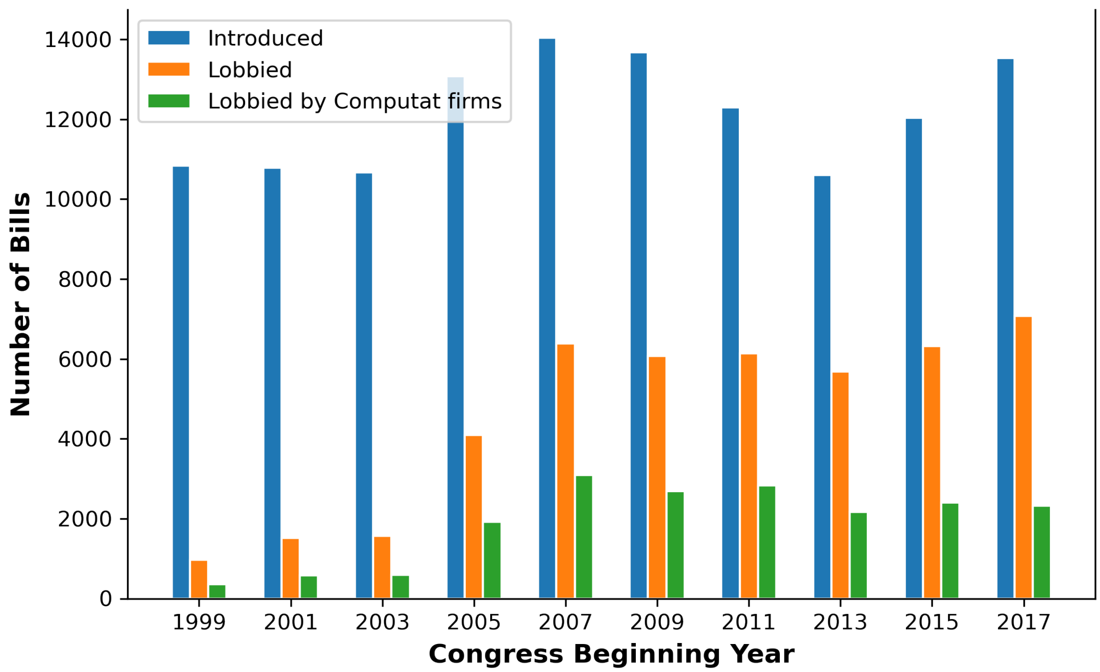


Figure 16: Number of Bills by status

Notes: The figure demonstrates the number of bills that are introduced and lobbied by compustat and non-compustat firms in congressional period of 106-117. The green bar shows the number of bills lobbied by compustat firms that are announced in each congressional period. The blue bar shows the number of bills that are introduced to congress in each congressional period. The yellow bar shows the number of bills lobbied by any entity.

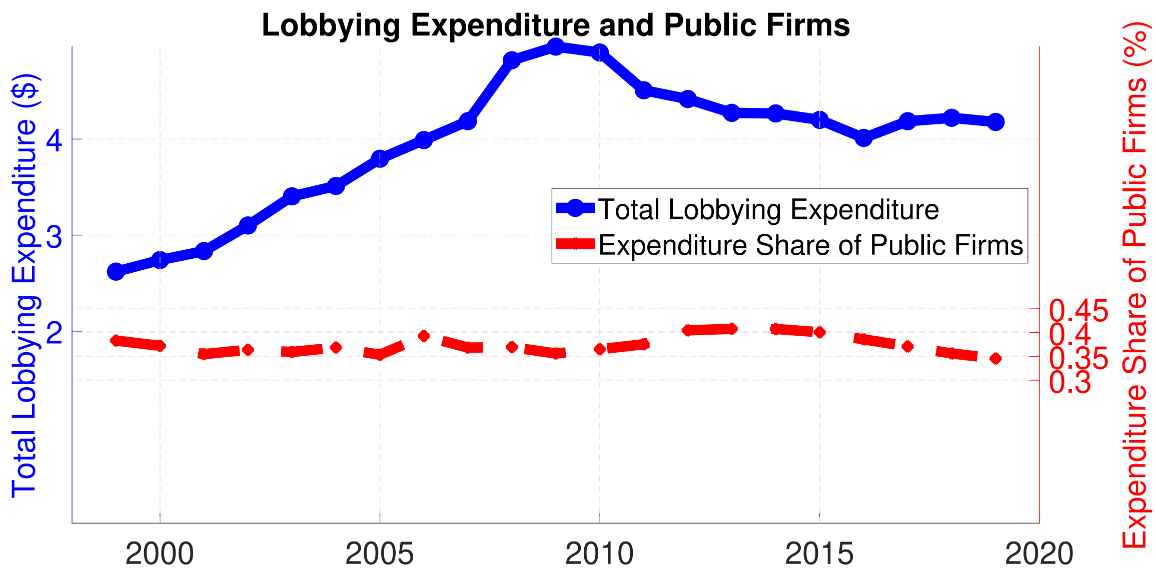


Figure 17: Decomposition of Total Lobbying Spending

Notes: The figure decomposes total lobby expenditure by the expenditure share of public firms in compustat over 1998 to 2020. The blue curve highlights the total lobby expenditure in billions of dollars in each period over the time horizon. The red curve highlights the lobbying share that are derived from public firms in the time horizon. Note that the lobby share by compustat firms is constant around 40-45% of total lobby expenditure. The gap between the two curves highlights the share of lobbying done through institutions and private firms.

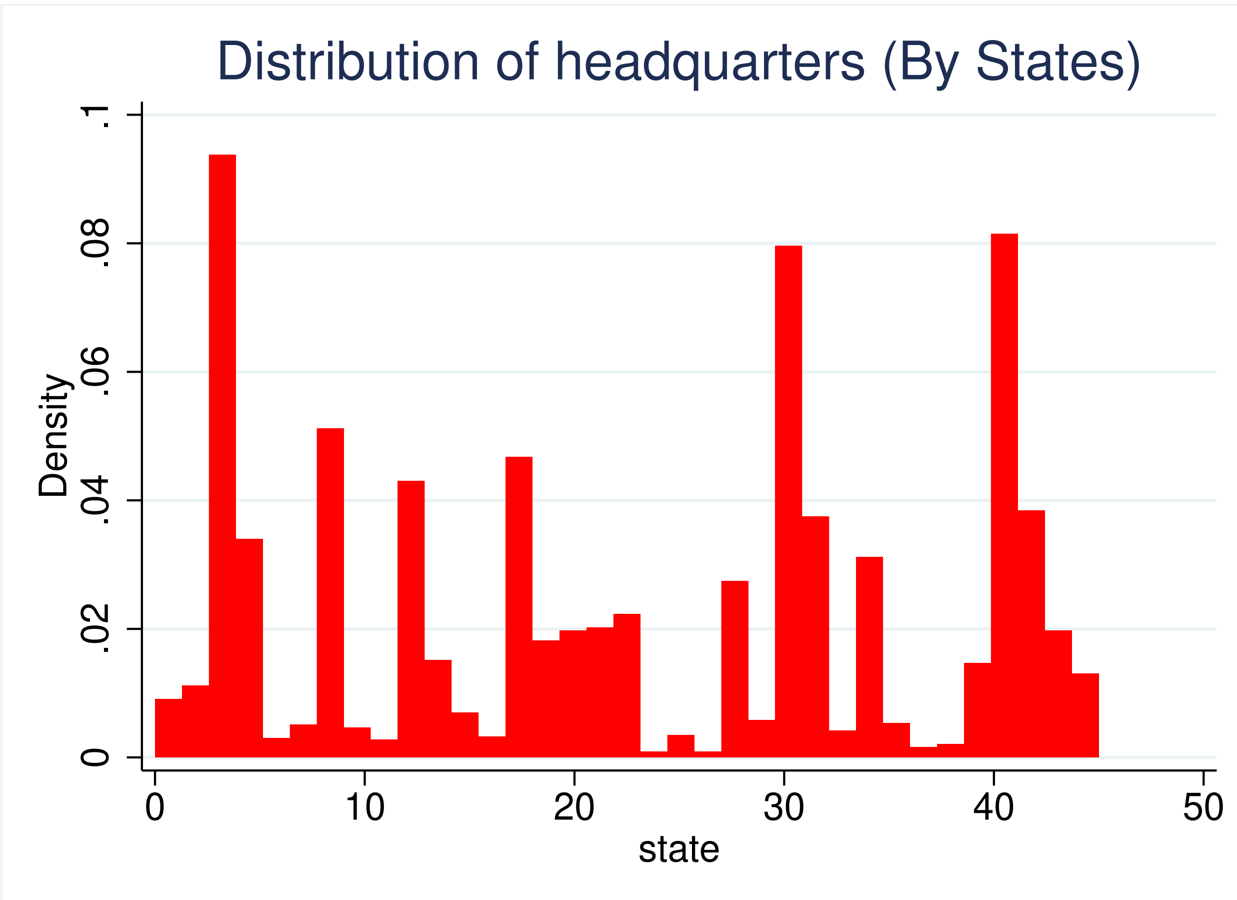


Figure 18: Distribution of headquarters by States

Notes: The figure highlights the distribution of headquarters in our sample of public firms in the United States. The largest mass is on the state of Delaware noted as state 5 in our sample. In our identification strategy, we provide a mapping between politicans and public firms using the co-location of firm headquarters and state representation. The distribution shows that there are enough mass of headquarter dispersion in our sample to provide variation in political connection.

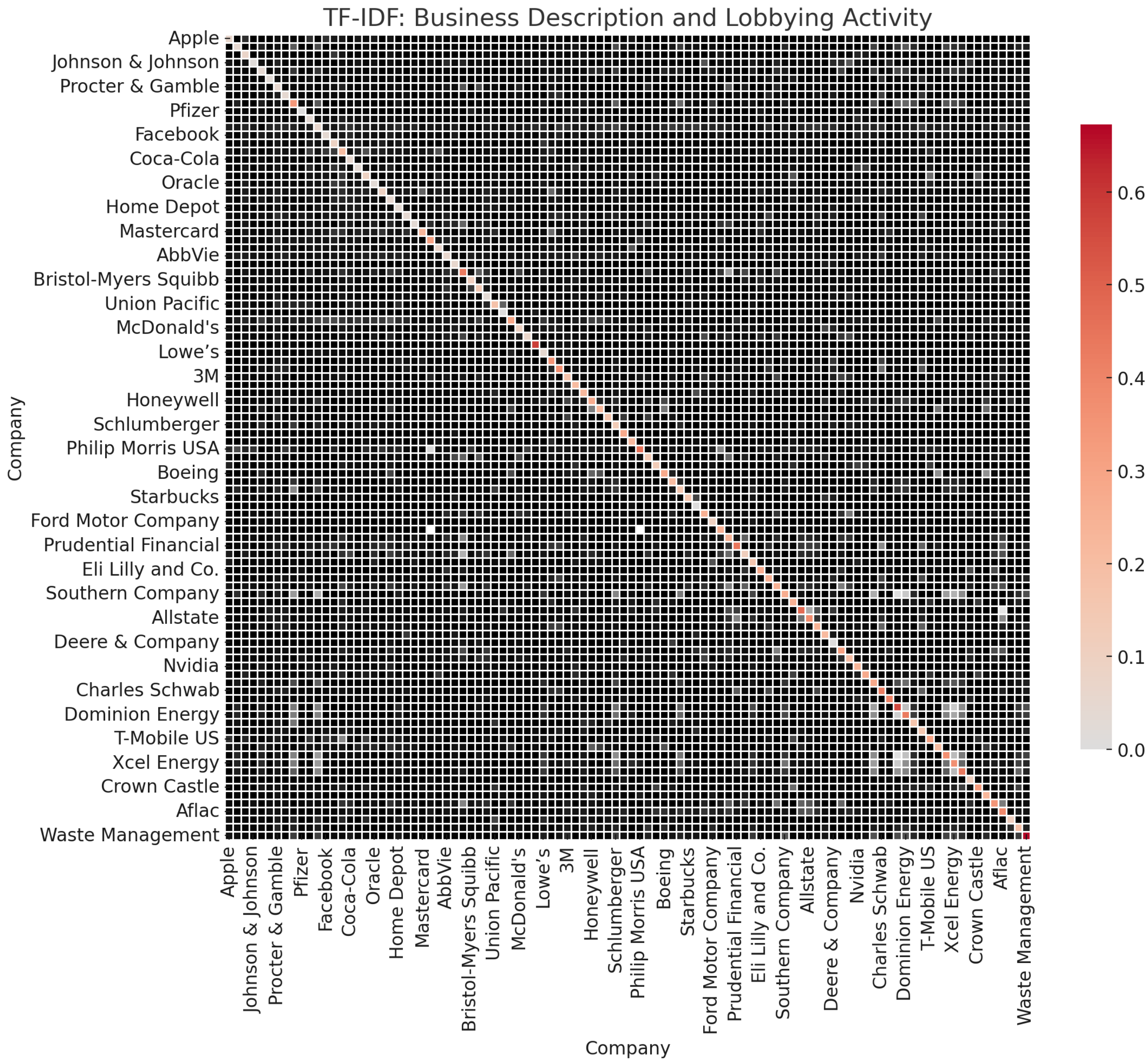


Figure 19: TF-IDF: Business Description and Lobbying Activity

Notes: The figure highlights the cosine similarity matrix of firm's business description and lobbying activity. The business description are from 10k filings of publicly traded firms that actively lobby and innovate. The lobby activity is from their lobbying reports. We highlight that the diagonal, which is the similarity of firm i's business description with their own lobby report are systematically higher than their counterpart firms.

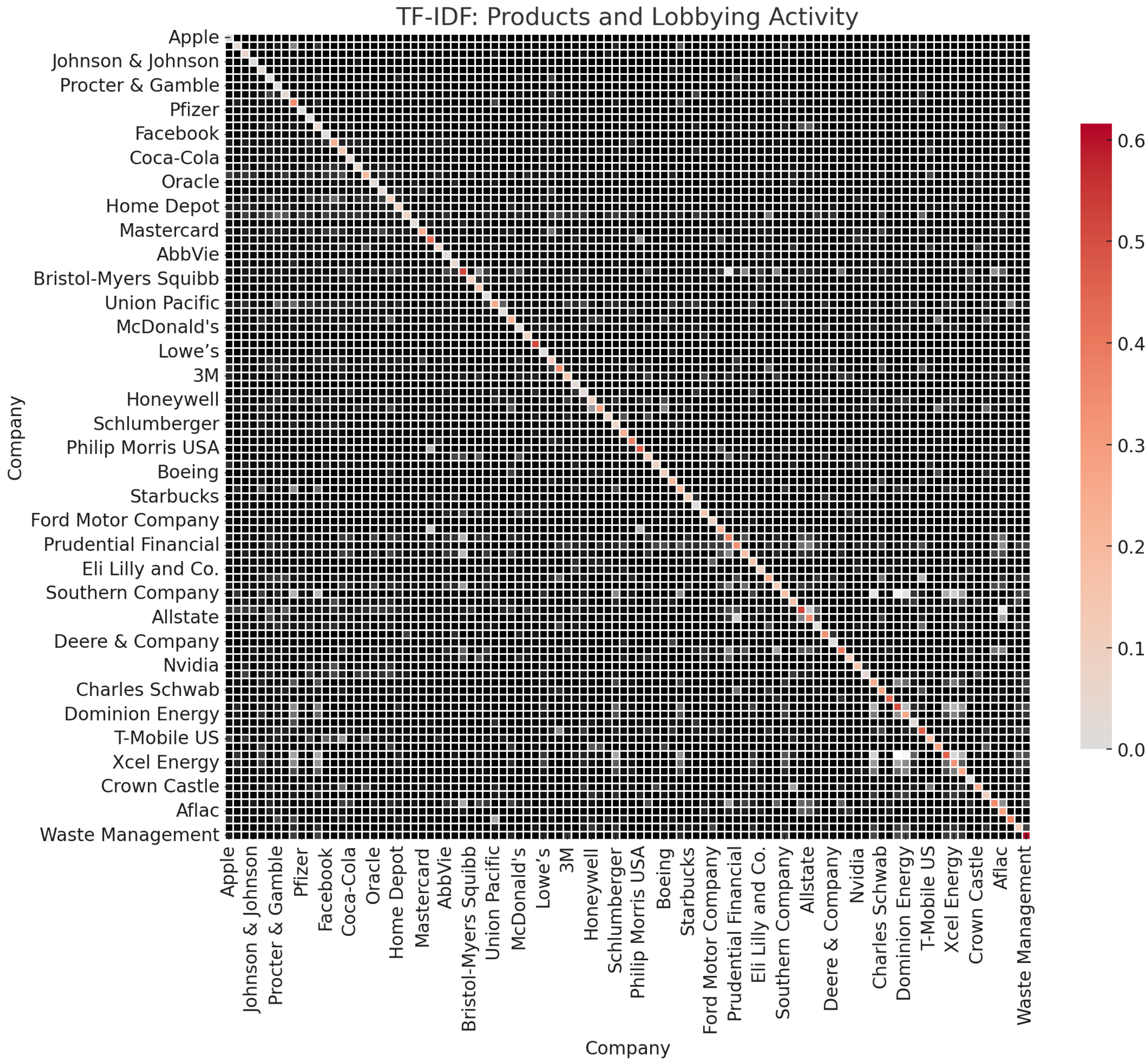


Figure 20: TF-IDF: Products/Services to Lobbying Activity

Notes: The figure highlights the cosine similarity matrix of firm's product/services and lobbying activity. The product/service data are from 10k filings of publicly traded firms that actively lobby and innovate. The lobby activity is from their lobbying reports. We highlight that the diagonal, which is the similarity of firm i's business product and services with their own lobby report are systematically higher than their counterpart firms.

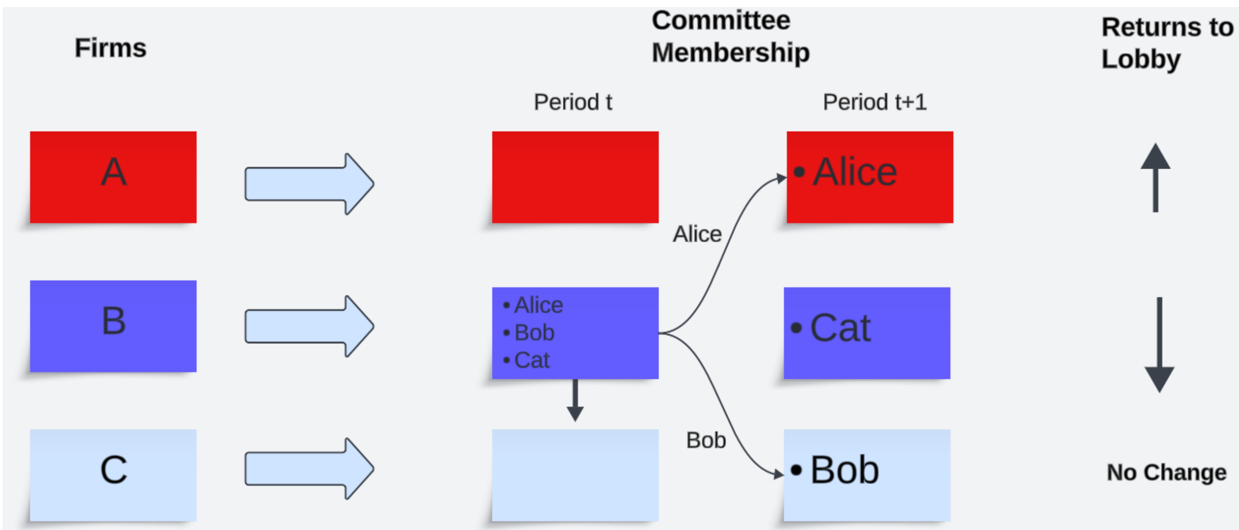


Figure 21: Illistrative example of shift-share instrumental variable

Notes: This figure presents the intuition of the shift-share instrumental variable. Each of the firms are represented with a colored box, highlight that this specific committee is highly important (share) to each firm. We exploit exogenity from the shifts of politicians across committees over time. For example, Alice moves from committee that is highly relevant for firm B to a committee that is relevant to firm A from period t and t+1. Given that Alice is politically connected with firm A, this increases the returns to lobbying that specific committee for firm A. We exploit many of these local shocks as identification for variation in lobby expenditure that is exogenous to firm's primitives.

Table 13: Cox Survival Analysis for Lobbying and Innovation Effects

	Exit	Exit	Exit
Lobby (Bills)	−0.099***	−0.087***	−0.075***
Innovation (Patents)		−0.293***	−0.288***
Ultra Lobby			−0.078***
Log Size	−0.123***	−0.116***	−0.113***
Log market share	−0.214***	−0.236***	−0.224***
Year FE	YES	YES	YES
Industry FE	YES	YES	YES
Observations	25,566	25,566	25,566

Notes: Cox proportional hazard model of firm survival as a function of lobbying and innovation at a point in time. A firm is considered to lobby if they have atleast 1 bill. A firm is considered to innovation, if they have granted atleast 1 patent. A firm is considered to be ultra lobby type if they are in the top 0.1% of lobby expenditure. Size is defined by sales and market share is defined as firm 's employment in industry x year . Efron method for tied failures is used here. We denote the significance $^{***} = p < 0.01$, $^{**} = p < 0.05$, $^{*} = p < 0.1$

10K Filings: Company Background

Apple Inc designs, manufactures, and markets smartphones, personal computers, tablets, wearables, accessories, and provides a variety of related services.

Figure 22: Description of Apple Inc. company background under Part 1, item 1 of form 10-k.

10K Filings: Products and Services

- **Smartwatches:** Apple Watch Ultra™ 2, Apple Watch® Series 9, Apple Watch SE®
- **Wireless Headphones:** AirPods®, AirPods Pro®, AirPods Max™, Beats® products

Figure 23: Description of two product-lines under Part 1, item 1 of form 10-k subsection **Products and Services**. Complete product-line consists of Iphone, Mac, Ipad, Wearables, Home Accessories and Apple TV. Service-line consists of Advertising, AppleCare, Cloud-Services, Digital Content and Payment Services

Apple Inc. Lobbying Report

- Apple health app and Apple smartwatch health features.
- Information related to Apple Pay.
- App Store policies and procedures.
- Apple product features and functionality.
- Apple's practices related to data requests.

Figure 24: Description of sample lobbying issues reported by Apple Inc in their 2015 lobbying reported mandated by the Lobbying Disclosure Act (1995). Each bullet point corresponds to a particular issue that Apple Inc explicitly lobbied for in their Q1-Q4 lobbying reports. Note that this is a subset of issues and bills that Apple Inc has lobbied in 2015.

Table 14: Textual Analysis: Business Activity & Lobbying Issues

	Business Description		**Product/Services**	
	(1)	**(2)**	**(3)**	**(4)**
β_1	**0.178*****	**0.159*****	**0.118*****	**0.176****
	(0.004)	(0.010)	(0.004)	(0.011)
N	10,000	10,000	10,000	10,000
Sector FE	✓	✓	✓	✓
Model	TF-IDF	BERT	TF-IDF	BERT
Industry (SIC-2)	10	10	10	10
F-Stat	179.9	64.4	125.8	38.4
R-squared	0.15	0.06	0.11	0.04

Notes: Robust asymptotic standard errors reported in parentheses are clustered at the firm level. The sample period is 2015. All regression specifications, control for industry fixed effects. We measure the sector at the SIC2 classification. A unit of observation is a pairwise similarity score between firm's business description and lobbyin report as well as product/service and lobby reports.We denote the significance $^{***} = p < 0.01$, $^{**} = p < 0.05$, $^{*} = p < 0.1$

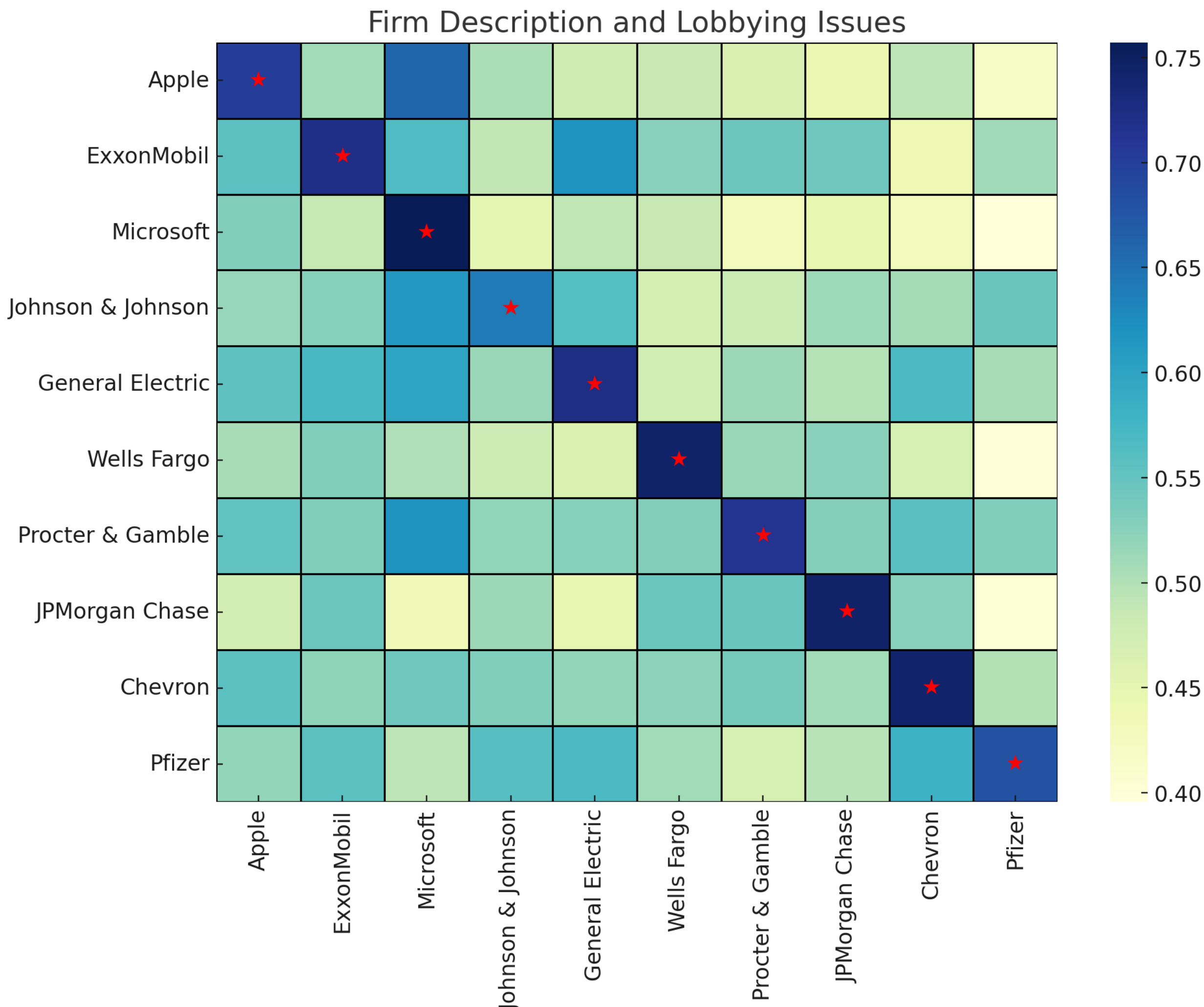
We estimate the following equation, whereby β_1 captures the differential effect of a firm business description and lobby report similarity to that of all other firms.

$$\text{Similarity Score}_{ij} = \beta_0 + \beta_1 \cdot \nVdash_{ij} + \gamma_s + \epsilon_{ij}$$

$$\nVdash_{ij} = \begin{cases} 1 & \text{if } i = j \\ 0 & \text{otherwise} \end{cases}$$

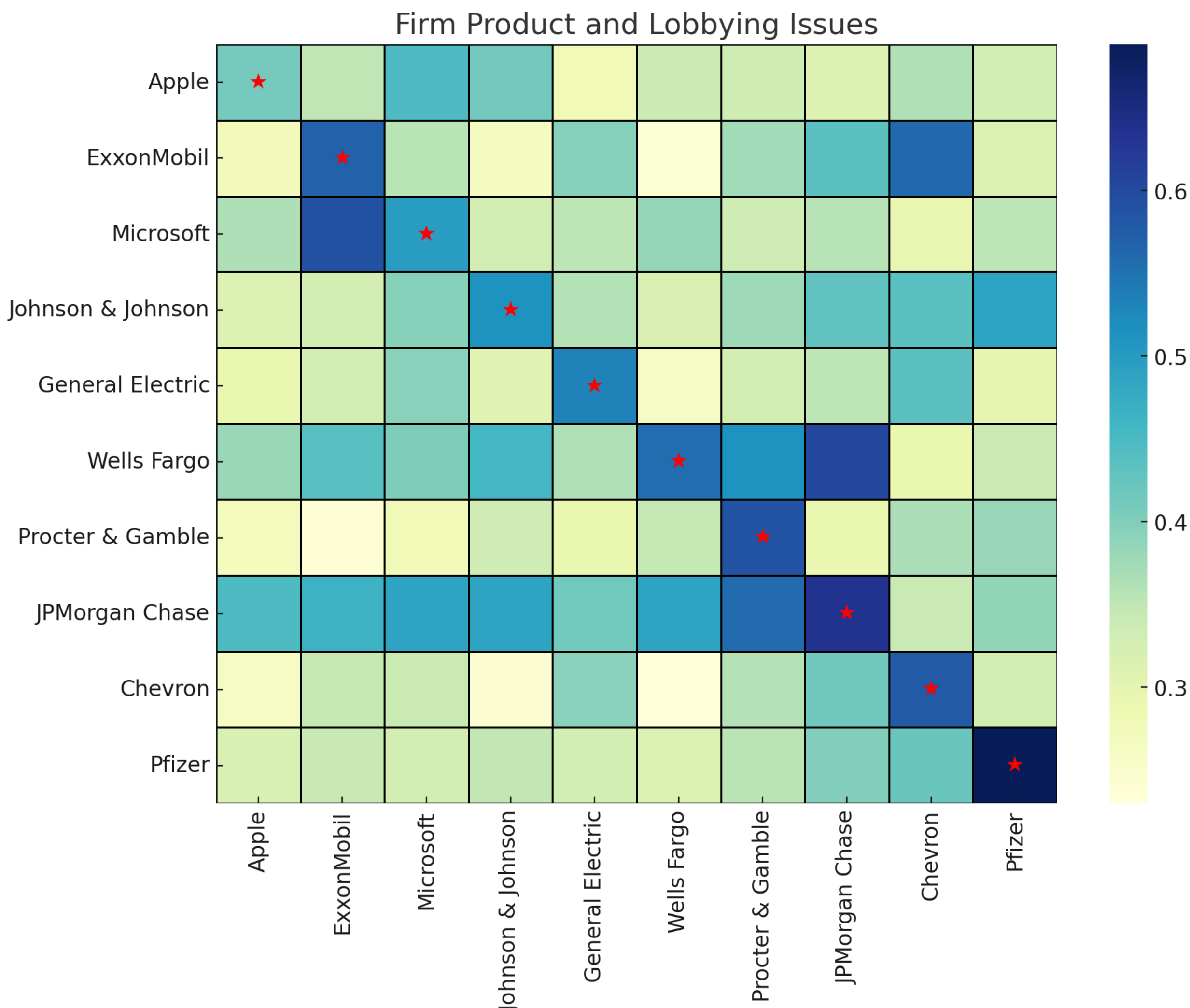
.

Figure 25: Similarity Matrix: Firm Business Activity and Lobbying Issues



The figure highlights the cosine similarity between firm's business description and lobbying issues documented in their lobbying reports using BERT analysis. A key characteristic is the similarity corresponding to the matrix diagonal, which highlights that firms tend to lobby for issues directly related to their business description.

Figure 26: Similarity Matrix: Firm Products and Services and Lobbying Issues



The figure highlights the cosine similarity between firm's products and services and lobbying issues documented in their lobbying reports using BERT analysis. A key characteristic is the similarity corresponding to the matrix diagonal, which highlights that firms tend to lobby for issues directly related to their products and services.

B Theory and Proofs

B.1 Stationary Equilibrium

Definition of Equilibrium. A stationary competitive equilibrium is defined by the following: allocations $\{C, Y, K, A, I, R, L, T\}$ (aggregate consumption, output, capital stock, assets, R&D expenditure, lobbying expenditure, and transfers), prices $\{r\}$, policy functions $\{l(z,s), k(z,s), \mu(z,s), \pi(z,s), y(z,s)\}$, and the firm distribution $F(z,s)$, satisfying:

1. **Households' Problem:** Given r, households choose $\{C, A\}$ to maximize lifetime utility.

2. **Firms' Static Problem:** Given r, firms choose $\{l(z,s), k(z,s)\}$ to maximize profits $\pi(z,s)$ and output $y(z,s)$.

3. **Firms' Dynamic Problem:** Given r, firms choose $\mu(z,s)$ to solve the dynamic problem, determining firm value $V(z,s)$.

4. **Government Budget Balance:** Lump-sum transfer T ensures budget balance:

$$T = \int_s \int_z \ell(z,s) dF(z,s).$$

5. **Market Clearing:**

   (a) *Final Goods Market:* Output clears with $Y = C + I + R + T$, where:

$$Y = \int_z \int_s y(z,s) dF(z,s), \quad I = \delta \int_z \int_s k(z,s) dF(z,s), \quad R = \int_z \int_s \chi \left[\mu(z,s) - \underline{\mu}\right]^2 z dF(z,s).$$

   (b) *Asset Market:* The asset market clears:

$$A = K + \int_z \int_s V(z,s) dF(z,s), \quad K = \int_z \int_s k(z,s) dF(z,s).$$

6. **Stationarity of Firm Distribution:** Firm distribution $F(z, s)$ is stationary and consistent with firm decisions:

$$F'(z', s') = \int_z \int_s \Lambda(z', s'|z, s) dF(z, s).$$

$$\Lambda(z', s'|z, s) = (1-\lambda) I(s' = s) \Phi' \left(\frac{log(z') - \mu(z, s) - \rho log(z)}{\sigma} \right) + \lambda I(z' = \underline{z}) \Phi' \left(\frac{log(s')}{\sigma_s} \right),$$

where $\Lambda(z, s)$ is the transition probability density function from the current state (z, s) to the next period's state (z', s'),

B.2 Micro-foundations of lobbying

In this subsection we propose a micro-foundation for a mapping between firm's lobbying effort and favorable distortions to result in improved profitability. We will impose a economic game consisting of 2 players, a social planner and firms. The social planner must consider the representative household's utility and lobbying expenditures. The social planner faces a trade-off between lobbying expenditures and distortions. The government allows for some distortions in order to accommodate for lobbying expenditures. Firms are willing to spend resources on lobbying to reap policy distortions that provide benefits.

Model Setup

The game consists of 2 players, the social planner and firms in three stages. In the first stage, exogenously all firms lobby, but they must choose how much to lobby. In the second stage, the planner chooses the distortions, given the firm's lobbying effort in stage 1. In the third stage, firms make decisions on their production given the planner's policy distortions, which will determine the aggregate output and household's consumptions decisions. We assume perfect foresight and no aggregate uncertainty, thus we solve the model using backward induction.

Stage 3. This stage of the game is the same structure as in the main model, however firm's do not make a decision to lobby. The firm's only produce and households consume. Given this structure, all lobbying decisions and policy distortions are well defined.

Stage 2. At this stage of the game the social planner solves the following problem:

$$W = \max_{\tau(z_i,s_i)} V^U(\{\theta(z,s)\},\{\tau(z_i,s_i)\}) + \alpha \left[\int_s \int_z \ell(z,s) dF(z,s) \right],$$

$s.t$

$$V^U(\{\theta(z,s)\},\{\tau(z_i,s_i)\}) = \frac{\int_z \int_s V(z,s)dF(z,s) + \int_z \int_s k(z,s)dF(z,s)^{1-\sigma}}{(1-\sigma)}$$

$$\frac{\partial \ell(z,s)}{\partial \tau(z,s)} = \frac{\partial \pi(z,s)}{\partial \tau(z,s)}$$

,

We define V^U as the indirect utility of the representative household. The α is the weight given to potential rents from political involvement via lobbying. The objective function states that the social planner welfare comprises of both the household's welfare but also welfare from lobbying. The planner may care about lobbying due to saving resources that the planner would otherwise have to spend such as preparing impact analysis on bills. The first constraint comes from the household's problem where σ governs the relative risk aversion. The second constraint is an incentive comparability constraint, whereby the firms actions across their lobby behavior is consistent. In other words, there is no incentive to deviate from how much they are willing to spend on lobbying the social planner, given the returns for the favorable distortions set by the planner.

Stage 1. This stage is consistent with the model solution, the firms choose how much to lobby, given that all firms will lobby in equilibrium.

B.3: Proofs

Proposition 1. Given the expected value of a firm $V(z,s)$ and the law of motion for productivity, we can combine the two equations and define it as $\hat{V}(z,s)$. Now we can do a full differentiation of the $\hat{V}$ with respect to z to obtain the expression.

Proposition 2. A firm characterized with (z,s) solves the following problem:

$$\Pi(z_{it}, s_i) = \max_{k_{it},\ell_{it}\geq 0} \left\{ \left[\theta(s_i\ell_{it})^{\kappa\omega} + (1-\theta)z_{it}^{\kappa}\right]^{\frac{1-\gamma}{\kappa}} k_{it}^{\gamma} - (r+\delta)k_{it} - \ell_{it} \right\}.$$

The optimality condition with respect to ℓ_{it} is:

$$\frac{\partial \Pi}{\partial \ell_{it}} = \frac{\partial}{\partial \ell_{it}} \left\{ \left[\theta(s_i\ell_{it})^{\kappa\omega} + (1-\theta)z_{it}^{\kappa}\right]^{\frac{1-\gamma}{\kappa}} k_{it}^{\gamma} - (r+\delta)k_{it} - \ell_{it} \right\}.$$

$$\frac{1-\gamma}{\kappa} \left[\theta(s_i\ell_{it})^{\kappa\omega} + (1-\theta)z_{it}^{\kappa}\right]^{\frac{1-\gamma}{\kappa}-1} \cdot \theta \cdot \kappa\omega(s_i\ell_{it})^{\kappa\omega-1} s_i \cdot k_{it}^{\gamma} = 1$$

The optimality condition with respect to k_{it} is:

$$\frac{\partial \Pi}{\partial_{it}} = \frac{\partial}{\partial_{it}} \left\{ \left[\theta(s_i\ell_{it})^{\kappa\omega} + (1-\theta)z_{it}^{\kappa}\right]^{\frac{1-\gamma}{\kappa}} k_{it}^{\gamma} - (r+\delta)k_{it} - \ell_{it} \right\}.$$

$$\gamma \left[\theta(s_i\ell_{it})^{\kappa\omega} + (1-\theta)z_{it}^{\kappa}\right]^{\frac{1-\gamma}{\kappa}} k_{it}^{\gamma-1} - (r+\delta) = 0$$

Solving for k_{it}, we get:

$$k_{it} = \left(\frac{\gamma}{r+\delta}\right)^{\frac{1}{1-\gamma}} \left[\theta(s_i\ell_{it})^{\kappa\omega} + (1-\theta)z_{it}^{\kappa}\right]^{\frac{1}{\kappa}}.$$

Substituting this back into the first-order condition for ℓ_{it}:

$$\frac{1-\gamma}{\kappa} \cdot \theta \cdot \kappa\omega(s_i\ell_{it})^{\kappa\omega-1} s_i \cdot \left(\frac{\gamma}{r+\delta}\right)^{\frac{\gamma}{1-\gamma}} \left[\theta(s_i\ell_{it})^{\kappa\omega} + (1-\theta)z_{it}^{\kappa}\right]^{\frac{1-\gamma}{\kappa}-1+\frac{\gamma}{\kappa}} - 1 = 0.$$

$$\frac{1-\gamma}{\kappa}\cdot\theta\cdot\kappa\omega(s_i\ell_{it})^{\kappa\omega-1}s_i\cdot\left(\frac{\gamma}{r+\delta}\right)^{\frac{\gamma}{1-\gamma}}\left[\theta(s_i\ell_{it})^{\kappa\omega}+(1-\theta)z_{it}^{\kappa}\right]^{\frac{1}{\kappa}-1}=1.$$

$$(1-\gamma)\left(\frac{\gamma}{r+\delta}\right)^{\frac{\gamma}{1-\gamma}}\left[\theta(s\ell)^{\kappa\omega}+(1-\theta)z^{\kappa}\right]^{\frac{1-\kappa}{\kappa}}\omega\theta s^{\omega\kappa}\ell^{\omega\kappa-1}=1.$$

Proposition 3.

Formally, we can define the the elasticity of ℓ with respect to z as:

$$\epsilon_{\ell,z}=\frac{d\ln\ell}{d\ln z}=\frac{z}{\ell}\cdot\frac{d\ell}{dz}.$$

We first derive $\frac{d\ell}{dz}$, we implicitly differentiate both sides of the main result from proposition 2 with respect to z. Taking logarithms of both sides and differentiating gives us the following expression:

$$\frac{1-\kappa}{\kappa}\cdot\frac{\theta\kappa(s\ell)^{\kappa\omega-1}s\frac{d\ell}{dz}+(1-\theta)\kappa z^{\kappa-1}}{\theta(s\ell)^{\kappa\omega}+(1-\theta)z^{\kappa}}+(\omega\kappa-1)\frac{1}{\ell}\frac{d\ell}{dz}=0.$$

$$\frac{d\ell}{dz}=-\frac{\frac{1-\kappa}{\kappa}\cdot\frac{(1-\theta)\kappa z^{\kappa-1}}{\theta(s\ell)^{\kappa\omega}+(1-\theta)z^{\kappa}}}{\frac{1-\kappa}{\kappa}\cdot\frac{\theta\kappa s(s\ell)^{\kappa\omega-1}}{\theta(s\ell)^{\kappa\omega}+(1-\theta)z^{\kappa}}+\frac{\omega\kappa-1}{\ell}}.$$

Substituting into the definition of the elasticity formulation above gives us:

$$\epsilon_{\ell,z}=\frac{z}{\ell}\cdot\left(-\frac{\frac{1-\kappa}{\kappa}\cdot\frac{(1-\theta)\kappa z^{\kappa-1}}{\theta(s\ell)^{\kappa\omega}+(1-\theta)z^{\kappa}}}{\frac{1-\kappa}{\kappa}\cdot\frac{\theta\kappa s(s\ell)^{\kappa\omega-1}}{\theta(s\ell)^{\kappa\omega}+(1-\theta)z^{\kappa}}+\frac{\omega\kappa-1}{\ell}}\right).$$

$$\epsilon_{\ell,z}=\frac{1-\kappa}{\kappa(1-\omega\kappa)}\cdot\frac{(1-\theta)\kappa z^{\kappa}}{\theta(s\ell)^{\kappa\omega}+(1-\theta)z^{\kappa}}.$$

Proposition 4. To show that when $\theta => 0$, the model exhibits sufficient statistic in productivity z, it is sufficient for us to show that the optimal capital policy, output and profit function are proportional to productivity z.

$$\Pi(z_{it}) = \max_{k_{it}} \left\{ z_{it}^{1-\gamma} k_{it}^{\gamma} - (r+\delta) k_{it} \right\}.$$

$$k_{it}(z_{it}) = B z_{it},$$

$$y_{it}^{*}(z_{it}) = C z_{it},$$

$$\Pi(z_{it}) = D z_{it}$$

where $B = \left(\frac{\gamma}{r+\delta}\right)^{\frac{1}{1-\gamma}}$, showing that k_{it}^{*} is linear in z_{it}. and $C = \left(\frac{\gamma}{r+\delta}\right)^{\frac{\gamma}{1-\gamma}}$, showing that the output is linear in z_{it} where $D = \left(\frac{\gamma}{r+\delta}\right)^{\frac{\gamma}{1-\gamma}} \left[1 - (r+\delta)\left(\frac{\gamma}{r+\delta}\right)^{\frac{1}{\gamma}}\right]$. showing that the profit is linear in z_{it}.

Welfare Decomposition

The model allows for an analytical decomposition of the welfare change, $\Delta W = W^A - W^B$, between any two stationary equilibrium A and B in both discrete and continuous time. In the main text, we showed this holds for discrete time, but without loss of generality we will show this here in continuous time.

In each stationary equilibrium, welfare can be derived as follows:

$$W^A = \int_0^{\infty} e^{-\rho t} \frac{(C_A)^{1-\theta} - 1}{1-\theta} \, dt, \quad W^B = \int_0^{\infty} e^{-\rho t} \frac{(C_B)^{1-\theta} - 1}{1-\theta} \, dt,$$

We define $(1+\Delta W)C_A$ such that adjusting consumption in equilibrium A provides the same utility as consumption C_B in equilibrium B:

$$\int_0^{\infty} e^{-\rho t} \frac{((1+\Delta W)C_A)^{1-\theta} - 1}{1-\theta} \, dt = \int_0^{\infty} e^{-\rho t} \frac{C_B^{1-\theta} - 1}{1-\theta} \, dt.$$

Using the stationarity of the model, we simplify and integrate $e^{-\rho t}$ over time:

$$\frac{((1+\Delta W)C_A)^{1-\theta}-1}{1-\theta}=\frac{C_B^{1-\theta}-1}{1-\theta}.$$

Solving for ΔW yields:

$$(1+\Delta W)C_A=C_B \Rightarrow \Delta W=\frac{C_B}{C_A}-1.$$

The consumption-equivalent welfare change between two stationary equilibrium A and B can be shown to be just changes in the level of consumption:

$$\Delta W=\frac{C_B}{C_A}-1.$$

C Computation

C.1: Model Estimation

This section of appendix will describe the estimation process of our model. There are 12 parameters to calibrate in the model: the decreasing returns to scale γ, the discount rate β, the depreciation rate δ, the exogenous exit rate λ, the elasticity of substitution between lobbying and R&D κ, the returns to lobbying ω, the scale and lower bound of innovation parameters $\chi, \underline{\mu}$, the CES lobby share θ, the persistence and dispersion in AR(1) process of innovation ρ, σ_ϵ, and the dispersion in lobbying ability σ_s.

A set of six parameters are externally calibrated. We set the decreasing returns to scale to $\gamma = 0.67$ as commonly used in the literature (Hsieh and Klenow, 2009, Huneeus and Kim, 2021), the discount rate $\beta = 0.96$ which implies a time discount rate of $r = 0.04$, the depreciation rate δ to 0.09 consistent with U.S NIPA, the exit rate to $\lambda = 0.02$ consistent with Compustat, the elasticity of substitution between lobbying and R&D and returns to lobbying κ, ω are estimated using our identification strategy in section 2.

The remaining six parameters $\chi, \underline{\mu}, \theta, \rho, \sigma_\epsilon, \sigma_s$ are jointly calibrated to match the following moments from United States- firm level data: (1) the average R&D intensity, (2) the average firm growth rate, (3) the average lobbying intensity, (4) the auto correlation of firm market value, (5) the coefficent of variation of firm market value, (6) the dispersion in lobby to sales ratio.

These 6 parameters are jointly calibrated via a moment-matching process, to match 6 moments in the data. In particular, given a value of parameter vector $\Theta = \{\chi, \underline{\mu}, \theta, \rho, \sigma_\epsilon, \sigma_s\}$, we solve the firm's dynamic problem, policy functions $\{l(z,s),\ k(z,s),\ \mu(z,s),\ \pi(z,s),\ y(z,s)\}$ are determined for each pairwise state s, z. We define estimator as the solution to the minimization of the norm distance between the vector Θ^{Model} and corresponding empirical vector θ^{Data}.

$$\hat{\theta} = \arg\min_{\theta} \left[\left(\Theta^{\text{model}}(\theta) - \Theta^{\text{data}} \right)^T W \left(\Theta^{\text{model}}(\theta) - \Theta^{\text{data}} \right) \right]$$

Data Moments and Sources. We target the moments discussed above. All moments are computed for the period 1998–2020 using data from the United States.

1. **Average R&D Intensity:** We define R&D intensity as the share of R&D expenditure relative to GDP. Data for aggregate R&D intensity is taken from the National Science Foundation (NSF), which reports total R&D expenditure divided by Gross Domestic Product. The corresponding average R&D intensity in the model is characterized as follows:

$$\frac{\int_z \int_s \chi \left[\mu(z,s) - \underline{\mu} \right]^2 z \, dF(z,s)}{\int_z \int_s y(z,s) \, dF(z,s)}$$

where $\int_z \int_s \chi \left[\mu(z,s) - \underline{\mu} \right]^2 z \, dF(z,s)$ represents total R&D expenditure, and $\int_z \int_s y(z,s) \, dF(z,s)$ denotes the economy's equilibrium GDP level.

2. **Average Firm Growth:** Firm growth is defined as TFP (Total Factor Productivity) growth, with summary statistics presented in Table 2. We focus on the productivity growth of firms identified as innovative and lobbying. COMPUSTAT is used to calculate the geometric average growth rates for these firm types. Firm growth rate is computed as the average productivity growth rate:

$$\int_z \int_s \left(\frac{\int_{-\infty}^{\infty} \exp\left(\mu(s,z) + \rho \log(z) + \epsilon \right) \cdot p(\epsilon) \, d\epsilon - z}{z} \right) dF(z,s)$$

across all firm types (z, s).

3. **Lobby Intensity:** The ratio of aggregate lobbying expenses to GDP is calculated using data from the OpenSecrets database, adjusted for inflation (available here). Lobby

intensity is measured as the average lobbying expenditure relative to GDP:

$$\frac{\int_s \int_z \ell(z,s)\, dF(z,s)}{\int_z \int_s y(z,s)\, dF(z,s)}$$

where $\int_s \int_z \ell(z,s)\, dF(z,s)$ is the aggregate level of lobbying expenditure in equilibrium.

4. **Auto-correlation and Coefficient of Variation:** We simulate 10,000 firms with initial productivity z_t and lobbying ability s_t from the equilibrium stationary distribution $F(z,s)$ to assess firm productivity dynamics. We compute next-period productivity using the AR(1) law of motion for productivity:

$$\log z_{it+1} = \mu_{it} + \rho \log z_{it} + \sigma \varepsilon_{it+1}$$

We then perform a linear regression of z' on z and compute residuals to obtain the coefficient of variation defined as

$$CV = \frac{\text{Std}_{\text{Residuals}}}{\text{mean}_{z'}}$$

$$= \frac{\sqrt{\frac{1}{N}\sum_{i=1}^{N}(R_i - \bar{R})^2}}{\frac{1}{N}\sum_{i=1}^{N} z_i'}$$

where:

- R_i represents each residual from the regression of z' on z,
- $\bar{R} = \frac{1}{N}\sum_{i=1}^{N} R_i$ is the mean of the residuals,
- z_i' are the predicted values of z',

and the autocorrelation as

$$\text{Autocorr} = \frac{\text{cov}(z,z')}{\sqrt{\text{var}(z) \times \text{var}(z')}}.$$

$$= \frac{\frac{1}{N}\sum_{i=1}^{N}(z_i - \bar{z})(z_i' - \bar{z'})}{\sqrt{\left(\frac{1}{N}\sum_{i=1}^{N}(z_i - \bar{z})^2\right)\left(\frac{1}{N}\sum_{i=1}^{N}(z_i' - \bar{z'})^2\right)}}$$

where:

- z_i and z_i' are the individual observations of z and z',
- $\bar{z} = \frac{1}{N}\sum_{i=1}^{N} z_i$ and $\bar{z'} = \frac{1}{N}\sum_{i=1}^{N} z_i'$ are the means of z and z',

We target the empirical counterparts consistent with our data and match to model-simulated productivity dynamics, as in Celik et al. (2022).

5. **Standard Deviation of log (Lobby/Sales):** We define the lobby/sales ratio as the ratio of lobbying expenditure to revenues at the firm level in a given year. Quarterly lobby expenditure data is aggregated to annual levels. Firm-level lobbying data is obtained through *lobbyviews*, with generous access provided by In Song Kim.

C.2: Solution Algorithm

In this subsection, we describe the algorithm used to compute the stationary equilibrium of the model. Given the parameter values $\gamma, \beta, \delta, \phi, \chi, \underline{\mu}, \hat{\theta}, \rho, \sigma_\epsilon, \sigma_s, \kappa, \omega$ we calculate the stationary equilibrium of the model as follows:

1. Initialize a guess for the value function $V(s, z)$ and innovation policy function $\mu(s, z)$.

2. For each (s, z) firm-types compute the optimal lobby $\ell(s, z)$ and capital $k(s, z)$ policy functions and the associated profit functions $\pi(s, z)$.

3. Value function iteration: Define the value function tolerance as ϵ_V. Iterate the following objective until: $\sup_{(z,s)\in\mathcal{Z}\times\mathcal{S}} \left|V^{(k+1)}(z, s) - V^{(k)}(z, s)\right| < \epsilon_V$

   - Given $V^k(z, s)$, solve for the optimal innovation policy $\mu^{k+1}(z, s)$ of a firm with lobby ability s and productivity z at the beginning of the period. For each possible

$\mu \in \{\underline{\mu}, 2\}$ solve the expected firm value

$$V^{k+1}(z,s) = \max_{\mu_z > \underline{\mu}} \left\{ \pi(z,s) - \chi(\mu - \underline{\mu})^2 z + \frac{1-\lambda}{1+r} E_{z'} V^k(z',s) \right\},$$

$$\mathbb{E}_{z'}\left[V(z',s)\right] = \int\int V(s,z')\Lambda(z',s'|z,s)dF(z,s)$$

- Now, once we calculate the expected value associated with each possible $\mu \in \{\underline{\mu}, 2\}$, we need to accordingly choose the μ that maximizes the expected firm value.

$$\mu(s,z) = \arg\max_{\mu} \left\{ \pi(z,s) - \chi(\mu - \underline{\mu})^2 z + \frac{1-\lambda}{1+r} E_{z'} V(z',s) \right\},$$

- Store the updated firm value function as $V^{(k+1)}(z,s)$. Now we compute the initial defined objective function $\sup_{(z,s)\in\mathcal{Z}\times\mathcal{S}} \left|V^{(k+1)}(z,s) - V^{(k)}(z,s)\right|$. If the uniform norm is greater than our threshold ϵ_V, update the value function guess $V^{(k+1)}(z,s)$ and the associated innovation policy function $\mu^{(k+1)}(z,s)$ and go back to re-iterate. If the uniform norm is satisfied, i.e $\sup_{(z,s)\in\mathcal{Z}\times\mathcal{S}} \left|V^{(k+1)}(z,s) - V^{(k)}(z,s)\right| < \epsilon_V$, then value function has converged.

4. Stationary Distribution: After the value function has converged, we compute the stationary distribution of firms across productivity (z) and lobby (s) states, denoted as $\Phi(z,s)$, which represents the long-run fraction of firms in each state. The stationary distribution is obtained as follows:

   (a) We compute the transition matrix $\Lambda(z', s|z, s)$ based on the firm's optimal innovation policy $\mu(z,s)$ and the exogenous law of motion for z. Note that if a firm dies exogenously, the exiting firm is replaced with a firm with productivity $z \in \min(z \in Z)$, which is the lowest productivity type in our state-space.

   (b) Now, we can solve for the stationary distribution $\Phi(z,s)$ by finding the vector that satisfies the following equation:

$$\Phi = \Phi\Lambda$$

This equation represents the fixed-point condition for the stationary distribution: the distribution must be invariant to the transitions defined by Λ. We define Φ as the eigenvector of the transition matrix Λ corresponding to the eigenvalue 1.

D Model Extensions

D.1 Model Estimation and Results by Lobbying Activity

In this subsection, we dis-aggregate the lobbying expenditure at the firm-level to the level of lobbying issue. In our data, we can identify 79 lobbying issues that firms can lobby issues/bills towards. Some of these include taxation, health, advertising, religion, defense, copright/patent/trademark etc. We parse through all lobby reports disclosed in a given year to calculate the lobbying expenditure per issue. The lobbying expense V_{ijt} for lobbying firm j on a particular issue i in year t is calculated as:

$$V_{ijt} = \sum_{r}^{R_{tj}} \left(\frac{L_{jr}}{|I_r|} \right)$$

where L_r is the total lobbying expense found on report r and I_r is the set of all legislative issues appearing in report r. Given this structure, we can define the total lobbying expenditure in a particular period, V_t, over the entire space of issues as follows:

$$V_t = \sum_{i}^{I} \sum_{j}^{L} \sum_{r}^{R_{tj}} \left(\frac{L_{jr}}{|I_r|} \right)$$

where we aggregate across all lobby issues, reports and firms.

Our main counterfactual compares a baseline economy which is calibrated to match moments on all lobby expenditure in the economy. The mechanism we exploit is a mapping between lobbying to generating favorable distortions at the firm-level. We do robustness by estimating the model and conducting counterfactual experiments using lobbying expenditure toward i) only taxation issues and ii) toward all 5 top lobby issues.

Table 15: Examples of Lobby Issues/Bills Related to Taxation for Apple Inc.

Bill/Issue	**Description**
116 S 3933	A bill to restore American leadership in semiconductor manufacturing by increasing Federal incentives to enable advanced research and development, secure the supply chain, and ensure long-term national security and economic competitiveness.
114 H 2584	Business Activity Tax Simplification Act of 2015.
114 H 1643	Digital Goods and Services Tax Fairness Act of 2015.
111 H 1083	A bill to regulate certain State taxation of interstate commerce, and for other purposes.
110 H 7060	A bill to amend the Internal Revenue Code of 1986 to provide incentives for energy production and conservation, extend certain expiring provisions, provide individual income tax relief, and for other purposes.
113 H 1	A bill to reduce from 2% to 1% the excise tax rate on the net investment income of tax-exempt private foundations and repeal the 1% reduction in such tax rate for private foundations.

This table provides examples of specific bills related to taxation for Apple Inc., illustrating lobbying efforts aimed at favorable economic conditions for the company.

Table 16: Lobby Issues by expenditure

Lobby Issue	**% of Total Expenditure**
Taxation	20.09
Trade	5.74
Gov Contract	5.00
Health	4.68
Financial Inst.	3.61

Notes: Top 5 Lobbying Issues by expenditure average across 2001-2020.

Table 17: Calibration with only Taxation expenditure

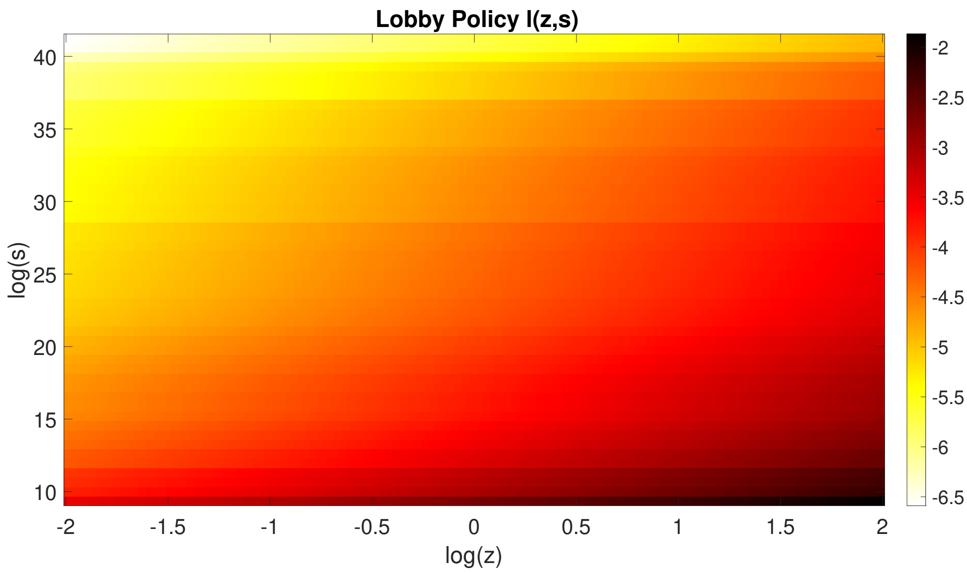
Parameter	Value	Target (Source)	Data	Model
Externally identified				
Decreasing returns to scale (γ)	0.67	Huneeus and Kim (2021)		
Discount rate (β)	0.96	Interest rate $r = 0.04$		
Depreciation rate (δ_{dep})	0.09	U.S. NIPA		
Exit rate (ψ)	0.02	Compustat		
Internally identified				
Innovation cost (χ)	308	Average R&D intensity	3.96%	4.31%
Lower bound prod drift ($\underline{\mu}$)	-0.016	Average firm growth rate	0.65%	0.61%
Lobby CES share ($\hat{\theta}$)	0.012	Average lobby intensity	0.01%	0.01%
Productivity persistence (ρ)	0.86	Productivity autocorrelation	0.94	0.82
S.d of innovation (σ_ϵ)	0.12	Coefficient of variation	0.37	0.29
S.d of lobby efficiency (σ_s)	4.86	S.D. log (lobby/sales)	0.90	0.93
Elasticity of substitution (κ)	0.64	Elasticity of lobby-innovation	0.81	0.81
Returns to lobbying (ω)	0.23	Sales-lobby elasticity	0.21	0.22

Table 18: Lobby Shutdown Counterfactual with only Taxation expenditure

Eliminating Lobbying	Baseline	No Lobbying	% Change
Aggregate Outcomes			
Output	1.00	1.02	1.77%
TFP	1.00	1.01	0.28%
CEWC	1.00	1.01	1.19%
Firm-level Outcomes			
Avg. R&D intensity	4.31%	4.32%	0.23%
Market Value	1.00	1.02	2%

Notes: This table presents the changes in the relevant macroeconomic aggregates under the lobbying shut down whereby $\theta = 0$, stationary equilibrium compared to the baseline economy.

Baseline Economy with only Taxation Lobbying: Lobby and Innovation Policies



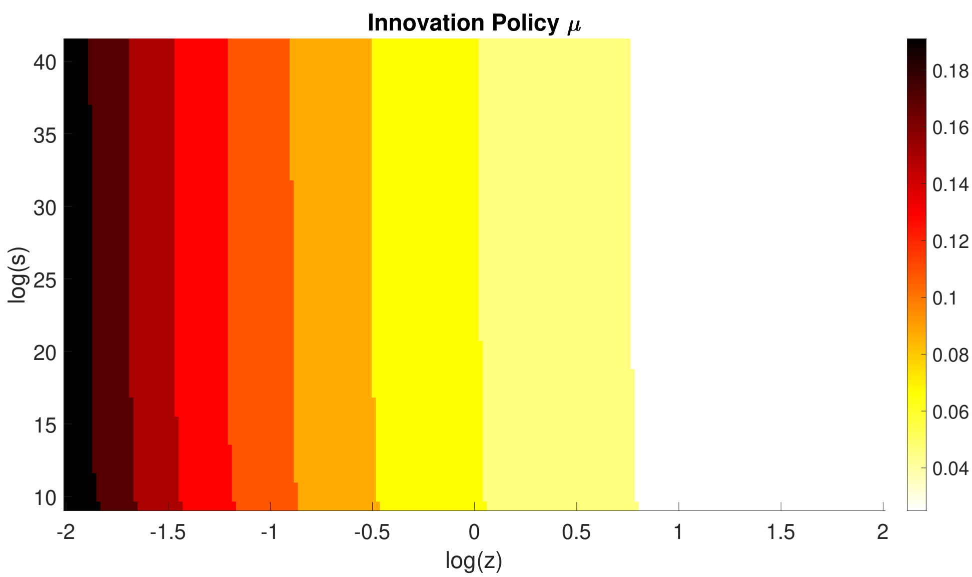


Figure 27: Notes. The figure shows the optimal lobby innovation policy function of firms with different productivity levels and lobbying ability (s, z) in panel a) and b) for the model calibrated with taxation lobbying only.

Table 19: Calibration with Taxation, Trade, Government Contract, Health and Financial Institution Lobbying Spending

Parameter	**Value**	**Target (Source)**	**Data**	**Model**
Externally identified				
Decreasing returns to scale (γ)	0.67	Huneeus and Kim (2021)		
Discount rate (β)	0.96	Interest rate $r = 0.04$		
Depreciation rate (δ_{dep})	0.09	U.S. NIPA		
Exit rate (ψ)	0.02	Compustat		
Internally identified				
Innovation cost (χ)	308	Average R&D intensity	3.96%	4.22%
Lower bound prod drift ($\underline{\mu}$)	-0.016	Average firm growth rate	0.65%	0.75%
Lobby CES share ($\hat{\theta}$)	0.024	Average lobby intensity	0.03%	0.03%
Productivity persistence (ρ)	0.86	Productivity autocorrelation	0.94	0.81
S.d of innovation (σ_ϵ)	0.12	Coefficient of variation	0.37	0.29
S.d of lobby efficiency (σ_s)	4.86	S.D. log (lobby/sales)	0.90	0.92
Elasticity of substitution (κ)	0.64	Elasticity of lobby-innovation	0.81	0.81
Returns to lobbying (ω)	0.23	Sales-lobby elasticity	0.21	0.22

Table 20: Lobby Shutdown Counterfactual with Taxation, Trade, Government Contract, Health and Financial Institution Lobbying Spending

Eliminating Lobbying	Baseline	No Lobbying	% Change
Aggregate Outcomes			
Output	1.00	1.03	3.09%
TFP	1.00	1.01	0.59%
CEWC	1.00	1.01	1.93%
Firm-level Outcomes			
Avg. R&D intensity	4.22%	4.32%	2.37%
Market Value	1.00	1.04	4.18%

Notes: This table presents the changes in the relevant macroeconomic aggregates under the lobbying shut down whereby $\theta = 0$, stationary equilibrium compared to the baseline economy.

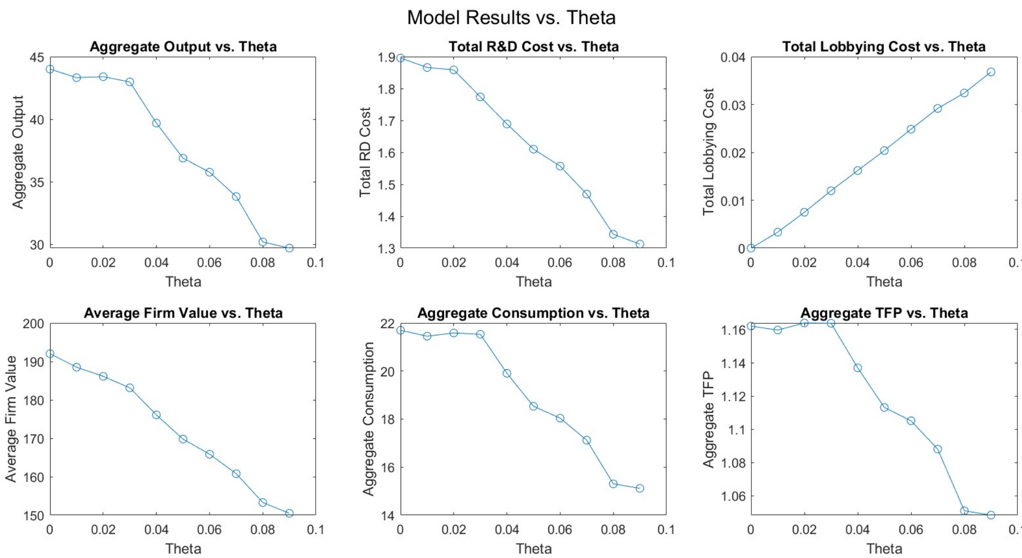


Figure 28: Model Moments across varying level of lobby share θ

Notes: The figure reports the comparative statics of aggregate output, total R&D cost, total lobbying cost, average firm value, aggregate consumption and TFP across varying levels of lobbying measured by θ. The model qualitatively delivers that with lower levels of θ, output, R&D cost, TFP, firm value and consumption are increasing. Lobbying cost is increasing function of lobbying share in the economy θ.

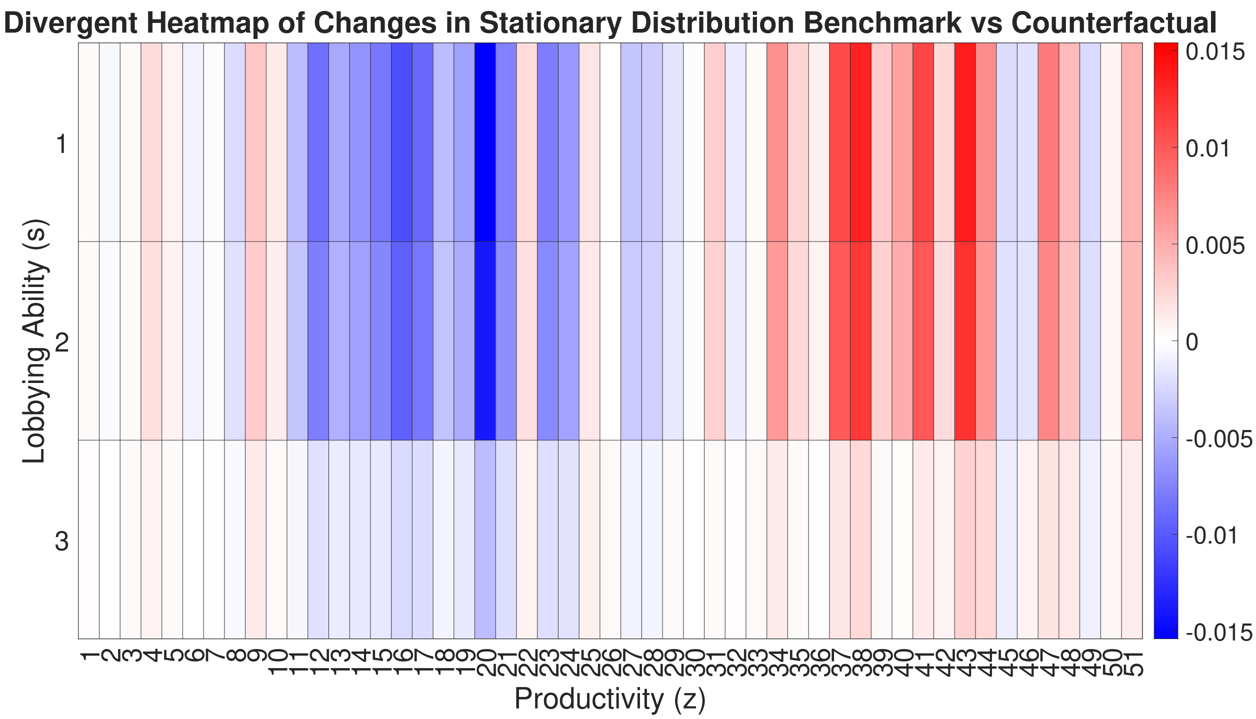
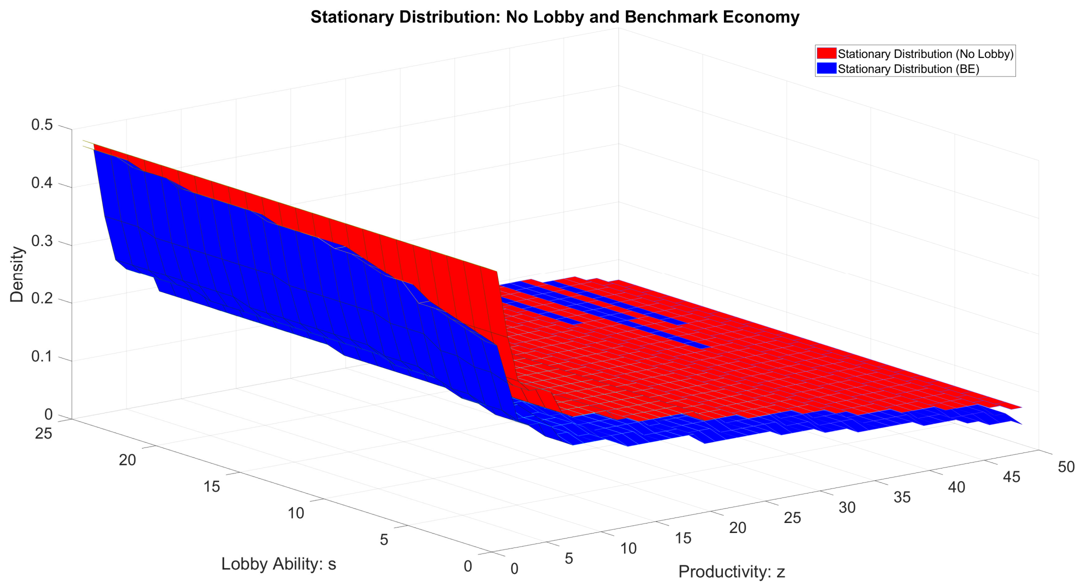


Figure 29: Divergent Heatmap of Benchmark and Counterfactual Distribution

Notes: The figure plots the changes in the distribution of firm types across (z,s) space between the benchmark economy and the counterfactual economy without lobbying. Key insight from the table is to show that the distribution of firm types across the productivity distribution is more concentrated on the upper tail, which increases the average productivity type firms in the counterfactual economy.

Figure 30: Stationary Distribution of Benchmark and No Lobby Economy



The figure compares the stationary distribution of firm types across (z,s) states for the benchmark and the counterfactual economy with no lobbying. The key finding is highlights the counterfactual economy without lobbying stochastically dominates across the productivity dimension, highlight an improvement in the distribution of firm-types relative to the benchmark economy.