# Capital-Based Corporate Tax Benefits: Endogenous Misallocation through Lobbying

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## Abstract

We propose a new mechanism for capital misallocation. The mechanism is based on firms lobbying for capital-based tax benefits, decreasing their marginal cost of capital, and becoming too large with respect to their productivity. We use lobbying and firm-level data from the U.S. to document that firms that lobby are larger, more capital intensive, enjoy lower effective tax rates, and have lower marginal product of capital than firms that do not lobby. A heterogeneous firms model with lobbying and technology choice is developed to explain these facts. The calibrated model shows that lobbying firms over-accumulate capital by $5.5\%$ on average. A tax reform that reduces the statutory tax rate improves aggregate efficiency by decreasing the incentives to lobby in equilibrium.

**Keywords**: Lobbying, Firm heterogeneity, Capital misallocation

**JEL classification**: D2, D72, E2

# 1  Introduction

The current U.S. tax system taxes corporate income at a statutory rate of $35\%$, the highest rate among the Organization for Economic Co-operation and Development (OECD) nations. The system, however, contains a number of deductions, exemptions, deferrals, and tax credits. The largest part of corporate tax benefits - also referred to as corporate tax expenditures - includes accelerated depreciation, domestic production activities deduction, deferral of income earned abroad, and credit for increasing research activities. These benefits affect firms unequally. Therefore, the effective tax rate, hereafter ETR, paid by U.S. corporations is highly heterogeneous and well below $35\%$, on average.[1] Despite a relatively high statutory tax rate, the average effective tax rate of the U.S. is in fact similar to the OECD weighted average. For instance, the median ETR paid by U.S. firms over the past decade is $22\%$, with a standard deviation of $12\%$.

Nevertheless, these tax benefits are not completely exogenous to every company. And because some tax benefits are applicable to a very restricted set of firms, there is room for corporate pressure through lobbying activities. Many companies successfully lobby for the creation of tax benefits or exemptions tailored to their profiles. Not surprisingly, lobbying for taxation purposes has been the top corporate lobbying issue in the past two decades. Tax benefits for the companies that lobby can be seen even in the raw data. Figure (1a) shows the distribution of ETRs for lobbying and non-lobbying firms.[2] Lobbying firms face consistently lower ETRs than non-lobbying firms. More specifically, the median ETR for lobbying firms is $21\%$, three percentage points lower than that of non-lobbying firms. Moreover, Figure (1b) shows that lobbying firms exhibit systematically lower levels of marginal product of capital, hereafter MPK. In particular, the median marginal product of capital among lobbying firms is $41\%$ lower than that of non-lobbying firms.

This paper studies the effect of capital-based tax benefits and corporate lobbying behavior on

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[1]The effective tax rate for a corporation is the average rate at which its pre-tax profits are taxed. It is computed by dividing total tax expenses by the firm's earnings before taxes.

[2]For the rest of the paper, the terms "lobbying firm" and "non-lobbying firm" are used to describe whether or not a firm spends money to lobby on tax-related issues. This is different from the common use of the term "lobbying firm", namely, a lobbyist or an entity that has one or more employees who are lobbyists on behalf of a client other than that entity.

Figure 1 Effective Tax Rates and Marginal Product of Capital



(a) Conditional Distribution of ETR  (b) Conditional Distribution of log(MPK)
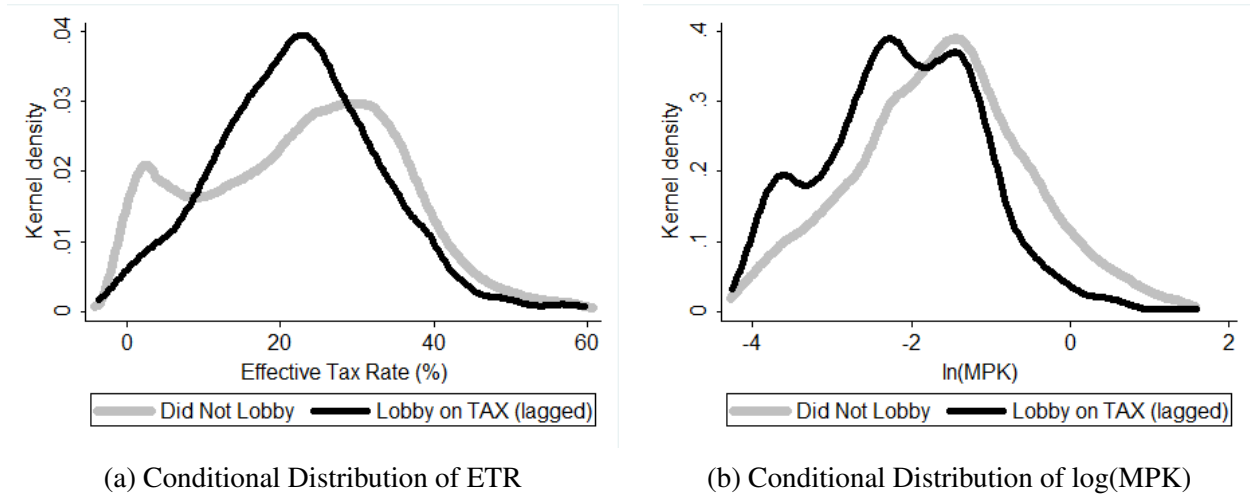
Notes: Based on firm-year observations over 1998-2014 for all sectors except finance, insurance and real estate sectors. ETR is a 3-year cash ETR defined in Appendix F. log(MPK) is a 3-year moving average. A firm is considered lobbying at time $t$ if it incurred tax-related lobbying expenditures at time $t - 2$.

the capital decision of firms and the potential aggregate impact of capital misallocation created by these benefits. The main novelty of this paper is to build a quantitative framework that rationalizes the empirical relationship between corporate lobbying, tax benefits and firm characteristics to study aggregate policy implications. In particular, lobbying firms are able to collect capital-based tax benefits that decrease their marginal cost of capital. Lower marginal cost of capital translates into over-accumulation of capital, consequently leading to an aggregate efficiency loss in the economy. Unlike the credit constraint channel, which renders small firms overwhelmingly small, the rent-seeking channel in this paper makes firms too big with respect to their productivity.

The goals of this paper are to lay the groundwork for a model-based study of corporate lobbying and firm decisions and to propose a new mechanism that delivers capital misallocation. The paper focuses exclusively on the empirical relationship between firm-level lobbying and capital decisions. It could still be true that other mechanisms, such as revolving doors, strategic lobbying, coalitions and free riding co-exist, and that under some circumstances, lobbying can have an overall positive impact by counteracting distortive taxation. Moreover, our model abstracts from other classical tax benefits related to the trade-off theory, i.e. firm's optimal leverage, or research subsidies. For this reason, the model is calibrated to match conditional correlations that control for

these alternatives forces, removing location and industry trends as well as firm characteristics such as leverage and $R\&D$ intensity.

Section 3 uses lobbying data from the Center for Responsive Politics matched with the Compustat database to obtain the firm characteristics that are necessary for calculating ETRs and MPK. We document three empirical regularities: i) the dominant issue of corporate lobbying is taxation; ii) lobbying firms are larger and more capital intensive than non-politically active firms; and iii) lobbying firms pay lower ETRs and have lower MPK. These empirical regularities provide support for the main mechanism of the model.

In Section 4, a heterogeneous firms model with lobbying and capital-based corporate tax benefits is developed to formalize the relationship among corporate lobbying, ETR, and MPK. Firms are heterogeneous in their productivity and political connections. There are two main differences with respect to the standard heterogeneous firms framework. First, firms choose between two technologies that differ in their degree of capital intensity to transform capital and labor into final goods. We introduce this feature to allow for large but efficient variations in capital intensity across firms.[3] Thus, the model could support the view that measured misallocation is due to differences in within-industry technologies and not to inefficiency. Second, firms lobby to obtain preferential tax benefits, which are granted as tax deductions associated with their capital holdings. With limited resources for tax expenditures, only a subset of the firms lobby in equilibrium. Analytic results confirm that the model can explain differences in ETR and MPK between lobbying and non-lobbying firms documented in Section 3. Tax benefits and lobbying activities can distort the economy along two margins: an extensive margin by inducing inefficient technology choices and an intensive margin by inducing inefficient capital choices within each technology class.

In Section 5, we extend the baseline model and calibrate it to the U.S. economy during 2011-13 in order to quantify the impact of heterogeneous taxation and corporate lobbying. To correct for other sources of heterogeneity, the model is calibrated to match conditional correlations from a

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[3]Oberfield and Raval (2014) allow for the substitution between capital and labor along both the intensive and extensive margins. That is, in response to factor prices, firms can substitute across inputs or shift to more-capital-intensive technology. They document that most of the decline in labor income share observed in the U.S. manufacturing sector is explained by the bias of technological change within industries.

regression analysis that confirms the differences in MPK and ETRs between lobbying and non-lobbying firms even after controlling for firm-level characteristics, locations, and industry-specific time trends. Because the model takes firms' political connections as exogenous, unobserved variables that affect simultaneously taxation and lobbying are the main empirical threat. We implement an instrumental variable strategy and show that the relationship between lobbying and taxation is robust to endogeneity concerns. Moreover, the ETR difference between lobbying and non-lobbying firms is still significant and the coefficient is not statistically different than the OLS estimate.

The calibrated model captures differences in size, productivity, effective tax rate, and capital intensity between lobbying and non-lobbying firms. In particular, productive and large firms are more likely to be politically connected and to lobby to influence tax policy and reap idiosyncratic capital-based tax benefits. The quantitative analysis shows that lobbying firms over-accumulate, on average, $5.5\%$ more capital with respect to an economy with no distortions. Moreover, $50\%$ of the over-accumulation is exclusively due to lobbying activities. In terms of efficiency, the average marginal product of capital in the baseline economy is 15 basis points lower than the non-distorted benchmark. Lobbying plays a significant role in explaining the distortions driven by tax deductions. Even though only $16\%$ of firms in the economy lobby, lobbying accounts for at least $25\%$ of the average firm-level distortions. Moreover, because lobbying firms account for $50\%$ of the aggregate capital, they concentrate most of the cost of heterogeneous taxation. For instance, in terms of welfare, the baseline economy could increase consumption by 10 basis points, with $90\%$ of that efficiency loss being due to lobbying-based distortions. The model suggests that for every unit of output spent on lobbying, the society loses $1.59$ units of consumption. Given that only a handful of firms do lobby and that the model is calibrated to the US economy, where lobbying accounts for a small share of GDP, these magnitudes are economically relevant. Therefore, in an economy where rent seeking and lobbying quickly give in to generalized bribery and corruption, the aggregate cost of this mechanism can become overwhelming. The calibrated model also shows that a tax reform that decreases the effective tax rate affects the incentives for firms to lobby and increases welfare even when the parameters that govern capital-based tax benefits are unchanged.

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This paper is organized as follows. Section 2 discusses related literature. Section 3 presents our database and the empirical regularities that motivate the model. Section 4 describes the model economy. Section 5 calibrates the model and quantifies the distortion created lobbying activities. Finally, Section 6 concludes the paper.

## 2    Related Literature

This paper belongs to the literature on capital misallocation and firm-level distortions. Closely related papers are Restuccia and Rogerson (2008) and Hsieh and Klenow (2009). They study a reduced-form distortion created by government policy in the context of heterogeneous firms, which leads to aggregate output and TFP loss.[4] A related article by Fajgelbaum et al. (2015) studies the effects of state-level variations in tax benefits in spatial misallocation. In their case, tax rates are exogenous and vary only at the state level. The main alternative mechanism to endogenously generate capital misallocation is financial frictions. Salient examples in this literature are Buera et al. (2011), Midrigan and Xu (2014), Moll (2014), and Gopinath et al. (2017). Credit constraints imply that some productive firms are unable to borrow in order to reach their optimal capital level. Thus, the marginal product of capital of these firms is too high (i.e., small firms are too small). The mechanism presented in this paper suggests that large firms face a lower marginal cost of capital due to the interaction of lobbying and capital-based tax benefits (i.e., large firms are too large). Therefore, this paper complements the existing endogenous misallocation literature by providing a channel that can study inefficiencies at the right tail of the size distribution.

We also contribute to the economic literature on corporate lobbying.[5] For instance, Igan et al. (2012) find that lobbying is associated with more risk-taking during 2000-07. Kerr et al. (2014) explore lobbying behavior toward immigration-specific issues. They document that lobbying is persistent and that it was positively associated with firm size. Kang (2016) quantifies the effect of

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[4]For an extensive review of the literature, refer to Hopenhayn (2014).

[5]Literature in political science has long studied lobbying under the context of the US legislative process and congressional system, both in theory and in practice. Some of the pioneering works are by Fenno (1973) and Rothenberg (1992).

lobbying expenditures on policy enactment in the energy sector. Hassan et al. (2016) use corporate lobbying data to test their firm-level political uncertainty measure. They document that firms respond to political uncertainty by lobbying on specific topics. Azzimonti (2017) shows that this class of political uncertainty can have real consequences, specially on investment. We also relate to a theoretical strand on political economy that model lobbying activities, an application to tax reform can be found in Ilzetzki (2015). Quantitative work is considerably less developed. One exception is the literature on the influence of lobbying activities on trade policy by Grossman and Helpman (1994), Mitra (1999), Gawande and Bandyopadhyay (2000), Bombardini (2008), and Bombardini and Trebbi (2012). Although tax-related lobbying accumulates more expenditures than trade issues for every single year in the data, to the best of our knowledge, this is the first paper to study how corporate lobbying can distort firm capital decisions.

# 3 Tax Lobbying and Firm Characteristics

In this section, we introduce the database used in the empirical analysis. Three empirical regularities are documented: i) the dominant issue of corporate lobbying is taxation, ii) lobbying firms are larger and more capital intensive, and iii) lobbying firms enjoy lower effective tax rates and have lower marginal product of capital than non-politically active firms.

## 3.1 Data Description

The empirical analysis relies on two sources of data. Lobbying data are obtained from the Center for Responsive Politics (CRP). These data are available due to the Lobbying Disclosure Act of 1995.[6] This Act requires filers to disclose detailed information about lobbying expenditures above $5,000 during a quarter. Firms with in-house lobbying activities are also required to report. However, the CRP data do not include bribes, other under-the-table payments or firms'

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[6]This Act was strengthened by the Honest Leadership and Open Government Act of 2011. Because the law did not change the mandatory disclosure, we decided to use the complete data for this analysis. Nevertheless, our empirical analysis is robust to the exclusion of the post-2011 data.

illegal expenditures aiming to influence policy outcomes. Lobbying activity is reported under one of 81 issue areas, and the expenditure allocated to lobbying on a particular report must be declared. Appendix A shows how this information is reported by the lobbyists. We match this database to Compustat to obtain information on firms' characteristics. Compustat contains detailed information on sales, employment, assets, and tax expenditures, among other variables, for publicly traded companies in the U.S. economy. Table (1) summarizes the raw data for the period spanning 1999 - 2013.

Table 1 Lobbying Data and Compustat

|  | CRP | Compustat | | Compustat (Manufacturing) | |
|---|---|---|---|---|---|
|  | Lobbying | All | Lobbying | All | Lobbying |
| # of obs. (firm-year) | 164,431 | 145,879 | 6,527 | 46,802 | 2,654 |
| Lobbying Expenditure ($ million) | 29,099 | N/A | 11,165 | N/A | 4,934 |
| Total Asset ($ billion) | N/A | 1,190,000 | 445,000 | 165,000 | 80,500 |

Notes: Numbers are based on aggregating all firm-year observations (1999–2013). In this table, we consider lobbying on tax issue. All amounts are in constant 2009 dollars.

Note that the CRP data contain not only corporate lobbying but also lobbying by organizations, individuals, and even foreign governments. Despite this wide variety of potential actors, lobbying firms in Compustat account for approximately $40\%$ of the total lobbying expenditure on tax issues in the CRP database. Therefore, most tax-related corporate lobbying activity is likely to be reflected in our sample. In addition, total assets held by firms with lobbying activity account for approximately 40% of total assets held by all Compustat firms and approximately 50% if we restrict firm-year observations to the manufacturing sector. Because most of the analysis in this paper involves productivity estimation, which is more accurate for the manufacturing sector, the empirical and quantitative analysis will focus solely on the manufacturing sector.[7] Firm-level variables in Compustat are used to calculate effective tax rates and revenue productivity. To minimize the noise generated by deferred tax liabilities, we follow the accounting literature, and we work with a 3-year aggregated measure of the effective tax rates. In particular, we follow Dyreng et al.

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[7]Appendices G and H show that the results are robust when using the full sample.

(2008) and calculate the effective tax rates as follows:

$$ETR_{i,t} = \frac{\sum_{h=1}^{w} TXPD_{i,t-h}}{\sum_{h=1}^{w} (PI_{i,t-h} - SPI_{i,t-h})} \tag{1}$$

where $TXPD_{i,t}$ is the cash taxes paid by firm $i$ at time $t$, $PI_{i,t}$ is the pre-tax income obtained by firm $i$ at time $t$, and $SPI_{i,t}$ is the special items of firm $i$ at time $t$. The special items are unusual or nonrecurring items of income presented before taxes by the company and are recorded separately. The numerator can be interpreted as cash paid over $w$ years, while the denominator is the sum of firm $i$'s income before tax over the same $w$ years. Our default choice is $w = 3$, which strikes a balance between measurement irregularities due to a small $w$ and a lack of dynamics in lobbying decisions due to a large $w$. Thus, throughout this section, a firm is considered a lobbying firm at time $t$ if it incurred tax-related lobbying expenditure at time $t - 2$.

We follow Imrohoroglu and Tuzel (2014) to calculate firm-level capital and employment series based on Compustat data. We then use the Wooldridge (2009)'s extension of the method developed by Levinsohn and Petrin (2003) to build firm-level revenue productivity measures.[8] With this measure, we use a Cobb Douglas production function to build our measure of marginal product of capital. Appendix F provides more details on the data construction.

## 3.2 Three Empirical Regularities

### Fact 1: Corporate Lobbying is Mainly Focused on Taxation

The main topic of corporate lobbying in the U.S. is taxation. Table (2) ranks the top five issues according to their share of the total corporate spending in lobbying between 1999 and 2013. Taxation always ranks first. Appendix C shows that the dominance of tax-related lobbying holds for every year and for a variety of measures.

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[8]As noted in Foster et al. (2016), this measure confounds demand and productivity components. Nevertheless, given that price data at the firm level are unavailable, this is the best proxy available. Moreover, in the model, productivity can also be written as a mixture of demand and technology, and the results will not be affected.

Table 2 Percentage of Aggregate Expenditures by Issues (Top 5, $1999 - 2013$)

| | All lobbying observations | | Compustat firms (all industries) | | Compustat firms (manufacturing) | |
|---|---|---|---|---|---|---|
| Ranking | Issue | % | Issue | % | Issue | % |
| 1 | Taxation | 8.39 | Taxation | 10.37 | Taxation | 9.22 |
| 2 | Budget/Appropriations | 6.23 | Trade (Domestic & Foreign) | 6.25 | Trade (Domestic & Foreign) | 7.74 |
| 3 | Health Issues | 5.59 | Health Issues | 5.57 | Health Issues | 6.25 |
| 4 | Trade (Domestic & Foreign) | 4.54 | Budget/Appropriations | 5.24 | Budget/Appropriations | 6.06 |
| 5 | Energy/Nuclear | 4.09 | Energy/Nuclear | 4.88 | Energy/Nuclear | 4.62 |

Notes: Numbers are based on aggregating all firm-year observations (1999–2013). Appendix C presents rankings by year and the list of all 82 possible issues.

## Fact 2: Lobbying Firms are Large and Capital Intensive

Lobbying firms are large and capital intensive. Figure 2a shows the median of the log capital of firms that lobby on tax issues relatively to the rest of the sample in the manufacturing sector. Note that every year, the median lobbying firm has approximately 28 times more capital than the rest of the sample. Moreover, Figure 2b shows that the median log capital intensity - logarithm of capital to labor ratio - of firms that lobby on tax-related issues is approximately 2 times larger than that of the rest of the sample in every year. This points to a disproportionately large capital to labor ratio of lobbying firms.

Figure 2 Conditional Median Capital and Capital Intensity
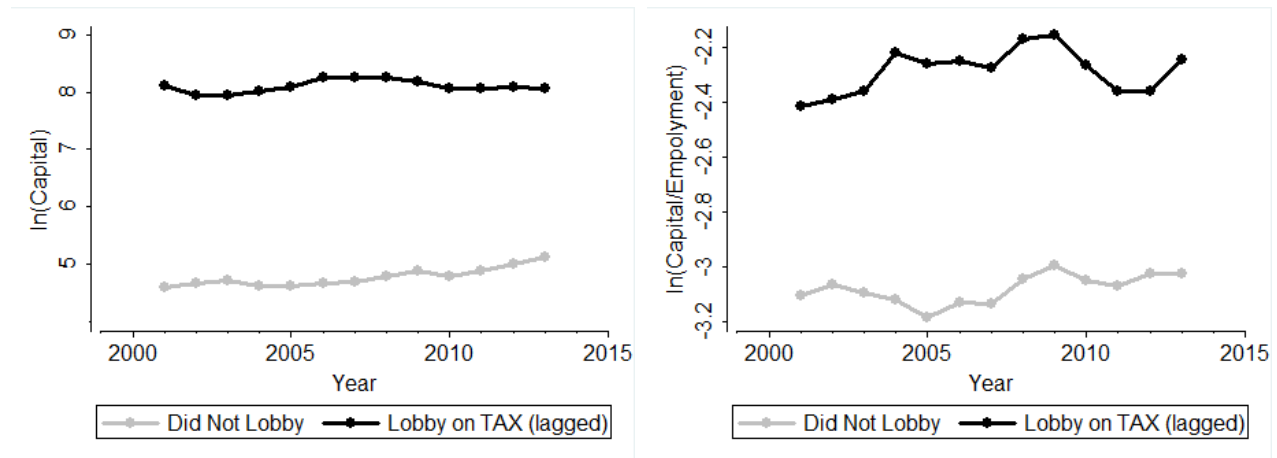


(a) Median log(Capital)    (b) Median log(Capital/Employment)

Notes: Manufacturing firms. Firms are grouped by their lobbying status on tax issues.

Fact 2 also holds at the industry level. Each observation in Figure 3 represents the year-industry median of capital and capital intensity for lobbying (y-axis) and non-lobbying (x-axis) pairs. Fig-

Figure 3 Industry - time Differences in Capital and Capital Intensity between Lobbying and Non-lobbying Firms



(a) Median log(Capital)    (b) Median log(Capital/Employment)
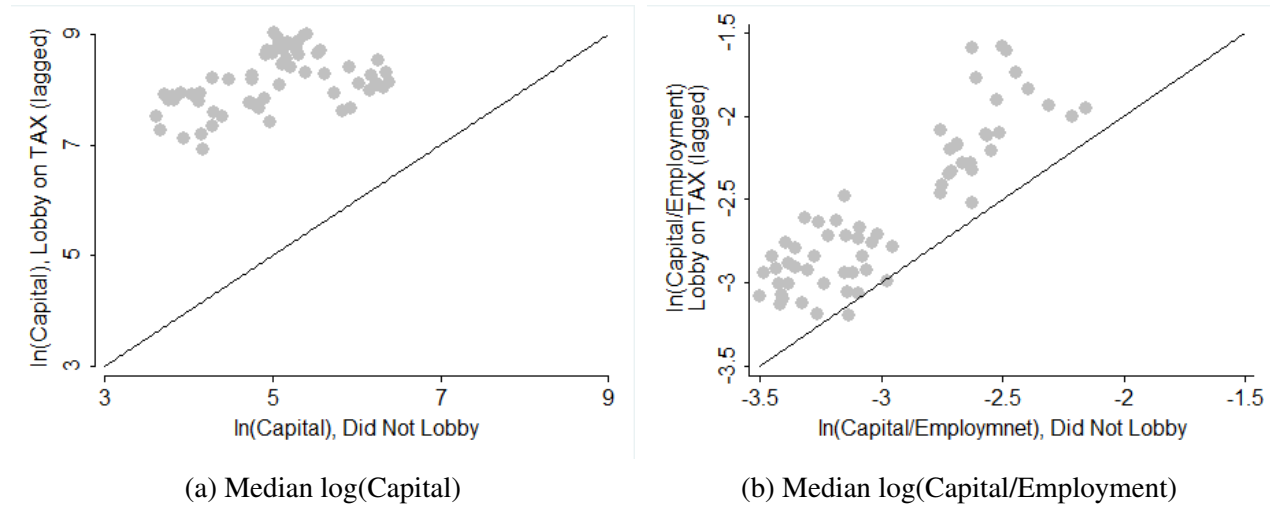
Notes: Manufacturing firms. Calculated for two digit industries (SIC) with more than 10 firms in each lobbying status.

ure 3a shows that the median lobbying firm in every industry is larger, and Figure 3b shows that the median lobbying firm is also more capital-intensive. Because revenue productivity is estimated at the industry level, it is clear that industry composition does not drive this fact.

**Fact 3: Lobbying Firms Enjoy Lower ETR and Have Lower MPK**

Firms that lobby on tax issues have lower effective tax rates and lower marginal product of capital than firms that do not lobby on tax issues. To support this claim, Figure (1) presents the median ETR and the median MPK for firms that lobby on tax issues over time. As shown in Figure (4a), lobbying firms have a lower median ETR than non-lobbying firms. Despite the downward trend documented by Dyreng et al. (2017), the gap in ETR between lobbying an non lobbying firms does not have a clear trend. This difference can be as large as five percentage points. Figure (4b) complements the analysis by showing that lobbying firms have a 40% lower median MPK than non-lobbying firms.[9]

Figure 5 displays the differences between lobbying and non-lobbying firms at the industry level. Each observation represents the year-industry median of ETR and MPK for lobbying (y-axis) and

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[9]For empirical and quantitative analysis, marginal product of capital is always measured in logarithm log(MPK).

non-lobbying (x-axis) pairs. Most observations are located under the 45-degree line, indicating that lobbying firms enjoy lower ETR compared to their non-lobbying counterparts in the same industry. In addition, lobbying firms tend to have lower MPK compared to non-lobbying firms in the same industry.

Table (3) summarizes the main differences between lobbying and non-lobbying firms in our sample. First, lobbying firms are larger. In fact, during the sample period, only 11% of manufacturing firms lobby on tax-related issues, but these firms account for almost 42.5% of the total physical capital held by all manufacturing firms in the sample. Firms that lobby on tax issues also have, on average, lower ETR and MPK, even when compared to the group of firms that lobby for non-tax issues.

Table 3 Comparison Between Lobbying Types

|  | Do not lobby | Lobby | |
|---|---|---|---|
|  |  | on non-tax issues | on tax issues |
| # of Firms (%) | 74 | 15 | 11 |
| Total capital held (%) | 41.3 | 16.2 | 42.5 |
| Median ETR (%) | 24.4 | 23.4 | 21.5 |
| Median log(MPK) | -1.6 | -1.8 | -2.2 |

Manufacturing firms. Each number is first computed year by year over 1999-2013. Then, we average these statistics over all years. See Appendix F for more details.

Figure 4 Conditional Effective Tax Rates
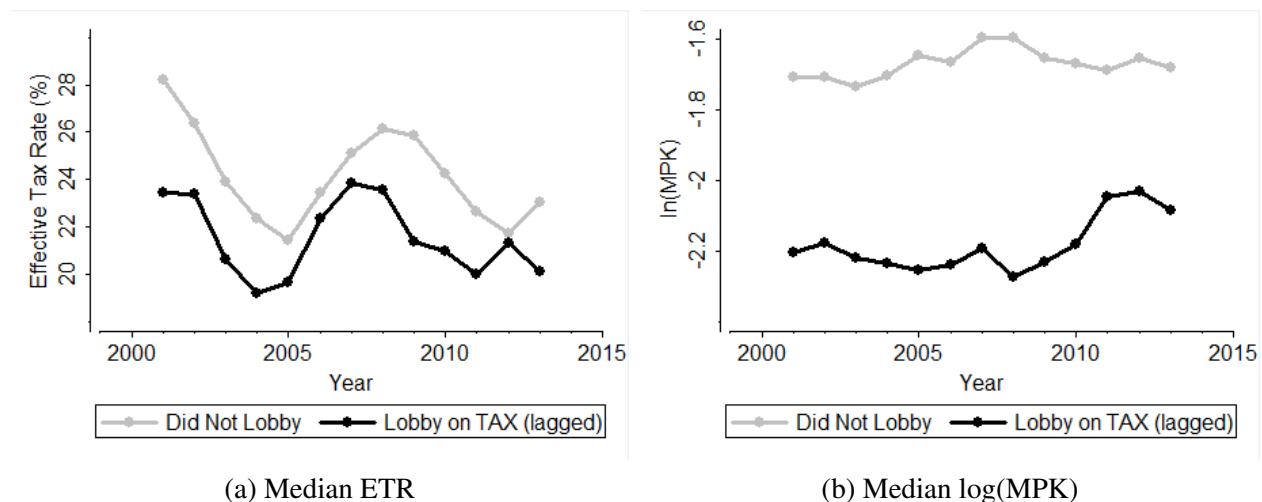


(a) Median ETR                    (b) Median log(MPK)

Notes: Manufacturing firms. Firms are grouped by their lobbying expenditures on tax issues.

Figure 5 Industry - time Differences in ETR and log(MPK) between Lobbying and Non-lobbying Firms
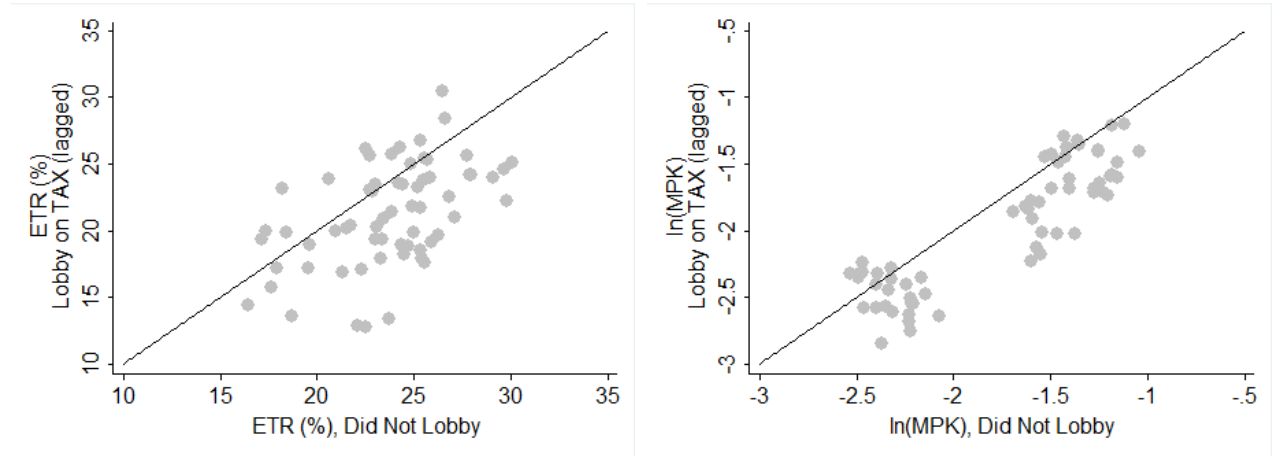


(a) Median ETR by industry/time          (b) Median log(MPK) by industry/time

Notes: Manufacturing firms. Calculated for two digit industries (SIC) with more than 10 firms in each category.

Therefore, U.S. firms lobby mainly on tax-related issues. Firms that lobby on tax issues are larger, more capital-intensive, enjoy lower effective tax rates, and have a lower marginal product of capital.

# 4    Model Economy

This section presents a heterogeneous firm model with lobbying and technology choice to formalize the mechanism that links corporate lobbying to lower ETR and MPK, and how this link leads to inefficiency and misallocation. Competitive firms have access to a decreasing returns to scale technology. Firms can substitute between capital and labor at both intensive and extensive margins by choosing between production technologies with different capital intensity. The firms' net income is subject to a corporate tax. A government, however, grants tax benefits in the form of tax deductions that depend on both capital holdings and lobbying activities. In particular, every firm has a permanent and idiosyncratic level of political connection governing firms' access to lobbying.[10] The focus of the model is measuring the effect of lobbying and heterogeneous taxation

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[10]Political connections might be viewed as a result of a firm having political influence from hiring lobbyists who have prior political connections or from making campaign contributions through a political action committee (PAC).

on the allocation of capital. We do not provide a complete micro-foundation for why some firms lobby and other firms do not. Those with better political connections have a greater chance to engage in lobbying activities, but the level of political connection is exogenous. Firms endogenously choose lobbying intensity, technology, capital, and labor based on their exogenous productivity and political connection level. Because the government has limited resources for tax expenditures, only a subset of firms lobby in equilibrium.

## 4.1 Consumers

There is an infinitely lived representative household that maximizes the utility

$$U = \sum_{t=0}^{\infty} \beta^t u(C_t) \tag{2}$$

where $C_t$ is consumption at time $t$ and $0 < \beta < 1$ is a discount factor. The household is endowed with one unit of labor supplied to firms at the market wage rate $w_t$. Moreover, the household has access to a risk-free bond that is in zero net supply and pays interest rate $r_t$, owns operating firms that pay dividends, and receives a lump sum transfer for the total amount of taxes collected.

## 4.2 Firms and Technology

Each firm produces output using a production function that combines productivity $z$, capital $k$, and labor $n$. A firm faces a discrete technological choice between two production functions, which differ in the level of capital intensity, both exhibiting decreasing returns to scale in capital and labor:

$$y = z \left( k^\alpha n^{1-\alpha} \right)^\eta \tag{3}$$

where $\alpha \in \{\underline{\alpha}, \overline{\alpha}\}, \eta \in (0, 1)$. As in Restuccia and Rogerson (2008), we abstract from productivity dynamics, so $z$ varies across firms but is constant over time for a given firm. The technology choice allows firms to choose a method of production that is more (or less) capital intensive, although

An alternative setting suggested by Kerr et al. (2014) among others is a firm-specific fixed costs of lobbying.

adopting more capital-intensive technology incurs a fixed cost $\varphi$. We allow for technology choice in order not to attribute all the observed heterogeneity in capital intensity to tax heterogeneity. After producing and selling its outputs, each firm is subject to the corporate income tax at the statutory rate $\tau$ on its net income denoted by $\pi = z\left(k^{\alpha}n^{1-\alpha}\right)^{\eta} - wn - (r+\delta)k$.[11]

The government, however, grants tax benefits in the form of tax deductions or tax credits, which will be deducted from the firm's taxable income. The amount is given by the tax benefit function:

$$\mathcal{R}\left(\varepsilon, l, k; \varepsilon^{*}\right) = \mathbf{1}\{\varepsilon \geq \varepsilon^{*}\}\gamma l^{1-\phi}k^{\phi}. \tag{4}$$

How much each firm can reap tax benefits depends on its capital $k$, in line with the fact that most tax benefits are tied to capital, either in the form of research activities or accelerated depreciation of machinery and equipment. How much preferential tax benefits lobbying firms can claim depends on how much they spend on lobbying activities. We assume that the elasticity of substitution between lobbying activities and capital in claiming additional tax benefits is equal to one. With limited resources for tax expenditures, only a subset of firms engage in lobbying. The likelihood that the firm can benefit from lobbying activities depends on its political connection $\varepsilon$. By spending $l$ on lobbying activities, the firm with political connection $\varepsilon$ above the endogenous threshold $\varepsilon^{*}$ receives tax deductions.

A reduced-form approach allows productivity and political connection to be jointly determined. In particular, each firm is characterized by an idiosyncratic and permanent type $(z, \varepsilon)$, which is drawn from the distribution $F(z, \varepsilon)$. Capital depreciates at the rate $\delta$. Therefore, given its productivity $z$ and political connection $\varepsilon$, the firm faces the following maximization problem at time

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[11]We assume that firms are only subject to the corporate income tax levied on the taxable profits of a firm. This assumption highlights the allocative effects of lobbying. Other types of corporate taxation, such as a capital tax, might create inefficient allocations and lobbying could be a second best option to correct these distortions. The framework in this paper can be used to study these situations.

$t$:

$$\max_{\substack{n_t, l_t, k_t \geq 0 \\ \alpha_t \in \{\underline{\alpha}, \overline{\alpha}\}}} \left\{ \begin{array}{l} (1-\tau) \left[ z \left( k_t^{\alpha_t} n_t^{1-\alpha_t} \right)^\eta - w_t n_t - (r_t + \delta) k_t \right] \\ +\tau \{\varepsilon \geq \varepsilon_t^*\} \gamma l_t^{1-\phi} k_t^\phi - l_t - \varphi \mathbf{1}\{\alpha_t = \overline{\alpha}\} \end{array} \right\}.$$

## 4.3 Government and Tax Policy

The government has a limited budget for exceptions and it forgoes only a fraction $\omega$ of its revenue on corporate tax expenditures. Thus, not every firm is granted tax benefits in equilibrium. We assume that tax benefits are granted starting with the firms that have the strongest political connection until the total budget available for tax expenditures is reached. Hence, the connection threshold $\varepsilon^*$ for lobbying and lobbying-related tax deductions is endogenously determined by the lobbying efforts of other firms and the total amount of tax expenditures. When the overall intensity of lobbying is high and the tax expenditure budget is limited, it is more difficult for firms with relatively weak political connections to collect benefits from lobbying. The allocation rule gives rise to a crowding out effect of tax benefits is absent in a model where any firm that pays a fixed cost can lobby and reap benefits.

## 4.4 Equilibrium

We consider the steady-state competitive equilibrium of the model in which the interest rate $r$, the wage rate $w$ and the connection threshold for lobbying $\varepsilon^*$ are constant. The households maximization problem implies that $\beta = \frac{1}{1+r}$ and that aggregate consumption is $C = w + \Pi + T$, where $\Pi$ is the after-tax profit of firms and $T$ is the lump-sum transfer collected from corporate income taxes.

A firm with productivity $z$ and political connection $\varepsilon$ makes a decision about its technology $\alpha$, capital $k$, lobbying activities $l$, and labor $n$. Conditional on capital $k$ and political connection $\varepsilon$,

the firm decides whether to engage in lobbying activities and how much to spend on lobbying:

$$l^*(k, \varepsilon; \underline{\varepsilon}) = \begin{cases} 0 & \varepsilon < \varepsilon^* \\ (\tau\gamma(1-\phi))^{\frac{1}{\phi}} k & \varepsilon \geq \varepsilon^*. \end{cases} \tag{5}$$

Labor input $n$ is chosen conditional on capital $k$ and a technology choice $\alpha$. The labor demand is given by

$$n^*(k, z) = \left( \frac{(1-\alpha)\eta z k^{\alpha\eta}}{w} \right)^{\frac{1}{1-(1-\alpha)\eta}}. \tag{6}$$

Given an optimal choice of lobbying and labor input, the firm makes the technology choice that will determine its optimal level of capital intensity and capital structure. After production, the firm pays corporate income tax based on its deductions entitlement and chooses capital for the next period. In particular, given the interest rate $r$, the wage rate $w$, and the political connection threshold for lobbying $\varepsilon^*$, the firm's maximization problem is

$$\max_{k, \alpha \in \{\underline{\alpha}, \overline{\alpha}\}} \left\{ (1-\tau)\pi^* + \tau\gamma l^{*1-\phi} k^\phi - l^* - \varphi\mathbf{1}\{\alpha = \overline{\alpha}\} \right\}, \tag{7}$$

where $\pi^* = z \left( k^\alpha n^{*1-\alpha} \right)^\eta - wn^* - (r+\delta)k$. The policy functions of technology choice and capital can also be expressed as a function of permanent productivity $z$ and political connection $\varepsilon$. Thus, we can write $\alpha^*(z, \varepsilon)$, $k^*(z, \varepsilon)$, $n^*(z, \varepsilon)$, and $l^*(z, \varepsilon)$.

Given the steady state interest rate $r$, the wage rate $w$ and the connection threshold for lobbying $\varepsilon^*$, the labor market clearing condition is

$$\int_{(z,\varepsilon)} n^*(z, \varepsilon)dF(z, \varepsilon) = 1. \tag{8}$$

Lastly, the government can only forgo a limited fraction $\omega$ of its revenue from corporate income taxes. The political connection threshold for lobbying $\varepsilon^*$ is endogenously determined by a tax

expenditure constraint:

$$\gamma \int_{(z,\varepsilon)} l^{*1-\phi} k^{*\phi} dF(z,\varepsilon) = \omega \int_{(z,\varepsilon)} \pi^* dF(z,\varepsilon), \tag{9}$$

where $\pi^* = z \left( k^{*\alpha^*} n^{*1-\alpha^*} \right)^\eta - wn^* - (r+\delta)k^*$. The government budget balance implies that the lump-sum transfer $T$ is equal to its revenue from corporate income taxes:

$$T = \tau \int_{(z,\varepsilon)} \left[ \pi^* - \gamma l^{*1-\phi} k^{*\phi} \right] dF(z,\varepsilon). \tag{10}$$

## 4.5 Characterizing the Mechanism: Lobbying and Technology

This subsection illustrates analytically how the new mechanisms of lobbying and technology choices together explain the differences in ETRs and in log(MPK) between the lobbying and non-lobbying firms documented in Section 3. This mechanism leads to an over-accumulation of capital and misallocation. Because the estimation of marginal product of capital and productivity from the data does not allow for within-industry technological differences, we use measured marginal product of capital $\log(\widehat{\text{MPK}})$ and measured productivity $\hat{z}$ as the model counterparts. They are defined as:

$$\log \widehat{\text{MPK}}_i = \log\left(\eta\tilde{\alpha}y_i/k_i\right) = \underbrace{\log \tilde{\alpha} - \log \alpha_i}_{\text{Mismeasurement}} + \underbrace{\log(\text{MPK})_i}_{\text{True MPK}}, \tag{11}$$

$$\hat{z}_i = y_i/(k_i^{\tilde{\alpha}} n_i^{1-\tilde{\alpha}})^\eta = \underbrace{z_i}_{\text{True } z_i} \underbrace{k_i^{\eta(\alpha_i-\tilde{\alpha})} n_i^{\eta(\tilde{\alpha}-\alpha_i)}}_{\text{Mismeasurement}}, \tag{12}$$

where $\tilde{\alpha}$ is the average capital income share. Note that dispersion in $\log \widehat{\text{MPK}}_i$ can be due either to technology mismeasurement or actual misallocation. Thus, the model does not assume that all measured misallocation is inefficient. The analysis focuses on the effect of lobbying activities on ETR and $\log(\widehat{\text{MPK}})$ and how technology choices may amplify this effect. The analytic results are obtained given a partial equilibrium setting in which the wage rate satisfies $w > \underline{w}$, where $\underline{w} \equiv (\frac{1}{\beta} - 1 + \delta) \left[ \left( \frac{\alpha^\alpha}{\tilde{\alpha}^{\tilde{\alpha}}} \right) \left( \frac{(1-\alpha)^{1-\alpha}}{(1-\tilde{\alpha})^{1-\tilde{\alpha}}} \right) \right]^{\frac{1}{\tilde{\alpha}-\alpha}}$. This ensures that, with high capital-intensive technology,

firms can produce goods at a lower unit cost, and therefore some firms are willing to pay the fixed cost and adopt high capital-intensive technology.

**Proposition 1.** *[Technology Choice Induced by Lobbying] If the equilibrium wage rate is such that $w > \underline{w}$,*

1. *For each lobbying type, there exists a technology cutoff $z_l^*$ and $z_{nl}^*$ such that lobbying firms with $z \geq z_l^*$ and non-lobbying firms with $z \geq z_{nl}^*$ choose high capital-intensive technology.*

2. *The technology cutoff is lower for lobbying firms, $z_l^* < z_{nl}^*$. Lobbying induces some firms to switch to high capital-intensive technology.*

*Proof.* See Appendix J.1. □

Lobbying endogenously creates a constant wedge of $x = (1 - \tau)^{-1}\phi(\tau\gamma)^{\frac{1}{\phi}}(1 - \phi)^{\frac{1-\phi}{\phi}}$ between the return to capital and the marginal cost of capital. All else equal, lobbying firms choose higher capital. Proposition 1 characterizes the optimal technology choices by the productivity cutoffs. This follows from the fact that the benefits from switching to high capital-intensive technology are strictly increasing in productivity $z$, while the cost is fixed. However, due to the wedge created by lobbying, these benefits are larger among lobbying firms, so the productivity cutoffs are lower among lobbying firms. Lobbying not only distorts the optimal choice of capital but also distorts the choice regarding capital-intensive technology. Proposition 1 also suggests that we can divide firms into three different groups according to their productivity level $z$: i) all firms with $z < z_l^*$ choose low capital-intensive technology regardless of their lobby activities; ii) for firms with $z_l^* \leq z < z_{nl}^*$, only lobbying firms choose high capital-intensive technology; and iii) all firms with $z \geq z_{nl}^*$ choose high capital-intensive technology regardless of their lobbying activities.

The ETR of non-lobbying firms is simply the statutory tax rate $\tau$. For $z < z_l^*$ or $z \geq z_{nl}^*$, when firms choose the same technology, lobbying firms with preferential tax treatment always have lower effective tax rates. For $z_l^* \leq z < z_{nl}^*$, in which technology choices are different, lobbying firms choose high capital-intensive technology, while non-lobbying firms choose low capital-intensive

technology. The former typically hold a larger amount of capital, are able to claim more tax benefits, and pay lower effective tax rates. Proposition 2 illustrates that the ETR gap is larger when lobbying firms switch to high capital-intensive technology. The gap also increases with the wedge $x$ created by lobbying.

**Proposition 2** (Effective Tax Rates and Measured Marginal Product of Capital)**.** *If the equilibrium wage rate is such that $w > \underline{w}$, and if we let $\alpha_l^*$ and $\alpha_{nl}^*$ be the optimal technology choices of lobbying firms and non-lobbying firms, respectively,*

1. *For a given level of productivity $z$, lobbying firms face a lower effective tax rate. That is,*
   $$ETR_l - ETR_{nl} = -\frac{1}{\phi}\frac{\alpha^*\eta x(1-\tau)}{(1-\eta)(r+\delta)-(1-(1-\alpha^*)\eta)x} < 0 \quad \forall z. \text{ Moreover, the conditional means of}$$
   *effective tax rates are such that $\mathbf{E}\left[ETR_l|z \geq z_l^*\right] < \mathbf{E}\left[ETR_l|z < z_l^*\right] < \mathbf{E}\left[ETR_{nl}\right] = \tau$.*

2. *For a given level of productivity $z$, lobbying firms have lower measured marginal product of capital. That is, $\log(\widehat{MPK})_l - \log(\widehat{MPK})_{nl} = \ln(\alpha_{nl}^*) - \ln(\alpha_l^*) + \ln(r+\delta-x) - \ln(r+\delta) < 0$ $\forall z$. Moreover, the conditional means of the measured marginal product of capital are such that $\mathbf{E}\left[\log(\widehat{MPK})_l|z \geq z_l^*\right] < \mathbf{E}\left[\log(\widehat{MPK})_l|z < z_l^*\right] < \mathbf{E}\left[\log(\widehat{MPK})_{nl}|z < z_{nl}^*\right].$*

*Proof.* See Appendix J.2. $\qquad\square$

Similar to the results of ETR, lobbying firms always have a lower $\log(\widehat{MPK})$. While the choice of capital-intensive technology may amplify this difference, it turns out that the presence of technology choices widens the gap only for a certain range of productivity $z_l^* \leq z < z_{nl}^*$. When $z < z_l^*$ or $z \geq z_{nl}^*$, both lobbying and non-lobbying firms choose the same technology, and the gap is merely determined by the capital wedge, $x$. Nevertheless, the dispersion of $\log(\widehat{MPK})$ can be large if most lobbying firms are highly productive and most non-lobbying firms are less productive. This leads to Proposition 3, in which we summarize all possible effects of the interplay between lobbying activities and technology choices in determining the average gap of ETR and $\log(\widehat{MPK})$ between lobbying and non-lobbying firms.

**Proposition 3** (Average Effective Tax Rates and Measured Marginal Product of Capital)**.** *In a partial equilibrium setting, given $r = \frac{1}{\beta} - 1$ and $w > \underline{w}$, lobbying and capital-intensive technology jointly determine the average gap of ETR and $\log(\widehat{MPK})$ between lobbying firms and non-lobbying firms through two different channels:*

1. *(Lobbying, Size Effect) Lobbying by itself decreases ETR and the $\log(\widehat{MPK})$ of lobbying firms. That is, $ETR_l - ETR_{nl} < 0$ and $\log(\widehat{MPK})_l - \log(\widehat{MPK})_{nl} < 0$.*

2. *(Technology Induced by Lobbying, Composition Effect) Lobbying induces some firms to switch to high capital-intensive technology, creating a larger gap of ETR and $\log(\widehat{MPK})$ between lobbying firms and non-lobbying firms.*

*Proof.* See Appendix J.3. □

Proposition 3 explains how the model can generate lower average ETR and $\log(\widehat{MPK})$ of lobbying firms through two main channels. The first channel is drawn directly from Proposition 2. This effect is mainly driven by lobbying activities, although it may be amplified by capital-intensive technology choices. We call this the *size effect*, given that it does not depend on the underlying distribution. Second, when lobbying induces firms to switch to high capital-intensive technology, it further reduces ETR and $\log(\widehat{MPK})$ among this group of lobbying firms. This also decreases the average ETR and $\log(\widehat{MPK})$ of lobbying firms. Despite being endogenously determined by firm behavior, this effect is called the *composition effect*, as it is generated by a change in the joint distribution of lobbying and technology choices. Section 5 analyzes the quantitative performance of these forces in a general equilibrium setting when other forms of tax benefits are also present.

# 5 Quantitative Analysis

## 5.1 Extended Framework and Regression Analysis

The quantitative exercise of this paper aims at measuring firm-level distortion created by lobbying and heterogeneous taxation. We extend the model economy for quantitative purposes. First,

to avoid attributing all ETR heterogeneity observed in the data to lobbying activities, we allow for tax deductions that are not related to lobbying. We extend the tax benefit function from Equation 4 to include two other sources of tax benefits: i) tax benefits that are independent of capital holdings and lobbying activities; and ii) tax benefits that are not subject to lobbying but are proportional to capital. In particular, we adopt the following functional form:

$$\mathcal{R}\left(\varepsilon, l, k, \chi, \pi; \varepsilon^*\right) = (\xi + \mathbf{1}\{\varepsilon \geq \varepsilon^*\}\gamma l^{1-\phi})k^\phi + \chi\pi, \tag{13}$$

where $\xi$ is determines the benefits that are independent of lobbying but are proportional to capital and $\chi$ is an idiosyncratic and permanent component that determines the benefits that neither depend capital holdings nor lobbying activities. We assume a normal distribution for the latter, so that $\chi \sim \mathcal{N}(\mu_\chi, \sigma_\chi^2)$. In this quantitative exercise, we assume that standard benefits are granted to every firm first. Then, if there are still resources to be allocated, lobbying-dependent tax benefits are granted, starting with the firms that have the strongest political connection until the total budget available for tax expenditures is reached.

Second, the joint distribution of firm specific characteristics $F(z, \varepsilon)$ follows a multivariate normal distribution:

$$\ln(z), \varepsilon \sim \mathcal{N}\left(\begin{pmatrix} \mu \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_z^2 & \rho\sigma_z \\ \rho\sigma_z & 1 \end{pmatrix}\right), \tag{14}$$

where $\rho$ determines which firm is more likely to be more politically connected or to hire lobbyists who have more political connections – large and productive firms or small and unproductive firms. Because what matters is the ranking of political connection $\varepsilon$, we normalize the mean to zero and the standard deviation to one.

To give an economic interpretation of these functional forms, we extend the empirical analysis in Section 3 and estimate the conditional correlation between ETR, capital-intensity, productivity, and lobbying using regression analysis. The empirical literature in accounting and finance on cor-

porate lobbying have studied the determinants of effective tax rates, including lobbying activities. Among others, Richter et al. (2009), Cooper et al. (2010), Meade and Li (2015), Brown et al. (2015), and Dyreng et al. (2017) find that political action by firms is positively correlated with profit and preferential tax treatment. Our regression analysis follows these studies and control for alternative variables that can explain ETR heterogeneity.

The first column of Table (4) shows the linear relationship between the 3-year cash ETR and lobbying activities of firms. Regression (2) shows the linear relationship between the log of capital-labor ratio and the lobbying activities of firms. Regression (3) shows the linear relationship between the log of revenue total factor productivity and the lobbying activities of firms. Regression (4) shows the linear relationship between the log(MPK) and the lobbying activities of firms. Lobbying activity is captured by the indicator variable - Lobbying on Tax - which takes value one if the firm's lobbying expenditure is greater than zero at time $t - 2$ and zero otherwise. Tax benefits vary over fiscal years and might have industry-specific trends. Therefore, all the regressions include time, industry by three-digit SIC code and time-industry fixed effects to control for industry-specific trends. Note that industry trends should capture any effect from lobbying associations at the industry levels or spillovers from industry-wide lobbying activities. We also include fixed effects at the state level to control for geographical variation in tax treatment. Other control variables are firm characteristics. Appendix H shows that these results are robust to the following changes: i) including firms in every sector, ii) other lag structures on lobbying, and iii) one-year and five-year average ETR. Regression (1) shows that the extensive lobbying decision at time $t - 2$ is related to a 2.22 percentage point lower effective tax rate. Also, regardless of their lobbying status, firms that are more capital-intensive have lower effective tax rates, providing indirect support to capital-based tax benefits that are independent of lobbying. Therefore, we can interpret $\xi$ from Equation 13 as capturing capital-based tax benefits that are standard to all firms and $\chi$ as a residual capturing every other force that is independent of lobbying and capital intensity, e.g. multinational activities, leverage, etc. Moreover, Regression (2) shows that lobbying firms are $34\%$ more capital-intensive than non-lobbying firms, indicating that lobbying benefits interact with capital providing potential

Table 4 Differences in ETR and MPK between Lobbying and Non-lobbying Firms

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | ETR | Capital Intensity | Productivity | log(MPK) |
| Lobbying on Tax | -2.2242 | 0.3463 | 0.3923 | -0.2648 |
| | (0.6630) | (0.0686) | (0.0323) | (0.0459) |
| R&D Expenditure | -0.0361 | 0.0033 | 0.0025 | -0.0006 |
| | (0.0084) | (0.0009) | (0.0003) | (0.0008) |
| Intangible Asset | 0.0011 | 0.0002 | 0.0008 | 0.0006 |
| | (0.0014) | (0.0001) | (0.0001) | (0.0001) |
| Leverage | -5.1627 | 0.3056 | 0.2342 | -0.2996 |
| | (1.3377) | (0.0871) | (0.0465) | (0.0826) |
| Capital Expenditure | -15.7106 | -1.5854 | 0.5273 | 2.1388 |
| | (2.3755) | (0.1568) | (0.1138) | (0.1523) |
| Cash Holdings | -0.0030 | 0.0012 | 0.0011 | 0.0005 |
| | (0.0024) | (0.0002) | (0.0001) | (0.0002) |
| NOL Dummy | -3.5003 | -0.0384 | -0.0225 | -0.0181 |
| | (0.5819) | (0.0283) | (0.0126) | (0.0232) |
| Multinational Dummy | 1.5990 | 0.1020 | 0.1911 | -0.1315 |
| | (0.4817) | (0.0487) | (0.0190) | (0.0351) |
| Employment | 0.0177 | 0.0478 | | |
| | (0.1624) | (0.0155) | | |
| Capital Intensity | -0.5247 | | | |
| | (0.2870) | | | |
| # of obs. | 8569 | 8569 | 8569 | 8569 |
| Adj. $R^2$ | 0.128 | 0.392 | 0.826 | 0.452 |

Notes: Firm-level regressions with industry, year, industry-year and location fixed effects. Estimations cluster standard errors by firms. Arbitrary autocorrelation structure of the regression error is allowed based on the Bartlett kernel with the lag length of 2 years. Industries are defined at the three-digit SIC code level. Location is defined by the state where the firm's headquarter is located. Variable definitions are given in the Appendix.

discipline for $\gamma$. Interestingly, Regression (3) shows that lobbying firms are $39\%$ more productive than non-lobbying firms, implying a positive value for $\rho$.[12] Finally, Regression (4) confirms that lobbying firms have a $26\%$ lower MPK than non lobbying firms. Combining Regressions (2) and (3), we infer that this difference is not due to lobbying firms having lower revenue productivity but it is due to the fact that lobbying firms accumulate excessive capital.

Endogeneity issues might arise with respect to Regression (1), challenging a causal interpre-

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[12]Because capital and employment are used when estimating revenue productivity and marginal product of capital, we do not use them again as controls in the last two regressions.

taion of the relationship between firm's lobbying on taxation and its effective tax rate. Specifically, given the model assumption of an exogenous level of political connection, the primary concern is an omitted-variable bias. For example, firms that lobby may be more aggressive in tax planning strategies through other channels than through the legislative process and lobbying activities. Although we have partially controlled for these possibilities (e.g., MNE, carryforward, industry trends and location fixed effects, etc.), some important factors which may affect effective tax rates and lobbying activities on taxation simultaneously might be omitted. To deal with potential endogeneity problems in identifying the relationship between effective tax rates and lobbying activities, we use a set of instruments that is based on firm's lobbying effort on other issues than taxation. Naturally, firms that lobby on other issues (e.g., defense, immigration, etc.) are more likely to be engaged in lobbying on taxation, because these firms have already built a connection with lobbying firms or hired in-house lobbyists. The exclusion restriction assumption is that firm's lobbying efforts on non-tax issues do not directly relate to effective tax rates conditional on other control variables, including firm's lobbying efforts on taxation. Moreover, lobbying on non-tax issues should affect ETR only because it affects the probability of lobbying on taxation. For example, firms that lobby on defense are not more aggressive in tax planning strategies than similar firms that do not lobby on defense. However, firms that lobby on taxation are allowed to be more aggressive in this respect.

We consider two instruments. The first instrument is a firm-year level indicator that takes a value one if the firm has a lobbying report that does not include "taxation" as its purpose in a given year. Otherwise, this indicator variable is zero. The unconditional correlation between this instrumental variable and our original indicator variable. i.e. the tax lobbying indicator, is 0.47. Secondly, we estimate a probit model for the tax lobbying indicator using as control variables other firm characteristics as well as the non-tax lobbying indicator. The coefficient of the non-tax lobbying indicator is highly significant, and the pseudo $R^2$ is above 55%. The estimated model implies that the average marginal effect of the non-tax lobbying decision is about 0.13. In other words, compared to firms that do not lobby on non-tax issues, firms that lobby on non-tax issues

are 13 percent more likely to put lobbying efforts on taxation. The second instrument is given by the fitted probabilities from the probit model.

Table 5 presents all the relevant results. The first column reports the OLS estimates, which is Regression (1) in Table 4. The second column presents the first-stage results for the instruments coming from the probit estimation. The third column shows the IV estimation results, in which the tax lobbying indicator is instrumented by the non-tax lobbying indicator and the fitted probability of a tax-lobbying indicator. The last two columns test the exclusion restriction for the instruments.

Column (2) in Table 5 shows that the instrument variable is valid and satisfies the exclusion restriction. Column (3) shows the main IV results. The coefficient estimate on the tax lobbying indicator is 2.36 percentage points, which is not statistically different from the OLS result that will be used for model calibration. The confidence interval becomes wider with the IV regression, but it still excludes zero at the 90% confidence level. Coefficient estimates on other controls are also similar. We cannot reject the null hypothesis of the Hansen J-test, i.e. instruments are uncorrelated with an error term in the ETR equation. The LM test statistic implies that our instruments are likely to be relevant, implying that the model is identified. The Kleinberger-Papp F test statistic for weak instruments indicates that the proposed instruments are not weak. Finally, in the last two columns, we include the constructed instruments as explanatory variables. Once controlled for firms characteristics and the tax lobbying indicator, there is no statistically significant effective tax differential between firms that engage in non-tax lobbying activities and firms that do not. The next subsection uses these conditional correlations and other firm-level moments to calibrate the model economy.

## Table 5 Instrumental Variable Regression of the Effective Tax Rates

|  | OLS | First Stage | IV |  |  |
| --- | --- | --- | --- | --- | --- |
| Dependent variable | ETR | Tax Lobbying | ETR | ETR | ETR |
|  | (1) | (2) | (3) | (4) | (5) |
| Lobbying Dummy (tax) | -2.2242 |  | -2.364 | -1.9428 | -2.1694 |
|  | (0.66) |  | (1.30) | (0.67) | (0.75) |
| Lobbying Dummy (non-tax) |  | 1.2086 |  | -0.7561 | -1.0049 |
|  |  | (0.08) |  | (0.49) | (0.67) |
| Fitted Probability (tax lobbying) |  |  |  |  | 1.3166 |
|  |  |  |  |  | (2.22) |
| R&D Expenditure | -0.0361 | 0.0021 | -0.036 | -0.0354 | -0.0359 |
|  | (0.01) | (0.00) | (0.01) | (0.01) | (0.01) |
| Intangible Asset | 0.0011 | 0.0006 | 0.0011 | 0.0011 | 0.0009 |
|  | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |
| Leverage | -5.1627 | 0.0743 | -5.1818 | -5.2279 | -5.1853 |
|  | (1.34) | (0.28) | (1.31) | (1.33) | (1.31) |
| Capital Expenditure | -15.7106 | -0.1244 | -15.7129 | -15.6993 | -15.6349 |
|  | (2.38) | (0.53) | (2.37) | (2.39) | (2.40) |
| Cash Holdings | -0.003 | 0.0004 | -0.003 | -0.0028 | -0.0028 |
|  | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |
| NOL Dummy | -3.5003 | -0.0228 | -3.5027 | -3.4975 | -3.4772 |
|  | (0.58) | (0.07) | (0.59) | (0.58) | (0.59) |
| Multinational Dummy | 1.599 | 0.4124 | 1.588 | 1.5784 | 1.5841 |
|  | (0.48) | (0.13) | (0.48) | (0.48) | (0.48) |
| Employment | 0.0177 | 0.4195 | 0.0313 | 0.084 | 0.0384 |
|  | (0.16) | (0.04) | (0.21) | (0.18) | (0.20) |
| Capital Intensity | -0.5247 | 0.2424 | -0.5187 | -0.502 | -0.5142 |
|  | (0.29) | (0.05) | (0.29) | (0.28) | (0.29) |
| $p$-value of J test |  |  | 0.174 |  |  |
| $p$-value of LM test |  |  | 0.039 |  |  |
| F-test weak identification |  |  | 264.14 |  |  |
| # of obs. | 8569 | 9681 | 8569 | 8569 | 8569 |
| Adj.R2 | 0.128 | 0.552 | 0.128 | 0.128 | 0.128 |

Notes: As in the Table 4 of the main text, only firms in the manufacturing industry are considered. All regressions include an intercept. Column (1) is the replication of the OLS regression in Column (1) in Table 4. Column (2) is the first stage, the firm-level probit regression of the lobbying indicator. Column (3) is IV regression. Columns (4) and (5) show that there is no statistically significant effect of non-tax lobbying activities on ETR once we controlled for firms characteristics and the tax lobbying indicator. ETR Regressions have the same industry, year, industry-year and location fixed effects than Table 4. Estimations cluster standard errors by firms. Arbitrary autocorrelation structure of the regression error is taken care based on the Bartlett kernel with the lag length of 2 years. We present the pseudo $R^2$ rather than Adj. $R^2$ for the probit model estimation. J-test refers to Hansen's over-identification test. The null hypothesis of this test is that instruments are uncorrelated with shocks in the ETR equation). The null hypothesis of the LM test is that model is under-identified, and the null hypothesis of the F-test is that instruments are weak. Both statistics are due to Kleibergen and Paap (2006).

## 5.2 Calibration and Validation

The model is calibrated to the manufacturing firms in the sample. Parameters are grouped into two categories. The first category includes standard parameters for which the values are either taken from the existing literature or are directly obtained from the data. The second category includes parameters chosen so that endogenous outcomes from the model match salient features of the U.S. firm-level data in 2011-13. Table 6 summarizes all parameter values.

### Table 6 Calibrated Parameter Values

|  | Value (%) | Description | Moments |
|---|---|---|---|
| $\sigma_z$ | 34.9 | Standard deviation, productivity | Standard deviation of log-employment |
| $\phi$ | 78.1 | Tax benefit, capital exponent | Regression, capital intensity and ETR |
| $\gamma$ | 2.7 | Lobbying benefit, scale | Regression, lobbying and capital intensity |
| $\xi$ | 0.3 | Tax benefit, standard deduction | Regression, lobbying and ETR |
| $\mu_\chi$ | 35.8 | Tax benefit, standard deduction | Fraction of firms that lobby |
| $\sigma_\chi$ | 36.8 | Tax benefit, standard deduction | Standard deviation of ETR |
| $\rho$ | 60.1 | Correlation | Regression, lobbying and measured TFP |
| $\overline{\alpha}$ | 38.3 | Capital intensity, high | Capital held by lobbying firms |
| $\underline{\alpha}$ | 19.9 | Capital intensity, low | Average capital exponent |
| $\varphi$ | 3.5 | Cost of high capital intensity | Average lobby expenditure to wage bill ratio |

The return to scale $\eta$ is set to $0.8$, which lies within the range commonly used in the firm dynamics literature. The depreciation rate $\delta$ is set to $0.08$, consistent with the estimates for the US economy. The statutory corporate tax rate $\tau$ is $35\%$ for the US corporate tax system. We set the discount factor $\beta$ to $0.96$, implying an annual real interest rate of $4$ percent. Tax expenditures are calculated directly from the data using total income taxes paid and total pre-tax income:

$$\omega = 1 - \frac{\text{Total income taxes paid}}{\tau \times \text{Total pre-tax income}}.$$

The calculation delivers $\omega = 0.38$, implying that $38\%$ of revenue losses are attributed to provisions of the tax codes that allow a special exclusion, exemption, or deduction from gross income or that provide a special credit, a preferential rate of tax, or a deferral of tax liability. The mean of log productivity is normalized to $0$. For the quantitative analysis, we discretize the distributions. We use discrete grids of 121 possible values of $z$ and $\varepsilon$, implying that a total of $14,641$ possible $(\ln(z), \varepsilon)$

pairs are drawn from the discretized multivariate normal distribution, as shown in Equation (14). $\chi$ is drawn independently from the discretized normal distribution $g(\chi)$ with 51 grid points.

The rest are internally calibrated parameters that determine tax benefits, lobbying activities, firm size distributions, and technology choices: $\phi, \xi, \gamma, \rho, \mu_\chi, \sigma_\chi, \overline{\alpha}, \underline{\alpha}, \varphi$, and $\sigma_z$. We calibrate the first four parameters to target the conditional correlations reported in Table 4. Specifically, because the tax benefit function from Equation (13) can be written:

$$\frac{\text{ETR}}{\tau} \approx -\chi - \ln(\xi) - \frac{x}{\tau\phi\xi}k^{1-\phi}\mathbf{1}\{l > 0\} - \phi\ln\left(\frac{k}{n}\right) + \phi\ln(n) + \ln(\pi), \qquad (15)$$

$\phi$ governs how ETR decreases with capital intensity and $\xi$ pins down the difference in ETR between lobbying and non-lobbying firms. From firms' lobbying decisions derived in Equation (5), $\gamma$ governs how lobbying and capital are linked, so it is calibrated to target the correlation between lobbying and capital intensity from Regression (2). The correlation $\rho$ determines the likelihood of productive firms having better political connections and, thus, the differential measured productivity $\hat{z}$ of lobbying firms obtained from Regression (3). Because standard tax benefits have priority in the government budget, the higher the average standard benefit, the lower the total benefits available for lobbying firms. Therefore, $\mu_\chi$ is calibrated to match the fraction of lobbying firms in the economy. The next group of parameters explains firms' technology choice. According to Proposition 1, lobbying firms are more likely to adopt high capital-intensive technology. Therefore, we discipline $\overline{\alpha}$ by targeting the fraction of capital held by lobbying firms. The low capital-intensive technology determined by $\underline{\alpha}$ is used to target an average $\alpha$ of 30%. Adopters of the capital intensive technology are larger and hire more workers due to factor complementary. All else equal, firms using high capital-intensive technology have a lower lobbying spending to wage bill ratio. Therefore, $\varphi$ is calibrated to match the average lobbying expenditure to wage bill ratio. Lastly, the standard deviation of productivity $z$ governs the distribution of firm size. The targeted moments are reported in Table 7.[13]

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[13]Regressions in the model are performed with a simulated sample with the same number of firms as in Table 4. We include idiosyncratic benefits that are not lobbying-related $\chi$ among the independent variables to capture the role of the non-modeled tax benefits such as leverage. Variables that are present in the model and data such as employment

Table 7 Targeted Moments

| Moments | Data | Model |
|---|---|---|
| Capital held by lobbying firms (%) | 53.41 | 49.17 |
| Average $\alpha$ (%) | 30.00 | 31.18 |
| Fraction of firms that lobby (%) | 15.79 | 16.26 |
| Standard deviation of log-employment | 1.92 | 1.90 |
| Regression, lobbying firms more capital intensive | 0.35 | 0.36 |
| Regression, capital intensity lowers ETR | -0.52 | -0.53 |
| Regression, lobbying firm lower ETR | -2.22 | -2.23 |
| Average wage bill to lobby expenditure ratio (%) | 0.22 | 0.19 |
| Standard deviation of ETR (%) | 11.35 | 11.10 |
| Regression, lobbying firms more productive | 0.39 | 0.43 |

Despite its parsimony, the model is able to successfully match the targets. The calibration procedure points to stark differences in technology with $\overline{\alpha}$ doubling $\underline{\alpha}$. Aligned with this calibration, Appendix F.4 shows that when the production function is estimated separately for lobbying and non-lobbying firms, lobbying firms seem to use a technology that is two times more capital intensive.

We test the model in different dimensions before proceeding to the quantitative analysis. First, Figure 6 shows the model-generated ETR distribution on the left panel and the data-generated ETR distribution on the right panel. In line with the data, the median effective tax rate in the model is 22%. The calibration procedure indirectly targets the mean of ETR, given how $\omega$ is constructed. It directly targets the standard deviation of ETR for all firms and the regression coefficient that captures the difference between lobbying and non-lobbying firms. Secondly, we compare the distribution of lobbying expenditures generated from the model with its empirical counterpart. While the calibration only targets the average lobbying expenditure to wage bill ratio, the model mimics very well the Pareto-shaped distribution of lobbying expenditures. In fact, the standard deviation relative to mean in the model is 1.383 compared to 1.325 in the data.

Finally, the calibrated model also captures well the conditional gap of measured MPK between

are included. Data moments are calculated by averaging over three years, 2011-2013, to avoid trends and crisis. They are, however, very stable during these three years. The regression results are from the full sample. The conclusions are qualitatively similar if the regressions are performed only in the later period. We prefer the full sample in order to have more statistical power.

Figure 6 Distribution of Effective Tax Rates
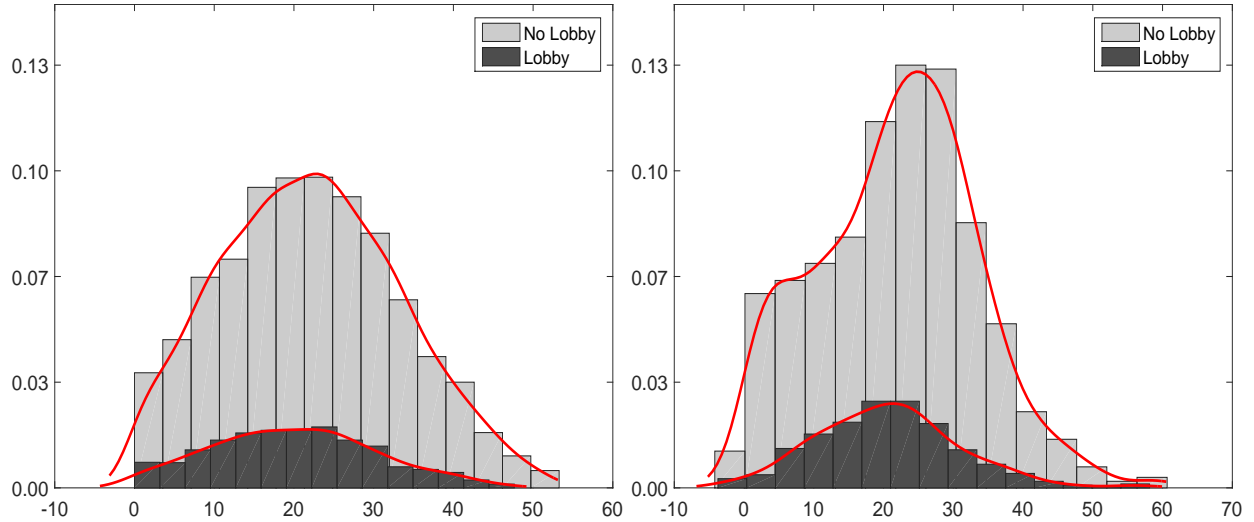


Notes: Model-generated [Left] and Data-generated [Right]

Figure 7 Distribution of Lobbying Expenditures Relative to Mean Expenditure
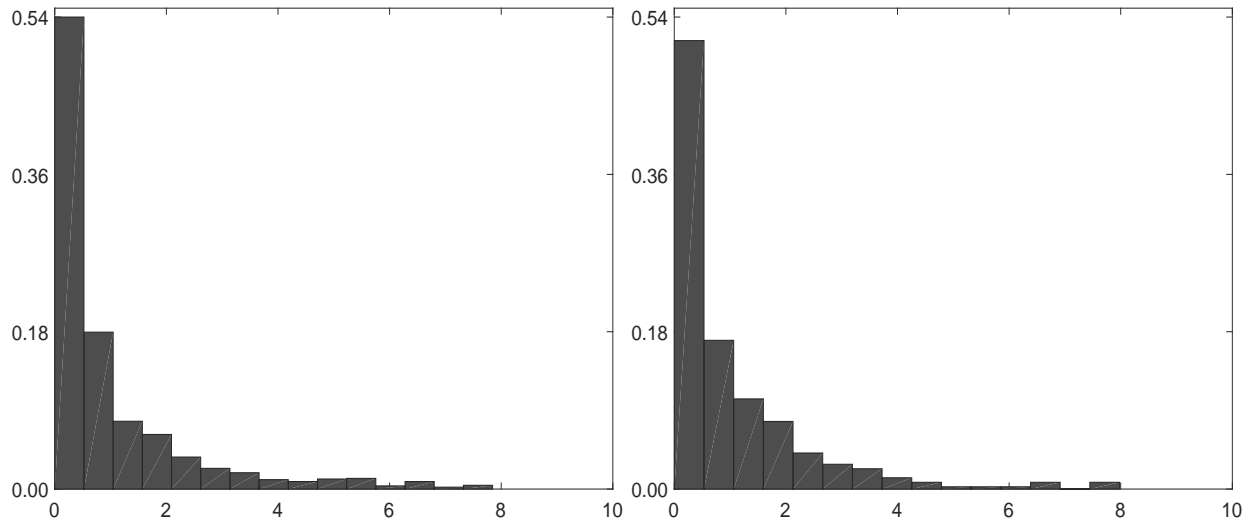


Notes: Model-generated [Left] and Data-generated [Right]

lobbying and non-lobbying firms. In particular, when replicating Regression (4) in Table 4, the model-generated sample delivers a coefficient of $-0.26$, exactly the point estimate of the empirical counterpart. Interestingly, the model generates a standard deviation of log measured MPK of $31\%$, which equals one-third of its empirical counterpart, suggesting that heterogeneous taxation and unobserved technological choices can potentially explain a significant fraction of measured misallocation. We conclude that the model economy can fit well both targeted and non-targeted

moments. In the next subsection, we use the calibrated model to highlight how tax benefits and technology choices together can trigger differences in ETR and MPK between lobbying and non-lobbying firms.

## 5.3  Revisiting the Empirical Results with Lobbying and Technology Choices

Having validated the calibrated model, we show how lobbying and technology choices together allow the model to quantitatively match the empirical patterns documented in Section 3. The first two columns of Table 8 show that the model captures differences in size, productivity, effective tax rates, and capital intensity between lobbying and non-lobbying firms. The quantitative analysis in this subsection follows the lines of Proposition 3, which characterizes the mechanisms that lead to lobbying firms having, on average, a lower effective tax rate and marginal product of capital than non-lobbying firms.

Table 8 Lobbying and Technology Choice

| Moment | Lobby | No Lobby | Lobby, $\overline{\alpha}$ | No Lobby, $\overline{\alpha}$ | Lobby, $\underline{\alpha}$ | No Lobby, $\underline{\alpha}$ |
|---|---|---|---|---|---|---|
| Fraction of Firms (%) | 16.26 | 83.74 | 15.16 | 45.96 | 1.10 | 37.79 |
| $\log(k)$ | 1.86 | -0.58 | 2.15 | 1.24 | -2.16 | -2.79 |
| $\log(k/n)$ | 1.68 | 1.32 | 1.74 | 1.73 | 0.84 | 0.83 |
| ETR (%) | 20.05 | 22.06 | 19.97 | 21.41 | 21.05 | 22.84 |
| $\log(\widehat{MPK})$ | -2.30 | -2.04 | -2.35 | -2.33 | -1.70 | -1.69 |

We first abstract from the distribution of firms by focusing solely on their endogenous decisions. Figure 8 displays the policy functions for capital $\log(k)$, capital intensity $\log(k/n)$, ETR and $\log(\widehat{MPK})$, conditional on $\chi = 0$, for lobbying firms (dashed line) and non-lobbying firms (solid line) across different levels of productivity $z$. The kink shows the threshold at which a firm switches from low capital-intensive technology to high capital-intensive technology. First, in line with Proposition 3.1, comparing two firms with the same productivity level ($z$) and standard tax benefits ($\chi$) but different lobbying status, we notice that the lobbying firm faces lower ETR and has lower $\log(\widehat{MPK})$ than the non-lobbying firm. The lobbying firm is also larger and more capital intensive. Moreover, the difference in ETR between lobbying and non-lobbying firms is amplified

with the choice of capital-intensive technology.

Secondly, as predicted by Proposition 3.2, lobbying firms switch to high capital-intensive technology at a lower productivity level $z$, i.e., $z_l^* < z_{nl}^*$. Therefore, there is a productivity range where we observe that the technology choice is induced by lobbying. In this range, the difference between lobbying and non-lobbying firms is amplified. In fact, lobbying firms that switch to high capital-intensive technology have the highest capital stock, the highest capital intensity, the lowest ETR and the lowest $\log(\widehat{\text{MPK}})$, while non-lobbying firms that choose low capital-intensive technology have the lowest capital stock, the lowest capital intensity, the highest ETR and the highest $\log(\widehat{\text{MPK}})$.

Figure 8 Policies in the Neighborhood of the Technology Threshold



(a) $\log(k)$ Policy

(b) $\log(k/n)$ Policy

(c) ETR Policy

(d) $\log(\widehat{\text{MPK}})$ Policy
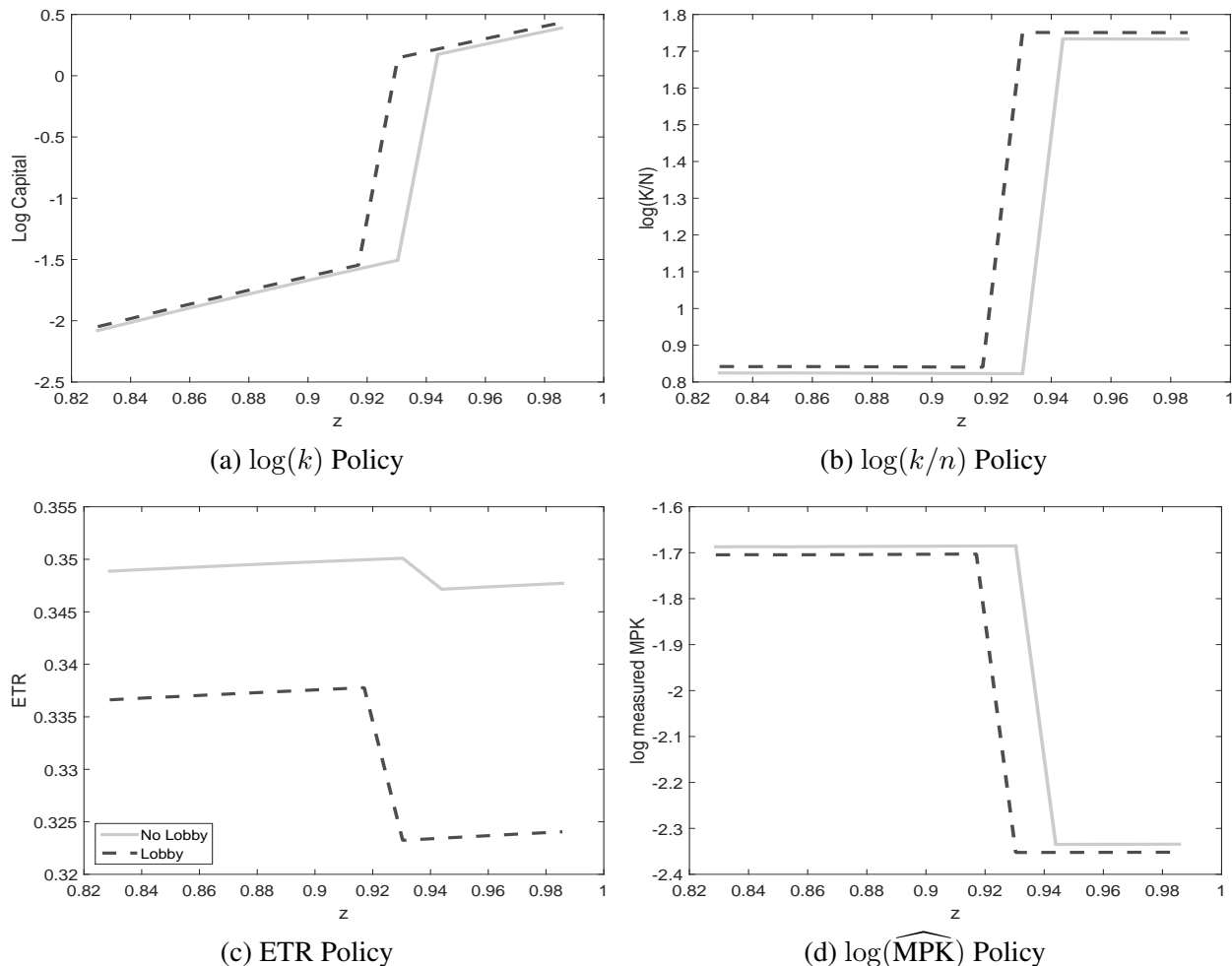
Lastly, we incorporate the equilibrium distribution of firms to show how the interplay between

lobbying and technology choices allows the model to replicate the empirical patterns of Section 3. In particular, we focus on the last four columns of Table 8. The first row of Table 8 shows that lobbying status and capital-intensive technology are positively related. Only $7\%$ of lobbying firms use low capital-intensive technology, while practically $40\%$ of total firms use low capital-intensive technology. Therefore, we are likely to observe firms that lobby and at the same time endogenously choose high capital-intensive technology. Although this is in part due to a lobby-induced technology choice (Proposition 3.2), the main driver of this association is the positive correlation between lobbying and productivity ($\rho > 0$). That is, more-productive firms are more likely to adopt high capital-intensive technology, and they are more likely to have high political connections and therefore engage in lobbying activities. Thus, allowing for a *pseudo* spurious negative correlation between lobbying status and $\widehat{\text{MPK}}$. Lobbying firms that choose high capital-intensive technology are 200 times larger, 2.5 times more capital intensive and have a $48\%$ lower $\widehat{\text{MPK}}$ than non-lobbying firms that choose low capital-intensive technology. Thus, the fact that choices regarding lobbying and capital-intensive technology are correlated is fundamental for the model to explain how small differences in ETR are consistent with large differences in capital intensity and $\widehat{\text{MPK}}$. Although the flexibility of the model allows, in principle, for a calibration where this correlation is the only quantitatively relevant force, the existence of technology choices is not the only driver of the differences between lobbying and non-lobbying firms, because they can still be observed within the same class of technology. Specifically, within the same class of technology, lobbying firms are $1.5 - 3$ times larger, $1.3\%$ more capital intensive, have $1.4\% - 1.8\%$ lower ETR, and have $1.3\%$ lower $\widehat{\text{MPK}}$, while within the same lobbying status, firms choosing high capital-intensive technology are $70 - 137$ times larger, 2.5 times more capital intensive, have $1.1\% - 1.4\%$ lower ETR, and have $48\%$ lower $\widehat{\text{MPK}}$. In a nutshell, technology choice is behind most of the size and $\widehat{\text{MPK}}$ differences between firms, while the lobbying decision contributes more to the heterogeneity in ETR. The next subsection studies how ETR heterogeneity induced by lobbying may distort the optimal capital decision of firms. Note that, dispersion in $\widehat{\text{MPK}}$ is not directly linked to misallocation, as it is also driven by mismeasurement. The next subsection

studies directly how lobbying and heterogeneous taxation disrupt optimal firm size.

## 5.4  Lobbying and Distortions

Capital-based tax benefits and lobbying activities distort firms' decisions. In an efficient economy, every firm accumulates capital to equate their MPK (not the measured $\widehat{\text{MPK}}$) to the marginal cost of capital $r + \delta$. Tax deductions create wedges between the return to capital and the marginal cost of capital, so firms over-accumulate capital. These wedges are heterogeneous across firms, depending on their eligibility to tax benefits, both standard and lobbying dependent. We study firm distortions by using their decisions in the economies with no lobbying and no tax benefits as a reference. Consider an alternative efficient economy, the OPT economy. In the OPT economy, every tax benefit is eliminated so that $\gamma = \xi = \chi = 0$ and the statutory tax rate is adjusted to keep the same average effective tax rate as in the baseline economy. This is done to rule out economy-wide effect on capital due to a higher average tax rate, despite not being distortive, in the OPT economy. The degree of capital over-accumulation of a firm is defined by the excess amount of capital with respect to the OPT economy, in percentage terms. To isolate the effect of lobbying from other tax benefits, a second alternative economy, the NL economy, is introduced as a reference. The NL economy eliminates lobbying by setting $\gamma = 0$, while other tax benefits that are not lobbying dependent remain available. Similarly, $\tau$ is reduced to keep the average effective tax rate at the baseline level. Note that in both the NL and the OPT economies, firms can still optimally choose their production technology. Therefore, the analysis in this section captures the effects of lobbying-dependent tax benefits and other tax benefits on the economy independently from the availability of a technology decision.

Figure 9 shows the degree of capital over-accumulation for two groups of firms. The left (right) panel tracks how firms that lobby (do not lobby) in the baseline economy change their capital decisions in the two alternative economies. The average degree of capital over-accumulation among lobbying firms is $5.5\%$ in the baseline economy. Eliminating lobby decreases the average degree of capital over-accumulation in this group to $2.4\%$. Thus, when given the option to lobby, lobby-

Figure 9 Over-accumulation of Capital (% relative to the economy without tax benefits)



(a) Lobbying Firms in Baseline Model    (b) Non-lobbying Firms in Baseline Model
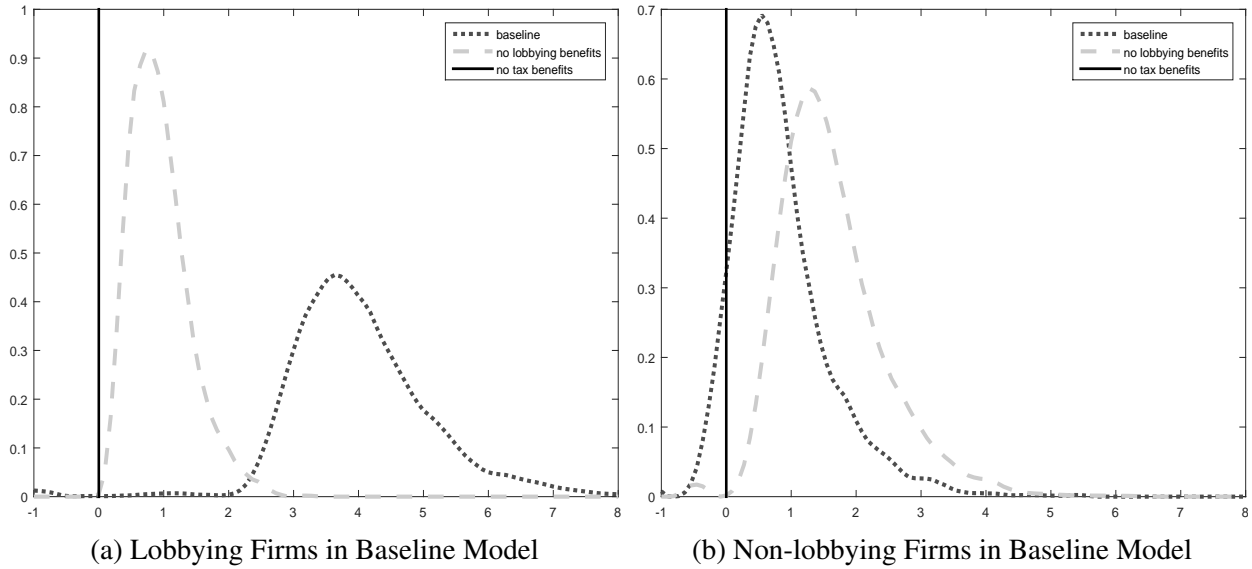
ing firms double their average firm-level distortion. Interestingly, the opposite movement occurs among non-lobbying firms. The average degree of capital over-accumulation among non-lobbying firms is $2.0\%$ in the baseline economy, and eliminating lobbying increases the average degree of capital over-accumulation among this group to $3.5\%$. The fact that the firms in this group become smaller when other firms lobby arises from the general equilibrium effect. In particular, when lobbying firms become larger, they increase the equilibrium wage, and non-lobbying firms, facing higher cost of labor, have to downsize their production. Therefore, lobbying can partially correct for the oversized non-lobbying firms due to non-lobby tax benefits.

We can also use the calibrated model to study firm-specific efficiency distortions. For this analysis, we focus on MPK heterogeneity. Figure 10a shows the firm-level MPK, or equivalently, the firm-specific marginal cost of capital, for all firms in the baseline economy (x axis) and for the same firms in the NL economy (y axis). The baseline economy induces more variation in MPK between firms than the NL economy, and lobbying firms are once again more distorted in the baseline economy. Moreover, most lobbying firms are well above the 45 degree line, showing a significant firm-level reduction in their cost of capital, while firm-level distortions for most non-lobbying firms are lower. Figure 10b shows the average firm-level MPK for each different

## Figure 10 Firm Distortions
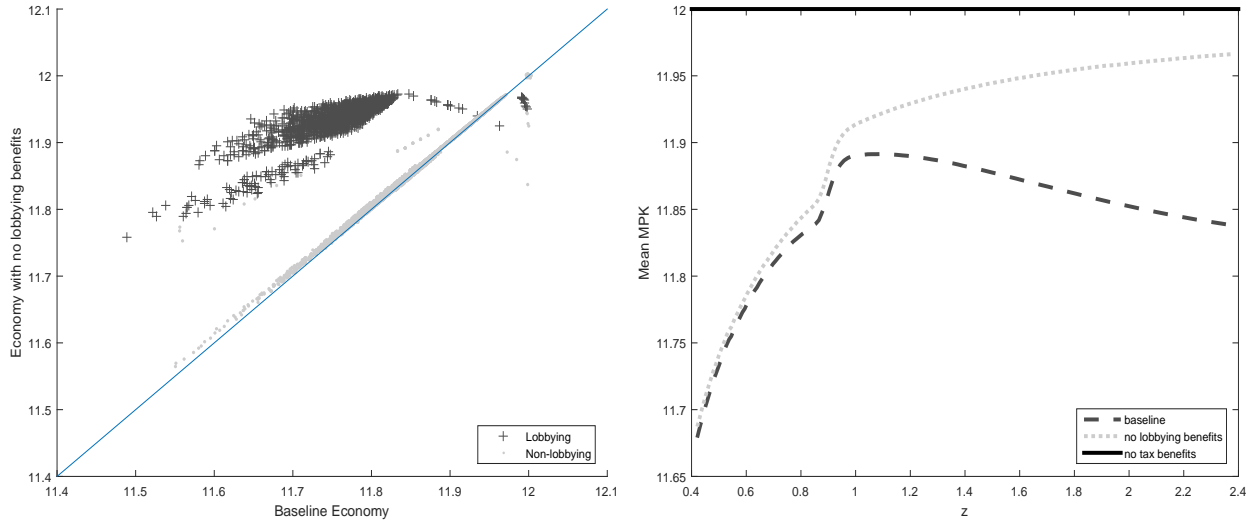


(a) MPK of Firms by Lobbying Status in Baseline Economy



(b) Average log(MPK) of Firms for Each Productivity

productivity level. Small (less-productive) firms are highly distorted, but given that their distortions barely change in the NL economy, the distortions are largely due to standard tax benefits and not to their lobbying activities. In fact, two forces explain the low prominence of lobbying benefits among small firms. First, because of the decreasing returns of standard tax benefits and the non-negativity constraint on ETR, firms with small profits are proportionally more distorted by standard capital-based tax benefits than firms with large profits. If standard benefits indeed capture free-riding effects in lobbying, the model implies that small firms tend to free ride on the lobbying efforts of larger firms. Second, given the empirical correlation between size and political connections, firms in the lower part of the productivity spectrum hardly gain enough political connections to lobby. Lobbying, however, does play a significant role among large and productive firms. In the baseline model, large (more-productive) firms are more likely to have better political connections and to lobby. Moreover, due to their large profits and the decreasing returns of standard capital-based tax benefits, they claim proportionately larger deductions from lobbying. Therefore, in the baseline economy, lobbying not only creates over-accumulation of capital among lobbying firms, but it also generates larger distortions among more productive firms.

## 5.5 Corporate Tax Policies, Lobbying and Capital Efficiency

This subsection examines the efficiency impact of lobbying. Aggregate consumption ($C$) in this economy corresponds to:

$$C = Y - \delta \cdot K - L - \varphi \cdot M_{\overline{\alpha}}, \tag{16}$$

where $Y$ is aggregate output, $\delta \cdot K$ is capital investment, $L$ is aggregate lobbying expenditures, and $M_{\overline{\alpha}}$ is the mass of firms paying the fixed cost of technology $\varphi$. Because the economy spends resources investing in capital, technology, and lobbying, we define the aggregate return on investment of the economy as:

$$r_C \equiv \frac{\text{output-investment Cost}}{\text{investment Cost}} = \frac{C}{\delta \cdot K + L + \varphi \cdot M_{\overline{\alpha}}}. \tag{17}$$

Note that for this analysis, investment refers to the firm's investment in capital, technology and lobbying activities. To understand the welfare implications of lobbying-induced distortions, we study the gains of inter-temporal reallocation in the baseline economy. In particular, while the baseline economy invests $K_B$ in capital for production, the alternative economy $j \in \{NL, OPT, LT, TR\}$ will invest $K_j$ in capital for production and $K_B - K_j$ in a risk-free bond.[14] In particular, define the potential welfare improvement in terms of consumption differential as:

$$\Delta_j \equiv 10000 \cdot \left[ \frac{C_j + r\left(K_B - K_j\right) - C_B}{C_B} \right]. \tag{18}$$

Table 9 displays four measures of distortion: i) the standard deviation of MPK, which reflects intra-temporal distortions through capital misallocation across firms; ii) the mean of MPK -$\delta$, which reflects inter-temporal distortions through a discrepancy between the firm's average marginal return to capital net of depreciation and the household's discount rate, $r$; iii) the aggregate return on in-

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[14]This is the optimal path for a small open economy that faces $r$ or from an industry perspective. It is still a good benchmark for a close economy that consumes the extra capital along the transition to a new steady state.

vestment, which quantifies the overall effect of distortions on the efficiency of the economy's total investment; and iv) the welfare measure $\Delta_j$. These measures are compared across five economies: the baseline economy; the NL economy; the OPT economy; the LT economy, where the benefit function is unchanged with respect to the baseline economy but the statutory tax rate is decreased to 22%; and the TR economy, which will be discussed at the end of this section.

Table 9 Heterogeneous Taxation and Aggregate Efficiency

| Scenario (%) | $\tau$ | mean(ETR) | mean(MPK-$\delta$) | std(MPK) | $r_C$ | $\Delta$ |
|---|---|---|---|---|---|---|
| Baseline | 35.00 | 22.00 | 3.85 | 0.08 | 363.01 | - |
| No Lobbying (NL) | 34.41 | 22.00 | 3.89 | 0.06 | 366.85 | 8.81 |
| Optimal (OPT) | 22.00 | 22.00 | 4.00 | 0.00 | 368.33 | 9.76 |
| Baseline low $\tau$ (LT) | 22.00 | 13.81 | 3.92 | 0.04 | 364.33 | 6.05 |
| Tax Reform (TR) | 22.72 | 21.76 | 3.90 | 0.05 | 364.36 | 4.50 |

First, we compare the baseline economy with the OPT economy to assess the total cost of heterogeneous taxation. Firms in the baseline economy have, on average, a 15 basis point lower marginal return, implying that welfare improvement can be achieved through inter-temporal allocation of resources. Unlike the OPT economy, the standard deviation of 8 basis points in the baseline economy shows that MPK is not equalized across firms, and greater output can be achieved through the allocation of resources across firms. In terms of efficiency, the aggregate return on investment in the baseline economy is 5.32 percentage points lower than that of the OPT economy. Secondly, using the NL economy as a reference point, we can decompose what fraction of the distortion cost is due to lobbying activities and what fraction is due to other tax benefits that are not lobbying dependent. Lobbying has an important share for every measure. While lobbying accounts for at least 25% of inter-temporal and intra-temporal distortions, lobbying is a dominant force explaining more than 70% of the efficiency loss when measured by the aggregate return to investment. This asymmetry in the importance of lobbying is due to the fact that lobbying firms hold 50% of the capital in the economy.

To understand the welfare consequences of lobbying, note that eliminating the lobbying channel delivers $\Delta_{NL} = 8.81$ basis points extra consumption, while eliminating all tax benefits adds

another 0.95 basis points extra consumption, i.e., $\Delta_{OPT} = 9.76$. In other words, $90\%$ of the aggregate consumption loss in the baseline economy is due to lobbying.[15] Alternatively, if we define the aggregate return on lobbying for the baseline economy along the lines of the return on investment in Equation (17) as:

$$r_L \equiv \frac{\text{net gain in consumption}}{\text{lobbying cost}} = \frac{C_B - C_{NL} - r\left(K_B - K_{NL}\right)}{L_B}, \tag{19}$$

we estimate $r_L = -1.59$, which implies the social loss from lobbying, i.e., for every unit of output spent on lobbying, the society loses $1.59$ units of consumption. Given that only $16.26\%$ of firms lobby and that the model is calibrated to the US economy, where lobbying accounts for a small share of GDP, these magnitudes are economically relevant. Therefore, in an economy where rent seeking and lobbying quickly give in to generalized bribery and corruption, the aggregate cost of this mechanism can become overwhelming.

The LT economy shows how an economy with a lower statutory tax rate can achieve less distortion and higher efficiency despite the existence of tax benefits and lobbying. The increase in efficiency can be inferred directly from Equation (5), which indicates that firms' lobbying incentives decrease with statutory tax rates. In particular, when comparing the LT economy with a statutory tax rate of $22\%$ and the baseline economy, Table 9 shows that the baseline distortions, both inter-temporal and intra-temporal, decrease by $50\%$, and the efficiency loss decreases by $25\%$. The results are driven by changes in firm lobbying decisions. In the LT economy, while the fraction of lobbying firms increases from $16.3\%$ to $20.7\%$, the total lobbying expenditure decreases by $36\%$, implying a $50\%$ decrease in the average lobbying spending for each lobbying firm. Therefore, large and politically connected firms lobby less intensively and collect fewer benefits, leaving more benefits to be collected by less-politically connected firms. Figure 11a shows the MPK for firms in the baseline economy (x axis) and for the same firms in the LT economy (y axis). Firms that did not switch their lobbying status are systematically above the 45 degree line, and hence,

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[15]If we abstract from the direct cost of lobbying by considering lobbying as consumption and not wasteful resources, the total gain is 4.22 basis points. In this case, $40\%$ of the loss is due to the distortions of lobbying.

they are less distorted in the LT economy. Firms that lobby in both economies spend less on lobbying activities in the LT economy and become less distorted. Firms that switch to lobbying are more distorted in the LT economy. However, because these firms are less productive than the original lobbying firms, they have lower profits and claim less benefits; therefore, their increase in distortion is relatively small. To highlight the increase in efficiency along the size distribution, Figure 11b shows the average firm-level MPK for the baseline and LT economies along different productivity levels. Firms are, on average, less distorted at every productivity level, as the increase in efficiency of non-switchers is the dominant effect.

Figure 11 Firm Distortions with lower Statutory Tax Rate



(a) MPK of Firms by Lobbying Status in Baseline Economy

(b) Average $\log(\text{MPK})$ of Firms for Each Productivity
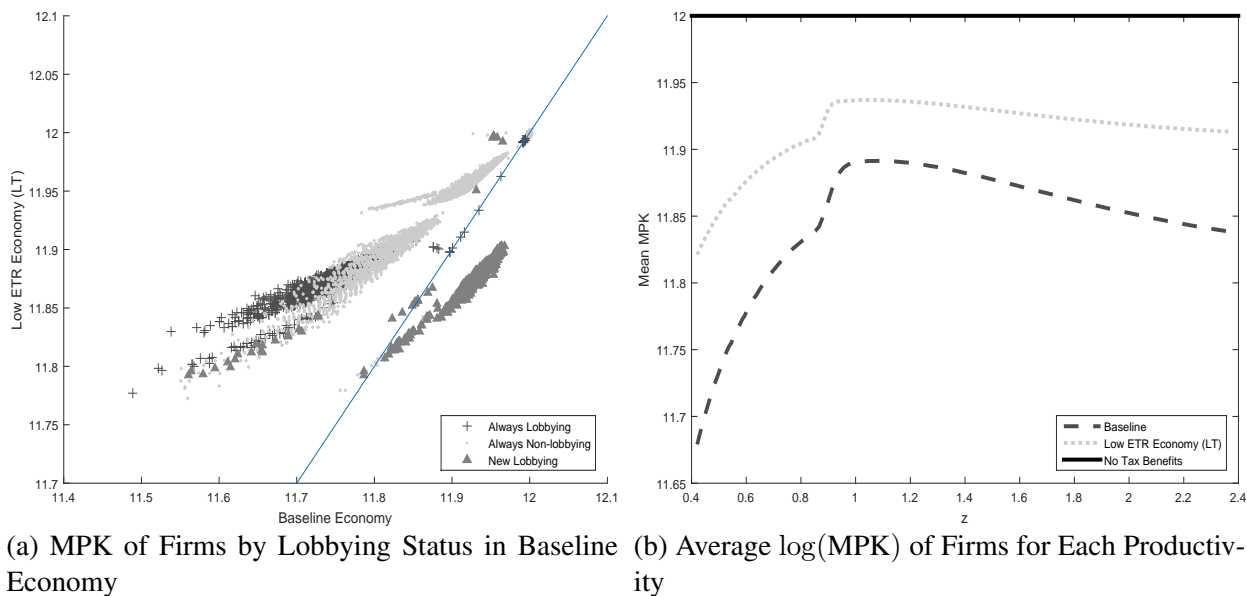
From an aggregate perspective, the baseline economy can increase consumption by $\Delta_{LT} = 6.05$ basis points. Therefore, the social loss from lobbying can be significantly reduced by reducing the statutory tax rate without any explicit intervention that targets lobbying. Nevertheless, absent any other reform, the reduction of the statutory tax rate decreases the government budget by $17\%$. Therefore, we conclude this section by studying a budget-neutral reform that jointly reduces the statutory tax rate and tax benefits that are not lobbying dependent. To design this reform, we start by decomposing the sources of tax benefits in the baseline economy. Table 10 decomposes the tax expenditures ($\omega$) of the baseline economy into different sources of tax benefits for all firms, both

lobbying and non-lobbying.

Table 10 Decomposition of Tax Benefits in the Baseline Economy

| (%) | Total Tax Expenditures | Profit | Capital-Standard | Capital-Lobbying |
|---|---|---|---|---|
| All Firms | 38.10 | 33.27 | 1.93 | 2.90 |
| Non-Lobbying Firms | 19.67 | 18.52 | 1.14 | - |
| Lobbying Firms | 18.43 | 14.75 | 0.79 | 2.89 |

In the baseline economy, more than $85\%$ of tax expenditures are allocated to profit-based benefits. Because more-productive firms lobby in equilibrium and claim more benefits, the $16.26\%$ of lobbying firms account for nearly $50\%$ of tax expenditures. Moreover, for lobbying firms, lobbying-related benefits are three times more important than standard capital-based benefits. We consider a tax reform that eliminates every idiosyncratic profit-based benefit and uses those resources to lower the statutory tax rate for every firm. Given that profit-based tax benefits do not create efficiency distortions in this economy, all the gains are driven by lower incentives to reap capital-based tax benefits. In particular, the reform consists of two adjustments: i) an elimination of every profit-based tax benefit ($\chi = 0$), which decreases the budget of tax expenditures by $85\%$ to $\omega = 5\%$; and ii) a decrease in the statutory tax rate to $22.7\%$ in order to maintain tax revenue with respect to the baseline economy. All capital-based tax benefit parameters are kept as in the baseline economy. The aggregate efficiency measures of this economy (TR) can be found in Table 9. In line with the analysis of the LT economy, total lobbying expenditures decrease by $28\%$, and the number of lobbying firms increases by $44\%$ with respect to the baseline economy. Given that the fraction of lobbying firms is higher in the LT economy, we know that every lobbying firm in the baseline economy can lobby as much as they desire after the reform. Interestingly, the fiscal neutral reform can increase consumption by $\Delta_{TR} = 4.5$ basis points with respect to the baseline economy, without eliminating any capital-based tax benefit. Therefore, eliminating idiosyncratic benefits and decreasing the statutory tax rate can generate efficiency gains in an economy even when the eliminated benefits themselves were not causing any inefficiency.

# 6  Conclusion

We document that corporate lobbying can be an endogenous mechanism affecting the use of capital at the intensive (substituting capital for labor) and extensive (choice of high capital-intensive technology) margins. The heterogeneous firm model presented in this paper formalizes this mechanism and provides a framework to quantify the role of capital-based tax benefits and firms' lobbying behavior in explaining firm-level distortions and potential aggregate effects in the economy. The calibrated model replicates the main regularities documented in the data. Lobbying firms are larger, more productive, and more likely to choose high capital-intensive technology. They also over-accumulate capital, exhibiting a lower marginal product of capital and driving non-lobbying firms to become smaller. Moreover, lobbying plays a significant role in explaining the distortions driven by the system with tax deductions. Only $16\%$ of firms in the economy lobby; nevertheless, lobbying accounts for at least $25\%$ of inter-temporal and intra-temporal distortions and more than $70\%$ of the efficiency loss due to capital-based tax benefits. The counterfactual experiment on a tax reform shows that a lower statutory tax rate can reduce firm-level distortions by $50\%$ and efficiency losses by $25\%$, as firms have less incentives to lobby.

This paper provides a new mechanism that can endogenously generate misallocation of resources in the economy. The main alternative channel in the literature to endogenize capital misallocation is the existence of credit-constrained firms that cannot achieve their optimal scale. However, credit access is usually an issue faced by small firms. In fact, it has not been an issue for large and publicly held firms in the U.S., even during the Great Recession. This paper provides an explanation for a distortion on the right tail of the size distribution, where big firms might in fact be *too big*. Nevertheless, in a developing economy where firms are likely to be credit-constrained and where weak institutions give wide access to rent-seeking behavior, the interaction of the two channels can be fundamental for the efficient design of public policy.[16]

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[16]Another avenue for future research is optimal capital taxation under lobbying, extending for instance the framework of Conesa et al. (2009) recognizing that taxation is partially endogenous.

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# APPENDIX

# A   An Example of a Lobbying Report

In this section, we present an example of a lobbying report.[17] Figures A.1 and A.2 show the first two pages of a typical lobbying report. This lobbying report was filed in 2012 (item 8) by Ms. Armistead (item 4a) for the Boeing Company (item 7). Lobbying expense reported in this report was $60,000 (item 12), and the item 15 shows that it was for the taxation (TAX), defence (DEF), and trade (TRD). The Boeing Company lobbied for the following specific issues (item 16):

1. H.R.4196, to amend the Internal Revenue Code of 1986 to extend the allowance for bonus depreciation for certain business assets (TAX, taxation);

2. Depot provisions in H.R.4310, National Defense Authorization Act for Fiscal Year 2013 (DEF, defence);

3. Export-Import Bank reauthorization; H.R.2072, Securing American Jobs Through Exports Act of 2011; S.1547, Export-Import bank Reauthorization Act of 2011 (TRD, trade).

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[17]This lobbying report can be viewed from: `https://soprweb.senate.gov/index.cfm?event=getFilingDetails&filingID=32B53156-15FA-4D00-BD0C-E14E34BE6E01&filingTypeID=51`

## Figure A.1 Example of a Lobbying Bill, Page 1

Clerk of the House of Representatives
Legislative Resource Center
B-106 Cannon Building
Washington, DC 20515
http://lobbyingdisclosure.house.gov

Secretary of the Senate
Office of Public Records
232 Hart Building
Washington, DC 20510
http://www.senate.gov/lobby

# LOBBYING REPORT

Lobbying Disclosure Act of 1995 (Section 5) - **All Filers Are Required to Complete This Page**

**1. Registrant Name** ☑ Organization/Lobbying Firm ☐ Self Employed Individual
Gephardt Group Government Affairs

**2. Address**
Address1  1101 K Street, NW          Address2  Suite 310
City  Washington          State  DC   Zip Code  20005          Country  USA

**3. Principal place of business (if different than line 2)**
City          State          Zip Code          Country

4a. Contact Name          b. Telephone Number  c. E-mail
Ms.  AMANDA ARMISTEAD          2024032041          amandaarmistead@gephardtgroup.com

**5. Senate ID#**
315717-1004571

7. Client Name          ☐ *Self*          ☐ *Check if client is a state or local government or instrumentality*
The Boeing Company

**6. House ID#**
392150008

## TYPE OF REPORT
8. Year  2012    Q1 (1/1 - 3/31) ☑    Q2 (4/1 - 6/30) ☐    Q3 (7/1 - 9/30) ☐    Q4 (10/1 - 12/31) ☐

9. Check if this filing amends a previously filed version of this report ☐

10. Check if this is a Termination Report ☐          Termination Date _____          11. No Lobbying Issue Activity ☐

### INCOME OR EXPENSES – YOU MUST complete either Line 12 or Line 13

| 12. Lobbying | 13. Organizations |
|---|---|
| **INCOME** relating to lobbying activities for this reporting period was: | **EXPENSE** relating to lobbying activities for this reporting period were: |
| Less than $5,000 ☐ | Less than $5,000 ☐ |
| $5,000 or more ☑ $ 60,000.00 | $5,000 or more ☐ $ _____ |
| Provide a good faith estimate, rounded to the nearest $10,000, of all lobbying related income from the client (including all payments to the registrant by any other entity for lobbying activities on behalf of the client). | **14. REPORTING** Check box to indicate expense accounting method. See instructions for description of options. |
| | ☐ **Method A.** Reporting amounts using LDA definitions only |
| | ☐ **Method B.** Reporting amounts under section 6033(b)(8) of the Internal Revenue Code |
| | ☐ **Method C.** Reporting amounts under section 162(e) of the Internal Revenue Code |

**Signature**  Digitally Signed By: Thomas J. O'Donnell, Managing Partner          **Date**  04/19/2012

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## Figure A.2 Example of a Lobbying Report, Page 2

**LOBBYING ACTIVITY.** Select as many codes as necessary to reflect the general issue areas in which the registrant engaged in lobbying on behalf of the client during the reporting period. Using a separate page for each code, provide information as requested. Add additional page(s) as needed.

15. General issue area code TAX

16. Specific lobbying issues

H.R.4196, to amend the Internal Revenue Code of 1986 to extend the allowance for bonus depreciation for certain business assets

17. House(s) of Congress and Federal agencies ☐ Check if None

U.S. HOUSE OF REPRESENTATIVES

18. Name of each individual who acted as a lobbyist in this issue area

| First Name | Last Name | Suffix | Covered Official Position (if applicable) | New |
|---|---|---|---|---|
| Michael | Messmer | | | ☐ |

19. Interest of each foreign entity in the specific issues listed on line 16 above ☑ Check if None

---

**LOBBYING ACTIVITY.** Select as many codes as necessary to reflect the general issue areas in which the registrant engaged in lobbying on behalf of the client during the reporting period. Using a separate page for each code, provide information as requested. Add additional page(s) as needed.

15. General issue area code DEF

16. Specific lobbying issues

depot provisions in H.R.4310, National Defense Authorization Act for Fiscal Year 2013

17. House(s) of Congress and Federal agencies ☐ Check if None

U.S. HOUSE OF REPRESENTATIVES, U.S. SENATE

18. Name of each individual who acted as a lobbyist in this issue area

| First Name | Last Name | Suffix | Covered Official Position (if applicable) | New |
|---|---|---|---|---|
| Michael | Messmer | | | ☐ |
| Christina | Hamilton | | | ☐ |

19. Interest of each foreign entity in the specific issues listed on line 16 above ☑ Check if None

---

**LOBBYING ACTIVITY.** Select as many codes as necessary to reflect the general issue areas in which the registrant engaged in lobbying on behalf of the client during the reporting period. Using a separate page for each code, provide information as requested. Add additional page(s) as needed.

15. General issue area code TRD

16. Specific lobbying issues

Export-Import Bank reauthorization; H.R.2072, Securing American Jobs Through Exports Act of 2011; S.1547, Export-Import bank Reauthorization Act of 2011

17. House(s) of Congress and Federal agencies ☐ Check if None

U.S. HOUSE OF REPRESENTATIVES, U.S. SENATE

18. Name of each individual who acted as a lobbyist in this issue area

| First Name | Last Name | Suffix | Covered Official Position (if applicable) | New |
|---|---|---|---|---|
| Thomas | O'Donnell | | | ☐ |
| Janice | O'Connell | | | ☐ |
| Michael | Messmer | | | ☐ |

# B  List of Lobbying Issues

Table B.1 List of Lobbying Issues

| Abbreviation | Full description | Abbreviation | Full description |
|---|---|---|---|
| ACC | Accounting | CSP | Consumer Issues/Safety/Protection |
| HOM | Homeland Security | RET | Retirement |
| ADV | Advertising | CON | Constitution |
| HOU | Housing | ROD | Roads/Highway |
| AER | Aerospace | CPT | Copyright/Patent/Trademark |
| IMM | Immigration | SCI | Science/Technology |
| AGR | Agriculture | DEF | Defense |
| IND | Indian/Native American Affairs | SMB | Small Business |
| ALC | Alcohol & Drug Abuse | DOC | District of Columbia |
| INS | Insurance | SPO | Sports/Athletics |
| ANI | Animals | DIS | Disaster Planning/Emergencies |
| INT | Intelligence and Surveillance | TAR | Miscellaneous Tariff Bills |
| APP | Apparel/Clothing Industry/Textiles | ECN | Economics/Economic Development |
| LBR | Labor Issues/Antitrust/Workplace | TAX | Taxation/Internal Revenue Code |
| ART | Arts/Entertainment | EDU | Education |
| LAW | Law Enforcement/Crime/Criminal Justice | TEC | Telecommunications |
| AUT | Automotive Industry | ENG | Energy/Nuclear |
| MAN | Manufacturing | TOB | Tobacco |
| AVI | Aviation/Aircraft/Airlines | ENV | Environmental/Superfund |
| MAR | Marine/Maritime/Boating/Fisheries | TOR | Torts |
| BAN | Banking | FAM | Family Issues/Abortion/Adoption |
| MIA | Media (Information/Publishing) | TRD | Trade (Domestic & Foreign) |
| BNK | Bankruptcy | FIR | Firearms/Guns/Ammunition |
| MED | Medical/Disease Research/Clinical Labs | TRA | Transportation |
| BEV | Beverage Industry | FIN | Financial Institutions/Investments/Securities |
| MMM | Medicare/Medicaid | TOU | Travel/Tourism |
| BUD | Budget/Appropriations | FOO | Food Industry (Safety, Labeling, etc.) |
| MON | Minting/Money/Gold Standard | TRU | Trucking/Shipping |
| CHM | Chemicals/Chemical Industry | FOR | Foreign Relations |
| NAT | Natural Resources | URB | Urban Development/Municipalities |
| CIV | Civil Rights/Civil Liberties | FUE | Fuel/Gas/Oil |
| PHA | Pharmacy | UNM | Unemployment |
| CAW | Clean Air & Water (Quality) | GAM | Gaming/Gambling/Casino |
| POS | Postal | UTI | Utilities |
| CDT | Commodities (Big Ticket) | GOV | Government Issues |
| RRR | Railroads | VET | Veterans |
| COM | Communications/Broadcasting/Radio/TV | HCR | Health Issues |
| RES | Real Estate/Land Use/Conservation | WAS | Waste (hazardous/solid/interstate/nuclear) |
| CPI | Computer Industry | WEL | Welfare |
| REL | Religion | TRF | Tariffs |
| MIN | Minting/Money/Gold Standard | | |

# C   Ranking of Lobbying Issues

In this section, we argue that the major issue of corporate lobbying is tax.

## C.1   Ranking based on expenditures

Table (C.2) lists the top ten lobbying issues by lobbying firms in the Compustat database, according to proportions of lobbying expenditures for specific issues. The ranking is based on the raw data, the matched data set, either among all firms in Compustat or among all manufacturing firms in Compustat, before the sample selection. During 1999-2013, taxation stays at the top for every single year for all lobbying firms and all Compustat firms. When we restrict our sample to only manufacturing firms, taxation is still the top one for most years. Otherwise, it ranks second.

# Table C.2 Top 10 Lobbying Issues Based on Aggregate Expenditures

**All lobbying firms**

| 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| TAX | TAX | TAX | TAX | TAX | TAX | TAX | TAX | TAX | TAX | TAX | TAX | TAX | TAX | TAX |
| HCR | BUD | BUD | BUD | BUD | BUD | BUD | BUD | BUD | BUD | HCR | HCR | BUD | BUD | BUD |
| BUD | TRD | HCR | HCR | HCR | HCR | HCR | HCR | HCR | HCR | BUD | BUD | HCR | HCR | HCR |
| TRD | HCR | TRD | TRD | TRD | TRD | TRD | TRD | TRD | ENG | ENG | ENG | ENG | TRD | TRD |
| ENV | ENV | ENV | ENG | MMM | TRA | TRA | ENG | ENG | TRD | ENV | FIN | TRD | ENG | ENG |
| LBR | LBR | ENG | ENV | ENG | MMM | ENG | RET | CPT | ENV | ENV | ENV | FIN | FIN | FIN |
| MMM | TRA | LBR | MMM | ENV | ENG | MMM | TRA | MMM | CPT | LBR | TRD | CPT | TRA | CPT |
| CPT | MMM | MMM | LBR | TOR | TOR | RET | CPT | HOM | MMM | CPT | TRA | TRA | ENV | HOM |
| GOV | TEC | TEC | FIN | TRA | DEF | TOR | HOM | ENV | DEF | FIN | LBR | ENV | HOM | ENV |
| TEC | ENG | DEF | INS | FIN | ENV | DEF | MMM | DEF | LBR | MMM | CPT | MMM | LBR | TRA |

**Compustat firms (All industries)**

| 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| TAX | TAX | TAX | TAX | TAX | TAX | TAX | TAX | TAX | TAX | TAX | TAX | TAX | TAX | TAX |
| TRD | TRD | TRD | TRD | TRD | TRD | TRD | TRD | TRD | TRD | HCR | ENG | BUD | TRD | TRD |
| HCR | HCR | HCR | HCR | HCR | BUD | BUD | BUD | BUD | ENG | ENG | HCR | TRD | BUD | BUD |
| ENV | BUD | BUD | BUD | BUD | HCR | HCR | HCR | CPT | BUD | BUD | FIN | HCR | HCR | HCR |
| BUD | ENV | ENV | ENG | ENG | TEC | ENG | CPT | HCR | ENV | TRD | TRD | ENG | ENG | ENG |
| LBR | LBR | ENG | ENV | DEF | DEF | TRA | RET | ENG | HCR | ENV | BUD | CPT | FIN | CPT |
| CPT | TEC | LBR | FIN | ENV | ENG | HOM | ENG | ENV | CPT | CPT | FIN | FIN | HOM | HOM |
| TEC | ENG | TEC | DEF | TOR | TOR | CPT | HOM | HOM | DEF | LBR | CPT | ENV | ENV | FIN |
| DEF | CPT | DEF | LBR | TEC | TRA | DEF | DEF | DEF | HOM | FIN | TRA | TRA | CPT | ENV |
| ENG | DEF | CPT | TEC | LBR | FIN | TEC | ENV | LBR | LBR | HOM | LBR | HOM | TRA | TRA |

**Compustat firms (Manufacturing)**

| 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| TAX | TRD | TRD | TRD | TAX | TAX | TAX | TRD | TRD | TAX | TAX | TAX | TAX | TAX | TAX |
| TRD | TAX | TAX | TAX | TRD | TRD | TRD | TAX | TAX | TRD | HCR | HCR | TRD | TRD | TRD |
| HCR | HCR | HCR | HCR | HCR | HCR | BUD | BUD | HCR | HCR | TRD | TRD | BUD | BUD | BUD |
| ENV | BUD | BUD | BUD | BUD | BUD | HCR | HCR | HCR | BUD | BUD | BUD | HCR | BUD | HCR |
| BUD | ENV | DEF | DEF | DEF | DEF | DEF | CPT | CPT | ENV | ENV | ENG | CPT | ENG | ENG |
| DEF | DEF | ENV | ENV | MMM | MMM | TRA | DEF | ENG | DEF | ENG | CPT | ENG | DEF | DEF |
| LBR | MMM | TRA | MMM | ENG | TRA | ENG | HOM | DEF | ENG | CPT | ENV | ENV | ENV | CPT |
| CPT | LBR | ENG | TRA | ENV | ENG | TOR | ENG | ENV | CPT | DEF | DEF | HOM | HOM | ENV |
| MMM | CPT | LBR | ENG | TOR | TOR | HOM | MMM | MMM | MMM | MMM | FIN | TRA | CPT | HOM |
| CSP | TRA | MMM | LBR | TRA | HOM | MMM | TRA | HOM | HOM | LBR | TRA | MMM | TRA | MMM |

[1] See Table (B.1) for an explanation of abbreviation.

## C.2 Number of issues per lobbying report

There can be multiple lobbying issues in one lobbying report. This implies that a firm's lobbying objective can be related to multiple three letter classification issues. In this section, we argue that there is no systematic difference in the number of issues per report across lobbying issues especially for the tax issue.

Table C.3 reports the average number of issues per report among reports that contains a specific issue. In the table, we present the three letter issue code in the first column; the average number of issues per report that contains the corresponding issue in the second column; the total number of reports that contain the corresponding issue in the last column. We order issues by the number of reports.

As in the previous section, TAX issue is again ranked top by the total number of reports. The number of average issues among reports that contain the TAX issue is 4.18, which is slightly lower than the average of all 81 issues (5.75).

Table C.3 The Average Number of Issues per Report (by Compustat firms, 1999–2013)

|  | Average number of issues | Number of reports |
|---|---|---|
| TAX | 4.18 | 34,518 |
| BUD | 4.38 | 21,272 |
| HCR | 3.79 | 21,007 |
| DEF | 2.94 | 18,692 |
| ENG | 4.30 | 18,543 |
| TRD | 5.36 | 14,679 |
| TEC | 3.17 | 12,912 |
| ENV | 5.43 | 12,308 |
| MMM | 3.28 | 11,944 |
| FIN | 4.28 | 10,795 |
| Statistics for all 81 issues | | |
| max | 10.20 | . |
| min | 2.89 | . |
| average | 5.76 | . |
| sd | 1.58 | . |

## C.3 Ranking based on discounted expenditure

To take account for multiple issues in one report we also measure the aggregate expenditures by weighting the amount on the lobbying report by the number of issues in the report. Taxation is still a dominant issue among 81 issues.

Taxation stays at the top for every single year for all lobbying Compustat firms. When we restrict our sample to only manufacturing firms, taxation is still the top one for most years. Otherwise, it ranks either top, second, or third.

Table C.4 Top 10 Lobbying Issues Based on Discounted Aggregate Expenditures

| All lobbying firms | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
| TAX | TAX | TAX | BUD | TAX | BUD | BUD | BUD | BUD | BUD | BUD | TAX | TAX | TAX | TAX |
| HCR | BUD | BUD | TAX | BUD | TAX | TAX | TAX | TAX | TAX | TAX | BUD | HCR | HCR | HCR |
| BUD | HCR | HCR | HCR | HCR | HCR | HCR | HCR | HCR | HCR | HCR | HCR | BUD | BUD | BUD |
| TRD | TRD | TRD | TRD | MMM | DEF | DEF | DEF | DEF | DEF | ENG | ENG | ENG | ENG | MMM |
| TEC | TEC | MMM | MMM | DEF | MMM | MMM | MMM | MMM | ENG | MMM | FIN | MMM | MMM | ENG |
| ENV | LBR | DEF | DEF | TRD | TRD | TRD | TRD | ENG | MMM | DEF | MMM | FIN | FIN | TRD |
| DEF | ENV | TEC | ENG | ENG | TRA | ENG | TEC | TRD | TRD | FIN | DEF | TRD | TRD | FIN |
| MMM | DEF | ENG | TRA | TRA | ENG | TRA | ENG | CPT | ENV | ENV | ENV | DEF | DEF | DEF |
| TRA | MMM | ENV | TEC | FIN | TEC | TEC | FIN | TEC | CPT | TRD | TRA | CPT | TRA | CPT |
| LBR | TRA | TRA | FIN | TEC | TOR | TOR | TRA | FIN | FIN | CPT | TRD | TRA | TEC | TRA |

| Compustat firms (All industries) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
| TAX | TAX | TAX | TAX | TAX | TAX | TAX | TAX | TAX | TAX | TAX | TAX | TAX | TAX | TAX |
| TRD | TRD | TRD | TRD | HCR | TEC | HCR | BUD | HCR | HCR | HCR | HCR | HCR | HCR | HCR |
| TEC | HCR | HCR | HCR | TRD | HCR | BUD | HCR | BUD | ENG | ENG | ENG | ENG | BUD | BUD |
| HCR | TEC | TEC | TEC | DEF | BUD | TEC | TRD | ENG | BUD | BUD | FIN | BUD | ENG | TRD |
| ENV | BUD | BUD | DEF | TEC | TRD | TRD | TEC | TRD | TRD | MMM | BUD | FIN | TRD | ENG |
| BUD | DEF | DEF | ENG | BUD | DEF | ENG | DEF | DEF | DEF | FIN | ENV | CPT | FIN | TEC |
| DEF | ENV | ENG | BUD | ENG | ENG | DEF | ENG | TEC | CPT | CPT | CPT | TRD | TEC | FIN |
| CPT | CPT | ENV | FIN | MMM | MMM | MMM | MMM | CPT | MMM | ENV | TRD | TEC | MMM | MMM |
| LBR | ENG | AVI | MMM | FIN | FIN | HOM | FIN | MMM | ENV | TRD | DEF | MMM | DEF | CPT |
| ENG | LBR | LBR | ENV | TOR | TOR | FIN | CPT | FIN | TEC | DEF | MMM | ENV | ENV | HOM |

| Compustat firms (Manufacturing) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
| TRD | TRD | TRD | TRD | TAX | TAX | TAX | HCR | HCR | TAX | TAX | TAX | TAX | TAX | TAX |
| TAX | TAX | TAX | HCR | DEF | DEF | HCR | TRD | TRD | HCR | HCR | HCR | HCR | HCR | HCR |
| DEF | HCR | HCR | TAX | HCR | HCR | DEF | TAX | TAX | DEF | DEF | DEF | TRD | TRD | TRD |
| HCR | DEF | DEF | DEF | TRD | TRD | TRD | DEF | DEF | TRD | ENG | ENG | DEF | BUD | BUD |
| ENV | BUD | BUD | BUD | MMM | BUD | BUD | BUD | BUD | BUD | BUD | BUD | BUD | DEF | DEF |
| CPT | ENV | MMM | MMM | BUD | MMM | MMM | MMM | CPT | ENG | CPT | TRD | CPT | ENG | ENG |
| BUD | CPT | ENV | ENG | ENG | ENG | ENG | ENG | ENG | CPT | TRD | CPT | ENG | MMM | MMM |
| MMM | MMM | CPT | ENV | TOR | TOR | CPT | CPT | MMM | MMM | MMM | MMM | MMM | ENV | CPT |
| LBR | TRA | ENG | TRA | ENV | TRA | TRA | HOM | ENV | ENV | ENV | ENV | ENV | CPT | ENV |
| TOB | ENG | TRA | CPT | TRA | HOM | TOR | TRA | HOM | HOM | HOM | HOM | TRA | HOM | HOM |

[1] See Table (B.1) for an explanation of abbreviation.

## C.4 Ranking based on aggregate expenditures of lobbying reports with single issue

In this subsection, we present the ranking of issues based on lobbying expenditures of lobbying reports that contain only one issue. This restricts the number of lobbying reports to 390,206 (out of 639,858) for all lobbying and to 77,744 (out of 141,639) for lobbying by Compustat firms during 1999–2013.

Based on this ranking we see that the taxation is still on the top list for the most of years and for the most of groups but not always top 1.

Table C.5 Top 10 Lobbying Issues Based on Aggregate Expenditures (only single issue report)

| All lobbying firms | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
| TAX | TAX | BUD | BUD | BUD | BUD | BUD | BUD | BUD | BUD | BUD | BUD | HCR | HCR | HCR |
| TEC | BUD | TAX | TAX | TAX | DEF | DEF | DEF | DEF | HCR | HCR | HCR | TAX | TAX | TAX |
| DEF | TEC | HCR | HCR | DEF | TAX | TAX | HCR | HCR | DEF | TAX | TAX | BUD | BUD | MMM |
| BUD | HCR | DEF | DEF | HCR | HCR | HCR | TAX | TAX | TAX | DEF | DEF | DEF | MMM | ENG |
| HCR | DEF | TEC | TEC | MMM | TEC | TEC | TEC | ENG | MMM | ENG | ENG | ENG | ENG | BUD |
| TRD | LBR | TRD | ENG | TEC | ENG | ENG | ENG | MMM | ENG | MMM | FIN | MMM | FIN | FIN |
| TRA | TRA | TRA | TRA | TRA | TRA | MMM | MMM | TEC | TEC | FIN | MMM | FIN | DEF | DEF |
| BAN | TRD | ENG | TRD | ENG | TOR | TRA | TRA | FIN | FIN | TEC | TEC | TEC | TEC | TEC |
| AVI | AVI | MMM | MMM | TRD | MMM | EDU | EDU | EDU | TRD | BAN | EDU | EDU | BAN | BAN |
| UTI | ENG | AVI | AVI | FIN | FIN | TRD | FIN | TRA | EDU | EDU | BAN | BAN | EDU | EDU |

| Compustat firms (All industries) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
| TEC | TEC | TEC | TEC | TEC | TEC | TEC | TEC | TEC | HCR | HCR | TAX | HCR | TAX | TAX |
| DEF | TAX | DEF | DEF | DEF | DEF | DEF | DEF | DEF | TEC | TAX | HCR | TAX | HCR | HCR |
| TAX | DEF | TAX | TAX | TAX | TAX | TAX | TAX | TAX | TAX | TEC | TEC | TEC | TEC | TEC |
| UTI | HCR | HCR | ENG | HCR | ENG | ENG | HCR | HCR | DEF | ENG | DEF | DEF | ENG | ENG |
| HCR | ENG | ENG | HCR | ENG | HCR | HCR | ENG | ENG | ENG | DEF | FIN | ENG | FIN | MMM |
| CPT | AVI | AVI | UTI | MMM | UTI | UTI | MMM | FIN | MMM | MMM | ENG | MMM | MMM | FIN |
| COM | CPT | UTI | AVI | UTI | FIN | MMM | FIN | MMM | FIN | FIN | MMM | FIN | DEF | DEF |
| TRD | TRD | TRD | MMM | FIN | MMM | HOM | UTI | UTI | UTI | UTI | BAN | BAN | BAN | BAN |
| AVI | TOB | BUD | TRD | AVI | BUD | BUD | BUD | BUD | COM | BAN | UTI | EDU | EDU | EDU |
| ENG | UTI | MMM | BUD | BUD | TRD | FIN | BAN | BAN | BAN | BUD | COM | COM | INS | INS |

| Compustat firms (Manufacturing) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
| DEF | DEF | DEF | DEF | DEF | DEF | DEF | DEF | DEF | DEF | DEF | DEF | HCR | HCR | HCR |
| CPT | HCR | TAX | TAX | TAX | HCR | HCR | HCR | HCR | HCR | HCR | HCR | DEF | DEF | TAX |
| TOB | CPT | HCR | HCR | HCR | TAX | MMM | BUD | ENG | ENG | ENG | TAX | TAX | TAX | DEF |
| HCR | TOB | TRD | TOB | MMM | MMM | BUD | MMM | BUD | MMM | TAX | ENG | ENG | ENG | ENG |
| TEC | FUE | TOB | MMM | BUD | ENG | TAX | ENG | TAX | TAX | MMM | MMM | MMM | MMM | MMM |
| TRD | TAX | TEC | TRD | TOB | BUD | ENG | TAX | MMM | TOB | TOB | CPT | ENV | TRD | AGR |
| ENV | TRD | BUD | BUD | SCI | TOB | MAN | TRD | TOB | BUD | BUD | BUD | TRD | TRA | TRD |
| TAX | TEC | MMM | ENG | TRD | TRD | TRD | FIN | TRD | TRD | CPT | BUD | TOB | BUD | PHA |
| MMM | BUD | ENG | AGR | ENG | AGR | TOB | TEC | CPT | CPT | HOM | TOB | BUD | ENV | ENV |
| BUD | ENV | ENV | ENV | TOR | TOR | AGR | PHA | HOM | ENV | ENV | HOM | CPT | PHA | POS |

[1] See Table (B.1) for an explanation of abbreviation.

# D The Relationship between Tax Issues and Other Issues

One may be interested in what kind of issues come together with the TAX issue. To shed some light on this we count the number of reports that contain the TAX and another issue. We rank non-tax issues by the number of reports and present the first 10 issues in table D.6. The Compustat firms lobby on tax issue together with ENG (Energy/Nuclear), TRD (Domestic & Foreign), BUD (Budget/Appropriations), HCR (Health) issues most frequently.

Table D.6 Top Lobbying Issues among Lobbying Reports Contain the Tax Issue (by Compustat firms, 1999–2013)

| | All Compustat firms | | | Manufacturing Compustat firms | |
|---|---|---|---|---|---|
| | Number of reports | % of total TAX | | Number of reports | % of total TAX |
| TAX | 34518 | 100% | TAX | 13352 | 100% |
| ENG | 7515 | 22% | TRD | 4551 | 34% |
| TRD | 7120 | 21% | HCR | 3581 | 27% |
| BUD | 6610 | 19% | ENG | 3578 | 27% |
| HCR | 6247 | 18% | BUD | 3369 | 25% |
| ENV | 5948 | 17% | ENV | 2924 | 22% |
| FIN | 4518 | 13% | CPT | 1914 | 14% |
| LBR | 3814 | 11% | DEF | 1771 | 13% |
| TRA | 3739 | 11% | TRA | 1730 | 13% |
| CPT | 3683 | 11% | MMM | 1682 | 13% |
| TEC | 3270 | 9% | LBR | 1516 | 11% |

# E  More on Lobbying Issues

In this section, we further analyze lobbying issues to get better impression about the objectives of TAX-lobbying firms (firms that lobbying on TAX issues). As we exemplified in section A, each lobbying report contains more information on the issue than the three letter code.

Table E.7 presents the most frequent words appeared in detailed TAX lobbying issue during 2008–2013 by Compustat firms and Compustat manufacturing firms.[18] We also present the most frequent words for all TAX issue lobbying reports. Naturally, the most frequent words include general terms like "tax", "act", "issues", "credit", "provisions", "revenue" (frequently together with "internal revenue code"), and "legislation" that indicates that the lobbying activity affects laws by reforming ("reform"), amending ("amend"), extending ("extension" and "extend"), supporting ("support"), and repealing ("repeal") the related law.

Excluding those general terms, words like "energy" (frequently together with "renewable"), "international"/"foreign", "research" (frequently together with "development"), "depreciation" (frequently together with "bonus"), "health"/"insurance", "job"/"jobs", and "investment" stand out from the lobbying report detailed issue.

**Caveats.** Not all details of lobbying reports contains the same amount of information. Following three detailed lobbying issues are taken from different lobbying reports.

1. "Issues related to Digital Goods and Services Tax Fairness Act of 2013 and Wireless Tax Fairness Act of 2013 H.R. 2309; Issues related to the Internet Tax Freedom Act S. 31 and H.R. 434; Issues related to corporate tax reform and spectrum auctions; Issues related to accelerated depreciation; Issues related to carried interest."

2. "H.R.8 The American Taxpayer Relief Act of 2012"

3. "Regarding corporate tax reform"

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[18]This detailed information is fully available starting from 2008. Prior to 2008, less than 10% of lobbying reports contain detailed information during 1998–2004, , 15% in 2005, 70% in 2006, 93% in 2007. In this analysis, we count words out of 23,039 lobbying reports for Compustat firms and 58,130 lobbying reports for all related reports.

Table E.7 Most Frequent Words Appeared in Lobbying Reports for the Tax Issues (2008–2013)

| | Compustat firms | | | Manufacturing firms | | | All | |
|---|---|---|---|---|---|---|---|---|
| Ranking | Word | Freq. | Ranking | Word | Freq. | Ranking | Word | Freq. |
| 1 | tax | 39642 | 1 | tax | 15834 | 1 | tax | 93136 |
| 2 | act | 25397 | 2 | act | 8444 | 2 | act | 61111 |
| 3 | issues | 11579 | 3 | issues | 4283 | 3 | issues | 22890 |
| 4 | related | 7792 | 4 | credit | 3907 | 4 | **energy** | 16964 |
| 5 | **energy** | 7473 | 5 | reform | 3076 | 5 | related | 15070 |
| 6 | reform | 6967 | 6 | **energy** | 2800 | 6 | credit | 14977 |
| 7 | credit | 6760 | 7 | related | 2730 | 7 | reform | 13896 |
| 8 | provisions | 6165 | 8 | provisions | 2319 | 8 | provisions | 13199 |
| 9 | revenue | 4271 | 9 | corporate | 2144 | 9 | revenue | 10343 |
| 10 | legislation | 4231 | 10 | **international** | 2011 | 10 | code | 10256 |
| 11 | corporate | 4206 | 11 | legislation | 1697 | 11 | legislation | 9959 |
| 12 | bill | 3909 | 12 | **research** | 1481 | 12 | bill | 8760 |
| 13 | taxation | 3830 | 13 | american | 1450 | 13 | internal | 8738 |
| 14 | code | 3760 | 14 | bill | 1426 | 14 | amend | 8090 |
| 15 | **international** | 3472 | 15 | extension | 1237 | 15 | relief | 7850 |
| 16 | american | 3375 | 16 | **foreign** | 1219 | 16 | business | 7268 |
| 17 | relief | 3374 | 17 | revenue | 1175 | 17 | american | 7228 |
| 18 | internal | 3329 | 18 | taxation | 1148 | 18 | taxation | 6911 |
| 19 | amend | 3298 | 19 | **development** | 1052 | 19 | relating | 6866 |
| 20 | income | 2965 | 20 | code | 1004 | 20 | income | 6682 |
| 21 | relating | 2840 | 21 | relief | 967 | 21 | extension | 6406 |
| 22 | business | 2834 | 22 | credits | 957 | 22 | **health** | 6263 |
| 23 | extension | 2690 | 23 | relating | 954 | 23 | corporate | 6173 |
| 24 | **renewable** | 2581 | 24 | general | 947 | 24 | **insurance** | 6056 |
| 25 | **foreign** | 2438 | 25 | **renewable** | 894 | 25 | **renewable** | 5973 |
| 26 | proposals | 2436 | 26 | including | 865 | 26 | repeal | 5669 |
| 27 | including | 2424 | 27 | **jobs** | 838 | 27 | section | 5604 |
| 28 | fairness | 2282 | 28 | excise | 829 | 28 | incentives | 5538 |
| 29 | incentives | 2267 | 29 | income | 822 | 29 | proposals | 5235 |
| 30 | **research** | 2098 | 30 | taxes | 817 | 30 | including | 5054 |
| 31 | general | 2089 | 31 | amend | 800 | 31 | **estate** | 4792 |
| 32 | repeal | 2029 | 32 | **medical** | 798 | 32 | credits | 4662 |
| 33 | credits | 1964 | 33 | internal | 786 | 33 | **jobs** | 4581 |
| 34 | **jobs** | 1949 | 34 | business | 782 | 34 | fairness | 4522 |
| 35 | **depreciation** | 1931 | 35 | alternative | 771 | 35 | **investment** | 4475 |
| 36 | extenders | 1900 | 36 | proposals | 765 | 36 | **international** | 4440 |
| 37 | excise | 1714 | 37 | section | 755 | 37 | support | 4419 |
| 38 | section | 1680 | 38 | **investment** | 750 | 38 | taxes | 4295 |
| 39 | alternative | 1675 | 39 | incentives | 731 | 39 | treatment | 4135 |
| 40 | taxes | 1672 | 40 | repeal | 691 | 40 | care | 4083 |
| 41 | budget | 1654 | 41 | extenders | 654 | 41 | small | 4058 |
| 42 | economic | 1621 | 42 | deferral | 640 | 42 | **foreign** | 4008 |
| 43 | extend | 1610 | 43 | budget | 637 | 43 | general | 3845 |
| 44 | treatment | 1607 | 44 | creation | 626 | 44 | **depreciation** | 3844 |
| 45 | **job** | 1598 | 45 | **job** | 618 | 45 | federal | 3801 |
| 46 | support | 1564 | 46 | economic | 592 | 46 | extenders | 3724 |
| 47 | **health** | 1547 | 47 | **health** | 566 | 47 | deduction | 3608 |
| 48 | **insurance** | 1538 | 48 | regarding | 521 | 48 | **development** | 3590 |
| 49 | **development** | 1537 | 49 | support | 521 | 49 | protection | 3555 |
| 50 | **investment** | 1536 | 50 | device | 514 | 50 | alternative | 3487 |

The first report contains the most detailed information while the third report contains nothing more than the firm lobbied on the TAX issue. The second one provides a rough idea about the objective of this lobby report (https://www.congress.gov/bill/112th-congress/

Table E.8 Share of Lobbying Reports on Tax Issue by Keywords (Dollar Amount)

| Year | Energy | Job | R&D | Health | International | Investment |
|------|--------|-----|-----|--------|--------------|------------|
| 2008 | 19% | 0% | 6% | 4% | 11% | 14% |
| 2009 | 9% | 2% | 13% | 7% | 16% | 22% |
| 2010 | 11% | 3% | 11% | 5% | 16% | 22% |
| 2011 | 7% | 1% | 8% | 4% | 20% | 17% |
| 2012 | 9% | 2% | 7% | 6% | 19% | 26% |
| 2013 | 9% | 1% | 4% | 6% | 18% | 12% |
| Average | 11% | 1% | 8% | 5% | 17% | 19% |

*Notes:* Health includes both "Health" and "Insurance". International includes both "International" and "Foreign". Investment includes "Investment", "Capital", "Depreciation". Based on all lobbying reports by Compustat firms during 2008–2013.

`house-bill/8`): H.R.8 was first introduced 7/24/2012 and passed 1/2/2013 by the US Congress. As this is involved with 31 sections for the business tax extenders (including "Extension and modification of bonus depreciation, "Extension and modification of research credit,", etc.), it is generally hard to nail down what is the actual issue of this lobby report beyond TAX.

Having said that this analysis provides a general impression about the TAX-issue lobbying. It seems that the TAX-issue lobbying effort by Compustat firms are most related to energy, investment, depreciation, R&D, health/insurance, international/foreign income/tax, etc.

Table E.8 presents the share of TAX issue lobbying reports that contain the selected keywords. For example, lobbying reports that contain terms related to capital holdings ("depreciation", "capital", "investment") account for 19% of total lobbying spending on taxation by firms in the Compustat database. Lobbying reports that contain "Energy" account 11% of total lobbying spending on taxation. Lobbying reports that contain "International" or "Foreign" account for 17% of total lobbying spending on taxation. Again, these numbers can be viewed as a lower bound of such share because some of the details of lobbying reports do not contain enough information to further refine the objective of lobbying than the three letter code (in our case TAX).

Given that issues with "Energy" and "R&D" are also related to capital intensive activities, we infer that a large share of lobbying expenditures on taxation is tied to firms' capital holdings.

# F    Data Sources and Sample Selection

## F.1    List of variables

Table (F.9) provides details and sources of all variables used in the regression analysis. Table (F.10) presents the variables used as regressors in this exercise and their Compustat codes.

### Table F.9 Variable Sources

| ETR-related variables | Code | Variable description | Source |
|---|---|---|---|
| | TXT | Income Taxes - Total | Compustat |
| | PI | Pretax Income | Compustat |
| | SPI | Special Items | Compustat |
| | | | |
| **Other variables** | Code | Variable description | Source |
| | AT | Assets - Total | Compustat |
| | PPEGT | Property, Plant and Equipment - Total (Gross) | Compustat |
| | PPENT | Property, Plant and Equipment - Net | Compustat |
| | CAPX | Capital Expenditure | Compustat |
| | DLTT | Long-Term Debt - Total | Compustat |
| | DLC | Debt in Current Liabilities - Total | Compustat |
| | XRD | Research and Development Expenses | Compustat |
| | SALE | Sales/Turnover (Net) | Compustat |
| | EMP | Employees | Compustat |
| | INTAN | Intangible assets | Compustat |
| | TLCF | Tax Loss Carry Forward | Compustat |
| | CH | Cash | Compustat |
| | PIFO | Pretax Income - Foreign | Compustat |
| | TXFO | Income Taxes - Foreign | Compustat |
| | INCORP | State/Province of incorporation | Compustat |
| | LOB | Lobbying expenditure | CRP |
| | DEF | GDP Implicit price deflator | FRED |
| | IVTDEF | Investment price deflator | Author's calculation |

## F.2    Effective tax rate

Each firm's 3-year cash effective tax rate is computed using data from Compustat as:

$$ETR_t = \frac{\sum_{i=t-2}^{t} TXPD_t}{\sum_{i=t-2}^{t}(PI_t - SPI_t)}. \tag{20}$$

where $TXPD$ is income taxes paid, $PI$ is pre-tax income, and $SPI$ is special items. Note that computation of the 3-year cash effective tax rate requires one to have information on $TXPD$, $PI$, and $SPI$ at least three consecutive years. If one of these three variables are missing in those three

Table F.10 Variable Definitions

| Dependent Variables | Description | Calculation |
|---|---|---|
| ETR | 3-year cash effective tax rate | See Eq 20. |
| Productivity | Detrended productivity | See Appendix F. |
| MPK | Marginal product of capital | See Appendix F. |
| Capital Intensity | Deflated captial scaled by employment | $PPENT/EMP/IVTDEF$ |

| Explanatory Variables | Description | Calculation |
|---|---|---|
| Lobbying Dummy | Indicator variable that takes 1 in year $t$ if the corresponding firm lobbied on tax issue in year $t-2$ | $1\{LOB(t-2) > 0\}$ |
| R&D Expenditure | Amount of R&D expenditure scaled by employment | $XRD/EMP/DEF$ |
| Intangible Asset | Intangible assets scaled by employment | $INTAN/EMP/DEF$ |
| Leverage | Long-term debt to total asset ratio | $(DLTT + DLC)/AT$ |
| Capital Expenditure | Amount spent on capital assets divided by the gross value of property, plant and equipment. | $CAPX/PPEGT$ |
| Cash Holdings | Cash holdings scaled by employment | $CH/EMP/DEF$ |
| NOL Dummy | Indicator variable that takes value 1 if the firm has a net operating loss carry forward balance. | $1\{NOL > 0\}$ |
| Multinational Dummy | Indicator variable that takes value 1 if either firm's pretax foreign income is greater than zero or if its foreign tax expense is non-zero. | $1\{PIFO > 0 \text{ or } TXFO = 0\}$ |
| Employment | Natural logarithm of the number of employees | $EMP$ |
| Location fixed effects | The state where the firm's headquarter is located. | $INCORP$ |

years, we treat $ETR_t$ as the missing variable. We drop firm-year observation pair with negative pretax income.

## F.3 Additional data management

For the linear regression, we further refine the data by winsorizing the 3-year ETR at lower 1% and upper 99%. We also drop the firms that do not have any of regressors used in Table 4. After the selection and modification, there are 19,225 firm-year observations for the regression analysis. It is an unbalanced panel. Nominal variables are deflated by the GDP deflator so that they are in

2009 dollars.

## F.4   Marginal product of capital and production function estimation

**Production function estimation.**   Marginal product of capital is based on the estimated production function using the Compustat data from 1962 to 2013. We estimate the following firm-level production function following Olley and Pakes (1996) and Wooldridge (2009),[19]

$$y_{it} = \beta_k^j k_{it} + \beta_l^j l_{it} + \sum_{t=1962}^{2013} \delta_t^j d_{it}^j + \log(z_{it}) + \eta_{it}$$

where $i$ refers to firm id, $t$ refers to year, and $j$ refers to the industry that the firm $i$ belongs to. The value added ($\exp(y_{it})$) is measured as net sales minus materials and materials is computed as total expenses except labor expenses. The capital stock $\exp(k_{it})$ is measured by net property, plant, and equipment (PPENT), deflated by the age-adjusted investment price deflator. The labor stock $\exp(l_{it})$ is measured by the number of employees (EMP). The dummy variable $d_{it}^j$ takes one in year $t$ for firm $i$ that belongs to the industry $j$. In the estimation, we include the industry-specific time fixed effect ($\delta_t^j$) to take out the deterministic component in productivity. We denote the de-trended productivity measure as $z_{it}$. We adopt the same set of assumptions for the idiosyncratic shock ($\eta_{it}$) as in Wooldridge (2009). In addition, we approximate a mapping between the productivity, the capital stock and the capital investment using the third-order polynomials. Estimated coefficients range from 0.53 (0.01) to 0.85 (0.03) for $\beta_k^j$ and from 0.07 (0.03) to 0.14 (0.05) for $\beta_l^j$ across industries. When we restrict the sample to manufacturing sector, coefficient estimates are $\beta_k = 0.78$ (0.007) and $\beta_l = 0.13$ (0.013). Then, we further restrict the sample to only lobbying firms. That is, we estimate the production function using only manufacturing firms that ever appeared in both Compustat database and lobbying database. This automatically restricts the firms that are

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[19]For the variables used in the estimation of the productivity function, we follow Imrohoroglu and Tuzel (2014) who estimate the productivity function using the Compustat data based on Olley and Pakes (1996)'s method. We employ the Wooldridge (2009)'s extension of the method developed by Olley and Pakes (1996) and Levinsohn and Petrin (2003) to build firm level revenue productivity measures. We use the gross capital investment (CAPX deflated by the deflator based on price index for private fixed investment) as a proxy for TFP.

Table F.11 More on Production Function Estimates (Manufacturing Firms)

| (a) Years: 1999-2013 | $\beta_l$ | $se(\beta_l)$ | $\beta_k$ | $se(\beta_k)$ |
|---|---|---|---|---|
| Ever lobbied but never on tax | 0.75 | 0.027 | 0.05 | 0.073 |
| Ever lobbied on tax | 0.58 | 0.025 | 0.29 | 0.055 |
| Ever lobbied | 0.67 | 0.019 | 0.15 | 0.050 |
| Never lobbied | 0.78 | 0.015 | 0.14 | 0.031 |
| Never lobbied on tax | 0.77 | 0.013 | 0.12 | 0.029 |
| All firms appeared in 1999-2013 | 0.74 | 0.012 | 0.14 | 0.026 |

| (b) Years: 1962-2013 | $\beta_l$ | $se(\beta_l)$ | $\beta_k$ | $se(\beta_k)$ |
|---|---|---|---|---|
| Ever lobbied but never on tax | 0.77 | 0.019 | 0.13 | 0.058 |
| Ever lobbied on tax | 0.63 | 0.019 | 0.22 | 0.037 |
| Ever lobbied | 0.70 | 0.015 | 0.18 | 0.038 |
| Never lobbied | 0.79 | 0.013 | 0.12 | 0.020 |
| Never lobbied on tax | 0.78 | 0.011 | 0.12 | 0.019 |
| All firms appeared in 1999-2013 | 0.75 | 0.010 | 0.14 | 0.018 |
| All firms appeared in 1962-2013 | 0.78 | 0.007 | 0.13 | 0.013 |

appreared in the Compustat database during 1999-2013 whether the firm did lobbying activity or not due to data availability of lobbying database. Whether we include firm data starting from 1962 or starting from 1999, we get to the same conclusion: Firms that ever lobbied on tax issue during 1999-2013 have lower $\beta_l$ and higher $\beta_k$ than other groups. Moreover, the difference in production function estimates between firms that ever lobbied but not on tax issue and firms that never lobbied is little. Therefore, in line with our calibration, firms that lobby for tax issues use on average a technology that is practically two times more capital intensive than the one used by the average firm.

**Marginal product of capital.** Having estimated parameters in the production function, de-trended productivity measures are computed as

$$\log(\widehat{z}_{it}) = y_{it} - \widehat{\beta}_k^j k_{it} - \widehat{\beta}_l^j l_{it} - \sum_{t=1962}^{2013} \widehat{\delta}_t^j d_{it}^j,$$

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and the marginal product of capital for firm $i$ in year $t$ is computed as

$$\log(\widehat{\text{MPK}}_{it}) = \log(\widehat{\beta}_k^j) + y_{it} - k_{it}.$$

For robustness check, we also consider the average productivity of capital as an alternative proxy for the marginal product of capital, which is defined as

$$\widehat{\text{MPK}}_t^\dagger = \frac{\text{SALE}}{\text{PPEGT}}.$$

The correlation between $\log(\widehat{\text{MPK}}_{it})$ and $\log(\widehat{\text{MPK}}_{it}^\dagger)$ is approximately 0.81.

# G Robustness Check: Full sample

## G.1 Figures

As a robustness check for Section 3, we provide a series of figures, which are presented in the main text for manufacturing firms, with full sample including observations from all industries except finance, insurance and real estate sectors. The general findings hold. That is, lobbying firms 1) are larger and more capital intensive; and 2) enjoy lower effective tax rates and have lower marginal product of capital.

Industry-year scatter plot, however, reveals that lobbying firms pay higher effective tax rates than non-lobbying firms for service and mining sector.

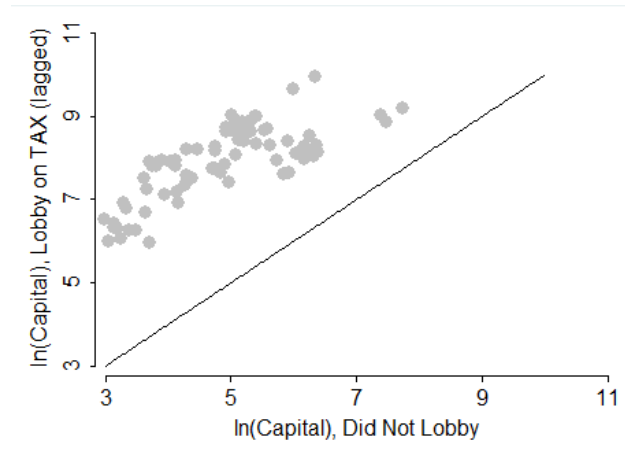Figure G.3 Conditional Median Capital and Capital Intensity (All Industries)
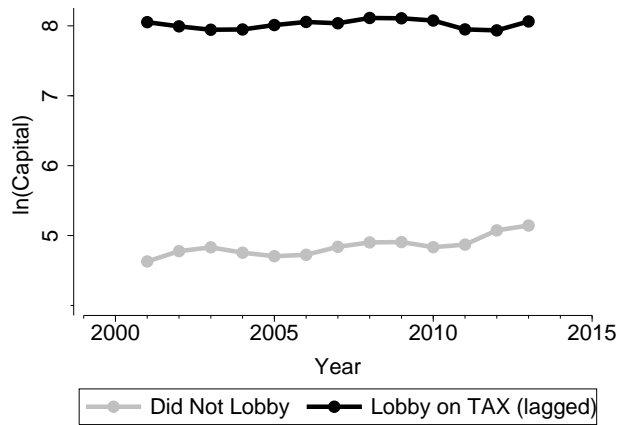


(a) Median log(Capital)
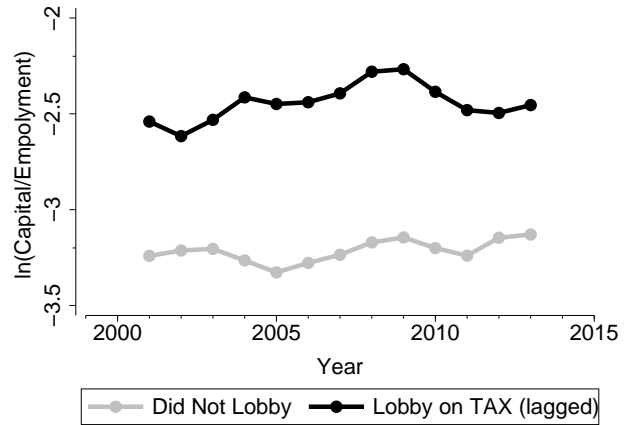
(b) Median log(Capital/Employment)

Figure G.4 Industry-time Differences in Capital and Capital Intensity for Lobbying and Non-lobbying Firms (All Industries)
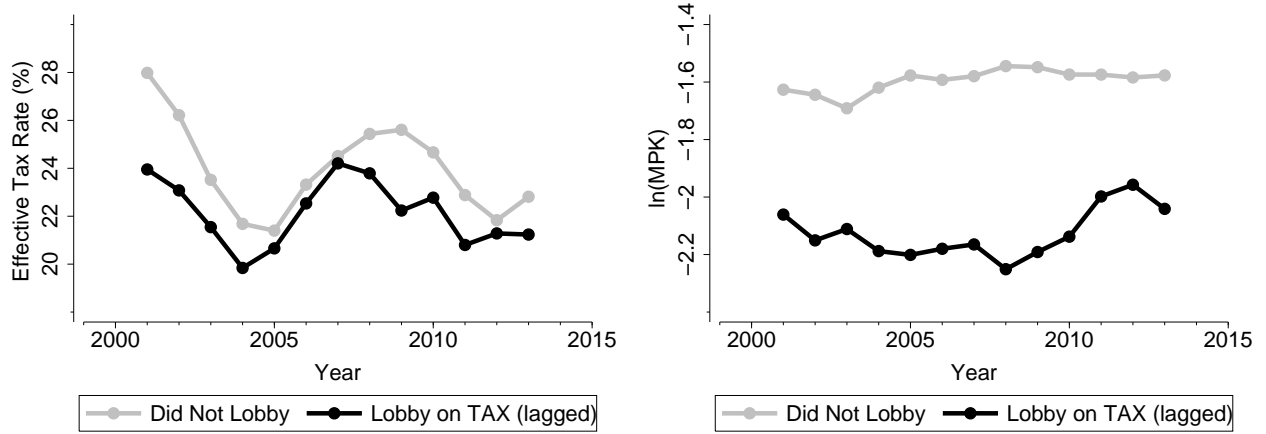


(a) Median log(Capital)

(b) Median log(Capital/Employment)

Notes: Calculated for two digit industries (SIC) with more than 10 firms in each lobbying status.

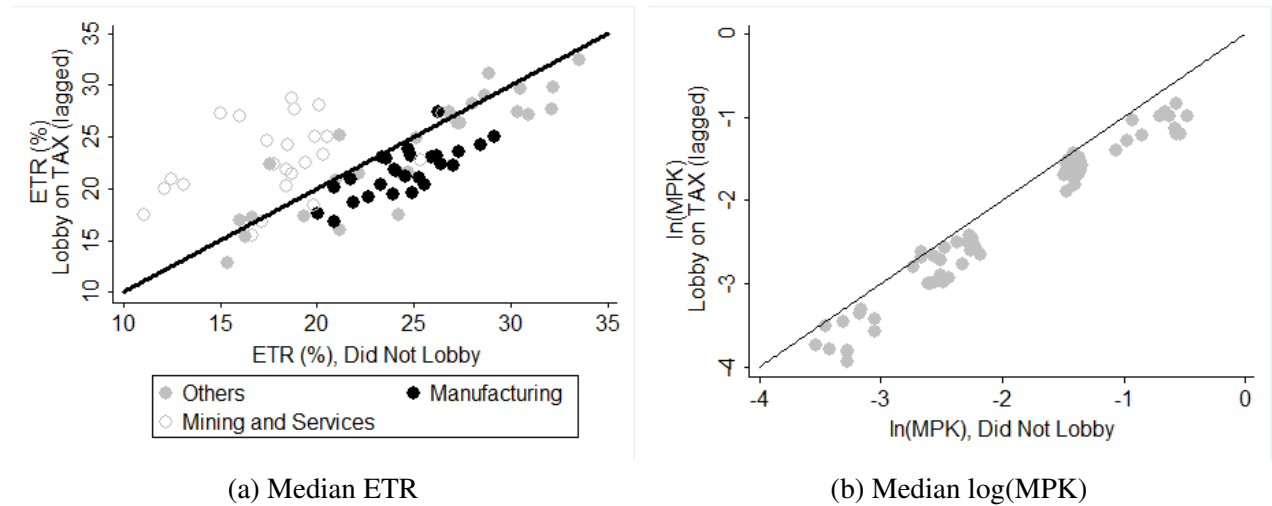Figure G.5 Conditional Effective Tax Rates (All Industries)



(a) Median ETR

(b) Median log(MPK)

Notes: Firms are grouped by their lobbying expenditures on tax issues.

Figure G.6 Industry-time Differences in ETR and log(MPK) for Lobbying and Non-lobbying Firms (All Industries)



(a) Median ETR

(b) Median log(MPK)

Notes: Calculated for two digit industries (SIC) with more than 10 firms in each lobbying status.

## G.2 Regression

Table G.12 presents the regression output with firms in all industries but finance, insurance, and real estate firms. The sign and significance of the regression coefficients are similar to those in the main text.

Table G.12 Differences in ETR and MPK between Lobbying and Non-lobbying Firms

|  | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
|  | ETR | Captial Intensity | Productivity | log(MPK) |
| Lobbying Dummy | -1.2245 | 0.4157 | 0.4430 | -0.1785 |
|  | (0.5438) | (0.0711) | (0.0279) | (0.0451) |
| R&D Expenditure | -0.0479 | 0.0042 | 0.0034 | -0.0005 |
|  | (0.0083) | (0.0009) | (0.0005) | (0.0007) |
| Intangible Asset | -0.0002 | 0.0001 | 0.0004 | 0.0003 |
|  | (0.0005) | (0.0001) | (0.0001) | (0.0000) |
| Leverage | -4.1726 | 0.8195 | 0.2834 | -0.5135 |
|  | (0.8425) | (0.1633) | (0.0418) | (0.1315) |
| Capital Expenditure | -12.5971 | -1.4559 | 0.4933 | 1.9091 |
|  | (2.0028) | (0.1695) | (0.0648) | (0.1571) |
| Cash Holdings | 0.0020 | 0.0011 | 0.0004 | -0.0001 |
|  | (0.0012) | (0.0004) | (0.0002) | (0.0001) |
| NOL Dummy | -3.4879 | -0.0299 | -0.0255 | -0.0056 |
|  | (0.3910) | (0.0301) | (0.0124) | (0.0234) |
| Multinational Dummy | 1.7580 | 0.0657 | 0.1580 | -0.0410 |
|  | (0.3531) | (0.0478) | (0.0154) | (0.0311) |
| Employment | 0.3286 | -0.0359* |  |  |
|  | (0.1607) | (0.0204) |  |  |
| Capital Intensity | -1.2969 |  |  |  |
|  | (0.2258) |  |  |  |
| # of obs. | 17217 | 17217 | 17217 | 17217 |
| Adj. R2 | 0.180 | 0.532 | 0.849 | 0.492 |

Notes: Firm-level regressions with industry, year, industry-year and location fixed effects. Estimations cluster standard errors by firms. Arbitrary autocorrelation structure of the regression error is taken care based on the Bartlett kernel with the lag length of 2 years. Industries are defined at the two-digit SIC code level. Location is defined by the state where the firm's headquarter is located.

The overall set of control variables includes the following: 1) R&D scaled by employment to control for systematic differences arising from research activities that are subject to benefits; 2) the ratio of intangible assets to employment to control for tax treatment of intangible assets; 3) the

ratio of total debt to total assets to account for tax benefits arising from corporate capital structure; 4) the amount spent on capital assets scaled by total property, plant and equipment to control for systematic differences in the investment behavior of firms; 5) cash divided by employment to avoid attributing the effects of excessive liquidity to lobbying; 6) the NOL dummy is an indicator variable equal to one if the firm reports a tax-loss carried forward and zero otherwise; 7) the Multinational dummy is another indicator variable that takes value one if the firm is multinational and zero if it is purely domestic for the given year; 8) log employment is used to control for firm size when needed; and 9) log of capital to labor ratio is used to control for capital intensity when appropriate.

The coefficients in Regression (1) are aligned with the literature on corporate taxation and firm dynamics. It is interesting to see that multinationals seem to pay more taxes, on average. Note that, in regression (4), carrying a loss forward is not strongly associated with lower MPK, as this type of benefit is likely unrelated to capital holdings.

# H  Robustness Check: Regression Analysis

This section presents ETR and MPK regression with different definition of the cash ETR and MPK.

(1) The same regression as in the main text. 3-year cash ETR as a dependent variable and 2-year lag of lobbying status as a lobbying dummy.

(2) One-year cash ETR as a dependent variable and one-year lag of lobbying status as a lobbying dummy.

(3) 5-year cash ETR as a dependent variable and 4-year lag of lobbying status as a lobbying dummy.

(4) 3-year cash ETR as a dependent variable and the lobbying dummy that takes value one at time $t$ if the corresponding firm spent money on lobbying either in time $t - 1$ or $t - 2$.

(5) The same MPK regression as in the main text but with a different lobbying dummy. The lobbying dummy takes value one at time $t$ if the corresponding firm spent money on lobbying either in time $t - 1$ or $t - 2$.

The sign and significance of the coefficients agree with those presented in the main text. That is, lobbying firms enjoy lower ETR and have lower MPK. Conditional on other controls, more capital-intensive firms enjoy lower ETR.

Table H.13 Differences in ETR and MPK between Lobbying and Non-lobbying Firms

| | (1) ETR3y | (2) ETR1y | (3) ETR5y | (4) ETR3y | (5) log(MPK) |
|---|---|---|---|---|---|
| Lobbying Dummy | -2.2242 | -2.8788 | -2.0913 | -2.2900 | -0.2554 |
| | (0.6630) | (0.7709) | (0.7463) | (0.6321) | (0.0488) |
| R&D Expenditure | -0.0361 | -0.0352 | -0.0203 | -0.0356 | -0.0001 |
| | (0.0084) | (0.0082) | (0.0096) | (0.0082) | (0.0007) |
| Intangible Asset | 0.0011 | 0.0007 | -0.0019 | 0.0012 | 0.0005 |
| | (0.0014) | (0.0010) | (0.0012) | (0.0014) | (0.0001) |
| Leverage | -5.1627 | -4.0492 | -7.1412 | -4.6738 | -0.2588 |
| | (1.3377) | (1.5436) | (1.5631) | (1.3411) | (0.0722) |
| Capital Expenditure | -15.7106 | -6.0907 | -18.9768 | -14.9616 | 2.3516 |
| | (2.3755) | (2.9324) | (2.4264) | (2.3062) | (0.1280) |
| Cash Holdings | -0.0030 | -0.0054 | -0.0046 | -0.0033 | 0.0004 |
| | (0.0024) | (0.0024) | (0.0028) | (0.0024) | (0.0002) |
| NOL Dummy | -3.5003 | -3.8413 | -2.0955 | -3.5081 | -0.0260 |
| | (0.5819) | (0.8014) | (0.3940) | (0.5631) | (0.0233) |
| Multinational Dummy | 1.5990 | 1.7650 | 1.4405 | 1.5427 | -0.1319 |
| | (0.4817) | (0.5587) | (0.5745) | (0.4613) | (0.0374) |
| Employment | 0.0177 | -0.0639 | -0.3494 | 0.0187 | |
| | (0.1624) | (0.1716) | (0.1705) | (0.1582) | |
| Capital Intensity | -0.5247 | -0.4857 | -0.8007 | -0.6325 | |
| | (0.2870) | (0.3559) | (0.3326) | (0.3007) | |
| # of obs. | 8569 | 11438 | 5263 | 9292 | 9261 |
| Adj. R2 | 0.128 | 0.054 | 0.144 | 0.133 | 0.473 |

 Notes: Firm-level regressions with industry, year, industry-year and location fixed effects. Estimations cluster standard errors by firms. Arbitrary autocorrelation structure of the regression error is taken care based on the Bartlett kernel with the lag length of 2 years. Industries are defined at the two-digit SIC code level. Location is defined by the state where the firm's headquarter is located.

# I   Additional notes on the data and econometric procedures

**Firm name matching.**   To link the lobbying data to Compustat data we utilize the gvkey (a firm identifier variable in the Compustat data) information in the firm level lobbying database processed by In Song Kim at MIT (`https://www.lobbyview.org/#/`). This firm level lobbying database is used in Kim (2017).

**OLS and IV estimation and inference.**   All IV and OLS estimation/inference results are produced by the "ivreg2" package written by Baum et al. (2010) using the STATA software.

# J Proofs

## J.1 Proposition 1

In this section, we prove Proposition 1 by first establish Lemma 1 an Lemma 2. Denote an increase in profits from switching to high capital-intensive technology for lobbying firm $l$ and non-lobbying firms $nl$:

$$\Delta V_j = V_j(\overline{\alpha}, z) - V_j(\underline{\alpha}, z), \ \text{ where } j \in \{l, nl\},$$

where

$$
\begin{aligned}
V_l(\alpha, z) &= (1-\tau)\pi(k_l^*(\alpha), \alpha) + \tau\gamma l^{*1-\phi}k_l^*(\alpha)^\phi - l^* \\
&= (1-\tau)\pi(k_l^*(\alpha), \alpha) + \phi(\tau\gamma)^{\frac{1}{\phi}}(1-\phi)^{\frac{1-\phi}{\phi}}k_l^*(\alpha) \\
&\quad ; \ \text{where } l^* = (\tau\gamma(1-\phi))^{\frac{1}{\phi}} k_l^*(\alpha) \\
&= (1-\tau)\left[\pi(k_l^*(\alpha), \alpha) + xk_l^*(\alpha)\right]; \\
&\quad ; \text{where } x = (1-\tau)^{-1}(\tau\gamma)^{\frac{1}{\phi}}\phi(1-\phi)^{\frac{1-\phi}{\phi}}. \\
V_{nl}(\alpha, z) &= (1-\tau)\pi(k_{nl}^*(\alpha), \alpha).
\end{aligned}
$$

In what follows, capital and profit are expressed as a function of technology $\alpha$ whenever necessary.

### J.1.1 Lemma 1

**Lemma 1.** *Lobbying creates a constant wedge of $x = (1-\tau)^{-1}\phi(\tau\gamma)^{\frac{1}{\phi}}(1-\phi)^{\frac{1-\phi}{\phi}}$ between the return to capital and the marginal cost of capital.*

*Proof.* Take first order condition of the firm's maximization problem 7. For non-lobbying firms:

$$\tilde{\pi}'(k_{nl}^*) = r + \delta. \tag{21}$$

For lobbying firms:

$$\tilde{\pi}'(k_l^*) + (1 - \tau)^{-1}\tau\phi\gamma l^{*1-\phi}(k_l^*)^{\phi-1} = r + \delta$$

$$\tilde{\pi}'(k_l^*) + x = r + \delta; \ l^* = (\tau\gamma(1-\phi))^{\frac{1}{\phi}} k_l^* \qquad (22)$$

where $\tilde{\pi}'(k) = \alpha\eta \left( z \left( \frac{(1-\alpha)\eta}{w} \right)^{(1-\alpha)\eta} \right)^{\frac{1}{1-(1-\alpha)\eta}} k^{\frac{\eta-1}{1-(1-\alpha)\eta}}$. The constant wedge is $x$. $\qquad\square$

### J.1.2 Lemma 2

**Lemma 2.** *If the equilibrium wage rate is such that $w > \underline{w}$,*

1. *For each lobbying type, an increase in profit from switching to high capital-intensive technology is strictly increasing in productivity $z$.*

2. *For a given productivity level $z$, an increase in profit from switching to high capital-intensive technology is strictly larger among lobbying firms.*

*Proof.* For non-lobbying firms,

$$\Delta V_{nl} = (1 - \tau)\left[\pi(k_{nl}^*(\overline{\alpha}), \overline{\alpha}) - \pi(k_{nl}^*(\underline{\alpha}), \underline{\alpha})\right]$$

Substitute $k_{nl}^*(\alpha) = \left(\frac{\alpha\eta}{r+\delta}\right)^{\frac{1-(1-\alpha)\eta}{1-\eta}} \left(\frac{(1-\alpha)\eta}{w}\right)^{\frac{(1-\alpha)\eta}{1-\eta}} z^{\frac{1}{1-\eta}}$ and Eq 21;

$$
\begin{aligned}
\Delta V_{nl} &= (1 - \tau)\left[\frac{(1 - (1 - \overline{\alpha})\eta)(r + \delta)k_{nl}^*(\overline{\alpha})}{\overline{\alpha}\eta} - (r + \delta)k_{nl}^*(\overline{\alpha})\right] \\
&\quad -(1 - \tau)\left[\frac{(1 - (1 - \underline{\alpha})\eta)(r + \delta)k_{nl}^*(\underline{\alpha})}{\underline{\alpha}\eta} - (r + \delta)k_{nl}^*(\underline{\alpha})\right] \\
&= (1 - \eta)(z\eta)^{\frac{1}{1-\eta}}(1 - \tau)B \\
&\quad ; B = \left[ \left(\frac{\overline{\alpha}}{r+\delta}\right)^{\frac{\overline{\alpha}\eta}{1-\eta}} \left(\frac{1-\overline{\alpha}}{w}\right)^{\frac{(1-\overline{\alpha})\eta}{1-\eta}} - \left(\frac{\underline{\alpha}}{r+\delta}\right)^{\frac{\underline{\alpha}\eta}{1-\eta}} \left(\frac{1-\underline{\alpha}}{w}\right)^{\frac{(1-\underline{\alpha})\eta}{1-\eta}} \right] \qquad (23) \\
&\Rightarrow \frac{d\Delta V_{nl}}{dz} > 0
\end{aligned}
$$

The last line follows from the wage rate condition $w > \underline{w}$ and that in the steady state $r = \frac{1}{\beta} - 1$, which implies that $B > 0$.

For lobbying firms;

$$\Delta V_l = (1 - \tau) \left[ \pi(k_l^*(\overline{\alpha}), \overline{\alpha}) - \pi(k_l^*(\underline{\alpha}), \underline{\alpha}) + x k_l^*(\overline{\alpha}) - x k_l^*(\underline{\alpha}) \right]$$

Substitute $k_l^*(\alpha) = \left( \frac{\alpha \eta}{r + \delta - x} \right)^{\frac{1 - (1 - \alpha)\eta}{1 - \eta}} \left( \frac{(1 - \alpha)\eta}{w} \right)^{\frac{(1 - \alpha)\eta}{1 - \eta}} z^{\frac{1}{1 - \eta}}$ and Eq 22;

$$
\begin{aligned}
\Delta V_l &= (1 - \eta)(z\eta)^{\frac{1}{1-\eta}} (1 - \tau) A; \\
A &= \left[ \left( \frac{\overline{\alpha}}{r + \delta - x} \right)^{\frac{\overline{\alpha}\eta}{1-\eta}} \left( \frac{1 - \overline{\alpha}}{w} \right)^{\frac{(1 - \overline{\alpha})\eta}{1-\eta}} - \left( \frac{\underline{\alpha}}{r + \delta - x} \right)^{\frac{\underline{\alpha}\eta}{1-\eta}} \left( \frac{1 - \underline{\alpha}}{w} \right)^{\frac{(1 - \underline{\alpha})\eta}{1-\eta}} \right] \quad (24) \\
&\Rightarrow \frac{d\Delta V_l}{dz} > 0.
\end{aligned}
$$

The last line follows from the wage rate condition $w > \underline{w}$ and that in the steady state $r = \frac{1}{\beta} - 1$, which implies that $A > 0$ for $x = (1 - \tau)^{-1} \phi (\tau \gamma)^{\frac{1}{\phi}} (1 - \phi)^{\frac{1 - \phi}{\phi}}$.

Next, we show that for a given $z$, $\Delta V_l > \Delta V_{nl}$. Consider Eq 23 and 24, $\Delta V_{nl}$ equals $\Delta V_l$ if $x = 0$. Thus, it suffices to show that $A$ is increasing in $x$.

$$
\begin{aligned}
\frac{dA}{dx} &= \frac{1}{r + \delta - x} \frac{\eta}{1 - \eta} \left[ \overline{\alpha} \left( \frac{r + \delta}{r + \delta - x} \right)^{\frac{\overline{\alpha}\eta}{1-\eta}} B - \underline{\alpha} \left( \frac{r + \delta}{r + \delta - x} \right)^{\frac{\underline{\alpha}\eta}{1-\eta}} C \right] \\
\text{where} \quad B &= \left( \frac{\overline{\alpha}}{r + \delta} \right)^{\frac{\overline{\alpha}\eta}{1-\eta}} \left( \frac{1 - \overline{\alpha}}{w} \right)^{\frac{(1 - \overline{\alpha})\eta}{1-\eta}} \\
C &= \left( \frac{\underline{\alpha}}{r + \delta} \right)^{\frac{\underline{\alpha}\eta}{1-\eta}} \left( \frac{1 - \underline{\alpha}}{w} \right)^{\frac{(1 - \underline{\alpha})\eta}{1-\eta}} \\
&> B - C \\
&> 0 \qquad \text{; from wage rate condition.}
\end{aligned}
$$

$\square$

We use Lemma 1 an Lemma 2 to prove Proposition 1.

1. *Proof.* $\frac{d\Delta V_{nl}}{dz} > 0$ and the cost of switching technology is constant $\varphi$. Thus, there exists $z_{nl}^*$ such that $\Delta V_{nl}(z_{nl}^*) = \varphi$. Similarly, there exists $z_{nl}^*$ such that $\Delta V_l(z_l^*) = \varphi$. $\square$

2. *Proof.* If $z_l^* \geq z_{nl}^*$, $\varphi = \Delta V_l(z_l^*) > \Delta V_{nl}(z_l^*) \geq \Delta V_{nl}(z_{nl}^*)$, where the first equality holds

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by definition, the second inequality follows from $\Delta V_l > \Delta V_{nl}$ for a given $z$, and the third inequality follows from $\frac{d\Delta V_{nl}}{dz} > 0 \Rightarrow\Leftarrow$. $\qquad\square$

## J.2 Proposition 2

1. *Proof.* The effective tax rate of non-lobbying firms does not depend on $z$ or $\alpha$. In particular, $ETR_{nl} = \tau$ for all $z$. $\Delta ETR = ETR_l - ETR_{nl} = \frac{\tau\pi(k_l^*) - (\tau\gamma)^{\frac{1}{\phi}}(1-\phi)^{\frac{1-\phi}{\phi}}k_l^*}{\pi(k_l^*)} - \tau = -\frac{(\tau\gamma)^{\frac{1}{\phi}}(1-\phi)^{\frac{1-\phi}{\phi}}k_l^*}{\pi(k_l^*)} < 0$. It is obvious to show that $\mathbf{E}\left[ETR_{nl}|z \geq z_l^*\right] = \mathbf{E}\left[ETR_{nl}|z < z_l^*\right] = \tau$. Consider $z < z_l^*$, lobbying firms choose low capital-intensive technology. Substitute $k_l^*(\underline{\alpha})$, we obtain $ETR_l = \tau - \frac{1}{\phi}\frac{\underline{\alpha}\eta x(1-\tau)}{(1-\eta)(r+\delta)-(1-(1-\underline{\alpha})\eta)x} < \tau$, where $x = (1-\tau)^{-1}\phi(\tau\gamma)^{\frac{1}{\phi}}(1-\phi)^{\frac{1-\phi}{\phi}}$. For $z \geq z_l^*$, lobbying firms choose high capital-intensive technology. Substitute $k_l^*(\overline{\alpha})$, we obtain $ETR_l = \tau - \frac{1}{\phi}\frac{\overline{\alpha}\eta x(1-\tau)}{(1-\eta)(r+\delta)-(1-(1-\overline{\alpha})\eta)x} < \tau$.

$\overline{\alpha} > \underline{\alpha} \Rightarrow \frac{\overline{\alpha}}{(1-\eta)(r+\delta)-(1-(1-\overline{\alpha})\eta)x} > \frac{\underline{\alpha}}{(1-\eta)(r+\delta)-(1-(1-\underline{\alpha})\eta)x}$

$\Rightarrow \mathbf{E}\left[ETR_l|z \geq z_l^*\right] < \mathbf{E}\left[ETR_l|z < z_l^*\right] < \tau$. $\qquad\square$

2. *Proof.* Let $\tilde{\alpha}$ be the weighted average of $\alpha$ obtained from the regression. The measured MPK is calculated by:

$$\log(\widehat{\mathrm{MPK}}) = \log(y) + \log(\tilde{\alpha}\eta) - \log(k).$$

Because $y$ and $k$ are observable, substitute $y = zk^{*\alpha\eta}n^{*(1-\alpha)\eta}$, the optimal choice of labor $n^*$ and the optimal $k^* = \left(\frac{\alpha\eta}{R}\right)^{\frac{1-(1-\alpha)\eta}{1-\eta}}\left(\frac{(1-\alpha)\eta}{w}\right)^{\frac{(1-\alpha)\eta}{1-\eta}}z^{\frac{1}{1-\eta}}$ where $R = r - \delta$ for non-lobbying firms and $R = r - \delta - x$ for lobbying firms. Then,

$$\log(\widehat{\mathrm{MPK}}) = \log\left(\frac{\tilde{\alpha}}{\alpha}R\right).$$

For $z < z_l^*$ and $z \geq z_{nl}^*$, lobbying firms and non-lobbying firms choose the same capital-intensive technology. Thus, $\Delta\log(\widehat{\mathrm{MPK}}) = \log(\widehat{\mathrm{MPK}}_l) - \log(\widehat{\mathrm{MPK}}_{nl}) = \log(r + \delta - x) - \log(r + \delta) < 0$. For $z_l^* \leq z < z_{nl}^*$, lobbying firms choose high capital-intensive technol-

ogy while non-lobbying firms choose low capital-intensive technology. So, $\Delta \log(\widehat{\text{MPK}}) = \log(\widehat{\text{MPK}}_l) - \log(\widehat{\text{MPK}}_{nl}) = [\log(\underline{\alpha}) - \log(\overline{\alpha})] + [\log(r + \delta - x) - \log(r + \delta)] < 0$. From $\log(\widehat{\text{MPK}}) = \log\left(\frac{\tilde{\alpha}R}{\alpha}\right)$, it can be shown that

$$\mathbf{E}\left[\log(\widehat{\text{MPK}}_{nl})|z < z_{nl}^*\right] = \log\left(\frac{\tilde{\alpha}(r + \delta)}{\underline{\alpha}}\right),$$

$$\mathbf{E}\left[\log(\widehat{\text{MPK}}_{nl})|z \geq z_{nl}^*\right] = \log\left(\frac{\tilde{\alpha}(r + \delta)}{\overline{\alpha}}\right),$$

$$\mathbf{E}\left[\log(\widehat{\text{MPK}}_l)|z < z_l^*\right] = \log\left(\frac{\tilde{\alpha}(r + \delta - x)}{\underline{\alpha}}\right),$$

$$\mathbf{E}\left[\log(\widehat{\text{MPK}}_l)|z \geq z_l^*\right] = \log\left(\frac{\tilde{\alpha}(r + \delta - x)}{\overline{\alpha}}\right).$$

Therefore,

$$\mathbf{E}\left[\log(\widehat{\text{MPK}})_l|z \geq z_l^*\right] < \left\{ \begin{array}{c} \mathbf{E}\left[\log(\widehat{\text{MPK}})_l|z < z_l^*\right] \\ \geqq \\ \lessgtr \\ \mathbf{E}\left[\log(\widehat{\text{MPK}})_{nl}|z \geq z_{nl}^*\right] \end{array} \right\} < \mathbf{E}\left[\log(\widehat{\text{MPK}})_{nl}|z < z_{nl}^*\right].$$

$\square$

## J.3   Proposition 3

1. *Proof.*  Follows directly from Proposition 2. $\square$

2. *Proof.*  For $z_l^* \leq z < z_{nl}^*$, because lobbying firms switch to high capital-intensive technology $\Delta ETR = \left|-\frac{\overline{\alpha}\eta x(1-\tau)/\phi}{(1-\eta)(r+\delta)-(1-(1-\overline{\alpha})\eta)x}\right|$. If lobbying firms did not switch technology, $\Delta ETR = \left|-\frac{\underline{\alpha}\eta x(1-\tau)/\phi}{(1-\eta)(r+\delta)-(1-(1-\underline{\alpha})\eta)x}\right| < \left|-\frac{\overline{\alpha}\eta x(1-\tau)/\phi}{(1-\eta)(r+\delta)-(1-(1-\overline{\alpha})\eta)x}\right|$. Similarly,

$$\begin{aligned} \Delta \log(\widehat{\text{MPK}}) &= |[\log(\underline{\alpha}) - \log(\overline{\alpha})] + [\log(r + \delta - x) - \log(r + \delta)]| \\ &< |\log(r + \delta - x) - \log(r + \delta)|, \end{aligned}$$

if lobbying firms did not switch to high capital-intensive technology. $\square$