Lobbying, Trade, and Misallocation^{*}

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Abstract

This paper studies the impact of lobbying on resource misallocation. I develop a model of heterogeneous firms that can lobby to decrease their output tax/distortion. This lobbying effort can either magnify or mitigate a pre-lobbying level of misallocation depending on whether the more productive firms are initially more distorted. If the more productive firms are burdened by higher pre-lobbying exogenous distortions, they can lobby to overcome these distortions, which increases aggregate total factor productivity (TFP). The TFP influences of lobbying can be affected by international trade as exporters increase their lobbying expenditures due to complementarities between market size and gains from a lower tax post-lobbying. I estimate the model by reducedform instrumental variables techniques and structurally using firm-level data. I find that lobbying can increase US TFP by 4-7% compared to a counterfactual economy with the same pattern of pre-lobbying distortions, but where lobbying is not allowed.

Keywords: lobbying, misallocation, international trade *JEL Codes:* D24, D72, F14

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1 Introduction

The economic consequences of firms' political engagement have received much attention in both politics and academic research. An abundance of evidence shows that politically active firms spend large sums of money to influence the policy-making process (Roosevelt, 1910; Drutman, 2015; Zingales, 2017).¹ According to the data collected in compliance with the Lobbying Disclosure Act (1995), which requires lobbyists to report lobbying expenditures to the US Congress, firms spent \$3.51 billion on lobbying alone in 2019. Larger firms spend more on lobbying, a phenomenon that is even more pronounced with the advent of superstar firms brought on by globalization. However, it is still an open question how much lobbying affects the overall resource allocation in an economy.

This paper examines the effects of corporate lobbying on aggregate total factor productivity (TFP). It is commonly believed that lobbying decreases the aggregate TFP of an economy because resources are allocated on the basis of a firm's political connections rather than its productivity. If there are no other distortions, what is trivially true. Contrary to this conventional wisdom, I argue that when an economy is subject to pre-lobbying distortions, it is possible for lobbying to improve aggregate TFP.² By quantifying the impact of lobbying on the US aggregate TFP, I show that indeed lobbying raises aggregate TFP in the US.

I begin by setting up an open-economy heterogeneous firm model (Melitz, 2003) with misallocation manifested in firm-specific taxes/distortions (Hsieh and Klenow, 2009). Firms decide whether to pay a fixed cost to lobby the policymaker and how much to spend on lobbying to reduce its firm-specific distortion. Because of the fixed cost, not all firms lobby, and larger firms are more likely to engage in lobbying activity. I first show analytically that whether lobbying increases or decreases aggregate TFP depends on the pre-lobbying distribution of exogenous taxes/distortions across firms. The intuition for this result is that if the firms that lobby in the equilibrium face relatively higher pre-lobbying distortions, lobbying reduces those distorted, lobbying can improve TFP because these more productive firms are more distorted, lobbying distortions, leading to improvements in the resource allocation in an economy.³

¹The debate over the influence of special interests on the US politics has a long history. In a speech given in Kansas in 1910, Theodore Roosevelt, the 26th president of the US, said that "... Exactly as the special interests of cotton and slavery threatened our political integrity before the Civil War, so now the great special business interests too often control and corrupt the men and methods of government for their own profit. We must drive the special interests out of politics..." (Roosevelt, 1910).

²The impact of lobbying on resource allocation has been studied in the previous literature. Lobbying may decrease TFP if special interests provide pecuniary benefits to policymakers in exchange for favorable policies (Krueger, 1974; Grossman and Helpman, 1994). However, lobbying can improve resource allocation by transmitting information to policymakers when the policymakers cannot observe the true state of the economy due to information frictions (Milgrom and Roberts, 1986). Grossman and Helpman (2001) summarize the literature.

³Size-dependent policies are one example of policies that make the more productive firms more distorted (Guner et al., 2008; Garicano et al., 2016).

The model implies that the key to quantifying the net impact of lobbying on aggregate TFP is the covariance between firm productivity and exogenous wedges driven by pre-lobbying exogenous distortions. Whether the more productive firms are subject to higher pre-lobbying distortions depends on the sign of this covariance. While I do not observe the covariance between firm productivity and exogenous wedges, the theoretical framework provides guidance on which objects observable in the data can be used to identify this covariance. Because of the complementarity between firm size and gains from a lower tax post-lobbying, lobbying expenditures increase in both productivity and exogenous wedges. Using these monotonic relationships, I show that the covariance between firm productivity and exogenous wedges, which can be computed from the data. In the simpler environment, I formally show that there is a one-to-one relationship between firm lobbying expenditures and exogenous wedges.

I combine Compustat balance sheet data and firm lobbying expenditures disclosed publicly since the Lobbying Disclosure Act (1995). I estimate the parameters of the model using the instrumental variable (IV) approach and the method of moments. To estimate the parameter that governs how effectively lobbying decreases firm-specific distortions, I regress firm-specific distortions on lobbying expenditures instrumented by the state-level time-varying appointment of a Congress member as chairperson of the Appropriations Committees of House and Senate. The IV estimates imply that a 1% increase in lobbying expenditures lowers the output distortions by 0.09-0.1%. The covariance between productivity and exogenous wedges is identified by targeting the identifying moment. I calibrate the remaining parameters by matching the moments from the model to their data counterparts. Using the estimated parameters, I find that the more productive firms tend to face higher pre-lobbying distortions in the US.

To quantify the impact of lobbying on the aggregate TFP of the US, I compare the baseline US economy, where lobbying is allowed, to a counterfactual economy with the same level of pre-lobbying distortions, but where lobbying is not allowed. If lobbying were not allowed, the TFP of the US economy would be 4-7% lower.

The TFP influences of lobbying can be affected by international trade through market size effects. Because of the complementarity between market size and gains from a lower tax post-lobbying, trade opening causes non-exporters to decrease but exporters to increase lobbying expenditures. This prediction is supported by reduced-form empirical findings using the China shock (Autor et al., 2013). I find that a one standard deviation increase in the China shock led to a divergence of about 0.4 standard deviations in lobbying expenditures between firms at 25th and the 75th percentile of the size distribution. Quantitatively, I find that when opening to trade, the positive TFP gains from lobbying decrease by 0.1% compared to autarky. This is because the increased market size induced by trade causes exporters to spend more on lobbying than in autarky, reallocating to these lobbying exporters. This increased concentration of resources among exporters decreases the positive TFP gains from lobbying.

Related Literature. This paper contributes to the literature on firm-level resource misallocation pioneered by Hsieh and Klenow (2009) and Restuccia and Rogerson (2008). While many papers have examined specific factors behind resource misallocation, this paper specifically examines lobbying as a source of resource misallocation.⁴ My work is most closely related to Arayavechkit et al. (2017) and Huneeus and Kim (2018) which also models to quantify the impact of lobbying on resource misallocation. In contrast to their work, I analytically characterize the conditions under which lobbying increases aggregate TFP as the second-best under firm-specific pre-lobbying distortions and consider the implications of lobbying in an open economy.

I also contribute to the empirical literature on corporate lobbying, including Bombardini and Trebbi (2011), Igan et al. (2012), Blanes i Vidal et al. (2012), Bertrand et al. (2014), Kerr et al. (2014), and Bertrand et al. (2020).⁵ While these papers have empirically studied lobbying in the US, the quantitative implications of lobbying have been less studied. Using a novel instrumental variable approach, at the micro-level, I find large private returns to lobbying in line with the literature (Richter et al., 2009; Kang, 2016; Kim, 2017). At the macro-level, however, I find that lobbying can increase the aggregate TFP of the US. This result emphasizes the importance of understanding the general equilibrium effects of lobbying. This paper is also related to research on firm lobbying in the trade literature, including Grossman and Helpman (1994), Goldberg and Maggi (1999), Gawande and Bandyopadhyay (2000), Bombardini (2008), Bombardini and Trebbi (2012), Gawande et al. (2012), Kim (2017), and Blanga-Gubbay et al. (2020). I provide a novel empirical finding that market size changes induced by international trade lead to divergence in the lobbying practices of small- and large-sized firms.

Finally, this paper contributes to the literature that studies the impact of trade on distorted economies. Domestic distortions such as institutions, contracting frictions, and imperfect competition can affect gains from trade.⁶ Unlike previous studies, this paper studies lobbying as a source of distortions and examines the joint implications of lobbying and international trade. While Berthou et al. (2018), Costa-Scottini (2018), Bai et al. (2019), and Chung (2019) examine gains from trade in the presence of firm-specific exogenous distortions, I treat distortions as an endogenous outcome of lobbying.

⁴Examples in the literature are Buera et al. (2011), Midrigan and Xu (2014), Moll (2014), and Gopinath et al. (2017) for financial frictions; Fajgelbaum et al. (2019) for tax; Edmond et al. (2015) for a firm's market power; Guner et al. (2008), Lafontaine and Sivadasan (2009), Petrin and Sivadasan (2013), and Garicano et al. (2016) for labor regulation. ⁵Bombardini and Trebbi (2020) provides an insightful review of the recent literature.

⁶Important contributions include Levchenko (2007), Nunn (2007), Do and Levchenko (2009), Levchenko (2013) on institutions; Khandelwal et al. (2013) on state-owned enterprises; Edmond et al. (2015) on imperfect competition; Manova (2013) on financial friction.

The remainder of this paper proceeds as follows. Section 2 outlines the quantitative model and derives the conditions under which lobbying can increase aggregate TFP. Section 3 discusses how the key parameters of the model are identified and quantitatively assesses the effects of lobbying on TFP and welfare. Section 4 presents empirical evidence on the effects of import exposure on firm lobbying behaviors and quantifies the impact of international trade on the level of misallocation through lobbying. Section 5 concludes the paper.

2 Theoretical Framework

I construct a general equilibrium heterogeneous firm model with lobbying. There are two potentially asymmetric countries, Home and Foreign, indexed by c = H, F. Country c is populated by L_c identical households, which supply a unit of labor inelastically and earn wage w_c . A representative consumer in country c chooses the amount of final goods consumption C_c to maximize utility subject to their budget constraint.

Final Goods Producers. A final good Q_c is produced by a representative final goods producer under perfect competition. A final goods producer combines intermediate varieties available in the country through a constant elasticity of substitution (CES) aggregator:

$$Q_c = \left[\int_{\omega\in\Omega_c\cup\Omega_c^x} q(\omega)^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}},$$

where each variety is denoted as ω , σ is the elasticity of substitution, and q is the quantity demanded of each variety. Ω_c and Ω_c^x are the sets of domestic and foreign varieties available in country c, which are endogenously determined in the equilibrium. The ideal price index is

$$P_c = \left[\int_{\omega \in \Omega_c} p(\omega)^{1-\sigma} + \int_{\omega \in \Omega_c^x} p^x(\omega)^{1-\sigma} \right]^{\frac{1}{1-\sigma}},$$

where p and p^x are prices charged by domestic and foreign intermediate goods producers.

Intermediate Goods Producers and Lobbying. There is a fixed mass of monopolistically competitive intermediate goods producers M_c in country c. Labor is the only factor of input for production. The production function for each variety is

$$y(\omega) = \phi(\omega)l(\omega),$$

where y is output produced, ϕ is productivity, and l is the labor input. The production of each variety requires fixed production costs f_c in units of labor, so the total labor used for production is $y/\phi + f_c$. Intermediate goods producers can export after incurring fixed export costs f_c^x in units

of domestic labor (Melitz, 2003). They also incur iceberg trade costs $\tau_x \ge 1$ when exporting, so delivering one unit of an intermediate good to a foreign country requires τ_x units. Iceberg trade costs are symmetric across countries.

Intermediate goods producers are subject to domestic output distortions τ^Y . These output distortions are interpreted as taxes in the model, so τ^Y is the firm-specific tax rate.⁷ Output distortions decrease in lobbying amounts. Thus, if a producer increases its lobbying amounts, it will be taxed less or subsidized more proportionately to its revenues. I assume that output wedges induced by output distortions have the following functional form:



where b is lobbying amounts chosen by an intermediate goods producer and $1 - \bar{\tau}^Y$ is an exogenous wedge drawn from a given distribution. $1 - \tau^Y$ is composed of an exogenous and an endogenous wedge. The exogenous wedge $1 - \bar{\tau}^Y$ á la Hsieh and Klenow (2009) captures distortions not related to lobbying. Firms take $1 - \bar{\tau}^Y$ as given and make a lobbying decision. The endogenous wedge $(1 + b)^{\theta}$ where b is in the units of domestic final goods is the results of lobbying. θ is one of the key parameters of the model. It captures how effectively lobbying decreases output distortions (or increases output wedges).⁸ With higher values of θ , the same amount of lobbying can decrease the output distortion more. On the other hand, when $\theta = 0$, lobbying cannot affect the output distortion, so no firms participate in lobbying.

Firms incur fixed costs $f^b\eta$ to participate in lobbying, which is also in the units of domestic final goods.⁹ Because of stochastic η , each firm has a different level of fixed lobbying costs.¹⁰ A higher η indicates that firms have to pay higher fixed costs to participate in lobbying. Once a firm decides to participate in lobbying, the total lobbying cost is the sum of the variable and the fixed lobbying costs:

$$P_c(b+f^b\eta).$$

Aggregate lobbying expenditure is redistributed to domestic consumers through lump-sum trans-

⁷If $\tau^{Y} < 0$, firms are subsidized and if $\tau^{Y} > 0$, firms are taxed.

 $^{^{8}\}theta$ may reflect quality of institutions or political system. For example, θ will be higher in countries where corruption is prevalent.

⁹The fixed lobbying cost rationalizes the pattern in the firm-level data that only a fraction of firms (13.7% on average) participate in lobbying, which is well documented in Kerr et al. (2014).

¹⁰The stochastic component of the fixed lobbying cost η rationalizes the pattern in the data that some small-sized firms exhibit sizable lobbying expenditure. Although firm size and lobbying expenditures are highly correlated, firm size alone cannot fully explain lobbying behavior. Without η , firm size and lobbying expenditures are perfectly correlated. The relationship between size and lobbying expenditure is documented in greater detail in Online Appendix Section C. For example, a firm may have lower fixed lobbying costs (low η) if the CEO is well-connected with local politicians or a firm is located near K Street in Washington DC.

fers.¹¹ I impose restrictions on θ and σ as follows:¹²

Assumption 1. θ and σ satisfy (i) $0 < 1 - \theta \sigma < 1$, and (ii) $\sigma > 1$.

Intermediate goods producers are heterogeneous along three dimensions: productivity ϕ , exogenous wedges $1 - \bar{\tau}^Y$, and stochastic fixed lobbying costs η . The firm-specific vector of shocks $(\phi, 1 - \bar{\tau}^Y, \eta)$ is drawn from a joint distribution $F_c(\phi, 1 - \bar{\tau}^Y, \eta)$ with an arbitrary correlation structure. Each draw is independent across firms.

An intermediate goods producer takes the demand function in domestic and foreign markets as given and maximizes its profits. An intermediate goods producer solves the following maximization problem:

$$\pi = \max_{b,p,p^x,q,q^x,x} (1 - \bar{\tau}^Y)(1 + b)^{\theta} pq - \frac{w_c}{\phi} q - wf_c + x \left\{ (1 - \bar{\tau}^Y)(1 + b)^{\theta} p^x q^x - \frac{w_c}{\phi} q^x - wf_c^x \right\} - P_c b - P_c f^b \eta [b > 0],$$

subject to $q = p^{-\sigma} P_c^{\sigma-1} E_c, \quad q^x = (p^x)^{-\sigma} P_{c'}^{\sigma-1} E_{c'}, \quad x \in \{0,1\}, \quad (2.1)$

where E_c is the total expenditure of country c, x is a binary export decision, p^x is the export price, and q^x is the export quantity.

Equilibrium. The government budget is balanced and the total amount of tax revenue is transferred to consumers in lump-sum:

$$T_{c} = \int_{\omega \in \Omega_{c}^{L}} \left(1 - (1 - \bar{\tau}^{Y}(\omega))(1 + b(\omega))^{\theta} \right) \left(p(\omega)q(\omega) + x(\omega)p^{x}(\omega)q^{x}(\omega) \right) d\omega + \int_{\omega \notin \Omega_{c}^{L}} \bar{\tau}^{Y}(\omega) \left(p(\omega)q(\omega) + x(\omega)p^{x}(\omega)q^{x}(\omega) \right) d\omega + P_{c} \int_{\omega \in \Omega^{L}} \left(b(\omega) + f^{b}\eta(\omega) \right) d\omega, \quad (2.2)$$

where Ω_c^L is country c's set of intermediate goods producers participating in lobbying. The first two terms on the right-hand side are the tax revenues from lobbying and non-lobbying firms respectively. The last term is the total lobbying expenditure of lobbying firms.

¹¹This is consistent with the current lobbying market of the US, in which firms hire lobbyists to influence the policymaking process and lobbyists use their earnings to consume goods. Assuming that aggregate lobbying expenditure is redistributed back to domestic consumers, I implicitly assume that there are no resources wasted in the lobbying process. If parts of the lobbying expenditures are pure waste, there would be a larger welfare loss. For example, Esteban and Ray (2006) considers lobbying a costly signal.

¹²The parametric restrictions guarantee that firms do not spend infinite amounts on lobbying. If $1 - \theta \sigma \ge 1$, the output distortions decrease too quickly with an increase in lobbying amounts *b*. Technically, this is the second-order condition of a firm's maximization problem. The assumption is also empirically supported from the estimate of θ in Section 3.3. With the estimate of θ around 0.09-0.11, the assumption is satisfied with the commonly used values for the elasticity of substitution in the literature.

Goods market-clearing implies that

$$P_c Q_c = E_c = w_c L_c + \Pi_c + T_c$$

where Π_c is the dividend income from households' portfolio. Each household only owns a portfolio of domestic firms, so Π_c is equal to the aggregate profits of domestic firms. Labor market clearing is $L_c = \int_{\omega \in \Omega_c} (l(\omega) + f_c + x(\omega)f_c^x)d\omega$ and balanced trade implies that $\int_{\omega \in \Omega_c^x} p^x(\omega)q^x(\omega)d\omega = \int_{\omega \in \Omega_c^x} p^x(\omega)q^x(\omega)d\omega$.

An equilibrium is formally defined as

Definition 1. An equilibrium of the economy is defined as (a) a list of wages $\{w_c\}_{c\in\{H,F\}}$, (b) functions $\{p(\omega), p^x(\omega), q(\omega), q^x(\omega), x(\omega), l(\omega), b(\omega), \tau^y(\omega)\}_{\omega\in\Omega_c, c\in\{H,F\}}$, (c) aggregate price indices $\{P_c\}_{c\in\{H,F\}}$, and (d) lump-sum government transfers $\{T_c\}_{c\in\{H,F\}}$ such that (i) a representative household maximizes utility subject to its budget constraint; (ii) firms maximize profits; (iii) the labor market clearing conditions are satisfied; (iv) the goods market clearing conditions are satisfied; (v) the goods market clearing conditions are satisfied; (v) trade is balanced in both countries.

Equilibrium Properties. The model nests the two standard models in the literature, Melitz (2003) and Hsieh and Klenow (2009). As $\theta \to 0$ and $Var(1 - \bar{\tau}^Y) \to 0$, the model becomes the Melitz model without any firm-specific distortions. If $\theta \to 0$ (or $f^b \to \infty$), in which no firms lobby at all, the model becomes the two-country open economy version of the Hsieh and Klenow (HK) model with exogenous wedges.

I first consider profits conditional on not lobbying. Firms charge constant mark-up $\mu = \sigma/(\sigma - 1)$ over their marginal costs and choose to export if profits in the foreign market are sufficiently large to cover the fixed export costs. Profits conditional on not lobbying are expressed as

$$\pi(0;\phi,\bar{\tau}^{Y},\eta) = \max_{x \in \{0,1\}} \bigg\{ \pi^{d}(0;\phi,\bar{\tau}^{Y},\eta) + x\pi^{x}(0;\phi,\bar{\tau}^{Y},\eta) \bigg\},\$$

where $\pi^d(0; \phi, \bar{\tau}^Y, \eta)$ are profits conditional on not lobbying in the domestic market:

$$\pi^{d}(0;\phi,\bar{\tau}^{Y},\eta) = \underbrace{\frac{1}{\sigma} \left(\mu \frac{w_{c}}{\phi}\right)^{1-\sigma} (1-\bar{\tau}^{Y})^{\sigma} P_{c}^{\sigma-1} E_{c}}_{=\tilde{\pi}^{d}(0;\phi,\bar{\tau}^{Y},\eta)} - w_{c} f_{c},$$

and $\pi^x(0;\phi,\bar{\tau}^Y,\eta)$ are profits conditional on not lobbying in the foreign market:

$$\pi^{x}(0;\phi,\bar{\tau}^{Y},\eta) = \underbrace{\frac{1}{\sigma} \left(\mu \frac{\tau_{x} w_{c}}{\phi} \right)^{1-\sigma} (1-\bar{\tau}^{Y})^{\sigma} P_{c'}^{\sigma-1} E_{c'}}_{=\tilde{\pi}^{x}(0;\phi,\bar{\tau}^{Y},\eta)} - w_{c} f_{c}^{x}.$$

 $\tilde{\pi}_c^d(0; \phi, \bar{\tau}^Y, \eta)$ and $\tilde{\pi}^x(0; \phi, \bar{\tau}^Y, \eta)$ are the variable profits conditional on not lobbying in domestic and foreign markets.

Once a firm decides to participate in lobbying, the optimal lobbying expenditure is characterized by a firm's first-order condition with respect to b. The optimal lobbying amounts for non-exporters and exporters can be written in terms of variable profits conditional on not lobbying, aggregate variables, and model parameters. The optimal lobbying amounts for non-exporters and exporters, b^{d*} and b^{x*} , are expressed as

$$b^{d*} = C_c^1 \tilde{\pi}^d (0; \phi, \bar{\tau}^Y, \eta)^{\frac{1}{1-\theta\sigma}} - 1, \qquad C_c^1 = \left(\frac{\theta\sigma}{P_c}\right)^{\frac{1}{1-\theta\sigma}},$$
(2.3)

and

$$b^{x*} = C_c^1 \{ \tilde{\pi}^d(0; \phi, \bar{\tau}^Y, \eta) + \tilde{\pi}^x(0; \phi, \bar{\tau}^Y, \eta) \}^{\frac{1}{1 - \theta\sigma}} - 1.$$
(2.4)

Substituting Equation (2.3) into Equation (2.1), profits conditional on lobbying for non-exporters are expressed as

$$\pi^{d}(b^{d*};\phi,\bar{\tau}^{Y},\eta) = C_{c}^{2}\tilde{\pi}^{d}(0;\phi,\bar{\tau}^{Y},\eta)^{\frac{1}{1-\theta\sigma}} - w_{c}f_{c} - P_{c}[f^{b}\eta - 1], \qquad C_{c}^{2} = (C_{c}^{1})^{\theta\sigma} - C_{c}^{1}$$
(2.5)

and profits conditional on lobbying for exporters are expressed as

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$$\pi^{x}(b^{x*};\phi,\bar{\tau}^{Y},\eta) = C_{c}^{2}\{\tilde{\pi}^{d}(0;\phi,\bar{\tau}^{Y},\eta) + \tilde{\pi}^{x}(0;\phi,\bar{\tau}^{Y},\eta)\}^{\frac{1}{1-\theta\sigma}} - w_{c}f_{c} - w_{c}f_{c}^{x} - P_{c}[f^{b}\eta - 1].$$
(2.6)

The benefits of lobbying are higher revenues due to lower firm-specific distortions. Because lobbying exponentiates the variable profits conditional on not lobbying to the power of $1/(1 - \theta \sigma)$, firms with higher ϕ or higher $1 - \overline{\tau}^Y$ get larger benefits from lobbying.

Lobbying and export decisions are jointly determined. Because of lobbying, firm export decisions are not independent across markets. With lobbying and export decisions, a firm has four possible options and compares the total profits of each option.¹³ A firm's final profit is determined as the maximum of the four options:

$$\begin{aligned} \pi(\phi, \bar{\tau}^{Y}, \eta) &= \max \bigg\{ \pi^{d}(0; \phi, \bar{\tau}^{Y}, \eta), \pi^{d}(0; \phi, \bar{\tau}^{Y}, \eta) + \pi^{x}(0; \phi, \bar{\tau}^{Y}, \eta), \\ \pi^{d}(b^{d*}; \phi, \bar{\tau}^{Y}, \eta), \pi^{x}(b^{x*}; \phi, \bar{\tau}^{Y}, \eta) \bigg\}, \end{aligned}$$

where the terms inside the bracket are non-lobbying non-exporters' profits, non-lobbying exporters' profits, lobbying non-exporters' profits, and lobbying exporters' profits respectively.

¹³For example, firms with low productivity (low ϕ) and low fixed lobbying costs (low η) may exist that are not productive enough to be exporters without lobbying, but can be profitable in exporting after lobbying.

With the fixed lobbying costs, lobbying decisions are characterized by a cutoff productivity. The unique cutoff productivity $\bar{\phi}_c^b(\bar{\tau}^Y, \eta)$ is determined by

$$\max\left\{\pi^{d}(0;\bar{\phi}_{c}^{b}(\bar{\tau}^{Y},\eta),\bar{\tau}^{Y},\eta),\pi^{d}(0;\bar{\phi}_{c}^{b}(\bar{\tau}^{Y},\eta),\bar{\tau}^{Y},\eta)+\pi^{x}(0;\bar{\phi}_{c}^{b}(\bar{\tau}^{Y},\eta),\bar{\tau}^{Y},\eta)\right\}$$
$$=\max\left\{\pi^{d}(b^{d*};\bar{\phi}_{c}^{b}(\bar{\tau}^{Y},\eta),\bar{\tau}^{Y},\eta),\pi^{x}(b^{x*};\bar{\phi}_{c}^{b}(\bar{\tau}^{Y},\eta),\bar{\tau}^{Y},\eta)\right\},\quad(2.7)$$

where the left-hand side is the maximum profit conditional on not lobbying and the right-hand side is the maximum profit conditional on lobbying. Only firms with productivity above $\bar{\phi}_c^b(\bar{\tau}^Y,\eta)$ participate in lobbying. The cutoff increases in both $\bar{\tau}^Y$ and η .

Similarly, the fixed export costs characterize the unique export cutoff productivity $\bar{\phi}_c^x(\bar{\tau}^Y,\eta)$:

$$\max\left\{\pi^{d}(0;\bar{\phi}_{c}^{x}(\bar{\tau}^{Y},\eta),\bar{\tau}^{Y},\eta) + \pi^{x}(0;\bar{\phi}_{c}^{x}(\bar{\tau}^{Y},\eta),\bar{\tau}^{Y},\eta),\pi^{x}(b^{x*};\bar{\phi}_{c}^{x}(\bar{\tau}^{Y},\eta),\bar{\tau}^{Y},\eta)\right\}$$
$$= \max\left\{\pi^{d}(0;\bar{\phi}_{c}^{x}(\bar{\tau}^{Y},\eta),\bar{\tau}^{Y},\eta),\pi^{d}(b^{d*};\bar{\phi}_{c}^{x}(\bar{\tau}^{Y},\eta),\bar{\tau}^{Y},\eta)\right\}, \quad (2.8)$$

where the left-hand side is the maximum profit conditional on exporting and the right-hand side is the maximum profit conditional on not exporting.

Proposition 1. Given Assumption 1,

(i) A firm's optimal lobbying amounts and profits conditional on lobbying, characterized by Equations (2.3), (2.4), (2.5) and (2.6), increase in productivity ϕ , decrease in exogenous distortions $\bar{\tau}^Y$ (or increase in $1 - \bar{\tau}^Y$), and increase in market size $P_c^{\sigma-1}E_c + xP_{c'}^{\sigma-1}E_{c'}$;

and (ii) there exists a unique cutoff productivity of lobbying $\bar{\phi}_c^b(\bar{\tau}^Y,\eta)$, determined by Equation (2.7), which increases in exogenous distortions $\bar{\tau}^Y$ (or decreases in $1 - \bar{\tau}^Y$) and increases in stochastic fixed lobbying costs η .

Proposition 1 states that higher productivity, lower exogenous distortions, or larger market size are complementary to lobbying. Firms with higher productivity or lower exogenous distortions spend more on lobbying and are more likely to participate in lobbying. In addition, a larger market size increases the firms' overall level of lobbying.

2.1 Analytical Results: Aggregate TFP

To develop an intuition for the mechanism behind the possible TFP-improving effect of lobbying, I analytically characterize the effects of lobbying on aggregate TFP in a simpler environment. TFP is defined as the output per worker. To obtain the analytical results, I consider a closed economy in which the fixed lobbying and production costs are zero, so every firm participates in lobbying and

production in this environment. The fixed mass of firm M is normalized to be 1. I also assume that $(\phi, 1 - \overline{\tau}^Y)$ follows a joint log-normal distribution.

Assumption 2. (i) $(\phi, 1 - \overline{\tau}^Y)$ follows a joint log-normal distribution, (ii) $f_c = 0$, (iii) $f^b = 0$, (iv) M = 1, and (v) $\tau_x = \infty$.

I compare the three economies. In the first economy, there are no distortions and lobbying is not allowed (Melitz, 2003). In this economy, resources are allocated based on firm productivity, yielding the most efficient outcome. In the second economy, the exogenous distortions are introduced (Hsieh and Klenow, 2009). In this economy, resources are allocated based on both productivity and exogenous distortions. In the third economy, firms can lobby to decrease their output distortions, so overall distortions are endogenously determined by exogenous distortions and firm lobbying decisions. The aggregate TFPs of each economy are derived in the following proposition.

Proposition 2. Under Assumptions 1 and 2,
(i) the aggregate TFP of the efficient economy, TFP_{eff}, is

$$\log(TFP_{eff}) = \mathbb{E}[\log\phi] + \frac{(\sigma-1)}{2} Var(\log\phi), \qquad (2.9)$$

(ii) the aggregate TFP of the exogenous wedge economy, TFP_{exo} , is

$$\log(TFP_{exo}) = \mathbb{E}[\log\phi] + \frac{(\sigma-1)}{2} Var(\log\phi) - \frac{\sigma}{2} Var(\log(1-\bar{\tau}^Y)), \qquad (2.10)$$

and (iii) the aggregate TFP of the lobbying economy, TFP_{endo} , is

$$\log(TFP_{endo}) = \mathbb{E}[\log \phi] + \underbrace{\left(\frac{(\sigma[(1-\theta)^2 - 1] + 1)}{(1-\theta\sigma)^2}\right)}_{Concentration \ effect}} \times \frac{(\sigma - 1)}{2} Var(\log \phi)$$

$$- \underbrace{\frac{1}{(1-\theta\sigma)^2}}_{\substack{>1\\Amplification\\effect}} \times \frac{\sigma}{2} Var(\log(1-\bar{\tau}^Y)) - \underbrace{\frac{(\sigma - 1)\sigma\theta}{(1-\theta\sigma)^2}}_{Covariance}}_{effect} \times Cov(\log \phi, \log(1-\bar{\tau}^Y)). \quad (2.11)$$

The TFP of the efficient economy (Equation (2.9)) increases in the average productivity $\mathbb{E}[log\phi]$ and the variance of productivity $Var(\log \phi)$. The effect of variance of productivity increases in the elasticity of substitution. With a higher variance of productivity, firms with higher productivity are more likely to operate in the economy and provide their goods at a lower price, and as σ becomes larger, the final goods producer is more likely to substitute for a variety at a lower price, increasing the positive effects of the variance of productivity.

When compared to the efficient economy, in the exogenous wedge economy, the variance of the exogenous wedges $Var(\log(1-\bar{\tau}^Y))$ appears as a new term in the TFP (Equation (2.10)). As the dispersion of exogenous wedges becomes larger, resources are more likely to be allocated to firms with low productivity but with high $1-\bar{\tau}^Y$. Therefore, TFP decreases in the variance of the dispersion of the wedge. A higher elasticity of substitution amplifies the negative effect of the variance of the wedges because a final goods producer is more likely to substitute for a lower-priced variety charged by a firm with higher $1-\bar{\tau}^Y$. The covariance between $\log \phi$ and $\log(1-\bar{\tau}^Y)$ does not enter the expression, which is an artifact of the joint log-normality assumption.¹⁴

When compared to the TFP of the exogenous wedge economy, the three new terms are introduced in the TFP of the lobbying economy (Equation (2.11)), which I label concentration, amplification, and covariance effects. The concentration effect implies that lobbying diminishes the positive effects of the productivity variance. This is because firms with higher productivity lobby more, distorting resource allocation. Similarly, because firms with higher $1 - \bar{\tau}^Y$ also lobby more, lobbying amplifies the negative effect of the variance of the exogenous wedges, captured by the amplification effect.

The covariance effect has the most important TFP implications in the second-best world. Depending on the sign of the covariance effect, lobbying can improve TFP over the exogenous wedge economy. If the more productive firms are initially subject to higher exogenous distortions $\bar{\tau}^Y$, which is captured by the negative covariance, they can lobby to decrease the initial distortions. To examine the implications of the covariance effect, I summarize the relationships between the TFPs of the three different economies using the following proposition.

Proposition 3. Under Assumptions 1 and 2, (i) As $\theta \to 0$, $TFP_{endo} \to TFP_{exo}$ and as $Var(\log(1 - \bar{\tau}^Y)) \to 0$, $TFP_{exo} \to TFP_{eff}$; (ii) $TFP_{eff} \ge TFP_{endo}$ and $TFP_{eff} \ge TFP_{exo}$; and (iii) lobbying can increase TFP, that is, $TFP_{exo} < TFP_{endo}$ under certain conditions. The necessary condition is $Cov(\log \phi, \log(1 - \bar{\tau}^Y)) < 0$.

Lobbying always decreases TFP when compared to the efficient economy (Proposition 3(ii)). However, TFP can increase over the exogenous wedge economy under certain conditions through the covariance effect (Proposition 3(iii)). The necessary condition is $Cov(\log \phi, \log(1 - \bar{\tau}^Y)) < 0$, the condition under which the more productive firms are subject to a higher pre-lobbying exogenous

¹⁴Hopenhayn (2014) discusses the impact of the correlation between productivity and distortions on the aggregate TFP. A marginal increase in correlation decreases TFP. However, as the TFP level gets lower, there is overall less demand for labor. This frees up employment, and they are reallocated across all firms in proportion to their marginal product of labor in general equilibrium. Under the joint log-normality assumption, these two effects exactly offset each other.

distortion. With negative covariance, the more productive firms can overcome a higher pre-lobbying distortion through lobbying, which can increases aggregate TFP. However, if the covariance effect takes positive values because lobbying allocates resources excessively toward large lobbying firms, lobbying always amplifies the initial level of resource misallocation. Since the net effect depends on the sign and magnitude of $Cov(\log \phi, \log(1 - \bar{\tau}^Y))$, the measurement of this covariance will be the key to the quantification below.

Trade can affect aggregate TFP through lobbying, although the direction is ambiguous. Suppose the more productive firms are subject to higher pre-lobbying distortions, and there is a decrease in trade costs. An increase in market size induced by trade can increase TFP through the covariance effect by inducing more productive exporters to lobby more. However, other directions are also possible. Because only exporters are better off from increased market size, lobbying expenses can be more unequally concentrated among a few big exporters, making the concentration and amplification effects dominate the covariance effect. Section 4 considers the impact of globalization on lobbying and TFP in detail.

3 Quantification

This section quantitatively assesses the impact of lobbying. I discuss how $Cov(\log \phi, \log(1-\bar{\tau}^Y))$, the key condition for the welfare implications of lobbying, can be identified from the observable moments in the data. Using an instrumental variable (IV) strategy based on the institutional details of US political system, I structurally estimate θ , which governs the elasticity of output taxes with respect to lobbying expenditure. The remaining parameters are calibrated to the firm-level data and other data sources using the method of moments, allowing for heterogeneity in productivity, exogenous wedges, and fixed lobbying costs.¹⁵ I then evaluate the TFP and welfare implications of lobbying under different scenarios.

3.1 Data

I combine firm balance sheet data with lobbying, trade, and sector-level databases. I match firm-level balance sheet data to the lobbying database based on firm name, and then the firm-level data are matched to the trade and sector-level data according to firm industry affiliation.

Lobbying and Firm-Level Data. I construct the main firm-level database by merging the lobbying data obtained from the Center for Responsive Politics (CRP) with Compustat, which covers

¹⁵I choose the model with a fixed mass of firms as the baseline for two reasons. First, Compustat only covers big firms in the US. The free entry assumption is inconsistent with this feature of the data. Second, although the entry effect of lobbying is also an interesting issue, the main focus of this paper is the effect of lobbying given the firm-specific exogenous distortions across firms. I also show that my quantitative results are robust under the free entry assumption, which is reported in Panel B of Table 5.

Sales (\$1M) (1)	Lobbying Amounts (\$1K) (2)	$1[Lobby_{it} > 0]$ (3)	$1[Lobby_{it} > 0] \\ \neq 1[Lobby_{i,t-1} > 0] \\ (4)$
$1980.4 \\ (11055.7)$	188.1 (1387.5)	$0.137 \\ (0.344)$	$0.080 \\ (0.271)$

TABLE 1: Descriptive Statistics

Notes. This table provides descriptive statistics of the main data set. There are 39,692 firm-year level observations with unique 4989 firms. Standard deviations are reported in parentheses. The sample period is 1998-2015.

public firms listed on the North American stock markets. The sample period is from 1998 to 2015. The lobbying data became publicly disclosed since 1998 after the Lobbying Disclosure Act (LDA) (1995). LDA requires active registered lobbyists to file activity reports each quarter. Each report contains various information on firm lobbying practices, such as lobbying expenditures, issue areas, and a brief description of lobbying activities. I restrict my sample to the manufacturing sectors.

Descriptive statistics of the raw data are presented in Table 1. Columns (1) and (2) report the average sales and average lobbying expenditures. In column (3), about 13% of firm-year level observations have spent positive amounts on lobbying. Column (4) reports the percentage of extensive margin changes. Only about 8% of the total observations changed the lobbying status during the sample period, indicating that lobbying status is persistent.¹⁶

Industry and Trade Data. Bilateral trade data are extracted from the UN Comtrade at the 6-digit HS product level. I convert 6-digit HS codes into 4-digit SIC codes using Pierce and Schott's (2012) concordance. Following Autor et al. (2013), I aggregate at a slightly higher level so that each industry code is matched with at least one six-digit HS code. Industry data comes from the NBER-CES Manufacturing Industry Database for 1971-2009. The industry and trade data are matched with the firm-level data using firm SIC 4-digit codes and headquartered states. For some firms that report only 2-digit or 3-digit SIC codes, I take the average across 4-digit SIC codes and then match at the aggregated level.

 $^{^{16}}$ This number is consistent with Kerr et al. (2014) who also report that about 92% of firms lobby in a given year also participate in lobbying in the next year.

3.2 Identification of $\text{Cov}(\log \phi, \log(1 - \bar{\tau}^Y))$

The direction of the impact of lobbying on aggregate TFP depends on $Cov(\log \phi_{it}, \log(1-\bar{\tau}_{it}^Y))$, where subscripts *i* and *t* denote for firm and period.¹⁷ Although ϕ_{it} and $1-\bar{\tau}_{it}^Y$ are not directly observable in the data, I show that the covariance between log of the optimal lobbying expenditure b_{it}^* and log of exogenous wedges $Cov(\log(1+b_{it}^*), \log(1-\bar{\tau}_{it}^Y))$ is the identifying moment for $Cov(\log \phi_{it}, \log(1-\bar{\tau}_{it}^Y))$ and $Cov(\log(1+b_{it}^*), \log(1-\bar{\tau}_{it}^Y))$ can be computed from the data (Nakamura and Steinsson, 2018).

I first describe how to back out $\log(1 - \bar{\tau}_{it}^Y)$ from the data and then how to compute $Cov(\log(1 + b_{it}^*), \log(1 - \bar{\tau}_{it}^Y))$. Following Hsieh and Klenow (2009), overall firm output wedges inclusive of both exogenous and endogenous wedges are identified from the measured revenue total factor productivity (TFPR)¹⁸:

$$TFPR_{it} = \frac{1}{MRPL_{it}} = \underbrace{\left(\frac{\text{Value-Added}_{it}}{\text{Employment}_{it}}\right)^{-1}}_{\text{Data}} \propto \underbrace{\left(1 + b_{it}^*\right)^{\theta}}_{\text{Data}} \times \underbrace{\left(1 - \bar{\tau}_{it}^Y\right)}_{\text{Unobservable}}.$$

Given the estimate of θ and the data on the lobbying amounts b_{it}^* , after dividing the TFPR by $(1+b_{it}^*)^{\theta}$, I can separately identify the endogenous wedges $(1+b_{it}^*)^{\theta}$ and the exogenous wedges $1-\bar{\tau}_{it}^Y$ from the measured TFPR. Then, after measuring $(1+b_{it}^*)^{\theta}$ and $1-\bar{\tau}_{it}^Y$ from the data in the previous step, the empirical moment of the following object can be computed:

$$Cov(\underbrace{\log(1+b_{it}^*)}_{\text{Data}},\underbrace{\log(1-\bar{\tau}_{it}^Y)}_{\text{From the previous step}}),$$

which is the identifying moment of $Cov(\log \phi_{it}, \log(1 - \bar{\tau}_{it}^Y))$.

How can $Cov(\log(1 + b_{it}^*), \log(1 - \bar{\tau}_{it}^Y))$ be the identifying moment for $Cov(\log \phi_{it}, \log(1 - \bar{\tau}_{it}^Y))$? The optimal lobbying amounts b_{it}^* increase in both ϕ_{it} and $1 - \bar{\tau}_{it}^Y$. To infer $Cov(\log \phi_{it}, \log(1 - \bar{\tau}_{it}^Y))$, I use these monotonic relationships and $1 - \bar{\tau}_{it}^Y$ backed out from the data. Holding ϕ_{it} constant, firms with higher $1 - \bar{\tau}_{it}^Y$ (or lower $\bar{\tau}_{it}^Y$) spend larger lobbying amounts, so $\log(1 + b_{it}^*)$ and $\log(1 - \bar{\tau}_{it}^Y)$ are positively correlated. However, as $Cov(\log \phi_{it}, \log(1 - \bar{\tau}_{it}^Y))$ becomes more negative, because firms with higher ϕ_{it} also lobby more, this positive relationship between $\log(1 + b_{it}^*)$ and $1 - \bar{\tau}_{it}^Y$ is weakened. For the sufficiently negative values of $Cov(\log \phi_{it}, \log(1 - \bar{\tau}_{it}^Y))$, which is the necessary condition of the TFP-improving effects, $Cov(\log(1 + b_{it}^*), \log(1 - \bar{\tau}_{it}^Y))$ can take negative values. In fact, the more

¹⁷The model presented in the previous section is static, whereas I observe multiple periods in the data. I interpret the observations in the data as the repeated sequence of the static model.

¹⁸If there were no firm-specific output wedges, the inverse of MRPL does not vary across firms within industry, because all firms are equalizing its MRPL to a common wage. Any within industry variations in the inverse of MRPL are attributable to firm-specific output wedges and these variations can be used to infer firm-specific output wedges. TFPR is equivalent to the inverse of MRPL when labor is the only factor of production.

negative $Cov(\log \phi_{it}, \log(1 - \bar{\tau}_{it}^Y))$ is, the more negative $Cov(\log(1 + b_{it}^*), \log(1 - \bar{\tau}_{it}^Y))$ becomes. From this monotonic relationship, I can infer the sign and magnitude of $Cov(\log(1 + b_{it}^*), \log(1 - \bar{\tau}_{it}^Y))$. The following proposition summarizes this.

Proposition 4. (Identifying Moment) Under Assumptions 1 and 2(i, iii),

- (i) when $f^b = 0$ and in a closed economy,
 - (a) $Cov(\log(1+b_{it}^*), \log(1-\bar{\tau}_{it}^Y))$ is expressed as

$$\underbrace{Cov(\log(1+b_{it}^*),\log(1-\bar{\tau}_{it}^Y))}_{\substack{>0 \text{ or } < 0, \\ Observable}} = \underbrace{\frac{\sigma-1}{1-\theta\sigma}}_{>0} \times \underbrace{Cov(\log\phi_{it},\log(1-\bar{\tau}_{it}^Y))}_{\substack{>0, \text{ or } < 0, \\ Unbservable}} + \underbrace{\frac{\sigma}{1-\theta\sigma} \times Var(\log(1-\bar{\tau}_{it}^Y))}_{\substack{>0, \\ Observable}},$$

(b) there is a one-to-one mapping between $Cov(\log(1+b_{it}^*), \log(1-\bar{\tau}_{it}^Y))$ and $Cov(\log\phi_{it}, \log(1-\bar{\tau}_{it}^Y))$,

(c) $Cov(\log(1+b_{it}^*), \log(1-\bar{\tau}_{it}^Y)) < 0$ only if $Cov(\log \phi_{it}, \log(1-\bar{\tau}_{it}^Y)) < 0$. and (ii) when $f^b > 0$ and in an open economy,

$$\underbrace{\underbrace{Cov(\log(1+b_{it}^{*}),\log(1-\bar{\tau}_{it}^{Y})|b_{it}^{*}>0)}_{Observable} = \sum_{\substack{x_{it}'\in\{0,1\}}} \mathbb{P}[\phi_{it} \ge \bar{\phi}_{c}^{b}(\bar{\tau}_{it}^{Y},\eta_{it}), x_{it}^{*} = x_{it}']}{\times \left\{\frac{\sigma-1}{1-\theta\sigma}Cov(\log\phi_{it},\log(1-\bar{\tau}_{it}^{Y})|\phi_{it} \ge \bar{\phi}_{c}^{b}(\bar{\tau}_{it}^{Y},\eta_{it}), x_{it}^{*} = x_{it}')\right. \\ \left. + \frac{\sigma}{1-\theta\sigma}Var(\log(1-\bar{\tau}_{it}^{Y})|\phi_{it} \ge \bar{\phi}_{c}^{b}(\bar{\tau}_{it}^{Y},\eta_{it}), x_{it}^{*} = x_{it}')\right\},$$

where x_{it}^* is a firm's optimal export decision.¹⁹

Proposition 4(i) states that in a closed economy in which $f^b = 0$ so that every firm is lobbying, there is a one-to-one mapping between $Cov(\log(1 + b_{it}^*), \log(1 - \bar{\tau}_{it}^Y))$ and $Cov(\log \phi_{it}, \log(1 - \bar{\tau}_{it}^Y))$ and $Cov(\log \phi_{it}, \log(1 - \bar{\tau}_{it}^Y))$ can be directly inferred from the observables. Given the estimate of θ , the value of the elasticity of substitution σ , and the measured $1 - \bar{\tau}_{it}^Y$, I can compute the empirical moment of $\sigma/(1 - \theta\sigma)Var(\log(1 - \bar{\tau}_{it}^Y))$. By subtracting this empirical moment from $Cov(\log(1 + b_{it}^*), \log(1 - \bar{\tau}_{it}^Y))$, I can recover $Cov(\log \phi_{it}, \log(1 - \bar{\tau}_{it}^Y))$. Moreover, $Cov(\log(1 + b_{it}^*), \log(1 - \bar{\tau}_{it}^Y))$ takes negative values only when the necessary condition of the TFP-improving effects is satisfied, that is, when $Cov(\log \phi_{it}, \log(1 - \bar{\tau}_{it}^Y))$ is negative. Therefore, if $Cov(\log(1 + b_{it}^*), \log(1 - \bar{\tau}_{it}^Y))$ computed from the data takes negative values, I can indirectly infer that the more productive firms are initially more taxed.

In an open economy with positive fixed lobbying and export costs, Proposition 4(ii) states that al-

¹⁹Note that $\{\phi_{it} \geq \bar{\phi}_c^b(\bar{\tau}_{it}^Y, \eta_{it}), x_{it}^* = 1\}$ and $\{\phi_{it} \geq \bar{\phi}_c^b(\bar{\tau}_{it}^Y, \eta_{it}), x_{it}^* = 0\}$ are equivalent to $\{\phi_{it} \geq \bar{\phi}_c^b(\bar{\tau}_{it}^Y, \eta_{it}), \phi_{it} \geq \bar{\phi}_c^x(\bar{\tau}_{it}^Y, \eta_{it})\}$ and $\{\phi_{it} \geq \bar{\phi}_c^b(\bar{\tau}_{it}^Y, \eta_{it}), \phi_{it} \leq \bar{\phi}_c^x(\bar{\tau}_{it}^Y, \eta_{it})\}$.

though $Cov(\log \phi_{it}, \log(1 - \bar{\tau}_{it}^Y))$ cannot be directly computed without further information on other aggregate endogenous variables and fixed lobbying costs, $Cov(\log(1 + b_{it}^*), \log(1 - \bar{\tau}_{it}^Y)|b_{it}^* > 0)$ is informative on $Cov(\log \phi_{it}, \log(1 - \bar{\tau}_{it}^Y))$ through its information on the conditional covariance $Cov(\log \phi_{it}, \log(1 - \bar{\tau}_{it}^Y)|\phi_{it} \ge \bar{\phi}_c^b(\bar{\tau}_{it}^Y, \eta_{it}), x_{it}^* = x_{it}')$, where x_{it}^* is an optimal export decision and $x_{it}' \in \{0, 1\}$ is an export status. $Cov(\log(1 + b_{it}^*), \log(1 - \bar{\tau}_{it}^Y)|b_{it}^* > 0)$ can be computed using the samples with positive lobbying amounts.

3.3 Estimation of θ

I assume that output wedges take the following form: for firm i in sector j at time t,

$$1 - \tau_{it}^Y = exp(\mathbf{X}'_{it}\boldsymbol{\beta} + \delta_i + \delta_{jt}) \times (1 - \bar{\tau}_{it}^Y)(1 + b^*_{it})^{\theta},$$

where \mathbf{X}_{it} are observable characteristics, and δ_i and δ_{jt} are firm and sector-time fixed effects, respectively. The inverse of the marginal revenue of product of labor (MRPL) is proportional to the output wedge:

$$\frac{1}{MRPL_{it}} = \frac{w_t L_{it}}{\text{Value Added}_{it}} \propto \left(exp(\mathbf{X}'_{it}\boldsymbol{\beta} + \delta_i + \delta_{jt}) \times (1 - \bar{\tau}^Y_{it})(1 + b^*_{it})^{\theta}\right),\tag{3.1}$$

where MRPL is measured as value-added divided by wage bills.²⁰

I introduce an additional dimension of heterogeneity in the variable costs of lobbying. I assume that to spend lobbying amount of b_{it} , a firm has to pay $Z_{it}b_{it}$ amount of variable costs, where Z_{it} is a firm-specific observable cost shifter. I use Z_{it} as an instrumental variable to consistently estimate θ , dealing with the endogeneity problem which is discussed later in the paper. This allows firms to have different levels of variable costs, depending on Z_{it} .²¹ With the additional heterogeneity in the variable costs of lobbying, the optimal lobbying expenditure b_{it}^* also depends on Z_{it} . Taking the log

²⁰Value-added is calculated as sales multiplied with sectoral value-added shares and the wage bills are calculated as employment multiplied with sector-state specific wage rate. Sectoral value-added shares are calculated from NBER-CES Manufacturing database. The wage rate is obtained from the US Census County Business Pattern data. If labor markets are segmented, firms may face different wages depending on their industry affiliations and location. In such a case, the regression results may be driven by variation in wages rather than variations in output wedges. Dividing value-added by wage bill mitigates this concern.

²¹In the model described in Section 2, all firms have the same level of variable costs of lobbying, that is, $Z_{it} = 1, \forall i$. With additional heterogeneity of Z_{it} , the total lobbying cost of firm *i* is $P_t(Z_{it}b_{it}^* + f^b\eta_{it})$.

on both sides of Equation (3.1), I can derive the following estimable regression model: ²²

$$\log 1/MRPL_{i,t+1} = \theta \log(1 + b_{it}^*) + \mathbf{X}'_{it} \boldsymbol{\beta} + \delta_i + \delta_{jt} + \log(1 - \bar{\tau}_{it}^Y),$$

where $b_{it}^* = b^*(\phi_{it}, \bar{\tau}_{it}^Y, \eta_{it}, Z_{it}).$ (3.2)

Because $\log(1 - \bar{\tau}_{it}^Y)$ appears as the structural error term in Equation (3.2), the OLS estimates suffer from the endogeneity problem. Because lobbying is a function of $1 - \bar{\tau}_{it}^Y$, $\log(1 + b_{it}^*)$ is correlated with the error term. In addition, a potential correlation between ϕ_{it} and $1 - \bar{\tau}_{it}^Y$ can cause $\log(1 + b_{it}^*)$ to be correlated with the error term. Because the correlation between ϕ_{it} and $1 - \bar{\tau}_{it}^Y$ has important TFP implications in the model, assuming independence between ϕ_{it} and $1 - \bar{\tau}_{it}^Y$ leads to both omitted variable bias econometrically and misleading TFP implications theoretically.

3.3.1 Instrumental Variable Strategy

I instrument for lobbying using the state-level time-varying appointment of a Congress member as chairperson of the Appropriations Committees of the Senate or House of Representative (Aghion et al., 2009; Cohen et al., 2011). The data on membership on all congressional committees are obtained from Stewart and Woon (2017).

Institutional Setting. A local Congress member's appointment as a chairperson of the Appropriations Committees works as an exogenous cost-shifter of lobbying. The Appropriations Committees are in charge of discretionary spending, giving the Appropriations Committees larger power than any other congressional committees and making them more prone to be lobbied.²³ With budget responsibilities, the chairperson of the Appropriations Committees has greater power than any other members and often allocates more federal spending to the state that the chairperson represents.²⁴ With an increase in potential grants and federal contracts opportunities through discretionary spending, local Congress members who are chairpersons in the Appropriations Committees can increase the efficiency of lobbying of local firms in the same state as local Congress members. Because the nomination of the chairperson of congressional committees is determined by seniority and a complicated political process, the nomination of the chairperson of the Appropriations Committees is

 $^{^{22}}b_{it}^*$ is in the units of final goods in the model but the data only reports the total lobbying expenditure $P_t b_{it}^*$. To map the model to the data, I assume that at the equilibrium, P_t is normalized to 1, implying that the lobbying expenditures reported in the data can be interpreted in terms of the units of final goods.

²³See Stewart and Groseclose (1999), Blanes i Vidal et al. (2012), and Berry and Fowler (2018).

 $^{^{24}}$ For example see Berry and Fowler (2016) finds that the chairs or the important positions of the Appropriations Committees bring more earmarks to the states they represent. Again et al. (2009) and Cohen et al. (2011) find that local earmarks or federal expenditures on education increase once local Congress members become the chair of the important committees in Congress.

exogenous to the economic conditions of individual states or firms.²⁵

IV Regression Results. I estimate Equation (3.2) in first differences with IV. The samples were averaged over six years.²⁶ The IV is the average of a dummy variable that equals one if a state Congress member is a chairperson in the Appropriations Committees in either Senate or House for six years. To control for the state-common effects of the nomination of chairpersonship, I control detailed state-level tax incentives and transfers from the federal government.²⁷ Columns (1)-(3) of Table 2 report the regression results. In column (3), dummies indicating quantiles of firm sales at the beginning of the period are controlled, allowing for possible heterogeneous trends in output wedges depending on firm size. Once the endogeneity problem is corrected using IV, I obtain significantly positive coefficients with strong first-stage results.²⁸ A 1% increase in lobbying was associated with a 0.09-0.1% increase in output wedges.

The direction of bias in the OLS estimate can be interpreted through the lens of the model. When comparing the OLS and IV estimates in Table 2, the OLS estimate is downward-biased. The direction of bias has implications for the underlying correlation between productivity and exogenous wedges. Holding ϕ_{it} and η_{it} constant, $\log(1 + b_{it}^*)$ is positively correlated with the error term $\log(1 - \bar{\tau}_{it}^Y)$, making the estimated coefficient be biased upward. However, when $Cov(\log \phi_{it}, \log(1 - \bar{\tau}_{it}^Y))$ is sufficiently negative, which is the necessary condition for lobbying to improve TFP, $\log(1 + b_{it}^*)$ can be negatively correlated with the error term, giving the OLS estimate a downward bias. I show that this is indeed the case in Section 3.5.

Additional Robustness Checks. I extend the model to include two production factors: labor and capital.²⁹ Lobbying has a statistically significant relationship with MRPL but not with marginal revenue product of capital (MRPK). These results are reported in Online Appendix Table D1. I also conduct an event study to check whether the appointment of the chairperson has pre-trends in lobbying expenditures.³⁰ The pre-trends can detect potential spurious correlations arising from preexisting confounding factors or reverse causality problems. These pre-trends are reported in Online Appendix Figure D1. I find no pre-trends in the appointment, supporting the exclusion restriction of the IV.

 $^{^{25}}$ A change of chairpersonship is associated with the unexpected loss of reelection, retirement, or death of the current chair (Aghion et al., 2009; Cohen et al., 2011).

²⁶This mitigates the potential seasonality of lobbying expenditures caused by political cycles and measurement errors of MRPL.

²⁷State-level tax incentives are obtained from Bartik (2018). Specifically, I control corporate income taxes, job creation tax credits, investment tax credits, R&D tax credits, property tax abatement. The transfers from the federal government are obtained from the US Census.

²⁸The first stage results are reported in Online Appendix Table D3.

²⁹See Online Appendix Section D.2 for more detail.

³⁰See Online Appendix Section D.1 for more detail.

TABLE 2:	Estimating	θ
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Dep.	log	g(1/MRP)	L)	lo	g(1 - ET)	R)
	OLS	IV	7	OLS	IA	V
	(1)	(2)	(3)	(4)	(5)	(6)
$\log(1+b_{it}^*)$	-0.004 (0.005)	0.092^{***} (0.032)	0.101^{**} (0.039)	-0.003 (0.003)	0.076^{**} (0.029)	0.077^{**} (0.032)
KP-F		31.81	29.84		31.81	29.84
Industry FE State Control Firm Control	Y Y N	Y Y N	Y Y Y	Y Y N	Y Y N	Y Y Y
Ν	1216	1216	1216	1216	1216	1216

Notes. This table reports OLS and IV estimates of Equation (3.2). The dependent variable is the log of the inverse of MRPL in columns (1)-(3), and the dependent variable is $\log(1 - ETR)$ in columns (4)-(6). ETR is defined in Equation (3.3). The OLS estimates are reported in columns (1) and (4). The IV estimates are reported in columns (2), (3), (5), and (6). The IV is the average of a dummy variable equals one if a Congress member of the state where a firm is headquartered becomes a chair of the Appropriations Committees in the House or Senate over six years. State control includes corporate income tax, job creation tax credit, investment tax credit, R&D tax credit, property tax abatement, and transfers from the federal government. Firm control includes dummies indicating quantiles of a firm's initial sales. KP-F is Kleibergen-Paap F-statistics. The samples are averaged over six years. Standard errors are clustered at the state level. * p<0.1; ** p<0.05; *** p<0.01.

External Validity. If the model is misspecified, it is problematic to infer the MRPL as a firm-specific wedge.³¹ To examine whether the findings are robust to model misspecification, I use the cash effective tax rate (ETR) developed by Dyreng et al. (2008, 2017) as an alternative proxy for a firm-specific wedge.³² The ETR captures a firm's long-run tax avoidance activities, such as tax and investment credits. The ETR is constructed directly from the data rather than relying on the model structure. The ETR is defined as

$$ETR_{it} = \frac{\sum_{h=1}^{6} TXPD_{it-h}}{\sum_{h=1}^{6} (PI_{it-h} - SPI_{it-h})},$$
(3.3)

³¹For example, although there is no firm-specific exogenous wedge, Asker et al. (2014) and David and Venkateswaran (2019) show that frictions of input adjustment can result in the dispersion of MRPL and MRPK.

³²Arayavechkit et al. (2017) similarly use this measure and shows that this measure is correlated with MRPK.

where $TXPD_{it}$, PI_{it} and SPI_{it} are the cash taxes paid, the pre-tax income and the special items, averaged over six years.³³ I use $\log(1 - ETR_{it})$ as the alternative dependent variable, consistent with the output wedges measured by the inverse of the MRPL.³⁴ Columns (4)-(6) of Table 2 report the regression results. The estimated coefficients are qualitatively and quantitatively similar to $\log(1/MRPL_{it})$.³⁵

3.4 Calibration

The two countries Home and Foreign are calibrated to the data corresponding to the US and the rest of the world. I assume that $(\log \phi, \log(1 - \bar{\tau}^Y))$ of the US follows a joint log-normal distribution:

$$\begin{pmatrix} \log \phi \\ \log(1-\bar{\tau}^Y) \end{pmatrix} \sim \mathcal{N}\left(\begin{pmatrix} \mu_{US} \\ 0 \end{pmatrix} \begin{pmatrix} \sigma_{\phi} & \rho \\ \rho & \sigma_{\bar{\tau}^Y} \end{pmatrix} \right),$$

where the mean of $1 - \bar{\tau}^Y$ is normalized to zero. σ_{ϕ} and $\sigma_{\bar{\tau}^Y}$ are standard deviation of $\log \phi$ and $\log(1 - \bar{\tau}^Y)$, and ρ is the correlation between $\log \phi$ and $\log(1 - \bar{\tau}^Y)$. I assume that η is independent of ϕ and $1 - \bar{\tau}^Y$. η is also log-normally distributed with a mean of zero and a standard deviation of σ_{η} .³⁶ Given the absence of micro-level data on Foreign and that Foreign affects the US only through the aggregate variables, I assume that foreign firms cannot lobby and Foreign has no distortions, and I take σ_{ϕ}^F , f, and f_x of Foreign to be the same as those of the US.

 $\{\theta, \sigma, L^{US}, L^F, \mu_{US}, \mu_F, \tau_x, M_e^{US}\}$ are calibrated externally. I set θ to 0.09, which is the baseline estimate in Table 2. The relative labor of Foreign to US L^F/L^{US} is set to be 7.2 to match the relative labor force from the Penn World Table (PWT) (Feenstra et al., 2015).³⁷ The relative mean of the US productivity to Foreign productivity μ_{US}/μ_F is calibrated to be 3.5 to match the relative GDP per capita from the PWT. I set the elasticity of substitution to be 3 following Hsieh and Klenow (2009). I set the symmetric iceberg trade costs τ_x to be 1.7 following Anderson and Van Wincoop (2004). The exogenous firm mass of the US M_e^{US} is normalized to 1.

The remaining parameters $\Theta = \{\sigma_{\phi}, \sigma_{\bar{\tau}^Y}, f^b, \sigma_{\eta}, \rho, f_x^{US}, M_e^F, f_x^F\}$ are calibrated jointly using the

 $^{^{33}}$ Special items represent unusual or nonrecurring items presented above taxes by the company. Following Hanlon and Slemrod (2009), I reset ETR to zero for a minimum and 0.5 for a maximum to mitigate the effect of outliers.

 $^{^{34}}$ The ETR is interpreted as firm-specific taxes, so 1 - ETR can be mapped to the output wedges in the model.

 $^{^{35}}$ The results are robust to different transformation of ETR and different winsorization schemes. The results are reported in Online Appendix Table D2

³⁶The mean of η is not separately identifiable with f^b .

³⁷To construct labor and aggregate productivity level of Foreign, I choose the top 15 trading partners in 2006: Canada, Mexico, China, Japan, Germany, United Kingdom, South Korea, Taiwan, France, Malaysia, Italy, Netherlands, Venezuela, Brazil, and Ireland. Then, I aggregate up import, export, GDP, and labor of these countries.

Parameter	Value	Identifying Moment
Externally calibrated		
σ Elasticity of substitution	3	Hsieh and Klenow (2009)
L_F/L_{US} Foreign & US Labor	7.2	Relative labor of Foreign to the US (PWT)
μ_{US}/μ_F Foreign & US productivity	3.5	Relative GDP per capita (PWT)
$ au_x$ Iceberg trade cost	1.7	Anderson and Van Wincoop (2004)
θ Lobbying parameter of output wedge	0.09	Own estimate
Intermedie estimated		
Internativ estimated	1.0	
σ_{ϕ} Std. productivity	1.9	Std. of log(Sale), Sales dist.
$\sigma_{\bar{\tau}^Y}$ Std. output wedge	0.83	Std. of $1/MRPL$
f^b Fixed cost of lobybing	7.2	Lobbying expenditures & sales dist.
σ_{η} Std. fixed lobbying cost	2.80	Lobbying expenditures & sales dist.
ρ Corr(output wedge, productivity)	-0.87	$Cov(\log(1+b^*), \log(1-\bar{\tau}^Y) b^*>0)$
f_x Fixed export	0.04	Fraction of firms exporting (Bernard et al., 2007)
f Fixed cost of production	1e-6	Sales dist.
M_e^{US} Mass of firms (US)	1	Normalization
M_e^F Mass of firms (Foreign)	1.3e-5	US export share (PWT)

TABLE 3: Model Parameters

Notes. This table summarizes the calibrated values for the parameters of the model and their identifying moments.

method of moments to match the model moments with the 1999 data counterparts.³⁸ I choose the moments that are relevant and informative about the underlying parameters. I fit ρ to match $Cov(\log(1 + b_{it}^*), \log(1 - \bar{\tau}_{it}^Y))$, the identifying moment in Proposition 4. The standard deviation of productivity σ_{ϕ} is set to match the sales distribution of Compustat. Five bins were constructed based on the four percentiles: 75th (p75), 50th (p50), 25th (p25), and 10th (p10). I fit the overall standard deviation of sales and the mean of the log sales of each bin. I fit $\sigma_{\bar{\tau}Y}$ to the standard deviation of $1/MRPL_{it}$. Because $1/MRPL_{it} = (1 - \bar{\tau}_{it}^Y)(1 + b_{it}^*)^{\theta}$, conditional on observable b and the value of parameter θ , $\sigma_{\bar{\tau}Y}$ can be identified from the standard deviation of 1/MRPL. The fixed

$$\hat{\Theta} = argmin_{\Theta}\{(\mathbf{m} - \mathbf{m}(\Theta))^{\prime}\mathbf{W}(\mathbf{m} - \mathbf{m}(\Theta))\}, \text{ subject to } L(\Theta) = 0,$$

³⁸More precisely, the parameters minimize the following objective function:

where **m** and $\mathbf{m}(\Theta)$ are empirical and model moments, W is the weighting matrix, and $L(\Theta) = 0$ is the set of constraints imposed by the equilibrium conditions. Following Su and Judd (2012), I solve the constrained minimization problem that minimizes the distance between empirical and model moments subject to the constraints imposed by a set of equilibrium conditions described in the previous section. I set W to be the identity matrix. The moments are normalized to convert the difference between the model and the empirical moments into the percentage deviation. The solution to the problem is not guaranteed to be the global minimum. Therefore, I solve the constrained minimization problem multiple times with different starting points to deal with the local minimum problem. The equilibrium conditions are described in more detail in Online Appendix Section E.1.

Target Moments	Data (1999)	Moment
Share of lobbying firms (sales above p90)	0.47	0.47
Share of lobbying firms (sales between p90 and p75)	0.09	0.09
Std. of log sales	2.48	2.60
Mean (sale \geq p75) - Mean (P75 \geq sale $>$ p50)	2.14	2.58
Mean (p75 \geq sale > p50) - Mean (P50 \geq sale > p25)	1.60	1.63
Mean (p50 \geq sale > p25) - Mean (P25 \geq sale > p10)	1.56	1.56
Mean (p25 \geq sale $>$ p10) - Mean (p10 $>$ sale)	2.35	2.00
Std of TFPR $(1/MRPL)$	0.86	0.81
Cov. $\log(1+b)$ and $\log(1-\bar{\tau}^Y)$	-0.38	-0.39
Share of exporters	0.18	0.19
Export share of GDP	0.10	0.10

TABLE 4: Data and Model Moments

Notes. All the moments except for share of exporters and export share of GDP are calculated from Compustat and the lobbying database. Share of exporters is from Bernard et al. (2007). Export share of GDP is from the PWT.

lobbying costs f^b and standard deviation σ_η are calibrated to match the share of lobbying firms in the different sales bins. f^b is identified by the overall share of lobbying firms. σ_η is identified by the fraction of medium-sized firms that are lobbying. In the model, the pattern of many mediumsized firms lobbying relative to their sales is rationalized by the high variance of η . Without this high variance of η , sales become highly correlated with lobbying expenditures and the model cannot predict medium-sized firms' lobbying. I fit the fixed costs of production using the difference between the mean of log sales of firms with sales between p25 and p50 and the mean of log sales of firms with sales below p10. Because the fixed costs of production only affect the production decisions of small-sized firms, this moment can pin down the parameter.

Model Fit. Table 3 reports internally estimated and externally chosen parameters. Table 4 reports the model fit. The data moments are well-approximated in the model. Figure 1 graphically illustrates the identifying moment observed in the data. Panel A plots $\log(1 + b_{it}^*)$ and $\log(1 - \bar{\tau}_{it}^Y)$ for firm-year level observations with positive lobbying amounts. The negative relationship implies that $\log \phi_{it}$ and $\log(1 - \bar{\tau}_{it}^Y)$ are likely to be negatively correlated in the underlying distribution. In Panel B of Figure 1, using the model-generated data, I plot the same figure with Panel A. The model reproduces the identifying moment observed in the data.



FIGURE 1: The Identifying Moment. $Cov(\log(1+b_{it}^*), \log(1-\bar{\tau}_{it}^Y)|b_{it}^*>0)$. Data and Model Fit

Notes. X and Y-axis represent $\log(1+b_{it}^*)$ and $\log(1-\bar{\tau}_{it}^Y)$ backed out from the 1999 data. $\log(1-\bar{\tau}_{it}^Y)$ is normalized by the mean of TFPR across firms weighted by value-added within industry. Each dot in Panels A and B is firm-year observation with positive lobbying amounts from the actual and the model-generated data. The red line represents linear fit with 99% confidence interval. The slope coefficients β are reported at the bottom. $\log(1+b_{it}^*)$ and $\log(1-\bar{\tau}_{it}^Y)$ are demeaned in both figures. The distributions at the top and the right are histograms and their associated kernel density estimates of $\log(1+b_{it}^*)$ and $\log(1-\bar{\tau}_{it}^Y)$.

3.5 Quantitative Results

Decomposition of the measured TFPR. The observed TFPR dispersion is commonly used to measure the extent of misallocation in an economy.³⁹ At an efficient equilibrium, firms equate their TFPR to the common wage, and therefore there should be no TFPR dispersion within industry. With output wedges, however, firms do not always equate their TFPR to the common wage, resulting in TFPR dispersion.

³⁹The dispersion of TFPR is equivalent to aggregate TFP under the assumptions presented in Hsieh and Klenow (2009). These assumptions include the Cobb-Douglas production function, CES demand structure with monopolistic competition, exogenous firm mass, and closed economy. If these assumptions are violated, the dispersion is not directly mapped to the aggregate TFP and becomes a reduced form measure for the aggregate TFP.

The observed TFPR dispersion can be decomposed as

$$Var\left(\log\frac{TFPR_{it}}{TFPR_{jt}}\right) = Var\left(\log\frac{1/MRPL_{it}}{TFPR_{jt}}\right) = Var(\log(1-\bar{\tau}_{it}^{Y})(1+b_{it}^{*})^{\theta})$$

$$= \underbrace{Var(\log(1-\bar{\tau}_{it}^{Y}))}_{HK \ dispersion} + \underbrace{\theta^{2}Var(\log(1+b_{it}^{*}))}_{Lobbying \ dispersion} + \underbrace{2\theta Cov(\log(1+b_{it}^{*}),\log(1-\bar{\tau}_{it}^{Y}))}_{\geq 0 \ or < 0},$$

$$\underbrace{20 \ or < 0}_{I-\bar{\tau}_{it}^{Y}} = (1-\bar{\tau}_{it}^{Y})/TFPR_{jt}, \quad (3.4)$$

where $1 - \bar{\tau}_{it}^{Y}$ is an exogenous wedge backed out from the data, normalized by the industry-level TFPR $(TFPR_{jt})$. The industry-level TFPR is obtained as the mean of TFPR across firms weighted by value-added within industry. The normalization differences out any sector-level distortions that are common across firms, which makes firms across different sectors comparable.

The observed overall dispersion can be decomposed into three components: (1) HK, (2) lobbying, and (3) covariance dispersion. The HK dispersion is induced by exogenous wedges (Hsieh and Klenow, 2009). If $\log(1 - \bar{\tau}_{it}^Y) = 0$ for all firms, the HK dispersion becomes zero. Without lobbying, this was the only source of dispersion. The question is whether lobbying mitigates or amplifies this pre-lobbying HK dispersion. Lobbying introduces two additional sources: lobbying and covariance dispersion. The lobbying dispersion is always positive, so the lobbying dispersion always amplifies the HK dispersion and increases the overall dispersion. Whether lobbying can mitigate the HK dispersion depends on the covariance dispersion is sufficiently negative, it can offset the lobbying dispersion and make the overall observed dispersion even smaller than the HK dispersion. However, if the covariance dispersion is positive, lobbying makes the overall dispersion larger than the HK dispersion.

The decomposition results are shown in Figure 2. The HK dispersion is larger than the overall TFPR dispersion observed in the data. This is because even though the lobbying dispersion is always positive, the covariance dispersion is sufficiently negative to decrease the pre-lobbying HK dispersion.⁴⁰ This implies that among publicly traded firms, the more productive firms tend to face higher exogenous distortions. Lobbying decreases the HK dispersion to the observed TFPR dispersion level, which is an average reduction of approximately 17%.

 $^{^{40}}$ Across the sample period, the mean observed variance of TFPR is 1.24. Note that this is larger than Hsieh and Klenow (2009) in which they use Census establishment data. The averages of the covariance, lobbying, and HK dispersion are -0.42, 0.16, and 1.5, respectively.



FIGURE 2: Decomposition of Dispersion of Measured TFPR

Notes. X-axis represents year and Y-axis represents each dispersion defined in Equation (3.4). The blue line is the dispersion of TFPR observed from the data. The orange, green, and red lines represent the HK, lobbying and covariance dispersion. The sum of HK, lobbying, and covariance dispersion is equal to the observed level of TFPR dispersion represented by the blue line.

TABLE 5: Relative TFP and Welfare of the Lobbying Economy to the Exogenous Wedge Economy

	Baseline	Free Entry	$\theta = 0.076$	$\theta = 0.045$	$\theta = 0.11$
	(1)	(2)	(3)	(4)	(5)
TFP (%)	7.10	3.98	7.90	7.25	3.98
Welfare $(\%)$	7.14	3.38	7.94	7.28	4.00

Notes. This table presents relative TFP and welfare of the lobbying economy to the exogenous wedge economy. In column (1), the baseline calibrated parameters are used. In column (2), the free entry condition is imposed. In columns (3), (4), and (5), θ is set to be 0.075, 0.045, and 0.11.

TFP and Welfare. I examine the effect of lobbying on TFP and welfare using the quantitative model. TFP is defined as real GDP per capita, which requires a producer price index (PPI). PPI is defined as $PPI = (\int_{\omega \in \Omega_{US}} p(\omega)^{1-\sigma} d\omega)^{(1/(1-\sigma)})$ where Ω_{US} is the set of domestic intermediate producers available in the US.⁴¹ Column (1) of Table 5 reports relative TFP and welfare of the lobbying economy to the exogenous wedge economy. TFP and welfare of the lobbying economy are 7.10% and 7.14% higher than those of the exogenous wedge economy. In column (2), I conduct the same analysis under the free entry condition. The entry cost is normalized to 1 in Home and the entry cost of Foreign is set to 0.14 following Bollard et al. (2016), so that entry cost is proportional to

⁴¹In a closed economy, this definition is equivalent to output per worker in Section 2.1. Burstein and Cravino (2015) discusses issues regarding the measurement of price index and real GDP in an open economy.



FIGURE 3: TFP. Exogenous Wedge Economy vs. Lobbying Economy

Notes. This figure displays relative TFP of the lobbying economy to the exogenous wedge economy. The vertical line represents the calibrated parameter. The results are based on the calibrated parameters reported in Table 3.

GDP per capita.⁴² Under the free entry condition, TFP and welfare gains from lobbying are 3.98% and 3.38%, lower than the baseline results in column (1).⁴³ Columns (3), (4), and (5) report the results with different values of θ . In column (3), I set $\theta = 0.76$ which is the estimate when using $\log(1 - ETR)$ in columns (3)-(4) of Table 2. In column (4), I set $\theta = 0.045$ and in column (5), I set $\theta = 0.11$. The results are robust for a wide range of θ .

Sensitivity Analysis. I examine the relative TFP of the lobbying economy to the exogenous wedge economy while varying one parameter and holding other parameters constant. The results for ρ , σ_{ϕ} ,

⁴²Bollard et al. (2016) finds that entry cost increases with productivity. I set the entry cost of Foreign to be 0.14 (=1/7.2), where 1/7.2 is the US and top 15 trading countries' population ratio.

 $^{^{43}}$ Under the free entry condition, lobbying by a few big firms may block small firms' entry, which may lower the gains from lobbying.

 $\sigma_{\bar{\tau}Y}$ and σ_{η} are reported in Panels A, B, C, and D of Figure 3. The vertical black line represents the calibrated parameter values. As the model predicts, Panel A shows that lobbying can mitigate misallocation from the exogenous wedges for a sufficiently low value of ρ near the calibrated value, but the concentration and amplification effects begin to dominate above -0.8. Panel B shows that the gains from lobbying become larger when σ_{ϕ} is above 1.7. Holding ρ fixed, higher σ_{ϕ} indicates that the more productive firms are more likely to face a higher exogenous distortion, which gives more room for lobbying to improve TFP. Panel C illustrates that as $\sigma_{\bar{\tau}Y}$ increases, lobbying decreases the economy through the amplification effect. Lastly, in Panel D, as σ_{η} increases, lobbying decreases gains from lobbying because less productive firms can participate in lobbying if they draw low fixed lobbying costs.

4 Globalization

This section first provides empirical evidence that the China shock affected firm lobbying decisions and then quantitatively assesses the impact of globalization on aggregate TFP through lobbying channels.

4.1 Empirical Evidence regarding Globalization and Lobbying

I provide empirical evidence that a decrease in market size decreases the lobbying of small- and medium-sized firms. I use the rise in the Chinese import exposure as an exogenous shock to US firm market size (Autor et al., 2013; Acemoglu et al., 2016). China's productivity growth and a decrease in bilateral trade costs with the US have dramatically increased US imports from China after China joined the WTO in 2001.⁴⁴ Following Acemoglu et al. (2016), the China shock is defined as follows:

$$China_{jt}^{oc,im} = 100 \times \frac{IM_{jt}^{oc,im}}{Y_{jt_0}^{US} + IM_{jt_0}^{US} - EX_{jt_0}^{US}}$$
(4.1)

for industry j at time t. $IM_{jt}^{oc,im}$ is the sum of imports of other developed countries from China.⁴⁵ The denominator is the initial US domestic absorption at the start of the sample period, which is the sum of gross output $GO_{jt_0}^{US}$ and the total exports $EX_{jt_0}^{US}$ minus the total imports $IM_{jt_0}^{US}$. China_{jt}^{oc,im} captures the exogenous market decrease of US firms driven by the China supply shock orthogonal to the US domestic demand shocks or firm-level conditions.

Figure 4 summarizes the main empirical findings. Based on the medians of the import exposure and the initial sales, firms are divided into four groups, as shown in Figure 4. The initial sales level is

⁴⁴For more on the China shock, see Autor et al. (2013); Acemoglu et al. (2016); di Giovanni et al. (2014); Pierce and Schott (2016); Handley and Limão (2017).

⁴⁵Following Autor et al. (2013), these high-income countries include Australia, Denmark, Finland, Germany, Japan, New Zealand, Spain, and Switzerland.



FIGURE 4: Trade-Induced Market Size Changes and Lobbying

Notes. The figure illustrates the average of log one plus lobbying of each group. Log one plus lobbying is residualized on firm and time fixed effects. Firms are grouped based on the medians of the distributions of the China shock defined in Equation (4.1) and the initial sales. If the import exposure of a firm's industry is above or below the median exposure across industries, it is categorized as "High China" or "Low China." If a firm's initial sales are above or below the median within 4-digit SIC code, it is labeled as "Big" or "Small." China's accession to the WTO in 2001 is denoted as the vertical black dashed line.

used as a proxy for firm size. Figure 4 shows that the gap in lobbying between large- and small-sized firms is rising only in industries that are more exposed to import exposure after China joined the WTO. This indicates that the import shock has heterogeneous effects on lobbying, depending on firm size.

The graphical results are confirmed by the following long difference regression model.⁴⁶ For a firm i of industry j at year t,

$$\Delta y_{it} = \beta_1 \Delta China_{jt}^{oc,im} + \beta_2 \log(Sale_{it_0}) \times \Delta China_{jt}^{oc,im} + \delta_i + \delta_t + \Delta\epsilon_{it}, \tag{4.2}$$

 $^{^{46}}$ In Appendix Section B.2, I provide the structural interpretation of the long difference regression model based on the model framework, which will be discussed in detail in the next section.

where y_{it} is a dependent variable and $China_{jt}^{oc,im}$ is the import shock defined in Equation (4.1).⁴⁷ I use three main dependent variables log one plus lobbying, inverse hyperbolic sine transformation of lobbying asinh(Lobby), and a dummy variable of positive lobbying multiplied 100.⁴⁸ The dummy dependent variable captures the extensive margin of lobbying. I control the interaction term between the log of the initial sales and the China shock to allow for heterogeneous effects of the China shock on firms of different sizes. I normalize the initial sales by the minimum value within 4-digit SIC industry so that β_1 can be interpreted as the effect of the import exposure on the firm with the minimum initial sales. I control for firm and time fixed effects to account for firm-specific trends and macroeconomic shocks. Given that lobbying is a long-term investment and may change alongside US political cycles, I average the samples over six years following the six-year terms of US senators.⁴⁹ All standard errors are clustered on 3-digit SIC industries. This allows an arbitrary correlation between the error terms of firms in the same 3-digit code.

Panel A of Table 6 reports these results. The dependent variable is log one plus lobbying in columns (1) and (2), asinh(Lobby) in columns (3) and (4), and a dummy variable of positive lobbying in columns (5) and (6). In columns (2), (4), and (6), I control for state-specific time fixed effects to account for omitted confounding factors at the state level. Across specifications, I find sizable heterogeneous responses to the import exposure. In columns (1) and (3), for the firm at the 25th percentile of the initial sales distribution, a one standard deviation of the import exposure decreases 0.4 standard deviations of the log of one plus lobbying and a similar magnitude for asinh(Lobby). However, lobbying of firms whose initial sales are above the 75th percentile is not affected by the import exposure.⁵⁰ Regarding the extensive margin in column (5), a one standard deviation of the import exposure decreases a firm's probability of lobbying by 37% but has negligible effects on firms whose initial sales exceed the 75th percentile. When controlling for state-specific time fixed effects in columns (2), (4), and (6), the coefficients retain the same signs and remain within the standard error of the baseline results in columns (1), (3), and (5).

The empirical finding is consistent with the complementarity between market size and lobbying, as stated in Proposition 1. This proposition implies that firms in industries that are more exposed to the China shock decrease their lobbying amounts on average because of decreases in market size and

⁴⁷Unlike Acemoglu et al. (2016) where $China_{jt}^{oc,im}$ is used as an instrumental variable, I estimate the model in a reduced-form, because the focus is to examine the reduced form relationship between market size and lobbying rather than giving a structural interpretation to the regression model.

⁴⁸Using a log of one plus lobbying can be misleading as it imposes strong functional form. The inverse hyperbolic sine function is defined as $\log(x + \sqrt{x^2 + 1})$. This is well-defined at zero and parallels the natural logarithm for positive values (Card and Dellavigna, 2020). I multiplied the dummy dependent variable by 100 so that the estimated coefficient can be interpreted as the percentage changes.

 $^{^{49}}$ For example, lobbying can decrease near the end of a senator's terms of office because of uncertainty regarding the results of the next election.

 $^{^{50}}$ This is calculated as 35 * (4.66 * 0.01 - 0.089)/3.74 where 35 and 3.74 are the standard deviations of the import exposure and log of one plus lobbying. 4.66 is the initial sales level at the 25th percentile normalized by the minimum sales within industry.

the effects are heterogeneous depending on firm size.

Export Exposure. In addition to US imports from China, US exports to China increased after China became a member of the WTO.⁵¹ If market size is an important determinant of lobbying, an increase in exports should increase firm lobbying expenditures in the direction opposite to the import exposure. To examine the effect of an increase in exports on a firm's lobbying, I additionally control for the US export exposure and its interaction with firm size, similar to the import exposure. Following Feenstra et al. (2019), I define the US export exposure as the relative export intensity:

$$China_{jt}^{oc,ex} = \frac{EX_{jt}^{oc,ex}}{GO_{jt_0}^{US}},\tag{4.3}$$

where $EX_{jt}^{oc,ex}$ is defined as the sum of eight developed countries' exports to China relative to the US gross output of the industry at the start of the sample period, analogous to the import exposure measure.

Panel B of Table 6 reports the results when controlling for the export exposure. The estimated coefficients of import exposure and its interaction have a larger magnitude and are estimated more precisely than the estimates without controlling for the export exposure. The heterogeneous effects of the export exposure are in the opposite direction to the import exposure, which is consistent with the market size effect. This effect predicts that marginal firms that were unable to export initially but could enter the Chinese market after a substantial reduction in bilateral trade costs may receive the largest benefit from market expansion due to extensive margin changes. The estimated coefficient of the interaction term in column (1) implies that a one standard deviation increase in the export exposure increases lobbying of a firm at the 25th and 75th percentile by 0.22 and 0.07 standard deviation of log one plus lobbying, decreasing their gap by 0.15 standard deviation. In column (3), I obtained a similar magnitude for asinh(Lobby). For the extensive margin of lobbying in column (5), the export exposure has zero effect for the firm at the 75th percentile but increases the probability of lobbying for a firm at the 25th percentile by 6%. When controlling for state-specific time fixed effects in columns (2), (4), and (6), the estimated coefficients retain the same sign and all remain within the standard error of the baseline results.

Non-Trade-Related Lobbying. If firms systematically change their lobbying patterns against trade with China, the empirical results may be driven by trade-related lobbying activities rather than the market size effect. I provide evidence that the results in Panel A are not driven by trade-related lobbying.⁵² I conduct the same analysis with non-trade-related lobbying expenditures. To identify

⁵¹Feenstra et al. (2019) finds that the expansion of the US exports to China increased the number of jobs of the US. ⁵²Suppose special interests lobby to influence an incumbent government's trade policy against rising Chinese import

competition. In such cases, the regression results may be driven by political factors rather than market size.

whether a firm's lobbying is related to trade, I use the general issue codes and summaries of lobbying activities, which are required to be reported by the Lobbying Disclosure Act. First, lobbying is classified as trade-related lobbying if its issue code is either TRD or TAR, where TRD covers general trade-related issues except for tariffs, and TAR covers issues related to tariffs.⁵³ Second, I also count any lobbying reports that mention "China" in their summary as trade-related lobbying because firms may lobby to increase trade barriers against Chinese imports using domestic policies that are seemingly non-trade-related. For example, firms may lobby for the strengthening of intellectual property rights or environmental regulations against Chinese firms, which may not be reported as trade-related issues in lobbying reports. Non-trade-related lobbying expenditures are obtained as the total lobbying expenditure minus the total trade-related lobbying expenditure. Panel C of Table 6 reports these results. The estimated coefficients are qualitatively and quantitatively similar to the results of Panel A up to two decimals, implying that the results are unlikely to be driven by trade-related lobbying activities.⁵⁴

Non-Parametric Regressions. The interaction term implies that heterogeneous effects are linear in the log of initial sales. This imposed linearity can be misleading if the effects are highly nonlinear. To examine whether the results are driven by the functional form assumption, instead of using the linear interaction term, I use interaction terms between the Chinese import exposure and a dummy of a group of firms defined based on the tercile of the initial sales distribution within each industry, which may capture nonlinearity more flexibly than the linear interaction term. The specification is as follows.

$$\Delta y_{it} = \sum_{q=1}^{3} \beta^q D_i^q \times \Delta China_{jt}^{oc,im} + \delta_i + \delta_t + \Delta \epsilon_{it}, \qquad (4.4)$$

where D_i^q is a dummy variable for each group q = 1, 2, 3 defined based on the tercile. β^q captures the average heterogeneous effects for each group.

The results are reported in Panel D of Table 6. Only the bottom group below the lowest tercile was negatively affected by the import exposure. The estimated coefficients in columns (1) and (3) imply that a one standard deviation increase in the import exposure decreases 0.75 standard deviations of the log of one plus lobbying and a similar magnitude for asinh(Lobby). The coefficient in column (5) indicates that a one standard deviation increase in the import exposure decreased the probability of

 $^{^{53}}$ TAR was added in 2009. Before 2009, TAR covered both general trade-related issues and tariff-related issues. On many occasions, multiple issues are covered by one report, and only the total expenditures are reported per each report. In this case, lobbying expenditures per each issue are not separately identifiable from the total expenditures, so I obtain the lobbying expenditure per issue as the total expenditure divided by the number of issues. Online Appendix Figure A1 and A2 display how lobbying expenditures, general issue codes, and summaries are reported in the lobbying reports.

⁵⁴In Online Appendix Table B3, I run the same regression with trade-related lobbying as dependent variables. I find no significant effects of the import and export exposure on trade-related lobbying.

Dep.	$\log(1 +$	Lobby)	asinh(1	Lobby)	$100 \times 1[L]$	obby > 0]
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Baselin	ne o o z o*	0.000**	0.00.1*	0.00.4**	0.0=4*	0 - 10**
$China_{oc,jt}^{im}$	-0.079*	-0.089**	-0.084*	-0.094**	-0.674*	-0.749**
or im	(0.041)	(0.040)	(0.043)	(0.042)	(0.349)	(0.339)
$\triangle China_{jt}^{bc,im}$	0.010**	0.010**	0.010**	0.011**	0.079**	0.080**
$\times \log(Sale_{it_0})$	(0.004)	(0.004)	(0.005)	(0.005)	(0.037)	(0.037)
Panel B. Export	Exposure					
$China_{oc.it}^{im}$	-0.167***	· -0.165***	-0.176***	-0.175***	· -1.378***	-1.358^{***}
,0	(0.026)	(0.031)	(0.028)	(0.033)	(0.240)	(0.278)
$\triangle China_{it}^{oc,im}$	0.020***	0.019***	0.021***	0.020***	0.157^{***}	0.147^{***}
$\times \log(Sale_{it_0})$	(0.004)	(0.004)	(0.004)	(0.004)	(0.031)	(0.035)
China ^{ex} _{oc.it}	0.057***	0.057***	0.061***	0.060***	0.490***	0.477^{***}
,0	(0.016)	(0.020)	(0.017)	(0.021)	(0.130)	(0.165)
$\triangle China_{it}^{oc,im}$	-0.005**	-0.005**	-0.006***	-0.006**	-0.049***	-0.048^{**}
$\times \log(Sale_{it_0})$	(0.002)	(0.002)	(0.002)	(0.002)	(0.016)	(0.019)
Panel C. Non-Tr	rade-Relat	ed Lobbyii	ig			
$China_{it}^{oc,im}$	-0.080**	-0.091**	-0.085**	-0.096**	-0.665**	-0.743**
ji	(0.039)	(0.038)	(0.041)	(0.040)	(0.333)	(0.327)
$\triangle China_{ii}^{oc,im}$	0.011**	0.011**	0.011**	0.011**	0.083**	0.083**
$\times \log(Sale_{it_0})$	(0.004)	(0.004)	(0.005)	(0.005)	(0.036)	(0.036)
Danal D. Non D.	anamtatnia	Dograadi	202.0			
$D^1 \times Chim a^{oc,im}$	0.077*	0.000**	0.001*	0 000**	0 69 1**	0 745**
$D \times China_{jt}$	-0.077	-0.062	-0.081	-0.000	-0.004	-0.740
$D^2 \times Chim a^{oc,im}$	(0.040)	(0.039)	(0.042)	(0.042)	(0.334)	(0.529)
$D \times China_{jt}$	-0.004	-0.001	-0.004	-0.001	-0.022	(0.980)
$D^3 \dots Cl \dots oc.im$	(0.027)	(0.052)	(0.028)	(0.034)	(0.239)	(0.269)
$D^{a} \times China_{jt}^{a}$	0.031	0.018	0.032	0.018	(0.170)	(0.051)
	(0.031)	(0.033)	(0.033)	(0.035)	(0.263)	(0.277)
Firm FE	Υ	Υ	Υ	Υ	Υ	Υ
Time FE	Υ	Ν	Υ	Ν	Υ	Ν
State \times Time FE	Ν	Υ	Ν	Υ	Ν	Υ
Ν	2770	2716	2770	2716	2770	2716

TABLE 6: Market Size and Lobbying

Notes. Panels A, B and C of the table reports results from estimating Equation (4.2) using OLS. Panel D reports results from estimating Equation (4.4) using OLS. The dependent variables are log one plus lobbying expenditures in columns (1) and (2), the inverse hyperbolic sine transformation of lobbying expenditures in columns (3) and (4) and a dummy variable of positive lobbying expenditures multiplied by 100 in columns (5) and (6). In Panel C, I use non trade-related lobbying expenditures as dependent variables. $China_{jt}^{oc,im}$ and $China_{jt}^{oc,ex}$ are defined in Equations (4.1) and (4.3). In all specifications, firm fixed effects are controlled. Samples are averaged over six years. Robust standard errors are reported in parentheses and clustered on 3-digit SIC industries. * p<0.1; ** p<0.05; *** p<0.01.

lobbying by 26% for the bottom group. When controlling state-specific fixed effects in columns (2), (4), and (6), the estimated coefficients all have the same sign and stay within the standard error of the results of columns (1), (3), and (5).

Additional Robustness Checks. I provide a battery of robustness checks. I run the analysis without averaging the sample and using initial employment or capital as alternative proxies for firm size. The results are reported in Panels A and B of Online Appendix Table B2. The estimated coefficients are consistent with the baseline specification.

4.2**Quantitative Analysis**

Gains from Trade. TFP gains from trade in the lobbying economy can be decomposed as follows:

$$\underbrace{log(TFP_{lobby}^{T}) - log(TFP_{lobby}^{A})}_{\text{Gains from trade} \text{ in the lobbying economy}} = \underbrace{\left\{ log(TFP_{exo}^{T}) - log(TFP_{exo}^{A}) \right\}}_{\text{Gains from trade} \text{ in the exogenous wedge economy}} + \underbrace{\left\{ log(TFP_{lobby}^{T}) - log(TFP_{exo}^{T}) \right\}}_{\text{Gains or losses from lobbying}} - \underbrace{\left\{ log(TFP_{lobby}^{A}) - log(TFP_{exo}^{A}) \right\}}_{\text{Gains or losses from lobbying}}, \quad (4.5)$$

$$\underbrace{\left\{ log(TFP_{lobby}^{T}) - log(TFP_{exo}^{T}) \right\}}_{\text{Gains or losses from lobbying}} - \underbrace{\left\{ log(TFP_{lobby}^{A}) - log(TFP_{exo}^{A}) \right\}}_{\text{Gains or losses from lobbying}}, \quad (4.5)$$

Trade opening vs. Autarky

where the superscripts T and A denote trade opening and autarky, respectively. TFP gains from trade in the lobbying economy are the sum of the following three terms: (1) gains from trade in the exogenous wedge economy, (2) gains or losses from lobbying in an open economy, and (3) gains or losses from lobbying in autarky. The simple algebra shows that the difference between gains from trade in the lobbying and exogenous wedge economy is the difference between gains from lobbying of the lobbying economy in an open economy and autarky. The difference between gains from lobbying in an open economy and autarky measures the extent to which opening to trade affects the TFP influences of lobbying. If opening to trade increases the TFP influences of lobbying, gains from trade in the lobbying economy would be larger than those in the exogenous wedge economy, and vice versa.

Table 7 reports on TFP and welfare gains from trade in the different economies, comparing autarky to an open economy with calibrated parameters. Compared to autarky, when opening of trade to the observed import level in the data, TFP increases by 4.13%, 4.23%, and 2.68% in the lobbying, exogenous wedge, and efficient economies. In both distorted economies, gains from trade are larger than gains from trade in the efficient economy.⁵⁵ Column (4) presents the changes of the

⁵⁵Bai et al. (2019) and Berthou et al. (2018) also show that idiosyncratic distortions can affect the gains from trade.

	Lobbying Economy (A)	Exogenous Wedge Economy (B)	Efficient Economy	Changes of TFP influences (A) - (B)
	(1)	(2)	(3)	(4)
Panel A.	Opening to Tra	ide, $\tau_x = \infty \Rightarrow \tau_x =$	1.7	
TFP $(\%)$	4.13	4.23	2.68	-0.10
Welfare $(\%)$	3.07	3.13	1.96	-0.07
Panel B.	Before and Afte	er the China shock		
TFP $(\%)$	2.26	2.34	1.58	-0.08
Welfare $(\%)$	2.76	2.84	2.01	-0.08

TABLE 7: International Trade and Lobbying. Opening to Trade

Notes. This table presents gains from trade in different economies. Panel A reports changes of welfare and TFP when opening to trade. Panel B reports changes of welfare and TFP before and after the China shock. Column (4) reports the difference of TFP and welfare gains between the lobbying and exogenous wedge economies. All the results are based on the calibrated parameters reported in Table 3

TFP influences, which is equivalent to the difference between gains from lobbying in autarky and an open economy. Compared to autarky, the gains from lobbying decrease by 0.1% because the concentration and amplification effects are exacerbated in the open economy. As lobbying expenditures become more unequally distributed in the open economy than autarky, this leads to too much input concentrated toward big-sized lobbying exporters, exacerbating the concentration and amplification effects.⁵⁶ Welfare can be decomposed in the same way, and there is a -0.07% reduction in welfare gains from lobbying in the open economy relative to autarky.

The China Shock. I evaluate the impact of the China shock on the aggregate TFP and welfare. The China shock is modeled as an increase in the mean level of Foreign productivity μ_{ϕ}^{F} . I fit μ_{ϕ}^{F} to the changes in the US import share with the 15 main trading countries. The manufacturing import share rose from 0.12 to 0.20 during the sample period, more than 55% from increases in imports from China. In the China shock counterfactual, I set μ_{ϕ}^{F} 53% higher so that the model fits the 67% increase in import share (0.20/0.12). Panel B in Table 7 presents these results. Welfare and TFP gains of the lobbying economy are larger than those of the efficient economy. After the China shock, TFP and welfare increased by 2.26% and 2.76%, and 1.58% and 2.01% in the efficient economy. After the China shock, both the TFP and welfare gains from lobbying decreased by -0.08%.

⁵⁶In the simulated data based on the model with the baseline parameters, the variance of $\log(1 + b_{it}^*)$ is 2.22 and 2.26 in autarky and the open economy. The variance of the open economy is 1.5% higher, implying that lobbying expenditures across firms become more unequal when opening to trade.

5 Conclusion

This paper evaluates the effects of lobbying on resource misallocation and aggregate TFP. I theoretically characterize the conditions under which lobbying increases or decreases TFP and provide a quantitative framework to evaluate the impact of lobbying under pre-lobbying exogenous distortions. The model developed here allows for the separate identification of the pre-lobbying exogenous wedge and the endogenous wedge and for the quantification of the effect of lobbying on aggregate TFP and welfare. Lobbying can improve TFP when the more productive firms face a higher pre-lobbying exogenous distortion because, in such cases, they can lobby to overcome that initial distortion. Although lobbying is seemingly distortionary at the micro-level, the aggregate implication of this activity can differ from the conventional wisdom, which implies the importance of considering the general equilibrium effects of lobbying.

From the firm-level data, I quantitatively find that lobbying can increase the aggregate TFP of the US economy by 4-7%. In addition, I find that international trade may affect firm lobbying decisions through the market size effect and, in turn, have an impact on aggregate TFP. The effect of trade on firm lobbying is supported by the reduced-form empirical evidence. I find that the China shock decreased small-sized firms' lobbying. Also, I quantitatively find that opening to trade can decrease the positive TFP influence of lobbying by 0.1%.

A caveat of this quantification exercise is that Compustat covers only publicly traded firms, which means that the data might not be representative of the entire US economy. Also, the model does not incorporate other important features of lobbying, such as strategic behaviors between firms and increasing barriers to entry by incumbents. Enriching both the data and the theory components to study the impact of lobbying on misallocation remains a fruitful avenue for future research.

References

- Acemoglu, Daron, David Autor, David Dorn, Gordon H. Hanson, and Brendan Price, "Import Competition and the Great US Employment Sag of the 2000s," *Journal of Labor Economics*, 2016, 34 (S1), S141–S198.
- Aghion, Philippe, Leah Boustan, Caroline Hoxby, and Jerome VandenBussche, "The Causal Impact of Education on Economic Growth: Evidence from U.S," *Mimeo*, 2009.
- Anderson, James E. and Eric Van Wincoop, "Trade Costs," Journal of Economic Literature, 2004, 42 (3), 691–751.
- Arayavechkit, Tanida, Felipe E. Saffie, and Minchul Shin, "Too Big to Pay: Tax Benefits and Corporate Lobbying," *Mimeo*, 2017.
- Asker, John, Allan Collard-Wexler, Jan De Loecker, and John Asker, "Dynamic Inputs and Resource (Mis)Allocation," *Journal of Political Economy*, 2014, 122 (5), 1013–1063.
- Autor, By David H, David Dorn, and Gordon H Hanson, "The China Syndrome: Local Labor Market Effects of Import Competition in the United States," *American Economic Review*, 2013, 103 (6), 2121–2168.
- Bai, Yan, Keyu Jin, and Dan Lu, "Misallocation Under Trade Liberalization," NBER Working Paper 26188, 2019.
- Bartik, Timothy J., "The PDIT Database," Upjohn Institute Technical Report 18-035. Kalamazoo, MI: W.E. Upjohn Institute for Employment Research. https://doi.org/10.17848/tr18-035., 2018.
- Bernard, Andrew B., J. Bradford Jensen, Stephen J. Redding, and Peter K. Schott, "Firms in International Trade," Journal of Economic Perspectives, 2007, 21 (3), 105–130.
- Berry, Christopher R. and Anthony Fowler, "Cardinals or Clerics? Congressional Committees and the Distribution of Pork," American Journal of Political Science, 2016, 60 (3), 692–708.
- _ and _ , "Congressional Committees, Legislative Influence, and the Hegemony of Chairs," Journal of Public Economics, 2018, 158, 1–11.
- Berthou, Antoine, Jong Hyun Chung, Kalina Manova, and Charlotte Sandoz Dit Bragard, "Productivity, (Mis)Allocation, and Trade," *Mimeo*, 2018.
- Bertrand, Marianne, Matilde Bombardini, and Francesco Trebbi, "Is it Whom you Know or What you Know? An Empirical Assessment of the Lobbying Orocess," *American Economic Review*, 2014, *104* (12), 4231–4239.
- ____, ___, Raymond Fisman, and Francesco Trebbi, "Tax-Exempt Lobbying: Corporate Philanthropy as a Tool for Political Influence," American Economic Review, 2020, 110 (7), 2065–2102.
- Blanes i Vidal, Jordi, Mirko Draca, and Christian Fons-Rosen, "Revolving Door Lobbyists," American Economic Review, 2012, 102 (7), 3731–3748.
- Blanga-Gubbay, Michael, Paola Conconi, and Mathieu Parenti, "Globalization for Sale," Mimeo, 2020.
- Bollard, Albert, Peter Klenow, and Huiyu Li, "Entry Costs Rise with Development," Mimeo, 2016.
- Bombardini, Matilde, "Firm Heterogeneity and Lobby Participation," Journal of International Economics, 2008, 75 (2), 329–348.

- _ and Francesco Trebbi, "Votes or money? Theory and evidence from the US Congress," Journal of Public Economics, 2011, 95 (7-8), 587-611.
- _ and _ , "Competition and Political Organization: Together or Alone in Lobbying for Trade Policy?," Journal of International Economics, 2012, 87 (1), 18–26.
- **__ and __**, "Empirical Models of Lobbying," 2020.
- Buera, By Francisco J, Joseph P. Kaboski, and Yongseok Shin, "Finance and Development: A Tale of Two Sectors," American Economic Review, 2011, 101 (5), 1964–2002.
- Burstein, Ariel and Javier Cravino, "Measured Aggregate Gains from International Trade," American Economic Journal: Macroeconomics, 2015, 7 (2), 181–218.
- Card, David and Stefano Dellavigna, "What Do Editors Maximize? Evidence from Four Economics Journals," *Review of Economics and Statistics*, 2020, 102 (1), 195–217.
- Chung, Jong Hyun, "Firm Heterogeneity, Misallocation, and Trade," Mimeo, 2019.
- Cohen, Lauren, Joshua Coval, and Christopher Malloy, "Do Powerful Politicians Cause Corporate Downsizing?," Journal of Political Economy, 2011, 119 (6), 1015–1060.
- Costa-Scottini, Lucas, "Firm-Level Distortions, Trade, and International Productivity Differences," Mimeo, 2018.
- David, Joel M. and Venky Venkateswaran, "The Sources of Capital Misallocation," American Economic Review, 2019, 109 (7), 2531–2567.
- di Giovanni, Julian, Andrei A. Levchenko, and Jing Zhang, "The Global Welfare Impact of China: Trade Integration and Technological Change," *American Economic Journal: Macroeconomics*, 2014, 6 (3), 153–183.
- **Do, Quy Toan and Andrei A. Levchenko**, "Trade, Inequality, and the Political Economy of Institutions," *Journal of Economic Theory*, 2009, 144 (4), 1489–1520.
- Drutman, Lee, The Business of America is Lobbying: How Corporations Became Politicized and Politics Became More Corporate, Oxford University Press, 2015.
- Dyreng, Scott D., Michelle Hanlon, and Edward L. Maydew, "Long-Run Corporate Tax Avoidance," Accounting Review, 2008, 83 (1), 61–82.
- ____, ___, ___, and Jacob R. Thornock, "Changes in Corporate Effective Tax Rates Over the Past 25 Years," Journal of Financial Economics, 2017, 124 (3), 441–463.
- Edmond, Chris, Virgiliu Midrigan, and Daniel Yi Xu, "Competition, Markups, and the Gains from International Trade," *American Economic Review*, 2015, *105* (10), 3183–3221.
- Esteban, By Joan and Debraj Ray, "Inequality, Lobbying, and Resource Allocation," American Economic Review, 2006, 96 (1), 257–279.
- Fajgelbaum, Pablo D., Eduardo Morales, Juan Carlos Suárez Serrato, and Owen Zidar, "State Taxes and Spatial Misallocation," *Review of Economic Studies*, 2019, 86 (1), 333–376.
- Feenstra, Robert C., Hong Ma, and Yuan Xu, "US Exports and Employment," Journal of International Economics, 2019, 120, 46–58.

- ___, Robert Inklaar, and Marcel P. Timmer, "The Next Generation of the Penn World Table," American Economic Review, 2015, 105 (10), 3150–3182.
- Garicano, Luis, Claire Lelarge, and John Van Reenen, "Firm Size Distortions and the Productivity Distribution: Evidence from France," *American Economic Review*, 2016, *106* (11), 3439–3479.
- Gawande, By Kishore, Pravin Krishna, and Marcelo Olarreaga, "Lobbying Competition Over Trade Policy," International Economic Review, 2012, 53 (1), 115–132.
- Gawande, Kishore and Usree Bandyopadhyay, "Is Protection for Sale? Evidence on the Grossman-Helpman Theory of Endogenous Protection," *Review of Economics and Statistics*, 2000, 82 (1), 139–152.
- Goldberg, Pinelopi Koujianou and Giovanni Maggi, "Protection for Sale: An Empirical Investigation," American Economic Review, 1999, 89 (5), 1135–1155.
- Gopinath, Gita, Şebnem Kalemli-Özcan, Loukas Karabarbounis, and Carolina Villegas-Sanchez, "Capital Allocation and Productivity in South Europe," *Quarterly Journal of Economics*, 2017, 132 (4), 1915–1967.
- Grossman, Gene M. and Elhanan Helpman, "Protection for Sale," American Economic Review, 1994, 84 (4), 833–850.
- _ and _ , Special Interest Politics, Cambridge, Mass., and London, U.K: MIT Press, 2001.
- Guner, Nezih, Gustavo Ventura, and Yi Xu, "Macroeconomic Implications of Size-Dependent Policies," Review of Economic Dynamics, 2008, 11 (4), 721–744.
- Handley, Kyle and Nuno Limão, "Policy Uncertainty, Trade, and Welfare: Theory and Evidence for China and the United States," American Economic Review, 2017, 107 (9), 123–175.
- Hanlon, Michelle and Joel Slemrod, "What Does Tax Aggressiveness Signal? Evidence from Stock Price Reactions to News about Tax Shelter Involvement," *Journal of Public Economics*, 2009, 93 (1-2), 126–141.
- Hopenhayn, Hugo A., "On the Measure of Distortions," NBER Working Paper 20404, 2014.
- Hsieh, Chang Tai and Peter J. Klenow, "Misallocation and Manufacturing TFP in China and India," Quarterly Journal of Economics, 2009, 124 (4), 1403–1448.
- Huneeus, Federico and In Song Kim, "The Effects of Firms' Lobbying on Resource Misallocation," Mimeo, 2018.
- Igan, Deniz, Prachi Mishra, and Thierry Tressel, "A Fistful of Dollars: Lobbying and the Financial Crisis," NBER Macroeconomics Annual, 2012, 26, 195–230.
- Kang, Karam, "Policy Influence and Private Returns from Lobbying in the Energy Sector," Review of Economic Studies, 2016, 83 (1), 269–305.
- Kerr, William R., William F. Lincoln, and Prachi Mishra, "The Dynamics of Firm Lobbying," American Economic Journal: Economic Policy, 2014, 6 (4), 343–379.
- Khandelwal, Amit K., Peter K. Schott, and Shang jin Wei, "Trade Liberalization and Embedded Institutional Reform: Evidence from Chinese Exporters," American Economic Review, 2013, 103 (6), 2169–2195.
- Kim, In Song, "Political Cleavages within Industry: Firm-Level Lobbying for Trade Liberalization," American Political Science Review, 2017, 111 (1), 1–20.

- Krueger, Anne O., "The Political Economy of the Rent-Seeking Society," American Economic Review, 1974, 64 (3), 291–303.
- Lafontaine, Francine and Jagadeesh Sivadasan, "Do Labor Market Rigidities Have Microeconomic Effects? Evidence from Within the Firm," American Economic Journal: Applied Economics, 2009, 1 (2), 88–127.
- Levchenko, Andrei A., "Institutional Quality and International Trade," *Review of Economic Studies*, 2007, 74 (3), 791–819.
- __, "International Trade and Institutional Change," Journal of Law, Economics, and Organization, 2013, 29 (5), 1145–1181.
- Manova, Kalina, "Credit Constraints, Heterogeneous Firms, and International Trade," Review of Economic Studies, 2013, 80 (2), 711–744.
- Melitz, Marc J., "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity," Econometrica, 2003, 71 (6), 1695–1725.
- Midrigan, Virgiliu and Daniel Yi Xu, "Finance and Misallocation: Evidence from Plant-Level Data," American Economic Review, 2014, 104 (2), 422–458.
- Milgrom, Paul and John Roberts, "Relying on the Information of Interested Parties," *RAND Journal of Economics*, 1986, 17 (1), 18–32.
- Moll, Benjamin, "Productivity Losses from Financial Frictions: Can Self-financing Undo Capital Misallocation?," American Economic Review, 2014, 104 (10), 3186–3221.
- Nakamura, Emi and Jón Steinsson, "Identification in Macroeconomics," Journal of Economic Perspectives, 2018, 32 (3), 59–86.
- Nunn, Nathan, "Relationship-Specificity, Incomplete Contracts, and the Pattern of Trade," Quarterly Journal of Economics, 2007, 122 (2), 569–600.
- Petrin, Amil and Jagadeesh Sivadasan, "Estimating Lost Output from Allocative Inefficiency, with an Application to Chile and Firing Costs," *Review of Economics and Statistics*, 2013, 95 (1), 286–301.
- Pierce, Justin R. and Peter K. Schott, "Concording U.S. Harmonized System Codes over Time," Journal of Official Statistics, 2012, 28 (1), 53–68.
- and ____, "The Surprisingly Swift Decline of US Manufacturing Employment," American Economic Review, 2016, 106 (7), 1632–1662.
- **Restuccia**, **Diego and Richard Rogerson**, "Policy Distortions and Aggregate Productivity with Heterogeneous Establishments," *Review of Economic Dynamics*, 2008, 11 (4), 707–720.
- Richter, Brian Kelleher, Krislert Samphantharak, and Jeffrey F. Timmons, "Lobbying and Taxes," American Journal of Political Science, 2009, 53 (4), 893–909.
- Roosevelt, Theodore, "The New Nationalism," 1910.
- Stewart, Charles III and Jonathan Woon, "Congressional Committee Assignments, 103rd to 114th Congresses, 1993–2017," 2017.

- _ and Tim Groseclose, "The Value of Committee Seats in the United States Senate, 1947-91," American Journal of Political Science, 1999, 43 (3), 963–973.
- Su, Che-Lin and Kenneth L. Judd, "Constrained Optimization Approaches to Estimation of Structural Models," *Econometrica*, 2012, 80 (5), 2213–2230.

Zingales, Luigi, "Towards a Political Theory of the Firm," Journal of Economic Perspectives, 2017, 31 (3), 113–130.

ONLINE APPENDIX (NOT FOR PUBLICATION)

Appendix A Construction of Data

Balance Sheet Data. Firms' balance sheet data comes from Compustat. The empirical analysis excludes:

- 1. Firms in industries other than manufacturing (SIC \notin [20, 40]).
- 2. Firms that are not incorporated in the US.
- 3. Firm-year observations whose employment, capital, or sales data are missing or below zero.
- 4. Firm-year observations with negative values of employment, capital, or sales.
- 5. Firm-year observations with top and bottom 0.5% of MRPL: I drop these outlier samples not to make my results be driven by outliers following Hsieh and Klenow (2009).

Lobbying Data. Lobbying data became publicly disclosed since LDA (1995). Lobbyists have to report summaries of their lobbying activities semi-annually from 1998 to 2007 and quarterly after 2007. The Center for Responsive Politics constructed the lobbying database based on these reports. I downloaded lobbying data from the Center for Responsive Politics. According to the LDA (1995), the "lobbying activities" are lobbying contacts and efforts in support of such contacts, including preparation and planning activities, research, and other background work that is intended, at the time it is performed, for use in contacts and coordination with the lobbying activities of others.

An example of the lobbying reports by lobbyists are displayed in Figure A1 and A2. This is the report by the lobbyists whose client was Apple Inc in the third quarter of 2020. In Figure A1, the total lobbying expenditure is reported. In Figure A2, general issue area code is reported. I use these issue area codes to construct the non-trade-related lobbying expenditures. In this example, Apple Inc lobbied for tax-related issues.

Trade Data. Sector-level trade data come from Comtrade. I covert HS 6-digit to SIC 4-digit using the conversion from Pierce and Schott (2012) and Acemoglu et al. (2016).

Industry-Level Data. Industry-level data comes from NBER-CES manufacturing data. The NBER-CES manufacturing data has detailed information on industry-level variables at SIC 4-digit code, such as gross output or value-added. Using the gross output data, I construct domestic absorption with imports and exports data from Comtrade. I also obtain value-added shares at the industry level by dividing value-added by gross output.

Congressional Committee Assignment. I obtain congressional committee assignment data from Stewart and Woon (2017).

Wage Data. I obtain 3-digit SIC industry-level wage data within each state from the Census of Business Pattern. I convert the 3-digit NAICS codes to the 3-digit SIC code. The constructed wage data is then matched with the firm-level data based on firms' headquarter locations and industry affiliation.

State-Level Tax. I obtain state-level tax data from the Panel Database on Incentives and Taxes (PDIT) database (Bartik, 2018). It has detailed information on corporate income tax, job creation tax credit, investment tax credit, R&D tax credit, and property tax abatement. These variables are used as controls in Equation 3.2.

Effective Tax Rates. The cash effective tax rates (ETR) developed by Dyreng et al. (2008) is defined as

$$ETR_{it} = \frac{\sum_{h=1}^{6} TXPD_{i,t-h}}{\sum_{h=1}^{6} (PI_{i,t-h} - SPI_{i,t-h})},$$
(A.1)

where TXPD is cash tax paid (Item 317), PI is pretax income (Item 122) and SPI is special itesm (Item 12) from Compustat

Following Dyreng et al. (2017) and Hanlon and Slemrod (2009),

- 1. samples should have non-missing and non-negative values of TXPD, PI, and SPI.
- 2. if ETR is larger than 0.5, I reset them to 0.5 to reduce the effect of outlier samples.

I average each variable over six years and calculate the long-run ETR. It is shown in Dyreng et al. (2008) that the long-run average is more reliable. ETR is used as an alternative dependent variable in Equation 3.2.

Name-Matching. I matched firm names in Compustat to parent firm names in the lobbying database. The matching step is described as follows. The matching is done year by year.

- Step 1: Match firm name based on their exact name without any modifications.
- Step 2: For the names not matched in the step 1, unify abbreviations and then match the remaining names. For example, "Incorporated" is converted into "INC."
- Step 3: For the names not matched in the step 2, Match a firm's name after dropping out abbreviations.
- Step 4: For the names not matched in the step 3, I use the fuzz-name matching algorithm. I calculate the fuzz ratio that measures the similarity between two different names with the fuzz-name matching algorithm. I keep the matched pair if their fuzz ratio is above 95 and the name is composed of more than 20 letters. These two criteria increase the accuracy of matching.

LD-2 Disclosure Form

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10. Check if this is a Termination Report	Termination Date	11. No Lobbying Issue	Activity
INCOME OR EXPEN	SES - YOU MUST comple	te either Line 12 or Line 13	3
12. Lobbying INCOME relating to lobbying activities for this reporting Less than \$5,000 \$5,000 or more \$5,000 or more \$5,000 or more \$5,000 or more \$10,000,00 Provide a good faith estimate, rounded to the nearest \$10 lobbying related income for the client (including all payn registrant by any other entity for lobbying activities on be client).	g period was: EXPENSE relatin Less than \$5,000 \$5,000 or more \$5,000 or more thatf of the shalf of the Method A. Ru Method B. Ru Internal Revenue (Method C. Ru Revenue Code	13. Organizations g to lobbying activities for this rep \$ \$ Check box to indicate expense act r description of options. eporting amounts using LDA defini eporting amounts under section 603 Code eporting amounts under section 162	orting period were: counting method. itions only i3(b)(8) of the 2(e) of the Internal
Signature Digitally Signed By: Nicole Dade		Dat	te 10/19/2020 11:22:17 AM

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FIGURE A1: The Lobbying Report by Apple Inc in 2020, Total Lobbying Expenditure

1/31/2021

LD-2 Disclosure Form

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 $% {A}^{\prime}$

16. Specific lobbying issues

Issues related to tax, trade, technology and broadband.

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

U.S. SENATE, 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
Joel	Johnson			
Susan	Brophy			
Gregg	Rothschild			
Jack	Krumholtz			
Rob	Seidman			
Paul	Poteet			
Megan	Moore		Special Advisor to the Director, Federal Housing Finance Agency; Deputy Assistant Secretary, Department of the Treasury; Special Assistant, Department of the Treasury; Leoislative Assistant, House of Remresentatives. Office of	 Image: A second s
			Rep. Jesse Jackson Jr	

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

https://lda.senate.gov/filings/public/filing/2fb2ab27-82ed-4c80-abe4-b74f0cbdadad/print/

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FIGURE A2: The Lobbying Report by Apple Inc in 2020, General Issue Codes

B.1 Additional Robustness Checks

Dep.	$\log(1 + 1)$	Lobby)	asinh(Lobby)		$100 \times 1[Lobby > 0]$	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Baselin	e					
$China_{oc,it}^{im}$	-0.018^{*}	-0.018**	-0.019*	-0.019**	-0.151^{*}	-0.153^{*}
	(0.009)	(0.009)	(0.010)	(0.010)	(0.089)	(0.087)
$\triangle China_{it}^{oc,im}$	0.002**	0.002**	0.002**	0.002**	0.019**	0.019^{**}
$\times \log(Sale_{it_0})$	(0.001)	(0.001)	(0.001)	(0.001)	(0.009)	(0.009)
Den al D. Francist	F					
Panel B. Export	Exposure					
$China_{oc,jt}^{im}$	-0.028**	-0.028**	-0.029**	-0.030**	-0.234^{**}	-0.240^{**}
	(0.012)	(0.011)	(0.012)	(0.012)	(0.112)	(0.112)
$China_{oc,jt}^{im}$	0.004^{***}	0.004^{***}	0.004^{***}	0.004^{***}	0.029^{**}	0.030^{**}
$\times \log(Sale_{it_0})$	(0.001)	(0.001)	(0.001)	(0.001)	(.012)	(0.012)
$China_{oc,it}^{ex}$	0.003	0.004	0.003	0.005	0.028	0.040
	(0.005)	(0.005)	(0.005)	(0.005)	(0.044)	(0.043)
$China_{oc,it}^{ex}$	-0.001	-0.001	-0.001	-0.001	-0.007	-0.009
$\times \log(Sale_{it_0})$	(0.001)	(0.001)	(0.001)	(0.001)	(0.006)	(0.006)
Firm FE	Y	Y	Y	Y	Y	Y
Time FE	v	N	v	N	v	N
State × Time FF	N	V	N	v	N	v
State A TIME LE	ΤN	T	1 N	T	1 N	T
Ν	33481	32667	33481	32667	33481	32667

TABLE B1: Robustness. Not Averaged. Market Size and Lobbying

Notes. Panel A, B and C of the table reports results from estimating Equation (4.2) using OLS. Panel D report results from estimating Equation (4.4) using OLS. The dependent variables are log one plus lobbying expenditures in columns (1) and (2), the inverse hyperbolic sine transformation of lobbying expenditures in columns (3) and (4) and a dummy variable of positive lobbying expenditures multiplied by 100 in columns (5) and (6). In Panel C, I use non trade-related lobbying expenditures as dependent variables. $China_{jt}^{oc,im}$ and $China_{jt}^{oc,ex}$ are defined in Equations (4.1) and (4.3). Robust standard errors are reported in parentheses and clustered on 3-digit SIC industries. * p<0.1; ** p<0.05; *** p<0.01.

TABLE B2: Robustness. Different Proxies for Initial Size. Market Size and Lobbying

Dep.	$\log(1 +$	Lobby)	asinh(Lobby)	$100 \times 1[$	Lobby > 0]
	(1)	(2)	(3)	(4)	(5)	(6)

Panel A. Initial	Level of E	mploymer	nt			
$China_{oc,it}^{im}$	-0.084^{**}	-0.100**	-0.088**	-0.105^{**}	-0.648^{*}	-0.771**
	(0.041)	(0.043)	(0.043)	(0.045)	(0.328)	(0.340)
$\log(Emp_{it_0})$	0.017^{**}	0.019^{**}	0.018^{**}	0.020^{**}	0.124^{**}	0.135^{**}
$\times \triangle China_{jt}^{oc,im}$	(0.007)	(0.008)	(0.008)	(0.009)	(0.055)	(0.061)
Panel B. Initial	Level of C	'apital				
$China_{oc,it}^{im}$	-0.094^{**}	-0.112^{**}	-0.099**	-0.118^{**}	-0.762^{**}	-0.909**
	(0.045)	(0.050)	(0.048)	(0.053)	(0.375)	(0.405)
$\log(Capital_{it_0})$	0.014^{***}	0.016^{**}	0.015^{***}	0.017^{**}	0.109^{**}	0.121^{**}
$\times \triangle China_{jt}^{oc,im}$	(0.005)	(0.006)	(0.006)	(0.006)	(0.043)	(0.049)
Firm FE	Y	Y	Υ	Y	Υ	Y
Time FE	Υ	Ν	Υ	Ν	Υ	Ν
State \times Time FE	Ν	Υ	Ν	Υ	Ν	Υ
Ν	2798	2744	2798	2744	2798	2744

Notes. Panel A and B the table reports results from estimating Equation (4.2) using OLS. The dependent variables are log one plus lobbying expenditures in columns (1) and (2), the inverse hyperbolic sine transformation of lobbying expenditures in columns (3) and (4) and a dummy variable of positive lobbying expenditures multiplied by 100 in columns (5) and (6). $China_{jt}^{oc,im}$ and $China_{jt}^{oc,ex}$ are defined in Equations (4.1) and (4.3). Capital is measured by *ppegt* from Compustat. The samples are averaged over six years. Robust standard errors are reported in parentheses and clustered on 3-digit SIC industries. * p<0.1; ** p<0.05; *** p<0.01.

_

Dep.	$\log(1 +$	Lobby)	asinh(Lobby)		$100 \times 1 [Lobby > 0]$	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Baselin	ne					
$China_{oc,jt}^{im}$	0.010	0.008	0.010	0.008	0.090	0.066
	(0.025)	(0.027)	(0.025)	(0.027)	(0.220)	(0.242)
$\log(Sale_{it_0})$	0.000	0.000	0.000	0.000	0.001	0.004
$\times \triangle China_{jt}^{oc,im}$	(0.003)	(0.004)	(0.003)	(0.004)	(0.031)	(0.034)
Panel B. Export	Exposure					
China ^{im} _{oc it}	-0.012	-0.018	-0.012	-0.018	-0.096	-0.153
00,50	(0.037)	(0.041)	(0.037)	(0.041)	(0.333)	(0.369)
$\log(Sale_{it_0})$	0.003	0.003	0.003	0.003	0.022	0.028
$\times \triangle China_{it}^{oc,im}$	(0.005)	(0.006)	(0.005)	(0.006)	(0.047)	(0.051)
China ^{im} _{oc it}	0.013	0.016	0.013	0.016	0.116	0.136
00,97	(0.012)	(0.013)	(0.012)	(0.013)	(0.108)	(0.115)
$\log(Sale_{it_0})$	-0.001	-0.002	-0.001	-0.002	-0.013	-0.016
$\times \triangle China_{jt}^{oc,im}$	(0.001)	(0.001)	(0.001)	(0.001)	(0.012)	(0.012)
Panel C. Non-P	arametric	Regressio	ons			
$Q_1 China_{it}^{oc,im}$	0.002	-0.001	0.002	-0.001	0.015	-0.014
Ji Ji	(0.004)	(0.006)	(0.004)	(0.006)	(0.038)	(0.060)
$Q_2China_{it}^{oc,im}$	-0.002	0.002	-0.002	0.002	-0.013	0.023
Ju Ju	(0.010)	(0.012)	(0.010)	(0.012)	(0.093)	(0.110)
$Q_3China_{ii}^{oc,im}$	0.017	0.013	0.017	0.013	0.130	0.089
ji	(0.020)	(0.023)	(0.020)	(0.023)	(0.185)	(0.202)
Firm FE	Y	Y	Y	Y	Y	Y
Time FE	Υ	Ν	Υ	Ν	Υ	Ν
State \times Time FE	Ν	Υ	Ν	Υ	Ν	Υ
Ν	2798	2744	2798	2744	2798	2744

TABLE B3: Robustness. Trade-Related Lobbying Expenditures as the Dependent Variable. Market Size and Lobbying

Notes. Panels A, B and C of the table reports results from estimating Equation (4.2) using OLS. Panel C reports results from estimating Equation (4.4) using OLS. The dependent variables are log one plus trade-related lobbying expenditures in columns (1) and (2), the inverse hyperbolic sine transformation of trade-related lobbying expenditures in columns (3) and (4) and a dummy variable of positive trade-related lobbying expenditures multiplied by 100 in columns (5) and (6). $China_{jt}^{oc,im}$ and $China_{jt}^{oc,ex}$ are defined in Equations (4.1) and (4.3). The samples are averaged over six years Robust standard errors are reported in parentheses and clustered on 3-digit SIC industries. * p<0.1; ** p<0.05; *** p<0.01.

B.2 Structural Interpretation of the China shock Regression

In this section, I show that regression model in Section 4.1 can be structurally derived from the model framework in Section 2. A firm's optimal lobbying expenditure is expressed as follows: for firm i, country c and time t,

$$1 + b^* = C^1 \pi(0; \phi, \bar{\tau}^Y, \eta)^{\frac{\theta\sigma}{1 - \theta\sigma}} = C_c^1 \left(\sum_{c' \in \Omega_i^c} \left(\frac{\sigma}{\sigma - 1} \frac{w_c \tau_{cc'}}{\phi} \right)^{1 - \sigma} (1 - \bar{\tau}^Y)^{\sigma} P_{c'}^{\sigma - 1} E_{c'} \right)^{\frac{\theta\sigma}{1 - \theta\sigma}}, \quad (B.1)$$

where Ω_i^c is a set of firm *i*'s markets, and C_c^1 is a constant common to all lobbying firms in country c, $\tau_{cc'}$ is an iceberg trade cost to export to country c' from country c.⁵⁷ Ω_i^c is endogenously determined in the equilibrium. Firms with higher productivity, lower exogenous distortions, or lower fixed lobbying costs will enter more foreign markets, because they can make profits even after incurring fixed export costs. $P_{c'}^{\sigma-1}E_{c'}$ measures size of market in country c'.

Taking log of both sides of Equation (B.1), I can derive the following regression model:

$$\log(1+b^*) = \text{Constant} + \underbrace{\frac{\theta\sigma}{1-\theta\sigma} \left(\sum_{c'\in\Omega_i^c} \tau_{c'}^{1-\sigma} P_{c'}^{\sigma-1} E_{c'}\right)}_{\text{Market Size}} + \underbrace{\frac{\theta\sigma}{1-\theta\sigma} ((\sigma-1)\log\phi + \sigma\log(1-\bar{\tau}^Y))}_{\text{Error Term}} \right)}_{\text{Error Term}}$$
(B.2)

which is analogous in Equation (4.2). In the regression model in Equation (4.2), $China_{jt}^{oc,im}$ and its interaction term with a firm's size is a proxy for market size effects. Depending on firm size, a firm's optimal lobbying expenditure is differentially affected by the China shock because of market size differential. The identifying assumption is that the China shock is uncorrelated with the error term which is a function of firm productivity and exogenous distortions.

⁵⁷If $c \neq c'$, $\tau_{cc'} = \tau_x$ and if c = c;, $\tau_{cc'} = 1$.

Appendix C Additional Evidence on Firm Heterogeneity

This section shows that firm size alone cannot explain the lobbying pattern in the data. In Figure C1, each dot represents a firm-year level observation with positive lobbying amounts. Within each industry and year, firms are divided into two groups based on the median of the sales distribution.



FIGURE C1: Additional Fact. Firm Size and Heterogeneity

Notes. Each dot represents a firm-year observation with positive lobbying amounts. X-axis and Y-axis plot the residuals of the log of sale and lobbying on 4-digit SIC and year fixed effects respectively. I divided firms into two groups based on whether their sale is above the median or not within each industry-year.

Table C1 reports the descriptive statistics of sales and lobbying expenditures of firms in different groups defined based on quartiles of the initial sales distribution within industry.⁵⁸ Firms with larger sizes tend to lobby more at both intensive and extensive margins. On average, 32% of the group above the third quartile participated in lobbying, whereas only 5% of the group below the first quartile participated. This shows that although firm size measured by sales and lobbying amounts are highly correlated, firm size alone cannot fully explain the pattern of lobbying. It is pretty common for small-sized firms to participate in lobbying, and their total sum of lobbying is non-negligible. The total sum of lobbying expenditures of the largest group and of the remaining groups are \$6.3 and \$1.2 billion respectively across the sample period. About 19% of the total lobbying expenditure comes from small or medium-sized firms. This implies an additional dimension of heterogeneity in lobbying. In my model, this additional dimension of heterogeneity is modeled as stochastic fixed lobbying costs η .

⁵⁸The number of firms of each group is not the same because the quartiles are defined based on the initial sales.

	Q1 (1)	Q2 (2)	Q3 (3)	$\begin{array}{c} Q4\\ (4) \end{array}$
		()	(-)	
Lobbying	697.2	78.67	25.13	10.70
Expenditures (\$1K)	(2725.6)	(745.3)	(209.9)	(87.79)
1[Lobbu > 0]	0 319	0 191	0.0817	0.0561
1[Lood g > 0]	(0.463)	(0.326)	(0.274)	(0.230)
Sales	6843.9	1159.9	387.1	109.7
	(21810.8)	(4814.7)	(1469.4)	(752.6)
Ν	9060	9940	10099	10593

TABLE C1: Additional Fact. Firm Size and Heterogeneity

Notes. This table reports the descriptive statistics of lobbying for each group. Firms are grouped by the quartiles based on their initial sales within a 4-digit SIC industry. The group with the largest and smallest size are denoted as Q1 and Q4. Standard deviation is reported in parentheses.

Appendix D Additional Results for Estimating θ

D.1 Discussions on Exclusion Restrictions

Suppose the chairperson IV satisfies the relevance condition, so the IV is significantly correlated with the lobbying expenditures in the first stage. A natural concern is that the first stage results may reflect spurious correlations rather than causality. Although the exclusion restriction is fundamentally untestable, an event study can detect spurious correlations caused by reverse causality problems or preexisting confounding factors by checking pre-trends.⁵⁹ I conduct an event study to examine whether there are preexisting trends in lobbying expenditures before a local Congress member's appointment of the chairperson on the Appropriations Committees. If there were reverse causality problems or preexisting confounding factors, it would violate the parallel trend assumption. The reverse causality problem can be detected if an increase in lobbying expenditures leads to the appointment. Also, if there were preexisting confounding factors, they may show up as differential pre-trends.





Notes. Panels A and B present event study coefficients β_{τ} in Equation (D.1). The dependent variable is log of one plus lobbying in Panel A and a dummy of positive lobbying in Panel B. The coefficient in t - 1 is normalized to be zero. In both panels, firm and sector-year fixed effects are controlled. Standard errors are clustered on 3-digit SIC industries. The vertical lines show the 95% confidence intervals.

⁵⁹For example, a reverse causality problem can arise if a firm lobbies to make a local Congress member be appointed as the chairperson.

I estimate the following event study regression:

$$y_{it} = \sum_{\tau=-4}^{4} \beta_{\tau} Chair_{i,\tau} + \delta_i + \delta_{jt} + \epsilon_{it}, \qquad (D.1)$$

where the dependent variables are log one plus lobbying or a dummy of positive lobbying multiplied 100. $Chair_{i,t-\tau}$ is the event study variables which is defined as $Chair_{i,\tau} := \mathbf{1}[t = \tau_i^{Chair} + \tau]$ where τ_i^{Chair} is the year when a local Congress member of the state in which firm *i* is headquartered is appointed as the chairperson and $\mathbf{1}[.]$ is the indicator function. $Chair_{i,-1}$ is normalized to be zero, so $\beta_{i,\tau}$ is interpreted as the changes of lobbying expenditures relative to the one year before the appointment. The samples include both treated and non-treated firms. Firm fixed effects δ_i and sector-time fixed effects δ_{jt} are controlled to absorb time-invariant unobservables and sectoral shocks. Standard errors are clustered on state-level, given that the chairpersonship shock is at the state-level.

Figure D1 illustrates estimated coefficients β_{τ} in Equation (D.1). Prior to the appointment, there are no pre-trends in lobbying expenditures, but once a local Congress member becomes the chairperson, firms start increasing their lobbying expenditures. The evidence of no pre-trends in lobbying expenditures indicates that the first-stage correlation is not driven by reverse causality problems or preexisting omitted confounding factors, which bolsters the support of the identifying assumption of the instrumental variable. After the appointment, the log one plus lobbying increases by 0.1 standard deviations, and the probability of lobbying increases by 2% relative to one year before the appointment.

D.2 Extension to Capital Wedge

Extension: Capital Wedge. The model can incorporate firm-specific capital distortions with capital as an additional factor of production. For simplicity, I only consider closed economy, but the model presented here can be easily extended to open economy settings. Firm production function is Cobb-Douglas with labor and capital:

$$y = \phi k^{\alpha} l^{1-\alpha}.$$

There are output and capital exogenous distortions. Capital distortions decrease marginal product of capital relative to marginal product of labor. Firms can decrease output distortions and increase capital distortions through lobbying. I assume the functional form of output and capital wedges driven by exogenous distortions as follows:

$$1 - \tau^{Y} = (1 - \bar{\tau}^{Y})(1 + b_{Y})^{\theta_{Y}}$$

$$1 + \tau^{K} = (1 + \bar{\tau}^{K})(1 + b_{K})^{-\theta_{K}},$$

where $1 - \bar{\tau}^Y$ and $1 - \bar{\tau}^K$ are exogenous output and capital wedges. θ_Y and θ_K are the parameters that capture how lobbying effectively increases and decreases output and capital wedges respectively.

Firm maximization problem is

$$\pi = \max_{b_Y, b_K, p, l, k} (1 - \bar{\tau}^Y) (1 + b_Y)^{-\theta_Y} pq - wl - (1 + \bar{\tau}^K) (1 + b_K)^{-\theta_K} rk - f^b \mathbf{1} [b_Y + b_K \ge 0]$$
(D.2)

subject to $q = p^{-\sigma}P^{\sigma-1}E$ where q is the demand that firm faces. Solving the model, I can derive two following regression models

$$\log MRPL_{i,t+1} = \log \frac{\operatorname{Sale}_{it}}{L_{it}} = -\theta_Y \log(1 + b_Y^*) + \epsilon_{it}$$
(D.3)

and

$$\log \frac{MRPK_{i,t+1}}{MRPL_{i,t+1}} = \log \frac{L_{it}}{K_{it}} = -\theta_K \log(1+b_K^*) + \epsilon_{it}, \tag{D.4}$$

where b_Y^* and b_K^* are optimal lobbying expenditures spent for output wedges and capital wedges.

In the data, I observe the total expenditure $b_Y^* + b_K^*$, but not b_Y^* and b_K^* separately. However, with the Cobb-Douglass production function, b_Y^* and b_K^* are proportional to the total lobbying expenditure plus some constant term, that is, $1 + b_Y^* = C_Y(2 + b_Y^* + b_K^*)$ and $1 + b_K^* = C_K(2 + b_Y^* + b_K^*)$, where $C_Y = \theta_Y \sigma / (\theta_Y \sigma - \theta_K \alpha)$ and $C_K = -\theta_K \alpha / (\theta_Y \sigma - \theta_K \alpha)$. Therefore, with the Cobb-Douglas constant return to scale production function, I can still recover θ_Y and θ_K using the total expenditure of lobbying observed in the data.

I estimate the following regressions in long differences using the chairperson IV:

$$\log(\operatorname{Sale}/\operatorname{Emp})_{i,t+1} = \theta_Y \log(2 + b_{it}^*) + \mathbf{X}'_{it}\boldsymbol{\beta} + \delta_i^Y + \delta_{jt}^Y + \log(1 - \bar{\tau}_{it}^Y)$$

$$\log(\operatorname{Emp}/\operatorname{Capital})_{i,t+1} = \theta_K \log(2 + b_{it}^*) + \mathbf{X}'_{it}\boldsymbol{\beta} + \delta_i^K + \delta_{jt}^K + \log(1 - \bar{\tau}_{it}^K),$$
(D.5)

where δ are fixed effects. I control the same set of fixed effects and firm-level controls with the baseline regression model. I also control 4-digit industry-specific fixed effects and firm fixed effects. The estimated θ_K are reported in columns (1)-(3) of Table D1. Across different specifications, the estimated coefficients are statistically insignificant. In columns (4)-(6), I use log(Value-Added/K) as an alternative dependent variable, but the estimated coefficients are also statistically insignificant.

Dep.	l	og(wL/K))	$\log(Sale/K)$		
	OLS	I	IV		IV	
	(1)	(2)	(3)	(4)	(5)	(6)
$\log(1+b_{it}^*)$	-0.011 (0.007)	0.016 (0.027)	0.020 (0.034)	-0.008 (0.007)	-0.060 (0.038)	-0.063 (0.047)
KP-F		31.81	26.90		31.81	26.90
Industry \times Time FE Firm Control	Y N	Y N	Y Y	Y N	Y N	Y Y
Ν	1216	1216	1216	1216	1216	1216

TABLE D1: Robustness. MRPK. Recovering θ_K

Notes. This table reports OLS and IV estimates of Equation (3.2). The dependent variable is a labor-capital ratio in columns (1)-(3), and the dependent variable is a log of MRPK in columns (4)-(6). The OLS estimates are reported in columns (1) and (4). The IV estimates are reported in columns (2), (3), (5), and (6). The IV is a dummy variable which equals one if a Congress member of the state where a firm is headquartered becomes a chair of the Appropriations Committees in the House or Senate. Firm control includes dummies indicating quantiles of a firm's initial sales. KP-F is Kleibergen-Paap F-statistics. The samples are averaged over six years. Standard errors are clustered at the state level. * p<0.1; ** p<0.05; *** p<0.01.

D.3 Additional Robustness Checks

ETR is an imperfect proxy for firm-specific tax rates, so the transformation into $\log(1 - ETR)$ may magnify measurement errors. To show that this is not the issue, I conduct the same analysis with a log of ETR as an alternative dependent variable. The results are reported in columns (1)-(3) of Table D2. Instead of setting ETR to 0.5 at a maximum, I reset 1 at a maximum and run the analysis to examine whether different winsorization schemes drive the results. The estimated coefficients reported in columns (4)-(6) of Table D2 show that the results are robust to different functional forms of dependent variables and winsorization schemes.

Dep.		$\log(ETR)$		$\log(ETR1)$		
	OLS	IV		OLS	IV	
	(1)	(2)	(3)	(4)	(5)	(6)
$\log(1+b_{it}^*)$	$0.017 \\ (0.016)$	-0.193** (0.090)	-0.238^{**} (0.098)	0.019 (0.016)	-0.191^{**} (0.091)	-0.237^{**} (0.098)
KP-F		23.25	18.96		23.25	18.96
Industry FE State Control Firm Control	Y Y N	Y Y N	Y Y Y	Y Y N	Y Y N	Y Y Y
Ν	873	873	873	873	873	873

TABLE D2: Recovering θ . Robustness. Different ETR Measures.

Notes. This table reports OLS and IV estimates of Equation (3.2). The dependent variable is log of ETR in columns (1)-(3) and the dependent variable is log of ETR that was winsorized at 1 instead of 0.5. *ETR* is defined in Equation (3.3). The OLS estimates are reported in columns (1) and (4). The IV estimates are reported in columns (2), (3), (5) and (6). The IV is a dummy variable which is equal to one if a Congress member of the state where a firm is headquartered in becomes a chair of the Appropriations Committee in the House or Senate. Firm control includes dummies indicating quantiles of a firm's initial sales. The samples are averaged over six years. Standard errors are clustered at the state-level. * p<0.1; ** p<0.05; *** p<0.01.

D.4 Additional Tables and Figures

Second Stage Dep.	$\log(1/M)$	(RPL)	$\log(1 -$	ETR)	
	(1)	(2)	(3)	(4)	
Chairperson IV	$\begin{array}{c} 0.942^{***} \\ (0.167) \end{array}$	$\begin{array}{c} 0.836^{***} \\ (0.161) \end{array}$	$\begin{array}{c} 0.942^{***} \\ (0.167) \end{array}$	$0.836^{***} \\ (0.161)$	
Industry FE	Υ	Y	Υ	Y	
State Control	Υ	Υ	Υ	Υ	
Firm Control	Ν	Υ	Ν	Υ	
Ν	1216	1216	1216	1216	

TABLE D3: First Stage Results

Notes. This table reports the first stage results of the IV estimates of Equation (3.2). The dependent variable is log one plus lobbying. Firm control includes dummies indicating quantiles of a firm's initial sales. Standard errors are clustered at the state-level. * p<0.1; ** p<0.05; *** p<0.01.

Appendix E Quantitative Appendix

E.1 Calibration Procedure

This section describes the calibration procedure using the method of moments. Parameters Θ minimize the following constrained maximization problem

$$\hat{\Theta} = argmin_{\Theta} \{ (\mathbf{m} - \mathbf{m}(\Theta))' \mathbf{W}(\mathbf{m} - \mathbf{m}(\Theta)) \text{ subject to } L(\Theta) = 0 \}$$

where **m** and $\mathbf{m}(\Theta)$ are empirical and model moments, W is the weighting matrix, and $L(\Theta)$ is the constraint imposed by the equilibrium conditions.

The constraints $L(\Theta) = 0$ are as follows:

$\int_{\omega \in \Omega_H^x} p^x(\omega) q^x(\omega) d\omega = \int_{\omega \in \Omega_F^x} p^x(\omega) q^x(\omega) d\omega$
$\int_{\omega\in\Omega_H} l(\omega)d\omega = L_H$
$\int_{\omega \in \Omega_F} l(\omega) d\omega = L_F$
$E_H = w_H L_H + \Pi_H + T_H$
$E_F = w_F L_F + \Pi_F + T_F$

I set W to be the identity matrix. The moments are normalized to convert the difference between the model and the empirical moments into the percentage deviation. The solution to the problem is not guaranteed to be the global minimum. Therefore, I solve the constrained minimization problem multiple times with different starting points to deal with the local minimum problem.

Appendix F Mathematical Derivation

F.1 Derivation of optimal lobbying amounts and profits.

I derive expressions for a firm's optimal lobbying amounts and profits conditional on lobbying. I first characterize non-exporters' optimal lobbying amounts and profits. Conditional on spending lobbying amounts of b, a firm's output wedge is given by $(1 - \overline{\tau}^Y)(1 + b)^{\theta}$. Under monopolistic competition with CES demand, a firm charges constant mark up over marginal costs. A firm's profit is

$$\pi^{d}(b;\phi,\bar{\tau}^{Y},\eta) = \frac{1}{\sigma} \left(\frac{\sigma}{\sigma-1} \frac{w_{c}}{\phi} \right)^{1-\sigma} ((1-\bar{\tau}^{Y})(1+b)^{\theta})^{\sigma} P_{c}^{\sigma-1} E_{c} - P_{c}b - P_{c}f^{b}$$

$$= \tilde{\pi}^{d}(0;\phi,\bar{\tau}^{Y},\eta)(1+b)^{\theta\sigma} - P_{c}b - P_{c}f^{b}$$
(F.1)

where $\tilde{\pi}^d(0; \phi, \bar{\tau}^Y, \eta)$ is variable profits conditional on not lobbying for non-exporters. A firm chooses the optimal lobbying amounts that maximizes profits in the above equation, which is characterized by the first-order condition (FOC). Taking the derivative with respect to b,

$$P_c = \theta \sigma \tilde{\pi}(0; \phi, \bar{\tau}^Y, \eta) (1+b)^{(\theta\sigma-1)}$$

Form the above equation, I can obtain that

$$b^{d*} = \left(\frac{\theta\sigma}{P_c}\right)^{\frac{1}{1-\theta\sigma}} \tilde{\pi}^d (0; \phi, \bar{\tau}^Y, \eta)^{\frac{1}{1-\theta\sigma}} - 1$$
(F.2)

After substituting the optimal lobbying amounts in Equation (F.2) into Equation (F.1), I obtain that

$$\pi^{d}(b^{d*};\phi,\bar{\tau}^{Y},\eta) = C_{c}^{2}\tilde{\pi}^{d}(0;\phi,\bar{\tau}^{Y},\eta)^{\frac{1}{1-\theta\sigma}} - w_{c}f_{c} - P_{c}[f^{b}\eta - 1].$$

Now consider an exporter. An exporter's profit is

$$\pi^{x}(b;\phi,\bar{\tau}^{Y},\eta) = \frac{1}{\sigma} \left(\frac{\sigma}{\sigma-1} \frac{w_{c}}{\phi} \right)^{1-\sigma} \left(P_{c}^{\sigma-1} E_{c} + \tau_{x} P_{c'}^{\sigma-1} E_{c'} \right) \times ((1-\bar{\tau}^{Y})(1+b)^{\theta})^{\sigma} - P_{c}b - P_{c}f^{b}\eta - w_{c}f_{c}^{x} = \tilde{\pi}^{x}(0;\phi,\bar{\tau}^{Y},\eta)(1+b)^{\theta\sigma} - P_{c}b - P_{c}f^{b}\eta - w_{c}f_{c}^{x},$$
(F.3)

where $\tilde{\pi}^x(0; \phi, \bar{\tau}^Y, \eta)$ is variable profits conditional on lobbying for exporters. Taking the first-order

condition with respect to b, I obtain that

$$b^{x*} = \left(\frac{\theta\sigma}{P_c}\right)^{\frac{1}{1-\theta\sigma}} (\tilde{\pi}^d(0;\phi,\bar{\tau}^Y,\eta) + \tilde{\pi}^x(0;\phi,\bar{\tau}^Y,\eta))^{\frac{1}{1-\theta\sigma}} - 1.$$
(F.4)

After substitution the optimal lobbying amounts in the above equation in to Equation (F.3), an exporter's profit is derived as follows:

$$\pi^{x}(b^{x*};\phi,\bar{\tau}^{Y},\eta) = C_{c}^{2}(\tilde{\pi}^{d}(0;\phi,\bar{\tau}^{Y},\eta) + \tilde{\pi}^{x}(0;\phi,\bar{\tau}^{Y},\eta))^{\frac{1}{1-\theta\sigma}} - w_{c}f_{c} - P_{c}[f^{b}\eta - 1].$$

F.2 Proof of Proposition 1

Using that lobbying is increasing in variable profits and variable profits increase in ϕ , $1 - \bar{\tau}^Y$, and $P_c^{\sigma-1}E_c + x(P_{c'}^*)^{\sigma-1}E_{c'}$, Proposition 1(i) can be proven.

For given $(1 - \bar{\tau}^Y, \eta)$, because $1 - \theta \sigma < 1$ under Assumption 1, the RHS of Equation 2.7 increases in ϕ by larger magnitude than the LHS of Equation (2.7). This implies that for a given level of fixed lobbying costs $f^b\eta$, a firm with $\phi > \bar{\phi}^b_c(\bar{\tau}^Y, \eta)$ participate in lobbying. Because a firm with lower $\bar{\tau}^Y$ has a larger tax gain post-lobbying and a firm with higher η has a larger fixed lobbying cost, $\phi^b_c(\bar{\tau}^Y, \eta)$ increases in both $\bar{\tau}^Y$ and η .

F.3 Proof of Proposition 2

Because the results of Proposition 2 are derived under the closed economy assumption, I omit subscripts indexing countries. I first provide two useful expressions for the proofs of Proposition 2.

Useful Expression 1. Suppose Y_1 and Y_2 follow a joint normal distribution. Define $X_i = exp^{Y_i}$ for i = 1, 2. By definition, X_1 and X_2 follow a joint log-normal distribution. Then, using that

$$\int \int X_1 X_2 dF_{X_1} dF_{X_2} = \int \int exp^{Y_1 + Y_2} dF_{Y_1} dF_{Y_2} = \mathbb{E}[exp^{Y_1 + Y_2}]$$

and that $Y_1 + Y_2 \sim N(\mu_1 + \mu_2, \sigma_1^2 + \sigma_2^2 + 2\rho\sigma_1\sigma_2)$, I can obtain

$$e^{Y_1+Y_2} \sim \log N(\mu_1 + \mu_2, \sigma_1^2 + \sigma_2^2 + 2\rho\sigma_1\sigma_2).$$

From the above equations, I can derive the following first useful expression.

$$\mathbb{E}[X_1 X_2] = \mathbb{E}[exp^{Y_1 + Y_2}] = exp(\mu_1 + \mu_2 + \frac{1}{2}[\sigma_1^2 + \sigma_2^2 + 2\rho\sigma_1\sigma_2]).$$
(F.5)

This gives the analytical expression for the expectation of multiplication of two log-normally distributed random variables.

Useful Expression 2. TFP of the aggregate economy is defined as output per worker TFP = Q/L, where Q is the aggregate output and L is the labor. TFP can be rewritten as follows:

$$\frac{1}{TFP} = \frac{L}{Q} = \frac{\int l(\omega)d\omega}{Q} = \int \frac{y(\omega)}{Q} \frac{1}{\phi(\omega)}d\omega = \int \frac{1}{\phi(\omega)} \left(\frac{p(\omega)}{P}\right)^{-\sigma}d\omega.$$
 (F.6)

Firm's optimal pricing is

$$p = \frac{\sigma}{\sigma - 1} \frac{w}{\phi} \left((1 - \bar{\tau}^Y)(1 + b^*)^{\theta} \right)^{-1},$$

where b^* is a firm's optimal lobbying amounts. By substituting the above equation in to Equation (F.6), I obtain the second useful expression:

$$TFP = M^{\frac{1}{\sigma-1}} \frac{\left[\int \phi^{\sigma-1} ((1-\bar{\tau}^Y)(1+b^*)^{\theta})^{\sigma-1} dF(\phi, 1-\bar{\tau}^Y)\right]^{-\frac{\sigma}{1-\sigma}}}{\int \phi^{\sigma-1} ((1-\bar{\tau}^Y)(1+b^*)^{\theta})^{\sigma} dF(\phi, 1-\bar{\tau}^Y)}.$$
 (F.7)

Proof of Proposition 2(i) (The Efficient Economy). If there are no exogenous distortions and lobbying is not allowed, using Equation (F.7), the TFP of the efficient economy reduces to

$$TFP_{eff} = M^{\frac{1}{\sigma-1}} \left[\int \phi^{\sigma-1} dF(\phi) \right]^{\frac{1}{\sigma-1}}.$$
 (F.8)

Using Equation (F.5) and taking log of both sides of Equation (F.8), I obtain that

$$\log(TFP_{eff}) = \frac{1}{\sigma - 1} \log M + \mathbb{E}[\log \phi] + \frac{(\sigma - 1)}{2} Var(\log \phi),$$

where $\frac{1}{\sigma-1}\log M = 0$ under Assumption 2(iv). This proves Proposition 1(i).

Proof of Proposition 2(ii) (The Exogenous Wedge Economy). If there were only exogenous distortions, using Equation (F.7), the TFP of the exogenous wedge economy reduces to

$$TFP_{exo} = M^{\frac{1}{\sigma-1}} \frac{\left[\int \phi^{\sigma-1} (1-\bar{\tau}^Y)^{\sigma-1} dF(\phi, 1-\bar{\tau}^Y)\right]^{-\frac{\sigma}{1-\sigma}}}{\int \phi^{\sigma-1} (1-\bar{\tau}^Y)^{\sigma} dF(\phi, 1-\bar{\tau}^Y)}.$$

Using Equation (F.5), the log of the numerator is expressed as

$$\begin{split} \log[\int \phi^{\sigma-1}(1-\bar{\tau}^Y)^{(\sigma-1)}dF(\phi,1-\bar{\tau}^Y)]^{-\frac{\sigma}{1-\sigma}} \\ &= \frac{\sigma}{\sigma-1} \bigg[(\sigma-1)\mathbb{E}[\log\phi] + (1-\sigma)\mathbb{E}[\log(1-\bar{\tau}^Y)] + \frac{(\sigma-1)^2}{2}Var(\log\phi) + \frac{(\sigma-1)^2}{2}Var(\log(1-\bar{\tau}^Y)) \\ &\quad + \sigma(\sigma-1)^2Cov(\log\phi,\log(1-\bar{\tau}^Y)) \bigg] \\ &= \sigma\mathbb{E}[\log\phi] - \sigma\mathbb{E}[\log(1-\bar{\tau}^Y)] + \frac{\sigma(\sigma-1)}{2}Var(\log\phi) \\ &\quad - \frac{(\sigma-1)\sigma}{2}Var(\log(1-\bar{\tau}^Y)) + (\sigma-1)\sigmaCov(\log\phi,\log(1-\bar{\tau}^Y)). \end{split}$$

The log of the denominator is expressed as

$$\log \int \phi^{\sigma-1} (1-\bar{\tau}^Y)^{\sigma} dF(\phi, 1-\bar{\tau}^Y) = (\sigma-1)\mathbb{E}[\log\phi] - \sigma\mathbb{E}[\log(1-\bar{\tau}^Y) + \frac{(\sigma-1)^2}{2} Var(\log\phi) + \frac{\sigma^2}{2} Var(\log(1-\bar{\tau}^Y)) - (\sigma-1)\sigma Cov(\log\phi, \log(1-\bar{\tau}^Y)).$$

Subtracting the log of the denominator from the log of the numerator,

$$\log(TFP_{exo}) = \frac{1}{\sigma - 1}\log M + \mathbb{E}[\log \phi] + \frac{(\sigma - 1)}{2}Var(\log \phi) - \frac{\sigma}{2}Var(\log(1 - \bar{\tau}^Y)),$$
(F.9)

where $\frac{1}{\sigma-1}\log M = 0$ under Assumption 2(iv). This proves Proposition 2(ii).

Proof of Proposition 2(iii) (The Lobbying Economy). Using Equation (F.7), the TFP of the lobbying economy reduces to

$$TFP_{endo} = M^{\frac{1}{\sigma-1}} \frac{\left[\int \phi^{\sigma-1} (1-\bar{\tau}^Y)(1+b^*)^{\theta}\right)^{\sigma-1} dF(\phi, 1-\bar{\tau}^Y)\right]^{-\frac{\sigma}{1-\sigma}}}{\int \phi^{\sigma-1} ((1-\bar{\tau}^Y)(1+b^*)^{\theta})^{\sigma} dF(\phi, 1-\bar{\tau}^Y)}.$$

The optimal lobbying expenditure in a closed economy is expressed as

$$1 + b^* = \left(\frac{\theta\sigma}{P}\right)^{\frac{1}{1-\theta\sigma}} \left[\frac{1}{\sigma} \left(\mu\frac{w}{\phi}\right)^{1-\sigma} (1-\bar{\tau}^Y)^{\sigma} P^{\sigma-1} E\right]^{\frac{1}{1-\theta\sigma}}.$$
 (F.10)

Define

$$\bar{C} = \left[\frac{\sigma\theta}{P}\frac{1}{\sigma}(\mu w)^{1-\sigma}P^{\sigma-1}E\right]^{\frac{1}{1-\theta\sigma}}.$$

Using Equation (F.5) and substituting (F.10) into the numerator and the denominator, the log of the numerator can be expressed as

$$\begin{split} &\log\left[\int \phi^{\sigma-1}((1-\bar{\tau}^Y)(1+b^*)^{\theta})^{\sigma-1}dF(\phi,1-\bar{\tau}^Y)\right]^{-\frac{\sigma}{1-\sigma}} \\ &= \frac{\sigma}{\sigma-1}\left[(\theta(\sigma-1)\log\bar{C} + \log\int \phi^{\frac{(\sigma-1)(1-\theta)}{1-\theta\sigma}}(1-\bar{\tau}^Y)^{\frac{\sigma-1}{1-\theta\sigma}}\right] \\ &= \theta\sigma\log\bar{C} + \frac{\sigma(1-\theta)}{(1-\theta\sigma)}\mathbb{E}[\log\phi] + \frac{\sigma}{1-\theta\sigma}\mathbb{E}[\log(1-\bar{\tau}^Y)] \\ &\quad + \frac{1}{2}\frac{(\sigma-1)\sigma(1-\theta)^2}{(1-\theta\sigma)^2}Var(\log\phi) + \frac{1}{2}\frac{(\sigma-1)\sigma}{(1-\theta\sigma)^2}Var(\log(1-\bar{\tau}^Y)) \\ &\quad + \frac{\sigma(1-\sigma)(1-\theta)}{(1-\theta\sigma)^2}Cov(\log\phi,\log(1-\bar{\tau}^Y)), \end{split}$$

and the log of the denominator can be expressed as

$$\begin{split} &\log\left[\int \phi^{\sigma-1}((1-\bar{\tau}^Y)(1+b^*)^{\theta})^{\sigma}dF(\phi,1-\bar{\tau}^Y)\right] \\ &= \sigma\theta\log\bar{C} + \log\left[\int \phi^{\frac{\sigma-1}{1-\theta\sigma}}(1-\bar{\tau}^Y)^{\frac{\sigma}{1-\theta\sigma}}dF(\phi,1-\bar{\tau}^Y)\right] \\ &= \sigma\theta\log\bar{C} + \frac{\sigma-1}{1-\theta\sigma}\mathbb{E}[\log\phi] + \frac{\sigma}{1-\theta\sigma}\mathbb{E}[\log(1-\bar{\tau}^Y)] \\ &+ \frac{1}{2}\frac{(\sigma-1)^2}{(1-\theta\sigma)^2}Var(\log\phi) + \frac{1}{2}\frac{\sigma^2}{(1-\theta\sigma)^2}Var(\log(1-\bar{\tau}^Y)) \\ &+ \frac{(\sigma-1)\sigma}{(1-\theta\sigma)^2}Cov(\log\phi,\log(1-\bar{\tau}^Y)) \end{split}$$

Subtracting the log of the denominator from the log of the numerator,

$$\log TFP_{endo} = \frac{1}{\sigma - 1} \log M + \mathbb{E}[\log \phi] + \frac{(\sigma - 1)}{2} \left(\frac{(\sigma[(1 - \theta)^2 - 1] + 1)}{(1 - \theta\sigma)^2} \right) Var(\log \phi) \\ - \frac{\sigma \theta^2}{2} \frac{1}{(1 - \theta\sigma)^2} Var(\log(1 - \bar{\tau}^Y)) - \frac{(\sigma - 1)\sigma\theta}{(1 - \theta\sigma)^2} Cov(\log \phi, \log(1 - \bar{\tau}^Y)),$$
(F.11)

where $\frac{1}{\sigma-1}\log M = 0$ under Assumption 2(iv).

Under Assumption 1(i), both $\frac{1}{(1-\theta\sigma)^2} > 1$ and $\frac{(\sigma-1)\sigma\theta}{(1-\theta\sigma)^2} > 0$ hold. It remains to show that $\left(\frac{(\sigma[(1-\theta)^2-1]+1)}{(1-\theta\sigma)^2}\right) < 1$. Note that

$$\left(\frac{(\sigma[(1-\theta)^2-1]+1)}{(1-\theta\sigma)^2}\right) < 1 \Leftrightarrow \sigma[(1-\theta)^2-1] + 1 < (1-\theta\sigma)^2$$
$$\Leftrightarrow \sigma[\theta^2 - 2\theta] < \theta^2 \sigma^2 - 2\theta\sigma$$
$$\Leftrightarrow 1 < \sigma,$$

where the last inequality holds under Assumption 1.

F.4 Proof of Proposition 3

Proof of Proposition 3(i). This comes from Equations (F.8), (F.9), and (F.11). \Box

Proof of Proposition 3(ii). $\log TFP_{eff} \geq \log TFP_{exo}$ is trivial. It remains to show that $\log TFP_{eff} \geq \log TFP_{endo}$. Taking the difference between $\log TFP_{eff}$ and $\log TFP_{endo}$, I can obtain

that

$$\begin{split} &\log TFP_{eff} - \log TFP_{endo} \\ &= \left(\frac{\sigma-1}{2}\right) \left[1 - \frac{1 + \sigma[(1-\theta)^2 - 1]}{(1-\theta\sigma)^2}\right] Var(\log\phi) + \frac{\sigma}{2} \frac{1}{(1-\theta\sigma)^2} Var(\log(1-\bar{\tau}^Y)) \\ &+ \frac{(\sigma-1)\sigma\theta}{(1-\theta\sigma)^2} \times \underbrace{Cov(\log\phi,\log(1-\bar{\tau}^Y))}_{=Corr(\log\phi,\log(1-\bar{\tau}^Y))} \sqrt{Var(\log\phi)} \sqrt{Var(\log(1-\bar{\tau}^Y))} \\ &= \frac{\sigma}{2(1-\theta\sigma)^2} \left[\theta^2(\sigma-1)^2 Var(\log\phi) \\ &+ 2(\sigma-1)\theta Corr(\log\phi,\log(1-\bar{\tau}^Y)) \sqrt{Var(\log\phi)} \sqrt{Var(\log(1-\bar{\tau}^Y))} + Var(\log(1-\bar{\tau}^Y))\right] \\ &\geq \frac{\sigma}{2(1-\theta\sigma)^2} \\ &\times \left[\theta^2(\sigma-1)^2 Var(\log\phi) - 2(\sigma-1)\theta \sqrt{Var(\log\phi)} \sqrt{Var(\log(1-\bar{\tau}^Y))} + Var(\log(1-\bar{\tau}^Y))\right] \\ &= \frac{\sigma}{2(1-\theta\sigma)^2} \left(\theta(\sigma-1)\sqrt{Var(\log\phi)} - \sqrt{Var(\log(1-\bar{\tau}^Y))}\right)^2 \ge 0, \end{split}$$

where the last inequality comes from that correlation between two random variables are bounded below by -1.

Proof of Proposition 3(iii). Note that

$$\log TFP_{endo} \ge \log TFP_{exo}$$

$$\Leftrightarrow -2(\sigma - 1)Cov(\log \phi, \log(1 - \bar{\tau}^Y)) \ge \theta(\sigma - 1)^2 Var(\log \phi) + \sigma(2 - \theta\sigma)Var(\log(1 - \bar{\tau}^Y)).$$

Because the RHS of the above equation is always non-negative, the above inequality holds only if $Cov(\log \phi, \log(1 - \bar{\tau}^Y)) \leq 0.$

F.5 Proof of Proposition 4

Proof of Proposition 4(i). Because the results of Proposition 4(i) are derived under the closed economy assumption, I omit the subscripts indexing countries. Under Assumptions 1 and 2, every firm is lobbying. Note that the optimal lobbying expenditure in a closed economy is

$$1 + b^* = C^1 \left[\frac{1}{\sigma} \left(\mu \frac{w}{\phi} \right)^{1 - \sigma} (1 - \bar{\tau}^Y)^{\sigma} P^{\sigma - 1} E \right]^{\frac{1}{1 - \theta \sigma}}, \qquad C^1 = (\theta \sigma / P)^{1/(1 - \theta \sigma))}.$$
(F.12)

Also, note that $Cov(\log(1+b^*),\log(1-\bar{\tau}^Y))$ can be written as

$$Cov(\log(1+b^*), \log(1-\bar{\tau}^Y)) = \mathbb{E}[\log(1+b^*)\log(1-\bar{\tau}^Y)] - \mathbb{E}[\log(1+b^*)] \times \mathbb{E}[\log(1-\bar{\tau}^Y)].$$
(F.13)

Substituting Equation (F.12) into $\mathbb{E}[\log(1+b^*)\log(1-\bar{\tau}^Y)]$, $\mathbb{E}[\log(1+b^*)\log(1-\bar{\tau}^Y)]$ can be expressed as

$$\mathbb{E}[\log(1+b^*)\log(1-\bar{\tau}^Y)] = \frac{\sigma-1}{1-\theta\sigma}\mathbb{E}[\log\phi\log(1-\bar{\tau}^Y))] + \frac{\sigma}{1-\theta\sigma}\mathbb{E}[(\log(1-\bar{\tau}^Y)^2] + \frac{1}{1-\theta\sigma}\mathbb{E}[\log(1-\bar{\tau}^Y)] \times \left[C^1 + \log\left(\frac{1}{\sigma}(\mu w)^{1-\sigma}\right) + \log(P^{\sigma-1}E)\right].$$
 (F.14)

Substituting Equation (F.12) into $\mathbb{E}[\log(1+b^*)] \times \mathbb{E}[\log(1-\bar{\tau}^Y)]$, $\mathbb{E}[\log(1+b^*)] \times \mathbb{E}[\log(1-\bar{\tau}^Y)]$ can be written as

$$\mathbb{E}[\log(1+b^*)] \times \mathbb{E}[\log(1-\bar{\tau}^Y)] = \frac{\sigma-1}{1-\theta\sigma} \mathbb{E}[\log\phi] \times \mathbb{E}[\log(1-\bar{\tau}^Y)] + \frac{\sigma}{1-\theta\sigma} (\mathbb{E}[\log(1-\bar{\tau}^Y)])^2 + \frac{1}{1-\theta\sigma} \mathbb{E}[\log(1-\bar{\tau}^Y)] \times \left[C^1 + \log\left(\frac{1}{\sigma}(\mu w)^{1-\sigma}\right) + \log P^{\sigma-1}E\right].$$
(F.15)

Substituting Equations (F.14) and (F.15) into Equation (F.13), I can obtain that

$$Cov(\log(1+b^*)\log(1-\bar{\tau}^Y)) = \mathbb{E}[\log(1+b^*)\log(1-\bar{\tau}^Y)] - \mathbb{E}[\log(1+b^*)] \times \mathbb{E}[\log(1-\bar{\tau}^Y)]$$
$$= \frac{\sigma-1}{1-\theta\sigma} \bigg(\mathbb{E}[\log\phi\log(1-\bar{\tau}^Y)] - \mathbb{E}[\log\phi] \times \mathbb{E}[\log(1-\bar{\tau}^Y)] \bigg)$$
$$+ \frac{\sigma}{1-\theta\sigma} \bigg(\mathbb{E}[(\log(1-\bar{\tau}^Y))^2] - \mathbb{E}[\log(1-\bar{\tau}^Y)]^2 \bigg),$$

which is equivalent to $Cov(\log \phi, \log(1 - \bar{\tau}^Y)) + \frac{\sigma}{1 - \theta \sigma} Var(\log(1 - \bar{\tau}^Y)).$

Proof of Proposition 4(ii). Note that

$$Cov(\log(1+b^*), \log(1-\bar{\tau}^Y)|b^*>0) = \mathbb{E}[\log(1+b^*)\log(1-\bar{\tau}^Y)|b^*>0] - \mathbb{E}[\log(1+b^*)|b^*>0] \times \mathbb{E}[\log(1-\bar{\tau}^Y)|b^*>0]. \quad (F.16)$$

 $\mathbb{E}[\log(1+b^*)\log(1-\bar{\tau}^Y)|b^*>0]$ can be written as

$$\mathbb{E}[\log(1+b^*)\log(1-\bar{\tau}^Y)|b^*>0] = \sum_{x'\in\{0,1\}} \left\{ \mathbb{P}[b^*\geq 0, x^*=x'] \mathbb{E}[\log(1+b^*)\log(1-\bar{\tau}^Y)|b^*\geq 0, x^*=x'] \right\}$$
(F.17)

where x^* is a firm's optimal export decision. Similarly, $\mathbb{E}[\log(1+b^*)|b^*>0] \times \mathbb{E}[\log(1-\bar{\tau}^Y)|b^*>0]$ can be written as

$$\mathbb{E}[\log(1+b^*)|b^*>0] \times \mathbb{E}[\log(1-\bar{\tau}^Y)|b^*>0] \\ = \sum_{x'\in\{0,1\}} \left\{ \mathbb{P}[b^*\geq 0, x^*=x'] \mathbb{E}[\log(1+b^*)|b^*\geq 0, x^*=x'] \right\},$$
(F.18)

Substituting Equations (F.17) and (F.18) into Equation (F.16), $Cov(\log(1+b^*), \log(1-\bar{\tau}^Y)|b^*>0)$ can be expressed as

$$Cov(\log(1+b^*), \log(1-\bar{\tau}^Y)|b^* > 0) = \sum_{x' \in \{0,1\}} \mathbb{P}[b^* \ge 0, x^* = x'] \left(\mathbb{E}[\log(1+b^*)\log(1-\bar{\tau}^Y)|b^* \ge 0, x^* = x'] - \mathbb{E}[\log(1+b^*)|b^* \ge 0, x^* = x'] \times \mathbb{E}[\log(1-\bar{\tau}^Y)|b^* \ge 0, x^* = x'] \right).$$
(F.19)

Also, note that the optimal lobbying expenditure is

$$1 + b^* = C_c^1 \left[\frac{1}{\sigma} \left(\mu \frac{w_c}{\phi} \right) (1 - \bar{\tau}^Y)^{\sigma} (P_c^{\sigma - 1} E_c + x^* \tau_x^{1 - \sigma} P_{c'}^{\sigma - 1} E_{c'}) \right]^{\frac{1}{1 - \theta\sigma}}, \qquad C_c^1 = (\theta\sigma/P_c)^{1/(1 - \theta\sigma))}$$
(F.20)

Using Equation (F.20), $\mathbb{E}[\log(1+b^*)\log(1-\bar{\tau}^Y)|b^* \ge 0, x = x']$ is computed as

$$\mathbb{E}[\log(1+b^*)\log(1-\bar{\tau}^Y)|b^* \ge 0, x = x'] = \frac{\sigma-1}{1-\theta\sigma}\mathbb{E}[\log\phi\log(1-\bar{\tau}^Y)|b^*\ge 0, x^* = x'] + \frac{\sigma}{1-\theta\sigma}\mathbb{E}[(\log(1-\bar{\tau}^Y))^2|b^*\ge 0, x^* = x'] + \frac{1}{1-\theta\sigma}\log\left(C_c^1\frac{1}{\sigma}(\mu w_c)^{1-\sigma}(P_c^{\sigma-1}E_c + x'\tau_x^{1-\sigma}P_{c'}^{\sigma-1}E_{c'})\right) \times \mathbb{E}[\log(1-\bar{\tau}^Y)|b^*\ge 0, x^* = x'].$$
(F.21)

Similarly, $\mathbb{E}[\log(1+b^*)|b^* \ge 0, x^* = x']\mathbb{E}[\log(1-\bar{\tau}^Y)|b^* \ge 0, x^* = x']$ is computed as

$$\mathbb{E}[\log(1+b^*)|b^* \ge 0, x^* = x'] \times \mathbb{E}[\log(1-\bar{\tau}^Y)|b^* \ge 0, x^* = x'] \\
= \frac{\sigma-1}{1-\theta\sigma} \mathbb{E}[\log\phi|b^* \ge 0, x^* = x'] \times \mathbb{E}[\log(1-\bar{\tau}^Y)|b^* \ge 0, x^* = x'] + \frac{\sigma}{1-\theta\sigma} (\mathbb{E}[\log(1-\bar{\tau}^Y)|b^* \ge 0, x^* = x'])^2 \\
+ \frac{1}{1-\theta\sigma} \log\left(C_c^1 \frac{1}{\sigma}(\mu w_c)^{1-\sigma} (P_c^{\sigma-1} E_c + x' \tau_x^{1-\sigma} P_{c'}^{\sigma-1} E_{c'})\right) \times \mathbb{E}[\log(1-\bar{\tau}^Y)|b^* \ge 0, x^* = x'] \quad (F.22)$$

Substituting Equation (F.21) and (F.22) into Equation (F.19), I can obtain

$$Cov(\log(1+b^*), \log(1-\bar{\tau}^Y)|b^*>0) = \sum_{x'\in\{0,1\}} \mathbb{P}[b^*\geq 0, x^*=x']$$

$$\times \left[(\mathbb{E}[\log\phi\log(1-\bar{\tau}^Y)|b^*\geq 0, x^*=x'] - \mathbb{E}[\log\phi|b^*\geq 0, x=x'] \times \mathbb{E}[\log(1-\bar{\tau}^Y)|b^*\geq 0, x^*=x']) + (\mathbb{E}[(\log(1-\bar{\tau}^Y))^2|b^*\geq 0, x=x'] - \mathbb{E}[\log(1-\bar{\tau}^Y)|b^*\geq 0, x^*=x']^2) \right], \quad (F.23)$$

which is equivalent to

$$Cov(\log(1+b^*), \log(1-\bar{\tau}^Y)|b^*>0) = \sum_{x'\in\{0,1\}} \mathbb{P}[b^* \ge 0, x^* = x'] \\ \times \left(\frac{\sigma-1}{1-\theta\sigma}Cov(\log\phi, \log(1-\bar{\tau}^Y)|b^*\ge 0, x^* = x']\right) + \frac{\sigma}{1-\theta\sigma}Var(\log(1-\bar{\tau}^Y)|b^*\ge 0, x^* = x')\right).$$

The events $\{b^* \ge 0, x^* = 1\}$ and $\{b^* \ge 0, x^* = 0\}$ are equivalent to $\{\phi \ge \bar{\phi}_c^b(\bar{\tau}^Y, \eta), \phi \ge \bar{\phi}_c^x(\bar{\tau}^Y, \eta)\}$ and $\{\phi \ge \bar{\phi}_c^b(\bar{\tau}^Y, \eta), \phi \le \bar{\phi}_c^x(\bar{\tau}^Y, \eta)\}$, where $\bar{\phi}_c^b(\bar{\tau}^Y, \eta)$ and $\bar{\phi}_c^x(\bar{\tau}^Y, \eta)$ are the lobbying and export cutoffs defined in Equations (2.7) and (2.8), which proves Proposition 4(ii).

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