Lobbying, Trade, and Misallocation*

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Abstract

This paper studies the impacts of openness to trade on firm lobbying and its welfare consequences. I develop an open economy model of heterogeneous firms that can lobby to influence firm-specific distortions. As trade costs become lower, exporters increase their lobbying relative to non-exporters due to complementarity between market size and gains from lobbying. These changes in lobbying affect allocative efficiency of an economy and therefore gains from trade. I estimate the model by reduced-form instrumental variable techniques and structurally using US firm-level data. I find that due to increased lobbying by large-sized exporters, welfare gains from trade are 4.7 percent lower than those in a counterfactual economy with the same import shares but without lobbying.

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 with the advent of large-sized firms brought on by globalization. An abundance of evidence shows that politically active large-sized firms have spent sizable sums of money to influence the policy-making process (Roosevelt, 1910; Drutman, 2015; Zingales, 2017).[1] However, how globalization affects firms' political influences and its welfare consequences are still open questions.

This paper studies the impact of openness to trade on corporate lobbying and its welfare consequences. To do so, I develop a two-country open-economy heterogeneous firm model (Melitz, 2003) with misallocation manifested in firm-specific distortions (Hsieh and Klenow, 2009) that are endogenous outcomes of firm lobbying decisions. Using this model calibrated to US firm-level data, I quantitatively assess the effects of openness to trade on firm lobbying and welfare gains from trade. The key finding is that due to increased lobbying by large-sized exporters, welfare gains from trade in the US can decrease by 4.7 percent when compared to those in the absence of lobbying.

In this model, lobbying increases firm-specific distortions and makes firms relatively more subsidized or less taxed but incurs variable and fixed costs. Because of the fixed costs, only selective firms that can overcome these fixed costs engage in lobbying activity. Larger-sized firms tend to spend more on lobbying because of complementarity between firm size and gains from higher subsidies post-lobbying.

Firms are heterogenous along three dimensions: productivity, exogenous distortions, and lobbying efficiency. Firms with higher productivity can produce at lower costs. Firms with higher exogenous distortions are more subsidized initially. These exogenous distortions explain components of distortions that account for other possible sources of misallocation not explained by lobbying. Firms with higher lobbying efficiency can achieve higher subsidies through lobbying after incurring lower variable lobbying costs. Conditional on lobbying efficiency, firms with higher productivity or exogenous distortions are larger and spend more on lobbying due to the complementarity. Conditional on productivity and exogenous distortions, firms with higher lobbying efficiency spend more on lobbying due to lower variable lobbying costs.

Openness to trade affects firm lobbying through the complementarity between firm size and lobbying. Lower trade costs induce larger firms to export more in foreign markets and increase their size, which leads to increased spending on lobbying by exporters due to the complementarity. As a result, openness to trade affects allocative efficiency of an economy and welfare gains from trade

[1] The debate over the influence of special interests on US politics has a long history. In a 1910 speech, President Theodore Roosevelt said, "*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). 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.

through its influences on lobbying.

I combine Compustat balance sheet data and firm lobbying expenditures disclosed publicly since the Lobbying Disclosure Act (1995) (LDA). Using this data, I estimate the parameters of the model using the instrumental variable (IV) approach and the method of moments. To estimate the parameter that governs the elasticity of lobbying on 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 House or Senate Appropriations Committee. The IV estimates imply that a 1 percent increase in lobbying expenditures lowers these distortions by 0.08 percent. I calibrate the remaining parameters by matching the moments from the model to their data counterparts.

Using the calibrated model, I evaluate how openness to trade affects firm lobbying when opening to trade from the autarky to the current equilibrium with the observed import shares. In the current equilibrium, relative to the autarky, exporters are more likely to lobby and spend more on it because of increased market size, whereas non-exporters are less likely to participate and spend less on it because of intensified foreign competition. When aggregating these heterogeneous responses across firms, at the extensive margin, the overall probability of participating in lobbying decreases by 0.5 percentage point; however, at the intensive margin, the average lobbying expenditures increases by 1.45 percent.

To examine welfare consequences of lobbying, I compare welfare gains from trade when opening to trade in the baseline economy with lobbying to that in the counterfactual economy with the same observed import shares but without lobbying. Because of the same import shares, welfare gains predicted by the formula developed by Arkolakis et al. (2012) are the same for both economies. However, lobbying as well as other distortions make micro structure matter for welfare. I find that the welfare gains from trade would have been 4.7 percent higher in the absence of lobbying. The gains from trade are lower in the baseline economy due to increased lobbying by exporters that deteriorates aggregate total factor productivity (TFP) by allocating more resources to exporters than the optimal level based on their productivity, allocating more resources to lobbying rather than production, and hindering the entry of new firms.

I also evaluate the China shock modeled as its productivity growth. I quantitatively assess the effects of the China shock on firm lobbying and its welfare effects. The China shock also had heterogeneous effects on firm lobbying depending on their export status: exporters increased their lobbying but non-exporters decreased it. This is because China's productivity growth increased China's real income and, therefore, foreign market size for exporters but reduced domestic market size for non-exporters through increased foreign competition. In the absence of lobbying, the welfare gains brought by the China shock would have been 3.3 percent higher. These smaller welfare gains in the presence of lobbying are again due to increased lobbying by exporters.

This paper contributes to the literature that studies gains from trade in distorted economies (see, among many others, Levchenko, 2007; Nunn, 2007; Khandelwal et al., 2013; Manova, 2013; Edmond et al., 2015; Święcki, 2017; Berthou et al., 2018; Costa-Scottini, 2018; Chung, 2019; Fajgelbaum et al., 2019). The most closely related paper is Bai et al. (2021), who examine gains from trade in the presence of firm-specific exogenous distortions pioneered by Hsieh and Klenow (2009) and Restuccia and Rogerson (2008). I extend their open-economy model to incorporate firm lobbying decisions. Bombardini et al. (2021) and Cutinelli-Rendina (2021) study escape competition effects of lobbying in an open economy, whereas I focus on the complementarity between firm size and lobbying.

I also contribute to the literature on corporate lobbying surveyed by Bombardini and Trebbi (2020) (see, among many others, Richter et al., 2009; Bombardini and Trebbi, 2011, 2012; Igan et al., 2012; Blanes i Vidal et al., 2012; Bertrand et al., 2014; Kerr et al., 2014; Kang, 2016; Arayavechkit et al., 2017; Kim, 2017; Bertrand et al., 2020; Blanga-Gubbay et al., 2020; Choi et al., 2021). My work is most closely related to Arayavechkit et al. (2017) and Huneeus and Kim (2018), who also model firm-specific distortions as endogenous outcomes of lobbying and quantitatively assess the impact of lobbying on resource misallocation in a closed economy. Unlike these two studies, I extend the model developed by Huneeus and Kim (2018) to an open economy and study the relationship between openness to trade and firm lobbying.

Finally, this paper is related to the literature on politics and trade (see, among many others, Grossman and Helpman, 1994; Goldberg and Maggi, 1999; Gawande and Bandyopadhyay, 2000; Bombardini, 2008; Do and Levchenko, 2009; Bombardini and Trebbi, 2012; Gawande et al., 2012; Levchenko, 2013; Campante et al., 2019; Bombardini et al., 2020; Blanga-Gubbay et al., 2020; Hennicke and Blanga-Gubbay, 2022). Unlike these studies, this paper examines the interaction between openness to trade and firm lobbying and quantifies its misallocation effects in an open economy.

The remainder of this paper proceeds as follows. Section 2 describes the data used for the empirical and quantitative analyses and provides motivating evidence on the effects of trade on firm lobbying. Section 3 outlines the quantitative model whose predictions are consistent with the motivating evidence. Section 4 discusses the calibration procedure of the model. Section 5 presents the quantitative results on the effects of openness to trade on firm lobbying and welfare gains from trade. Section 6 concludes.

2 Data and Motivating Evidence

In this section, I describe data used for my empirical and quantitative analyses. Using this data set, I provide empirical evidence on the effects of openness to trade on firm lobbying. This evidence motivates my quantitative framework.

2.1 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. See Online Appendix Section A for details on the construction of the data set and the descriptive statistics.

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 public firms listed on the North American stock markets. The sample period is from 1998 to 2015. The lobbying data have been publicly disclosed since 1998 after the LDA, which 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.

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. Industry data come from the NBER-CES Manufacturing Industry Database. The industry and trade data are matched with the firm-level data using firm SIC 4-digit codes and headquartered states. I obtain region-sector level wage rates from the US Census County Business Pattern data and match them with the firm data based on firms' headquarter states and industry affiliation.

2.2 Motivating Evidence

This section provides motivating empirical evidence on the impact of trade on firm lobbying using the China shock (Autor et al., 2013). Following Acemoglu et al. (2016), I define the China shock as follows:

$$\text{China}_{jt} = 100 \times \frac{\text{IM}^{\text{oc}}_{jt}}{Y^{\text{US}}_{jt_0} + \text{IM}^{\text{US}}_{jt_0} - \text{EX}^{\text{US}}_{jt_0}}, \tag{2.1}$$

for industry j at time t. $\text{IM}^{\text{oc}}_{jt}$ is the sum of imports of other developed countries from China, including Australia, Denmark, Finland, Germany, Japan, New Zealand, Spain, and Switzerland. The denominator is the initial US domestic absorption in 1998: sum of gross output $\text{GO}^{\text{US}}_{jt_0}$ and exports $\text{EX}^{\text{US}}_{jt_0}$ minus imports $\text{IM}^{\text{US}}_{jt_0}$.

I consider the following long-difference regression model between 1999 and 2011:

$$\triangle y_{ijt} = \beta \triangle \text{China}_{jt} + \mathbf{X}'_{ijt_0}\boldsymbol{\gamma} + \triangle \epsilon_{ijt}, \tag{2.2}$$

where i denotes firm, j sector, and t time.[2] Also, to examine heterogeneous effects of the China shock across firms depending on their size, I also consider the following regression model:

$$\triangle y_{ijt} = \sum_{q=1}^{3} \beta^q (D^q_{ijt_0} \times \triangle \text{China}_{jt}) + \mathbf{X}'_{ijt_0}\boldsymbol{\gamma} + \triangle \epsilon_{ijt}, \tag{2.3}$$

where $D^q_{ijt_0}$ is a dummy variable for each group $q = 1, 2, 3$ defined based on the tercile of the initial

[2] Unlike Acemoglu et al. (2016), who use China_{jt} as an IV, I estimate the model in a reduced-form, because the focus is to examine the reduced-form relationship between openness to trade and lobbying rather than giving structural interpretations to the regression model.

Table 1: China Shock and Firm Lobbying

Dep.	Asinh(Lobby)		$100 \times \mathbb{1}[\text{Lobby} > 0]$	
	(1)	(2)	(3)	(4)
$\triangle\text{China}_{jt}$	-0.007^{**}		-0.048^{**}	
	(0.003)		(0.020)	
$D^1_{ijt_0} \times \triangle\text{China}_{jt}$		-0.010^{***}		-0.075^{***}
		(0.003)		(0.024)
$D^2_{ijt_0} \times \triangle\text{China}_{jt}$		-0.011^{***}		-0.087^{***}
		(0.004)		(0.029)
$D^3_{ijt_0} \times \triangle\text{China}_{jt}$		-0.001		0.002
		(0.007)		(0.052)
N	913	913	913	913

Notes. This table reports the OLS estimates of Equations (2.2) and (2.3). The dependent variables are inverse hyperbolic sine transformations of lobbying expenditures in columns (1) and (2) and dummy variables of whether firms participate in lobbying multiplied by 100 in columns (3) and (4). $\triangle\text{China}_{jt}$ is the China shock defined in Equation (2.1). In all specifications, I control for state dummies and $D^q_{ijt_0}$. Standard errors are clustered at 3-digit SIC industry and state levels. * p<0.1; ** p<0.05; *** p<0.01.

employment of 1998 within 4-digit SIC industries. The interaction term between $\triangle\text{China}_{jt}$ and $D^q_{ijt_0}$ captures heterogeneous effects of the China shock depending on the initial firm size. $\mathbf{X}_{ijt_0}$ are the initial firm observables, including dummy variables for states in which headquarters are located and $D^q_{ijt_0}$. All standard errors are two-way clustered on 3-digit SIC industry and state levels.

Table 1 reports the results. The dependent variables are inverse hyperbolic sine transformations of lobbying expenditures in columns (1) and (2) and dummy variables of whether firms participate in lobbying multiplied by 100 in columns (3) and (4). The estimate in column (1) implies that a one standard deviation increase of the China shock decreased firm lobbying expenditures by 5 percent. The estimates in column (2) show that these effects were heterogeneous depending on firm size. The China shock had negative effects on lobbying only for small and medium-sized firms. In columns (3) and (4), I find similar patterns for the extensive margin of lobbying.

In Online Appendix Tables B1 and B2, I conduct robustness checks and find that these results are robust to different measures for initial firm size using sales and capital, and an alternative transformation of lobbying expenditures. In Online Appendix Table B3, to mitigate concerns that these results are driven by collective action among firms within industry against the trade shocks, I use lobbying expenditures unrelated to trade as dependent variables and find similar results reported.

To summarize, these empirical findings suggest that firms decreased lobbying when facing the intensified foreign competition and that smaller-sized firms were more negatively affected. These findings motivate my research questions and guide my modeling approach in the next section to study the interaction between trade and lobbying. I will construct a model whose predictions on the relationship between firm lobbying and intensified foreign competition are consistent with these empirical findings.

3 Theoretical Framework

Motivated by the empirical evidence in the previous section, I construct a general equilibrium heterogeneous firm model with lobbying. There are two potentially asymmetric countries, Home and Foreign, that can differ in labor endowment and distribution of firms. Households supply labor inelastically and are immobile across countries.

Consumers Representative consumers in Home choose amounts of final goods C to maximize their utility subject to the budget constraint: $PC = wL + \Pi + T$, where P is the price of final goods, w is wage rate, L is labor endowment, Π is dividend income, and T is the lump-sum transfer from the government.

Final Goods Producers Final goods are produced by representative final goods producers under perfect competition. Final goods are non-tradable and used for consumption. Final goods producers combine intermediate varieties available in the country through a constant elasticity of substitution (CES) aggregator:

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

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

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

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

Intermediate Goods Producers and Lobbying There is a mass of monopolistically competitive intermediate goods producers M, endogenous determined by their entry and production decisions. I call these intermediate goods producer firms. Prior to entry, potential entrants are identical and face sunk costs of entry f_e, in units of labor. The free entry condition is imposed, which ensures the aggregate profits are zero, $\Pi = 0$.

Labor is the only factor of input for production. The production function for each variety is linear in labor:

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

where y is output produced, ϕ is productivity, and l is labor input used for production. The production of each variety requires fixed production costs f, in units of labor, so the total labor used for production is $y/\phi + f$.

Firms can export after incurring fixed export costs f_c^x, in units of domestic labor (Melitz, 2003). They also incur iceberg costs $\tau_x > 1$ when exporting, so delivering one unit of an intermediate good to a foreign country requires τ_x units. Iceberg trade costs can be potentially asymmetric across countries.

Firms are subject to domestic output distortions τ^y. If $\tau^y > 1$ (or < 1), firms are subsidized (or taxed). Output distortions increase in lobbying amounts. Thus, if firms increase their lobbying, they will be relatively subsidized more or taxed less. I assume that output distortions are composed of exogenous and endogenous distortions with the following functional form:

$$\tau^y(\omega) = \tau(\omega) \times \max\{\bar{\tau}, b(\omega)^\theta\}, \tag{3.1}$$

where b are lobbying amounts chosen by firms, and τ are exogenous distortions drawn from a given distribution. The exogenous distortions τ á la Hsieh and Klenow (2009) capture distortions not related to lobbying. Firms take τ as given and make lobbying decisions. $\bar{\tau}$ is a common distortion across firms, which can be interpreted as common subsidies or taxes applied to all firms in an economy. I set $\bar{\tau}$ to one.[3]

The endogenous distortions, $\max\{\bar{\tau}, b^\theta\}$, are the results of lobbying. Once firms participate in lobbying, firms endogenously choose their output distortions after incurring variable and fixed costs of lobbying, both of which are in units of domestic labor. The total labor used for lobbying amounts of b is

$$w\Big(\kappa\frac{b}{\eta} + f_b\Big),$$

where $\kappa b/\eta$ and f_b are variable and fixed costs of lobbying. κ is a parameter that governs the overall level of the variable costs. η is stochastic firm-specific lobbying efficiency that rationalizes the pattern in the data that small-sized firms participate in lobbying within industry.[4] Firms with higher η incur lower variable costs to achieve the same endogenous output distortions compared to firms with lower η. The fixed lobbying cost rationalizes the pattern in the firm-level data that only a fraction of firms participate in lobbying (Kerr et al., 2014).

[3] Under the functional form, $\bar{\tau}$ may affect the extensive margin of lobbying because only firms whose optimal lobbying amounts satisfy $b^\theta > \bar{\tau}$ participate in lobbying. However, with the calibrated values, I computationally find that there are no firms whose optimal lobbying amounts are on the binding constraint. Therefore, setting $\bar{\tau}$ to one is innocuous as it does not affect firm lobbying decisions quantitatively, and the degree of misallocation does not depend on the common distortion level.

[4] An alternative way of rationalizing small firms' lobbying is through allowing for heterogeneity in fixed lobbying costs. One difference with this approach is that, unlike heterogeneity in fixed lobbying costs that do not enter in firm sales, variable lobbying efficiency enters in firm sales directly and, therefore, allows me to fit firm size distribution more flexibly.

θ is one of the key parameters of the model that captures how effectively lobbying increases output distortions.[5] By taking the maximum, lobbying becomes effective only when it is sufficiently large enough to make the endogenous distortions larger than a level $\bar{\tau}$ that is common for all firms. Therefore, lobbying firms receive lobbying-induced subsidies when compared to non-lobbying firms. With higher values of θ, the same amount of lobbying can increase the output distortions more. When $\theta = 0$, no firm participates in lobbying and the model collapses to the two-country heterogeneous firm model with exogenous distortions studied by Bai et al. (2021), who incorporate exogenous distortions á la Hsieh and Klenow (2009) under an open economy. I impose restrictions on θ and σ as follows[6]:

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

Firms are heterogeneous along three dimensions: productivity ϕ, exogenous distortions τ, and lobbying efficiency η. The firm-specific vector of primitives, $\boldsymbol{\psi} = (\phi, \tau, \eta)$, is drawn from a joint distribution $G(\boldsymbol{\psi})$ with an arbitrary correlation structure. Each draw is independent across firms. Because firms with the same $\boldsymbol{\psi}$ behave identically, I index firms by $\boldsymbol{\psi}$. Firms can draw primitives after incurring the entry costs f_e.

Firms take the demand function in domestic and foreign markets as given and maximize their profits. Firms solve the following maximization problem:

$$\pi = \max_{\substack{\{b,p,p^x,\\ q,q^x,x\}}} \Big(\tau \times \max\{\bar{\tau}, b^\theta\}\Big)\Big\{pq - w\frac{q}{\phi} - wf + x\Big(p^x q^x - w\frac{\tau_x q^x}{\phi} - wf_x\Big)\Big\} - w\Big(\kappa\frac{b}{\eta} + f_b\Big)\mathbb{1}[b > 0],$$

$$\text{subject to} \quad q = p^{-\sigma}P^{\sigma-1}E, \quad q^x = (p^x)^{-\sigma}P_f^{\sigma-1}E_f, \quad x \in \{0,1\}, \quad (3.2)$$

where E and E_f are the total expenditures of Home and Foreign, x is a binary export decision, p^x is export price, and q^x is export quantity.

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. Under monopolistic competition, conditional on lobbying amounts of b, firm price is given by

$$p = \Big(\mu\frac{w}{\phi}\Big)\Big(\tau \times \max\{\bar{\tau}, b^\theta\}\Big)^{-1}.$$

I first consider profits conditional on not lobbying. Profits conditional on not lobbying are ex-

[5] θ may reflect quality of institutions or political system. For example, θ can be higher in countries where corruption is prevalent.

[6] These parametric restrictions guarantee that firms do not spend infinite amounts on lobbying. If $1 - \theta\sigma \geq 1$, the output distortions increase too quickly with b. Technically, this is the second-order condition of firms' maximization problems. These assumptions are also empirically supported by my estimate of θ in Section 4.1. With the estimate of θ around 0.08, the assumption is satisfied with the commonly used values for the elasticity of substitution in the literature.

pressed as

$$\pi(0;\boldsymbol{\psi}) = \max_{x\in\{0,1\}} \Big\{\pi^d(0;\boldsymbol{\psi}) + x\pi^x(0;\boldsymbol{\psi})\Big\},$$

where $\pi^d(0;\boldsymbol{\psi})$ and $\pi^x(0;\boldsymbol{\psi})$ are profits conditional on not lobbying in the domestic and foreign markets, respectively:

$$\pi^d(0;\boldsymbol{\psi}) = \underbrace{\frac{1}{\sigma}\Big(\mu\frac{w}{\phi}\Big)^{1-\sigma}\tau^{\sigma}P^{\sigma-1}E}_{=\tilde{\pi}^d(0;\boldsymbol{\psi})} - wf \quad \text{and} \quad \pi^x(0;\boldsymbol{\psi}) = \underbrace{\frac{1}{\sigma}\Big(\mu\frac{\tau_x w}{\phi}\Big)^{1-\sigma}\tau^{\sigma}P^{\sigma-1}E}_{=\tilde{\pi}^x(0;\boldsymbol{\psi})} - wf_x.$$

$\tilde{\pi}^d(0;\boldsymbol{\psi})$ and $\tilde{\pi}^x(0;\boldsymbol{\psi})$ are the variable profits conditional on not lobbying in the domestic and foreign markets.

Once firms participate in lobbying, the optimal lobbying expenditures are characterized by firms' first-order conditions with respect to b. Because gains from lobbying are larger with larger market size, exporters disproportionately lobby more than non-exporters. 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 are expressed as follows:

$$b^* = \Big(\frac{\theta\sigma\eta}{\kappa w}\tilde{\pi}^d(0;\boldsymbol{\psi})\Big)^{\frac{1}{1-\theta\sigma}} \quad \text{and} \quad b^* = \Big(\frac{\theta\sigma\eta}{\kappa w}\Big(\tilde{\pi}^d(0;\boldsymbol{\psi}) + \tilde{\pi}^x(0;\boldsymbol{\psi})\Big)\Big)^{\frac{1}{1-\theta\sigma}}. \tag{3.3}$$

Substituting Equation (3.3) into Equation (3.2), profits conditional on lobbying for non-exporters and exporters are expressed as follows:

$$\pi^d(b^*;\boldsymbol{\psi}) = (1-\theta\sigma)\Big(\frac{\theta\sigma\eta}{\kappa w}\Big)^{\frac{\theta\sigma}{1-\theta\sigma}}\tilde{\pi}^d(0;\boldsymbol{\psi})^{\frac{1}{1-\theta\sigma}} - w(f+f_b)$$

and

$$\pi^x(b^*;\boldsymbol{\psi}) = (1-\theta\sigma)\Big(\frac{\theta\sigma\eta}{\kappa w}\Big)^{\frac{\theta\sigma}{1-\theta\sigma}}\Big(\tilde{\pi}^d(0;\boldsymbol{\psi}) + \tilde{\pi}^x(0;\boldsymbol{\psi})\Big)^{\frac{1}{1-\theta\sigma}} - w(f+f_x+f_b).$$

Because lobbying exponentiates the variable profits conditional on not lobbying to the power of $1/(1-\theta\sigma)$, firms with higher ϕ or τ get larger benefits from lobbying. Also, firms with higher lobbying efficiency η have larger gains from lobbying.

Lobbying and export decisions are jointly determined. Because lobbying increases output distortions for sales in both domestic and foreign markets, firm export decisions are not independent across markets. For example, there can be a set of firms with low productivity but low fixed lobbying costs that would not export to Foreign if lobbying technology were unavailable. With lobbying and export decisions, firms have four possible options and compare the total profits of each option. Their final profits are determined as the maximum of the four options:

$$\pi(\boldsymbol{\psi}) = \max\left\{\pi^d(0;\boldsymbol{\psi}), \pi^d(0;\boldsymbol{\psi}) + \pi^x(0;\boldsymbol{\psi}), \pi^d(b^*;\boldsymbol{\psi}), \pi^x(b^*;\boldsymbol{\psi})\right\},$$

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.

With the fixed production costs, firms start production only when their profits are larger than zero. These production decisions are characterized by a zero profit cutoff productivity, $\bar{\phi}^e(\tau,\eta)$, determined by:

$$\pi(\bar{\phi}^e(\tau,\eta),\tau,\eta) = 0,$$

which decreases in both τ and η. Holding τ and η constant, only firms with productivity above this cutoff participate in production.

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

$$\begin{aligned}\max&\left\{\pi^d(0;\bar{\phi}^b(\tau,\eta),\tau,\eta), \pi^d(0;\bar{\phi}^b(\tau,\eta),\tau,\eta) + \pi^x(0;\bar{\phi}^b(\tau,\eta),\tau,\eta)\right\}\\ &= \max\left\{\pi^d(b^*;\bar{\phi}^b(\tau,\eta),\tau,\eta), \pi^x(b^*;\bar{\phi}^b(\tau,\eta),\tau,\eta)\right\},\end{aligned} \tag{3.4}$$

where the left-hand side is the maximum profits conditional on not lobbying and the right-hand side is the maximum profits conditional on lobbying. Holding τ and η constant, only firms with productivity above $\bar{\phi}^b(\tau,\eta)$ participate in lobbying: $b(\boldsymbol{\psi}) > 0$ if $\phi \geq \bar{\phi}^b(\tau,\eta)$ and $b(\boldsymbol{\psi}) = 0$ otherwise. The lobbying cutoffs decrease in τ and η.

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

$$\begin{aligned}\max&\left\{\pi^d(0;\bar{\phi}^x(\tau,\eta),\tau,\eta) + \pi^x(0;\bar{\phi}^x(\tau,\eta),\tau,\eta), \pi^x(b^*;\bar{\phi}^x(\tau,\eta),\tau,\eta)\right\}\\ &= \max\left\{\pi^d(0;\bar{\phi}^x(\tau,\eta),\tau,\eta), \pi^d(b^*;\bar{\phi}^x(\tau,\eta),\tau,\eta)\right\},\end{aligned} \tag{3.5}$$

where the left-hand side is the maximum profits conditional on exporting and the right-hand side is the maximum profits conditional on not exporting. Holding τ and η constant, only firms with productivity above the export cutoffs participate in exporting: $x(\boldsymbol{\psi}) = 1$ if $\phi \geq \bar{\phi}^x(\tau,\eta)$ and $x(\boldsymbol{\psi}) = 0$ otherwise. The export cutoffs also decrease in τ and η.[7]

Equilibrium In the equilibrium, there are a mass of entrants M_e, a mass of operating producers M, and ex-post distribution of productivity, exogenous distortions, and stochastic components of the

[7] In Online Appendix Section C, I provide detailed expressions for the entry, lobbying, and export cutoffs.

fixed lobbying costs:

$$\hat{g}(\boldsymbol{\psi}) = \frac{g(\boldsymbol{\psi})}{\int_{\phi \geq \bar{\phi}^e(\tau,\eta)} g(\boldsymbol{\psi}) d\boldsymbol{\psi}}$$

if $\phi \geq \bar{\phi}^e(\tau, \eta)$ and $\hat{g}(\boldsymbol{\psi}) = 0$ otherwise. Let $\hat{G}(\boldsymbol{\psi})$ be the corresponding CDF of $\hat{g}(\boldsymbol{\psi})$. The probability of entry is $p_e = \int d\hat{G}(\boldsymbol{\psi})$. The mass of producers is equal to the mass of entrants multiplied by the probability of entry: $p_e M_e = M$.

The free entry condition implies that

$$p_e \left[\int \pi(\boldsymbol{\psi}) d\hat{G}(\boldsymbol{\psi}) \right] = w f_e.$$

The government budget is balanced, and the total tax revenues are transferred to consumers in lump-sum fashion:

$$T = M \left[\int \tau^y(\boldsymbol{\psi}) \Big(p(\boldsymbol{\psi}) q(\boldsymbol{\psi}) + x(\boldsymbol{\psi}) p^x(\boldsymbol{\psi}) q^x(\boldsymbol{\psi}) \Big) d\hat{G}(\boldsymbol{\psi}) \right].$$

Goods market-clearing implies that $C = Q$. Labor market clearing implies that

$$L = M \left[\int \Big(l(\boldsymbol{\psi}) + b(\boldsymbol{\psi}) + f + x(\boldsymbol{\psi}) f_x \Big) d\hat{G}(\boldsymbol{\psi}) \right] + M_e f_e.$$

Trade is balanced:

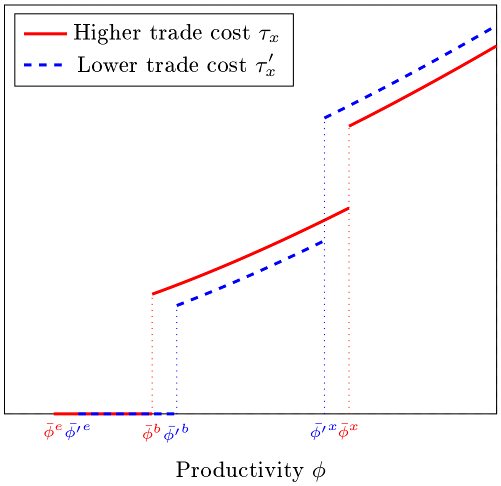
$$M \left[\int p^x(\boldsymbol{\psi}) q^x(\boldsymbol{\psi}) d\hat{G}(\boldsymbol{\psi}) \right] = M_f \left[\int p^x(\boldsymbol{\psi}) q^x(\boldsymbol{\psi}) d\hat{G}_f(\boldsymbol{\psi}) \right],$$

where subscript f denotes Foreign. The price index is expressed as

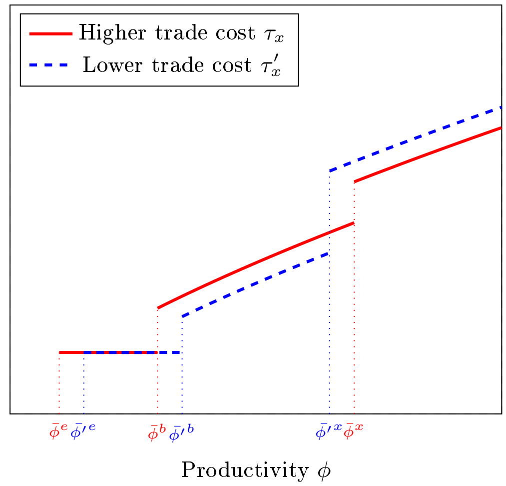
$$P^{1-\sigma} = M \left[\int p(\boldsymbol{\psi})^{1-\sigma} d\hat{G}(\boldsymbol{\psi}) \right] + M_f \left[\int x(\boldsymbol{\psi}) p(\boldsymbol{\psi})^{1-\sigma} d\hat{G}_f(\boldsymbol{\psi}) \right]$$

An equilibrium is formally defined as

Definition 1. *An equilibrium of the economy is defined as (a) a list of wages $\{w, w_f\}$, (b) functions of Home and Foreign $\{p(\omega), p^x(\omega), q(\omega), q^x(\omega), x(\omega), l(\omega), b(\omega), \tau^y(\omega)\}$, (c) aggregate price indices $\{P, P_f\}$, (d) lump-sum government transfers $\{T, T_f\}$, and (e) mass of entry and production firms $\{M, M_f, M_e, M_{e,f}\}$ such that (i) representative households maximize utility subject to their budget constraint; (ii) firms maximize profits; (iii) the labor and goods market clearing conditions are satisfied; (iv) the government budgets are balanced; (v) trade is balanced; and (vi) free entry condition is satisfied.*



A. Lobbying expenditures, $w \times \kappa \frac{b^*}{\eta}$



B. Output distortions, $\tau \times \max\{\bar{\tau}, b^\theta\}$

Figure 1. Lower trade costs induce exporters and non-exporters to increase and decrease their lobbying, respectively

Notes. This figure illustrates changes in firm lobbying and output distortions depending on their productivity level and changes in the entry, export, and lobbying cutoffs when trade costs become lower. This figure considers a special case in which the lobbying cutoff is lower than the export cutoff. Holding τ and η constant, Panels A and B plot firm lobbying expenditures and output distortions depending on their productivity ϕ. The x-axes are productivity ϕ.

Lobbying, Reallocation, and Gains from Trade Figure 1 illustrates that lower iceberg costs make exporters and non-exporters increase and decrease their lobbying, respectively.[8] When iceberg costs decrease from τ_x to τ'_x, due to increased foreign competition, the entry and lobbying cutoffs become higher: $\bar{\phi}^e(\tau, \eta) > \bar{\phi}'^e(\tau, \eta)$ and $\bar{\phi}^b(\tau, \eta) > \bar{\phi}'^b(\tau, \eta)$. However, the export cutoff becomes lower due to increased market size: $\bar{\phi}'^x(\tau, \eta) > \bar{\phi}^x(\tau, \eta)$.

Decreases in iceberg costs reallocate more resources to exporters through two channels. The first is the standard channel in which larger market size increases production by exporters as in Melitz (2003). In the presence of lobbying, however, there is an additional reallocation channel: exporters come to have relatively higher distortions by increasing their lobbying. These changes in distortions affect allocative efficiency of an economy and gains from trade.[9] If this divergence between exporters and non-exporters leads to larger dispersion in output distortions, allocative efficiency may

[8] In this figure, I consider a special case where η is sufficiently high that there are lobbying non-exporters for given τ and η, that is, the lobbying cutoff is lower than the export cutoff: $\bar{\phi}^b(\tau, \eta) < \bar{\phi}^x(\tau, \eta)$. In Online Appendix Figure C1, I graphically illustrate the case in which $\bar{\phi}^x(\tau, \eta) < \bar{\phi}^b(\tau, \eta)$ holds. Even in this case, lower iceberg costs induce exporters to increase their lobbying.

[9] In Online Appendix Section E, with the simplified setup, I derive a formula of changes in welfare due to local iceberg cost shocks as in Arkolakis et al. (2012), Melitz and Redding (2015), and Bai et al. (2021). I show that in the absence of lobbying $\theta = 0$, the formula collapses to the one developed by Bai et al. (2021) that studies the gains from trade in the presence of exogenous distortions.

deteriorate (Hsieh and Klenow, 2009).

In the model, the China shock in Section 2 can be interpreted as increased foreign competition due to increases in Foreign productivity or decreases in bilateral trade costs.[10] With such increased foreign competition, the model provides predictions consistent with the motivating evidence. Increased foreign competition can decrease the overall lobbying of domestic firms by shrinking their market size, consistent with column (1) of Table 1. However, exporters will be less likely to be affected because of the increased foreign market size.[11] These heterogeneous effects depending on export status are consistent with the results in column (2), in which initial firm size is used as a proxy for export status based on the standard theory in the trade literature which predicts larger firms are more likely to export.

4 Taking the Model to the Data

This section discusses the calibration procedure of the model presented in the previous section. Using an IV strategy based on the institutional details of the US political system, I structurally estimate the elasticity of output distortions to lobbying θ that governs the elasticity of output distortions with respect to lobbying expenditures. The remaining parameters are calibrated to the firm-level data and other data sources using the method of moments.

4.1 Estimation of the Elasticity of Output Distortions to Lobbying

I derive regression models from the theoretical framework and estimate θ using these regression models. The regression model incorporates sectoral and time dimensions that are absent in the theoretical framework but I assume that θ is common across these dimensions. By including these additional dimensions, I can control for sector-time and firm time-invariant fixed effects that allow me to account for sectoral differences in overall distortions and to utilize within-firm time-varying variation in lobbying expenditures to identify θ.

I assume that output distortions take the following form:

$$\tau^y_{it} = \exp(\mathbf{X}'_{it}\boldsymbol{\gamma} + \delta_i + \delta_{j(i)t}) \times \tau_{j(i)t} \times (b^*_{it})^\theta,$$

where i denotes firm, $j(i)$ firm i's sector, and t time. $\mathbf{X}_{it}$ are observable firm characteristics, and δ_i and $\delta_{j(i)t}$ are firm and sector-time fixed effects, respectively. Revenue-based total factor productivity (TFPR) measured as value-added divided by wage bills is proportional to the inverse of output distortions:

$$\text{TFPR}_{it} := \frac{\text{Value Added}_{it}}{w_{n(i)j(i)t}L_{it}} \propto \left(\exp(\mathbf{X}'_{it}\boldsymbol{\gamma} + \delta_i + \delta_{j(i)t}) \times \tau_{it} \times (b^*_{it})^\theta\right)^{-1},$$

[10] See, for example, di Giovanni et al. (2014) and Caliendo et al. (2019) for China's productivity growth and Pierce and Schott (2016) and Handley and Limão (2017) for decreases in bilateral trade costs.

[11] Not only lower bilateral trade costs, but also higher foreign productivity enlarges foreign market size through increased foreign real income.

where L_{it} is employment of firm i and $w_{n(i)j(i)t}$ is sector j wage rate in state n in which firm i's headquarter is located. $w_{n(i)j(i)t}$ soak out variation in distortions due to differences in wage rates across region-sectors.[12]

b^*_{it} are the optimally chosen distortions, whereas the data report lobbying expenditures in dollar terms. To derive estimable regression models, I map the reported expenditures to variable costs of lobbying $B^*_{it} := w_t b^*_{it}/\eta_{it}$ of the model. Another issue is zeros in the lobbying data. These zeros are problematic for log transformations, and by discarding them, I lose informative variation across lobbying and non-lobbying firms. For the baseline specification, to incorporate these zeros, I use inverse hyperbolic sine transformations. Using these mapping and transformations, I can derive the following regression model:

$$\ln 1/\mathrm{TFPR}_{i,t+1} = \theta \mathrm{asinh} B^*_{it} + \mathbf{X}'_{it}\boldsymbol{\gamma} + \delta_i + \delta_{j(i)t} + \underbrace{\theta \ln \eta_{it} + \ln \tau_{it}}_{:=u_{it}}, \tag{4.1}$$

where u_{it} is a structural error term that is a function of firm primitives and $\mathrm{asinh} B^*_{it}$ is inverse hyperbolic sine transformations of B^*_{it}. Because lobbying expenditures are a function of τ_{ijt} and η_{it}, lobbying expenditures are correlated with the error term. Also, potential correlations between ϕ_{it} and τ_{it} or η_{it} can cause lobbying expenditures to be correlated with the error term. These correlations make the OLS estimates suffer from the endogeneity problem.

Alternatively, using the relationship between sales and lobbying expenditures, I can also derive the following alternative estimable regression model:

$$\ln \mathrm{Sale}_{i,t+1} = \theta\sigma \mathrm{asinh} B^*_{it} + \mathbf{X}'_{it}\boldsymbol{\gamma} + \delta_i + \delta_{j(i)t} + \underbrace{(\sigma-1)\ln \phi_{it} + \sigma \ln \tau_{it} + \theta\sigma \ln \eta_{it}}_{:=u_{it}}, \tag{4.2}$$

which also suffers from the similar endogeneity problem due to the structural error term u_{it}.

Instrumental Variable To identify θ, I need exogenous variation that increases firm lobbying expenditures, uncorrelated with firm primitives. I instrument for lobbying expenditures using the state-level time-varying appointment of a Congress member as chairperson of the House or Senate Appropriations Committee. This IV strategy is in the spirit of Bertrand et al. (2020), who use variation in seats on committees to provide empirical evidence on the role of firms' charitable giving as a means of their political influences. The data on membership on all congressional committees are obtained from Stewart and Woon (2017).

A local Congress member's appointment as chairperson of the House or Senate Appropriations

[12] Value-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 rates. Sectoral value-added shares are calculated from the NBER-CES Manufacturing database. If labor markets are segmented, firms may face different wages depending on their industry affiliation and location. In such a case, variation in TFPR may reflect variation in wages rather than output distortions, and dividing value-added by wage bills mitigates this concern.

Committee works as an exogenous profitability-shifter of lobbying.[13] The Appropriations Committees are in charge of discretionary spending, giving them more power than any other congressional committee and making them more prone to be lobbied (Stewart and Groseclose, 1999; Blanes i Vidal et al., 2012; Berry and Fowler, 2018). With budget responsibilities, the chairperson of the House or Senate Appropriations Committee has greater power than any other member and often allocates more federal spending to the state that her or she represents.[14] With an increase in potential grants and federal contract opportunities through discretionary spending, local Congress members who are the chairperson of the House or Senate Appropriations Committee can increase the profitability of lobbying of local firms in the same state as local Congress members. Because the nomination of a chairperson of a congressional committee is determined by seniority and a complicated political process, the nomination of a chairperson of the House or Senate Appropriations Committee is associated with the unexpected loss of reelection, retirement, or death of the current chairperson and exogenous to the economic conditions of individual states or firms (Aghion et al., 2009; Cohen et al., 2011).

Using this IV, I estimate Equations (4.1) and (4.2) in first differences. The samples are averaged over six years, which mitigates the potential seasonality of lobbying expenditures caused by political cycles and measurement errors of TFPR. The IV is the six-year average of a dummy variable that equals one in a given year if a state Congress member is the chairperson of the House or Senate Appropriations Committee. To control for state-common effects of the nomination of chairpersonship, I control detailed state-level tax incentives and transfers from the federal government.[15]

Regression Results Table 2 reports the regression results. Once the endogeneity problem is corrected using the IV, I obtain significantly positive coefficients. The second-stage estimates imply that a 1 percent increase in lobbying expenditures is associated with a 0.077 percent increase in output distortions. Columns (3) and (4) report the OLS and IV estimates of the sales regression, respectively. The IV estimate is 0.27. This magnitude is consistent with the IV estimate in column (2) under the commonly assumed values of σ in the literature. The estimates from the sales regression can be mapped to $\theta\sigma$. Under the σ values of 3 and 4, the implied values of θ are 0.09 and 0.068, respectively, which are in line with the estimated θ in column (2). All specifications have the same first stage. The first stage estimate is 1.49, statistically significant under 1 percent, and the Kleinbergen-Papp F-statistics is above 31.

These estimated values are in line with the previous estimates of Huneeus and Kim (2018).

[13]Within the theoretical framework, the IV can be interpreted as a variable Z_{it} that shifts the profitability of lobbying: $\tau_{it} \times \max\{\bar{\tau}, Z_{it} b_{it}^{\theta}\}$.

[14]For example Berry and Fowler (2016) find that the chairpersons or the important positions of the Appropriations Committees bring more earmarks to the states they represent. Aghion et al. (2009) and Cohen et al. (2011) find that local earmarks or federal expenditures on education increase once a local Congress member becomes the chairperson of the important committees in Congress.

[15]State-level tax incentives are obtained from Bartik (2018) that include corporate income taxes, job creation tax credits, investment tax credits, R&D tax credits, and property tax abatement. The transfers from the federal government are obtained from the US Census.

Table 2: Estimation Results of θ

Dep.	$\ln 1/\text{TFPR}$		$\ln \text{Sale}$	
	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)
$\text{asinh} B_{it}^{*}$	-0.003	0.077^{**}	0.042^{***}	0.258^{***}
	(0.006)	(0.031)	(0.012)	(0.085)
KP-F		31.73		31.73
Industry FE	Y	Y	Y	Y
State Control	Y	Y	Y	Y
N	1206	1206	1206	1206

Notes. This table reports the OLS and IV estimates of Equation (4.1). The dependent variable is the log of inverse of TFPR and sales in columns (1) and (2) and columns (3) and (4), respectively. The OLS and IV estimates are reported in columns (1) and (3), and (2) and (4), respectively. The IV is the six-year average of a dummy variable that equals one in a given year if a Congress member of the state where a firm is headquartered becomes the chairperson of the House or Senate Appropriations Committee. State controls include corporate income tax, job creation tax credit, investment tax credit, R&D tax credit, property tax abatement, and transfers from the federal government. Firm controls include dummies indicating the quantiles of firms' 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.

They estimate the elasticity using the regression model similar to Equation (4.2). To deal with the endogeneity problem, they use the firm time-varying shift-share IV based on firms' political connections and the weights each firm gives to committees, motivated by Bombardini and Trebbi (2020). Although using different variation (state- vs. firm-level time-varying), their OLS and IV estimates of 0.048 and 0.216, respectively, are similar to my estimates, which stay within one standard deviation of the corresponding estimates in columns (3) and (4) of Table 2.

Direction of Bias Why does the OLS estimate differ from the IV estimate in Table 2? The direction of bias of the OLS estimate can be interpreted through the lens of the model. The bias is affected by covariances and variances of firm primitives. For exposition purposes, I will consider the regression model without any controls and a simplified closed economy setup in which every firm is operating and lobbying. These conditions are imposed to ensure that selection into production, exporting, and lobbying does not affect the bias, which allows me to derive the analytical expression for the bias.[16] In this setup, I can show that the OLS estimate $\hat{\beta}^{\text{OLS}}$ is biased and analytically characterize its bias:

$$\hat{\beta}^{\text{OLS}} \xrightarrow{p} \theta + \underbrace{\frac{\text{Cov}(\ln B_{it}^*, \theta \ln \eta_{it} + \ln \tau_{it})}{\text{Var}(\ln B_{it}^*)}}_{=\mathcal{B}(\ln \boldsymbol{\psi}_{it})}$$

where $\mathcal{B}(\ln \boldsymbol{\psi}_{it})$ is the bias that is a function of covariances and variances of firm primitives:

$$\mathcal{B}(\ln \boldsymbol{\psi}_{it}) = \frac{1}{\text{Var}(\ln B_{it}^*)} \Big(\frac{\theta^2 \sigma}{1-\theta\sigma} \text{Var}(\ln \eta_{it}) + \frac{\sigma}{1-\theta\sigma} \text{Var}(\ln \tau_{it}) \\ + \frac{\theta(\sigma-1)}{1-\theta\sigma} \text{Cov}(\ln \phi_{it}, \ln \eta_{it}) + \frac{2\theta\sigma}{1-\theta\sigma} \text{Cov}(\ln \tau_{it}, \ln \eta_{it}) + \frac{\sigma-1}{1-\theta\sigma} \text{Cov}(\ln \phi_{it}, \ln \tau_{it}) \Big). \quad (4.3)$$

Depending on the signs of the covariances, the bias can take both positive and negative values. If the covariances are sufficiently negative, the OLS estimate will be downward biased, as in Table 2. In the later part of this section, I estimate these covariances using the method of moments and find that the estimated covariances between $\ln \phi_{it}$ and $\ln \tau_{it}$ or $\ln \eta_{it}$ are negative. Based on the calibrated values and the estimates of the variances and covariances reported in Table 3 in the later section, the numerator of the bias, $\text{Cov}(\ln B_{it}^*, \theta \ln \eta_{it} + \ln \tau_{it})$, is -0.56, consistent with the downward bias.

Additional Robustness Checks To validate the identifying assumption of the IV, I conduct an event study to check whether the appointment of the chairperson has pre-trends in lobbying expenditures. The pre-trends can detect potential spurious correlations arising from pre-existing confounding factors or reverse causality problems that violate the identifying assumption. These event-study results are reported in Online Appendix Figure D1. I find no pre-trends in the appointment supporting the exclusion restriction of the IV.

If the model is misspecified, it is problematic to infer TFPR as firm-specific distortions. To examine whether the findings are robust to model misspecification, I use the cash effective tax rate (ETR) developed by Dyreng et al. (2008) as an alternative proxy for firm-specific distortions. The ETR captures firms' long-run tax avoidance activities, such as tax and investment credits. The ETR can be constructed directly from variables from Compustat. Using the same IV strategy, I find that lobbying decreases the ETR, consistent with the baseline results. In Online Appendix Section D.1.3, I explain the construction of the ETR and the regression results in detail.

I extend the model to include two production factors: labor and capital. Using the same IV strategy, I find that lobbying does not have statistically significant relationships with marginal revenue product of capital (MRPK). These results are reported in Online Appendix Table D1.

To examine whether the results are sensitive to the imposed functional forms, I use alternative transformations of lobbying expenditures: log one plus lobbying expenditures and a dummy variable

[16] This setup can be achieved by setting $\bar{\tau} = 0$, $f_b = 0$, $f = 0$, and $\tau_x \to \infty$. When these conditions are violated, the bias will be expressed as a more complicated function of firm primitives because selection into production, lobbying, and exporting will also affect the bias.

of positive lobbying. These results are reported in Online Appendix Table D3. The estimates from the log transformation, based on two decimals, are the same as the main results. When using the dummy variable, I also obtain statistically significant and positive estimates with the strong first stage.

4.2 Method of Moments

The two countries are calibrated to cross-sectional data corresponding to the US and China in 2007. I assume that $\ln \boldsymbol{\psi} := (\ln \phi, \ln \tau, \ln \eta)$ of the US follows a joint log-normal distribution:

$$\begin{pmatrix} \ln \phi \\ \ln \tau \\ \ln \eta \end{pmatrix} \sim \mathcal{N}\left(\begin{pmatrix} \mu_\phi^{\mathrm{US}} \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_\phi^2 & & \\ \rho_{\phi\tau}\sigma_\phi\sigma_\tau & \sigma_\tau^2 & \\ \rho_{\phi\eta}\sigma_\phi\sigma_\eta & \rho_{\tau\eta}\sigma_\tau\sigma_\eta & \sigma_\eta^2 \end{pmatrix}\right).$$

I normalize the mean of $\ln \tau$ and $\ln \eta$ to zero because the model is invariant to the mean of exogenous distortions and the mean of lobbying efficiency is not separately identifiable from κ. The covariance matrix is characterized by three standard deviations, $\boldsymbol{\sigma}_{\boldsymbol{\psi}} := (\sigma_\phi, \sigma_\tau, \sigma_\eta)$, and three correlations, $\boldsymbol{\rho}_{\boldsymbol{\psi}} := (\rho_{\phi\tau}, \rho_{\phi\eta}, \rho_{\tau\eta})$. Given the absence of micro-level data on Foreign, I assume that $\boldsymbol{\psi}$ of Foreign follows a joint log-normal distribution with the same $\boldsymbol{\sigma}_{\boldsymbol{\psi}}$ and $\boldsymbol{\rho}_{\boldsymbol{\psi}}$ with the US but with different productivity level μ_ϕ^F.[17] I also take f_e, f, and f_x of Foreign to be the same as those of the US and assume that foreign firms cannot lobby. Because foreign firms cannot lobby, the foreign variables are invariant to the mean of η, μ_η^F. Therefore, I set μ_η^F to be the same as the US. I indirectly infer these parameters related to the underlying distributions because of firm selection into production, exporting, and lobbying.

$\{\theta, \bar{\tau}, \mu_\phi^F, \sigma, f_e, L^{\mathrm{US}}, L^F\}$ are calibrated externally. I set θ to 0.077, the estimated value in Table 2. I normalize L^{US} to be 10 and set the relative labor of Foreign to US L^F/L^{US} to 5.2 to match the relative labor force between China and the US. I set the elasticity of substitution to be 3 as in Hsieh and Klenow (2009). I normalize the mean productivity level of China μ_ϕ^F to zero. As standard in the literature, I normalize the entry cost f_e to one. I set the common distortion $\bar{\tau}$ to one.

The remaining 12 parameters $\boldsymbol{\Theta} := \{\mu_\phi^{\mathrm{US}}, \sigma_\phi, \sigma_\tau, \sigma_\eta, \rho_{\phi\tau}, \rho_{\phi\eta}, \rho_{\tau\eta}, \kappa, f_b, \tau_x, f_x, f\}$ are jointly calibrated using the method of moments to match the model moments with the 2007 data counterparts. The parameters minimize the following objective function:

$$\hat{\boldsymbol{\Theta}} = \arg\min_{\boldsymbol{\Theta}} \{(\mathbf{m} - \mathbf{m}(\boldsymbol{\Theta}))' \mathbf{W} (\mathbf{m} - \mathbf{m}(\boldsymbol{\Theta}))\},$$

where $\mathbf{m}$ and $\mathbf{m}(\boldsymbol{\Theta})$ are empirical and model moments and $\mathbf{W}$ is the weighting matrix. I set $\mathbf{W}$ to

[17] The estimate of $\rho_{\phi\tau}$ from Bai et al. (2021) based on the Chinese micro data is -0.83, which is similar to my estimate of -0.81 based on the US firms in Compustat.

Table 3: Model Parameters

Parameter	Description	Value	Identifying Moment
Panel A. Externally calibrated			
θ	Lobbying elasticity	0.08	Own estimate, column (2) of Table 2
σ	Elasticity of substitution	3	Hsieh and Klenow (2009)
L^F/L^{US}	Foreign & US Labor	5.2	Relative labor of China to the US
μ_ϕ^F	China mean productivity	0	Normalization
μ_τ^{US}, μ_τ^F	US & China mean exo. distortion	0	Normalization
μ_η^{US}, μ_η^F	US & China mean lobbying effic.	0	Normalization
f_e	Entry cost	1	Normalization
$\bar{\tau}$	Common distortion	1	Normalization
Panel B. Internally calibrated			
μ_ϕ^{US}	US mean productivity	2.98	Relative real GDP of the US
σ_ϕ	Std. productivity	1.91	Std. TFPQ
σ_τ	Std. exo. distortion	0.93	Std. residual
σ_η	Std. lobbying effic.	2.70	Std. lobbying expenditures
$\rho_{\phi\tau}$	Corr. productivity & exo. distortion	−0.81	Corr. TFPQ & residual
$\rho_{\phi\eta}$	Corr. productivity & lobbying effic.	−0.62	Corr. TFPQ & lobbying expenditures
$\rho_{\tau\eta}$	Corr. exo. distortion & lobbying effic.	0.19	Corr. residual & lobbying expenditures
κ	Variable lobbying cost	0.01	Med. sales of lobbying & non-lobbying firms
f_b	Fixed lobbying cost	0.03	Lobbying expenditures & sales dist.
τ_x	Iceberg trade cost	4.15	US import share from China
f_x	Fixed export	0.03	Share of exporters, Bernard et al. (2007)
f	Fixed cost of production	1e-3	Sales dist.

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

be the identity matrix. The moments are normalized to convert the difference between the model and the empirical moments into percentage deviation.

I choose the moments that are relevant and informative about the underlying parameters. In Online Appendix Section D.2, relationships between the parameters and the chosen moments are explained in detail. μ_ϕ^{US} is calibrated to match the relative real GDP of the two countries. In the model, I define producer price index (PPI) as $\text{PPI} := M(\int p(\psi)^{1-\sigma} d\hat{G}(\psi))^{1/(1-\sigma)}$ and real GDP as total domestic and export revenues generated by domestic firms divided by PPI. κ is calibrated to match the log difference between the medians of sales among lobbying and non-lobbying firms. Because κ only governs the overall level of lobbying firms' sales, this moment identifies κ.

I set σ_ϕ to match the standard deviation of quantity-based total factor productivity (TFPQ)

Table 4: Data and Model Moments

Moments	Data (2007)	Model
Panel A. Targeted Moments		
Relative real GDP	1.36	1.36
Corr. TFPQ & residual	−0.80	−0.90
Corr. TFPQ & lobbying expenditures	0.35	0.54
Corr. residual & lobbying expenditures	−0.37	−0.24
Std. TFPQ	1.95	1.84
Std. residuals	0.91	0.98
Std. lobbying expenditures	1.55	1.44
Std. TFPR	0.80	0.93
Share of lobbying firms	0.15	0.16
Log diff. med. sales of lobbying & non-lobbying firms	2.69	2.52
Share of exporters	0.18	0.19
US import shares from China	0.05	0.05
Log diff. sales of the 50p and 10p	3.46	3.80
Log diff. sales of the 70p and 50p	1.86	1.69
Log diff. sales of the 50p and 25p	1.84	1.74
Panel B. Non-Targeted Moments		
Shares of lobbying firms (Sales $>$ 75p)	0.35	0.37
Shares of lobbying firms (75p $\geq$ Sales $>$ 50p)	0.12	0.21
Shares of lobbying firms (50p $\geq$ Sales $>$ 25p)	0.07	0.06
Shares of lobbying firms (25p $\geq$ Sales)	0.06	4e-4
Std. log sales	2.61	2.44
Corr. TFPQ & TFPR	0.81	0.81
Corr. sales & lobbying expenditures	0.54	0.86
Corr. sales & residual	−0.61	−0.61
Corr. sales & TFPR	0.54	0.45
Corr. sales & TFPQ	0.84	0.89

Notes. Panels A and B report the targeted and non-targeted moments of the model and the data counterparts, respectively. Except for the relative GDP, the share of exporters and the US import shares from China, all the moments are calculated from Compustat and the lobbying database of 2007. The relative GDP between the US and China is obtained from the Penn World Table. The share of exporters comes from Bernard et al. (2007), and the US import shares from China are calculated from the WIOD in 2007.

defined as TFPQ := (Value Added$^{\frac{\sigma}{\sigma-1}}$)$/wL$ that is proportional to ϕ. I set σ_τ to match the standard deviation of the residuals from Equation (4.1) that can be mapped to $\theta\eta + \tau$ in the model. I set σ_η to match the standard deviation of lobbying expenditures corresponding to wb/η in the model. I fit $\rho_{\phi\tau}$, $\rho_{\phi\eta}$, and $\rho_{\tau\eta}$ to the correlations between TFPQ and the residuals, TFPQ and log of lobbying expenditures, and log of lobbying expenditures and the residuals from Equation (4.1), respectively. I normalize TFPQ and the residuals by the weighted average within each industry, where the weights are given by value-added. Additionally, I fit three additional moments: the standard deviation of TFPR, the log difference between sales of the 75th and 50th percentiles (75p and 50p), and the log difference between sales of the 50th and 25th percentiles (50p and 25p). Because the distribution of TFPR and sales are a function of the primitives, these three moments are informative on the standard deviations and the correlations of the primitives.

I set f_b to match the shares of lobbying firms. I fit f using the difference between log sales of the 50th and the 10th percentiles (50p and 10p). Because f affects production decisions of small-sized firms at the bottom of the sales distribution, this moment can pin down the parameter. I fit f_x to match the shares of exporters to be 0.18, the reported value in Bernard et al. (2007). I set τ_x to match the import shares from China in the US in 2007. The estimated τ_x is 4.15, higher than the estimate of 1.7 in Anderson and Van Wincoop (2004), and 1.83 in Melitz and Redding (2015). This estimate of 4.15 may reflect high trade costs between the US and China.

Estimation Results Table 3 reports the calibrated parameters and describes their identifying moments. Table 4 reports the model fit. The data moments are well-approximated in the model. Also, Panel B reports non-targeted moments in the data. Matching these non-targeted moments is important because these non-targeted moments also have information on the primitives similar to that of the targeted moments. The model reproduces similar patterns for these non-targeted moments both qualitatively and quantitatively.

I find that the standard deviation of lobbying efficiency is larger than that of productivity or exogenous distortions. A negative correlation between productivity and exogenous distortions ($\rho_{\phi\tau} < 0$) reflects that more productive firms are less subsidized (or more taxed). A negative correlation between productivity and lobbying efficiency ($\rho_{\phi\eta} < 0$) implies that more productive firms have lower lobbying efficiency, and a positive correlation between exogenous distortions and lobbying efficiency ($\rho_{\tau\eta} > 0$) implies that firms with higher exogenous distortions have higher lobbying efficiency.

5 Quantitative Results

Based on the calibrated values, I quantitatively assess how openness to trade affects firm lobbying behaviors and how lobbying affects welfare gains from trade. I conduct two counterfactuals. The first counterfactual is opening to trade. I compare the US economy in the autarky to that in the current equilibrium with the observed import shares. The second counterfactual is the China shock modeled as its productivity growth. I compare the US economy before and after the productivity growth of

Table 5: Trade and Firm Lobbying

	Overall	Exporters	Non-exporters
	(1)	(2)	(3)
Panel A. Opening to Trade			
△ Avg. lobbying expenditures (%)	1.45	1.34	−18.08
△ Probability of lobbying (p.p)	−0.50	0.23	−0.68
Panel B. China Shock			
△ Avg. lobbying expenditures (%)	0.21	0.17	−4.94
△ Probability of lobbying (p.p)	−0.12	0.20	−0.19

Notes. This table reports the changes in US firm lobbying expenditures at intensive and extensive margins. Panel A reports the changes when moving from the autarky to the current equilibrium with the observed import shares. Panel B reports the changes when China's productivity grows from 1999 to 2007 level. Column (1) reports the average changes of all firms. Columns (2) and (3) report the average changes among exporters and non-exporters in the current equilibrium, respectively.

China.

Opening to Trade Table 5 reports the results on how firm lobbying would have been changed when the economy moves from the autarky to the current equilibrium. When opening to trade, the average lobbying expenditures increase by 1.45 percent, but fewer firms participate in lobbying: the probability of lobbying decreases by 0.5 percentage point.[18] However, these results are heterogeneous depending on export status in the current equilibrium. Exporters increase lobbying at both the intensive and extensive margins, whereas non-exporters decrease at both margins. Therefore, the aggregate increases at the intensive margins are driven by exporters, whereas the aggregate decreases at the extensive margins are driven by non-exporters. These results are consistent with Figure 1.

To examine the welfare effects of these changes in lobbying, I compare the gains from trade of the baseline economy with lobbying to that of the counterfactual economy in which import shares are the same as the baseline but lobbying is not allowed. This counterfactual economy is constructed

[18] More precisely, in column (1), I compare the average lobbying expenditures, $\int_{\bar{\phi}^e}(w\kappa b(\psi)/\eta)d\hat{G}(\psi)$, of the autarky and the current equilibrium. In column (2), I compare the average lobbying expenditures in the autarky and the current equilibrium among exporters that are operating in the current equilibrium: $\int_{\bar{\phi}^x}(w\kappa b^a(\psi)/\eta)d\hat{G}(\psi)$ and $\int_{\bar{\phi}^x}(w\kappa b^t(\psi)/\eta)d\hat{G}(\psi)$, where b^a and b^t are their optimal lobbying amounts in the autarky and the current equilibrium. I restrict the comparison to this set of firms because there is no notion of exporting in the autarky. Similarly, in column (3), I compare the average lobbying expenditures in the autarky and the current equilibrium among non-exporters operating in the current equilibrium: $\int_{\bar{\phi}^e}^{\bar{\phi}^x}(w\kappa b^a(\psi)/\eta)d\hat{G}(\psi)$ and $\int_{\bar{\phi}^e}^{\bar{\phi}^x}(w\kappa b^t(\psi)/\eta)d\hat{G}(\psi)$. I compute the extensive margin results analogously.

Table 6: Welfare Gains from Trade in the Presence and Absence of Lobbying

	Baseline (lobbying)	Counterfactual (no lobbying)
	(1)	(2)
Panel A. Opening to Trade		
$\triangle$ Welfare (%)	2.02	2.12
Panel B. China Shock		
$\triangle$ Welfare (%)	0.59	0.61

Notes. This table reports the welfare gains from trade in the presence and absence of lobbying (baseline and counterfactual economies). Panel A reports the welfare gains associated with moving from the autarky to the current equilibrium with the observed import shares. Panel B reports the welfare gains when China's productivity grows from 1999 to 2007 level.

by re-calibrating iceberg costs after setting $\theta = 0$. Because of the same import shares, the welfare gains predicted by the formula from Arkolakis et al. (2012) (henceforth ACR) are the same in both countries. However, lobbying as well as other exogenous distortions and the log-normality distributional assumption make micro structure important, and the two economies experience different welfare effects.[19] Panel A of Table 6 reports the results. The welfare gains are smaller in the baseline economy by 4.7 percent when compared to those in the counterfactual economy (2.02 percent and 2.12 percent, respectively).[20]

Why does lobbying drive smaller welfare gains from trade? I find that when opening to trade, increased lobbying by exporters relatively lowers aggregate TFP growth in the baseline economy compared to the counterfactual economy. I can express the aggregate quantity as follows:

$$Q = AL,$$

where L is total labor endowment and A is the aggregate TFP. The aggregate TFP can be expressed

[19] If productivity is the only source of heterogeneity and follows the Pareto distribution, micro structure does not matter for the welfare effects of trade in the absence of lobbying and exogenous distortions (Arkolakis et al., 2012). Exogenous distortions or deviations from the Pareto distributional assumption, including the log-normality distributional assumption in my model, make micro structure matter (Melitz and Redding, 2015; Bai et al., 2021). In my model, lobbying is an additional channel that makes micro structure important.

[20] In terms of the welfare level, the welfare of the baseline economy is 12 percent lower than that of the counterfactual economy.

as

$$A = \underbrace{M^{\frac{1}{\sigma-1}}}_{\text{Entry}} \times \underbrace{\left[\int \left(\frac{1}{\phi} \frac{q(\boldsymbol{\psi})}{\tilde{q}} \right) d\hat{G}(\boldsymbol{\psi}) + \int \left(x(\boldsymbol{\psi}) \frac{\tau_x}{\phi} \frac{q(\boldsymbol{\psi})}{\tilde{q}} \right) d\hat{G}(\boldsymbol{\psi}) \right]^{-1}}_{\text{Allocative efficiency}} \times \underbrace{\frac{L^p}{L}}_{\text{Labor}}, \tag{5.1}$$

where L^p is total labor inputs used for production: $L^p := M \int l(\boldsymbol{\psi}) d\hat{G}(\boldsymbol{\psi})$, and $\tilde{q}$ is the harmonic average quantity produced by firms: $\tilde{q} := (\int q(\boldsymbol{\psi})^{\frac{\sigma-1}{\sigma}} d\hat{G}(\boldsymbol{\psi}))^{\frac{\sigma}{\sigma-1}}$.

The aggregate TFP can be decomposed into three terms: entry, allocative efficiency, and labor terms. The entry term captures changes in the aggregate TFP due to changes in firm mass through the entry. The second term is related to allocative efficiency á la Hsieh and Klenow (2009).[21] Dispersion in TFPR decreases this allocative efficiency, and there is a loss of efficiency among exporters due to iceberg costs. The last term captures how much labor is allocated to production workers. If more labor is allocated to lobbying rather than production, resources are wasted for lobbying and this labor term becomes lower.

Opening to trade increases the aggregate TFP by improving the allocative efficiency and the labor terms. The allocative efficiency term improves as more resources are allocated to more productive firms by increasing their market size. The labor term improves as more workers are allocated to production rather than fixed production or entry costs. However, the entry term deteriorates because increased foreign competition induces less entry and more exit by domestic firms. These three channels are highlighted by Melitz (2003).

However, increased lobbying by exporters deteriorates the aggregate TFP growth of the baseline economy compared to the counterfactual economy through the three terms. First, increased lobbying brings larger dispersion in TFPR that deteriorates improvement in allocative efficiency. Second, as more resources are wasted on lobbying rather than production, increased lobbying by exporters worsens improvement in the labor terms. Third, there is even more negative growth in the entry term because increased lobbying hinders firm entry.

Table 7 reports the changes in the aggregate TFP and its three components when opening to trade. The aggregate TFP growth in the baseline is 4 percent lower than that of the counterfactual (5.03 percent and 5.23 percent, respectively). The entry, allocative efficiency, and labor terms explain about 20 percent, 40 percent, and 40 percent of this difference between the baseline and counterfactual economies, respectively.

China Shock Following di Giovanni et al. (2014) and Caliendo et al. (2019), I model the China shock as China's productivity growth captured by increases in its mean productivity μ_ϕ^F. I calibrate counterfactual productivity changes of China, $\mu_\phi^{c,F}/\mu_\phi^F$, by fitting the ratio of the real GDP of China between 1999 and 2007. Then, I examine how the China shock affected US firm lobbying and compare

[21] In the closed economy model, this allocative efficiency term coincides with the formula for aggregate TFP derived in Hsieh and Klenow (2009). See Online Appendix Section C for derivation in detail.

Table 7: Changes in the Aggregate TFP in the Presence and Absence of Lobbying

	Changes in the Aggregate TFP			
	Overall	Entry	Allocative	Labor
	(1)	(2)	(3)	(4)
Panel A. Opening to Trade				
Baseline (lobbying) (%)	5.03	−0.38	5.01	0.40
Counterfactual (no lobbying) (%)	5.23	−0.34	5.09	0.48
Panel B. China Shock				
Baseline (lobbying) (%)	0.98	−0.08	1.04	0.02
Counterfactual (no lobbying) (%)	1.02	−0.07	1.06	0.03

Notes. This table reports changes in the aggregate TFP in the presence and absence of lobbying (baseline and counterfactual). Panel A reports the aggregate TFP changes associated with moving from the autarky to the current equilibrium. Panel B reports the aggregate TFP changes associated when China's productivity grows from 1999 to 2007 level. Columns (2), (3), and (4) report the entry, allocative efficiency, and labor terms defined in Equation (5.1), respectively.

its welfare and TFP effects in the presence and absence of lobbying.

Panel B of Table 5 reports the effects of the China shock on firm lobbying. China's productivity growth led exporters to increase lobbying by 0.17 percent, on average, and participate in lobbying by 0.2 percentage point, because the productivity growth increased the real income of China and market size for exporters. However, it led non-exporters to decrease lobbying expenditures by 4.94 percent, on average, and to participate less in lobbying by 0.19 percentage point due to increased foreign competition in the domestic market. These heterogeneous responses are consistent with the motivating evidence in Section 2 (columns (2) and (4) of Table 1). When aggregating these heterogeneous responses, the average lobbying expenditures increased by 0.21 percent but the overall participation rates decreased by 0.12 percent point.[22]

Panel B of Table 6 reports the welfare results of the China shock. China's productivity growth improved US welfare by 0.59 percent in the baseline economy, but these gains are 3.3 percent lower than those in the counterfactual economy. These smaller welfare gains are again because of deteriorated TFP growth due to increased lobbying by exporters (Panel B of Table 7).

[22] Note that these aggregate changes in overall lobbying cannot be directly mapped to the motivating evidence for two reasons. First, sectoral heterogeneity is abstracted in the model. Second, the empirical analysis exploits sectoral variation of the China shock that only identifies relative differences across sectors and cannot speak to the aggregate outcomes.

Table 8: Sensitivity Analysis. Opening to Trade.

Parameters	$\rho_{\phi\tau}$		$\rho_{\phi\eta}$		$\rho_{\tau\eta}$		σ_{ϕ}		σ_{τ}		σ_{η}	
	$\downarrow$ 1%	$\uparrow$ 1%	$\downarrow$ 1%	$\uparrow$ 1%	$\downarrow$ 1%	$\uparrow$ 1%	$\downarrow$ 1%	$\uparrow$ 1%	$\downarrow$ 1%	$\uparrow$ 1%	$\downarrow$ 1%	$\uparrow$ 1%
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Panel A. Gains from Trade (%)											
$\triangle$ Welfare	2.04	2.03	2.03	2.02	2.02	2.01	2.01	2.04	2.02	2.0	2.02	1.93
	Panel B. $\triangle$ Avg. Lobbying Expenditures (%)											
Exporters (A)	1.19	2.01	1.44	3.89	1.40	3.10	1.39	1.85	2.45	3.18	10.37	28.18
Non-exporters (B)	−18.05	−17.77	−17.0	−17.84	−17.87	−17.31	−17.56	−17.89	−18.06	−17.66	−17.59	−17.65
Diff. (A-B)	19.24	19.78	18.44	21.73	19.27	20.42	18.95	19.74	20.51	20.84	27.96	45.83

Notes. This table reports the results of the sensitivity analysis of the parameters related to the distribution of the US firm primitives.

Sensitivity Analysis To understand how the parameters related to the underlying distributions of firm primitives interact with lobbying and to examine whether the results are sensitive to these parameters, I conduct the same analysis while varying one parameter and holding other parameters constant. I consider 1 percent increase and decrease of the magnitude of the baseline values while preserving their signs.

Table 8 reports the results on the gains from trade and changes in the average lobbying expenditures of exporters and non-exporters when opening to trade. I also report the differences in the changes in the average lobbying expenditures between these two groups. The higher values of these differences imply that there is a larger divergence of lobbying between exporters and non-exporters when opening to trade. The results imply that my baseline findings are not sensitive to the estimated parameter values and that the gains from trade become lower when the underlying parameters change in a way that increases a divergence of lobbying between exporters and non-exporters. With the larger divergence, output wedges that are endogenous outcomes of lobbying become more dispersed, which lowers allocative efficiency. I also conduct the sensitivity analysis on the parameters related to the distribution of foreign firm primitives. The results are reported in Online Appendix Table D4. As Foreign affects the US firms' decisions to export or lobby only through the aggregate variables, changes in these foreign parameters have negligible effects.

6 Conclusion

This paper quantitatively evaluates the effects of openness to trade on firm lobbying and the welfare gains from trade in the presence of lobbying. Because of the complementarity between gains from lobbying and market size, as trade costs become lower, exporters relatively increase their lobbying expenditures at both the intensive and extensive margins compared to non-exporters. These changes in exporters' lobbying affect allocative efficiency and welfare gains from trade.

However, Compustat data used for the quantitative exercises covers only publicly traded firms and are not representative of the entire US economy. Also, the model does not incorporate other important features of lobbying, such as strategic behaviors between firms, increasing barriers to entry by incumbents, and escape competition effects. Enriching both the data and the theory components to study the interaction between lobbying and openness to trade remains a fruitful avenue for future research.

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ONLINE APPENDIX

(NOT FOR PUBLICATION)

Appendix A Data

Balance Sheet Data Firm balance sheet data come from Compustat that covers publicly traded firms in the US. 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 percent of MRPL: I drop these outlier samples so that my results are not driven by outliers following Hsieh and Klenow (2009).

Lobbying Data Lobbying data became publicly disclosed since the LDA. Lobbyists have to report summaries of their lobbying activities semi-annually from 1998 to 2007 and quarterly after 2007. The CRP constructed the lobbying database based on these reports. I downloaded lobbying data from the CRP. According to the LDA, 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 Figures 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 come from NBER-CES manufacturing data. The NBER-CES manufacturing data have 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. 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.

Congressional Committee Assignment I obtain congressional committee assignment data from Stewart and Woon (2017). This data set has information on the date of committee assignment, the date of committee termination, and states represented by members. These three pieces of information give me state-level time-varying information on the chairpersonship of the Appropriation Committee, which is used as the IV in Equations (4.1) and (4.2).

Table A1: Descriptive Statistics

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

Notes. This table provides descriptive statistics of the main data set. There are $39,692$ firm-year level observations with 4,989 unique firms. Standard deviations are reported in parentheses. The sample period is 1998 to 2015.

Wage Data I obtain 3-digit SIC industry-level wage data within each state from the Census of Business Patterns. I convert the 3-digit NAICS codes to the 3-digit SIC code. The constructed wage data are then matched with the firm-level data based on firm headquarter locations and industry affiliation. Using this information, I construct wage bills by multiplying firm-level employment and obtained wage rates. The wage bill information is used for constructing TFPR in Equation (4.1).

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 (4.1).

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 step 1, unify abbreviations and then match the remaining names. For example, "Incorporated" is converted to "INC."
- Step 3: For the names not matched in step 2, Match a firm's name after dropping abbreviations.
- Step 4: For the names not matched in 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.

Descriptive Statistics Descriptive statistics of the final data set are presented in Table A1. Columns (1) and (2) report the average sales and average lobbying expenditures, respectively. In column (3), about 13 percent of firm-year level observations have spent positive amounts on lobbying. Column (4) reports the percentage of extensive margin changes. Only about 8 percent of the total observations changed lobbying status during the sample period, indicating that lobbying status is persistent. This number is consistent with Kerr et al. (2014), who also report that about 92 percent of firms that lobby in a given year also lobby in the next year.

1/31/2021 LD-2 Disclosure Form

Clerk of the House of Representatives	Secretary of the Senate
Legislative Resource Center	Office of Public Records
135 Cannon Building	232 Hart Building
Washington, DC 20515	Washington, DC 20510
http://lobbyingdisclosure.house.gov	http://www.senate.gov/lobby

LOBBYING REPORT

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

1. Registrant Name ☑ Organization/Lobbying Firm ☐ Self Employed Individual
The Glover Park Group LLC

2. Address
Address1 1025 F Street NW Address2 9th Floor
City Washington State DC Zip Code 20004 Country USA

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

4a. Contact Name Mr. Joel Johnson
b. Telephone Number 2023370808
c. E-mail jjohnson@gpg.com
5. Senate ID# 86196-1005700

7. Client Name ☐ *Self* ☐ *Check if client is a state or local government or instrumentality*
Apple, Inc.
6. House ID# 365480113

TYPE OF REPORT

8. Year 2020 Q1 (1/1 - 3/31) ☐ Q2 (4/1 - 6/30) ☐ Q3 (7/1 - 9/30) ☑ Q4 (10/1 - 12/31) ☐

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

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

INCOME OR EXPENSES - YOU MUST complete either Line 12 or Line 13

12. Lobbying	13. Organizations
INCOME relating to lobbying activities for this reporting period was:	**EXPENSE** relating to lobbying activities for this reporting period were:
Less than $5,000 ☐	Less than $5,000 ☐
$5,000 or more ☑ $ 40,000.00	$5,000 or more ☐ $
Provide a good faith estimate, rounded to the nearest $10,000, of all lobbying related income for the client (including all payments to the registrant by any other entity for lobbying activities on behalf of the client).	**14. REPORTING** Check box to indicate expense accounting method. See instructions for description of options.
	☐ **Method A.** Reporting amounts using LDA definitions only
	☐ **Method B.** Reporting amounts under section 6033(b)(8) of the Internal Revenue Code
	☐ **Method C.** Reporting amounts under section 162(e) of the Internal Revenue Code

Signature Digitally Signed By: Nicole Dade **Date** 10/19/2020 11:22:17 AM

https://lda.senate.gov/filings/public/filing/2fb2ab27-82ed-4c80-abe4-b74f0cbdadad/print/ 1/6

Figure A1. The Lobbying Report by Apple Inc in 2020, Total Lobbying Expenditure

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

15. General issue area code TAX

16. Specific lobbying issues

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; Legislative Assistant, House of Representatives, Office of Rep. Jesse Jackson Jr	☑

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

Figure A2. The Lobbying Report by Apple Inc in 2020, General Issue Codes

Appendix B Motivating Evidence

In this section, I provide robustness checks for the empirical evidence in Section 2.

Different Measures for Initial Firm Size In Table B1, I define $D^{q}_{ijt_0}$ based on initial sales and capital instead of employment. I use the Compustat variable PPEGT to measure capital. Regardless of using the different measures, the results are consistent with the baseline in Table 1.

Alternative Transformation Instead of using inverse hyperbolic sine transformation, I use log one plus lobbying expenditures as an alternative dependent variable. Table B2 reports the results. The estimates, based on two decimals, are the same as 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 effects. Suppose 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.

To show that the baseline results are not driven by trade-related lobbying, I run the same regression with non-trade-related lobbying expenditures. To identify whether firm lobbying is related to trade, I use the general issue codes and summaries of lobbying activities, which are required to be reported by the LDA. 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. 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 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. Figures A1 and A2 display how lobbying expenditures, general issue codes, and summaries are reported in the lobbying reports.

Non-trade-related lobbying expenditures are obtained as the total lobbying expenditure minus the total trade-related lobbying expenditure. Table B3 reports the regression results. The estimated coefficients are qualitatively and quantitatively similar to the baseline results, implying that the results are unlikely to be driven by trade-related lobbying activities.

Table B1: Robustness. Alternative Meausres for Initial Firm Size. China Shock and Firm Lobbying

Dep.	Asinh(Lobby)		$100 \times \mathbb{1}[\text{Lobby} > 0]$	
	(1)	(2)	(3)	(4)
Panel A. Initial Firm Size: Sales				
$\triangle\text{China}_{jt}$	-0.007^{**}		-0.047^{**}	
	(0.003)		(0.021)	
$D^1_{ijt_0} \times \triangle\text{China}_{jt}$		-0.009^{**}		-0.079^{**}
		(0.004)		(0.030)
$D^2_{ijt_0} \times \triangle\text{China}_{jt}$		-0.007		-0.050
		(0.004)		(0.036)
$D^3_{ijt_0} \times \triangle\text{China}_{jt}$		-0.005		-0.028
		(0.004)		(0.032)
Panel B. Initial Firm Size: Capital (PPEGT)				
$\triangle\text{China}_{jt}$	-0.007^{**}		-0.046^{**}	
	(0.003)		(0.020)	
$D^1_{ijt_0} \times \triangle\text{China}_{jt}$		-0.007^{***}		-0.060^{***}
		(0.002)		(0.018)
$D^2_{ijt_0} \times \triangle\text{China}_{jt}$		-0.014^{**}		-0.108^{**}
		(0.007)		(0.047)
$D^3_{ijt_0} \times \triangle\text{China}_{jt}$		-0.001		0.002
		(0.006)		(0.049)
N	913	913	913	913

Notes. This table reports the OLS estimates of Equations (2.2) and (2.3). The dependent variables are inverse hyperbolic sine transformations of lobbying expenditures in columns (1) and (2) and dummy variables of whether firms participate in lobbying multiplied by 100 in columns (3) and (4). $\triangle\text{China}_{jt}$ is the China shock defined in Equation (2.1). In all specifications, I control for state dummies and $D^q_{ijt_0}$. Standard errors are two-way clustered at 3-digit SIC industry and state levels. * p<0.1; ** p<0.05; *** p<0.01.

Table B2: Robustness. Alternative Transformation. China Shock and Firm Lobbying

Dep.	Log(1 + Lobby)	
	(1)	(2)
$\triangle\text{China}_{jt}$	-0.007^{**}	
	(0.003)	
$D^1_{ijt_0} \times \triangle\text{China}_{jt}$		-0.009^{***}
		(0.003)
$D^2_{ijt_0} \times \triangle\text{China}_{jt}$		-0.011^{***}
		(0.004)
$D^3_{ijt_0} \times \triangle\text{China}_{jt}$		-0.001
		(0.006)
N	913	913

Notes. This table reports the OLS estimates of Equations (2.2) and (2.3). Dependent variables are log one plus lobbying expenditures. $\triangle\text{China}_{jt}$ is the China shock defined in Equation (2.1). In all specifications, I control for state dummies and $D^q_{ijt_0}$. Standard errors are two-way clustered at 3-digit SIC industry and state levels. * p<0.1; ** p<0.05; *** p<0.01.

Table B3: Robustness. Non-Trade-Related Lobbying. China Shock and Firm Lobbying

Dep.	Asinh(Lobby)		$100 \times \mathbb{1}[\text{Lobby} > 0]$	
	(1)	(2)	(3)	(4)
$\triangle \text{China}_{jt}$	-0.007^{**}		-0.049^{**}	
	(0.003)		(0.021)	
$D^1_{ijt_0} \times \triangle \text{China}_{jt}$		-0.010^{***}		-0.079^{***}
		(0.003)		(0.025)
$D^2_{ijt_0} \times \triangle \text{China}_{jt}$		-0.011^{***}		-0.086^{***}
		(0.004)		(0.028)
$D^3_{ijt_0} \times \triangle \text{China}_{jt}$		-0.002		0.001
		(0.006)		(0.052)
N	913	913	913	913

Notes. This table reports the OLS estimates of Equations (2.2) and (2.3). The dependent variables are inverse hyperbolic sine transformations of non-trade-related lobbying expenditures in columns (1) and (2) and dummy variables of whether firms participate in non-trade-related lobbying multiplied by 100 in columns (3) and (4). $\triangle \text{China}_{jt}$ is the China shock defined in Equation (2.1). In all specifications, I control for state dummies and $D^q_{ijt_0}$. Standard errors are two-way clustered at 3-digit SIC industry and state levels. * p<0.1; ** p<0.05; *** p<0.01.

Appendix C Theory

C.1 Model Derivation

Derivation of Optimal Lobbying Amounts and Profits I derive expressions for firms' 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, non-exporters' profits are

$$\begin{aligned}\pi^d(b;\boldsymbol{\psi}) &= \frac{1}{\sigma}\Big(\mu\frac{w}{\phi}\Big)^{1-\sigma}\tau^\sigma b^{\theta\sigma}P^{\sigma-1}E - w\Big(\kappa\frac{b}{\eta}+f_b+f\Big) \\ &= \tilde{\pi}^d(0;\boldsymbol{\psi})b^{\theta\sigma} - w\Big(\kappa\frac{b}{\eta}+f_b+f\Big)\end{aligned} \tag{C.1}$$

where $\tilde{\pi}^d(0;\boldsymbol{\psi})$ are non-exporters' variable profits conditional on not lobbying.

Firms choose the optimal lobbying amounts that maximize profits, which is characterized by the first-order condition (FOC). Taking the derivative with respect to b, I obtain the following FOC:

$$\kappa\frac{w}{\eta} = \theta\sigma\tilde{\pi}^d(0;\boldsymbol{\psi})(b^*)^{(\theta\sigma-1)}.$$

After arranging the above equation, the optimal lobbying amounts can be expressed as follows:

$$b^* = \Big(\theta\sigma\frac{\eta}{\kappa w}\tilde{\pi}^d(0;\boldsymbol{\psi})\Big)^{\frac{1}{1-\theta\sigma}}.$$

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

$$\pi^d(b^*;\boldsymbol{\psi}) = \Big((\theta\sigma)^{\frac{\theta\sigma}{1-\theta\sigma}} - (\theta\sigma)^{\frac{1}{1-\theta\sigma}}\Big)\Big(\frac{\eta}{\kappa w}\Big)^{\frac{\theta\sigma}{1-\theta\sigma}}\tilde{\pi}^d(0;\boldsymbol{\psi})^{\frac{1}{1-\theta\sigma}} - w(f+f_b).$$

Exporters' optimal lobbying amounts and profits can be derived similarly. Conditional on spending lobbying amounts of b, exporters' profits are

$$\begin{aligned}\pi^x(b;\boldsymbol{\psi}) &= \Big[\frac{1}{\sigma}\Big(\mu\frac{w}{\phi}\Big)^{1-\sigma}\tau^\sigma P^{\sigma-1}E + \frac{1}{\sigma}\Big(\frac{\tau_x w}{\phi}\Big)^{1-\sigma}\tau^\sigma P_f^{\sigma-1}E_f\Big]b^{\theta\sigma} - w\Big(\kappa\frac{b}{\eta}+f_b+f+f_x\Big) \\ &= \tilde{\pi}^x(0;\boldsymbol{\psi})b^{\theta\sigma} - w\Big(\kappa\frac{b}{\eta}+f_b+f+f_x\Big).\end{aligned}$$

where $\tilde{\pi}^x(0;\boldsymbol{\psi})$ are non-exporters' variable profits conditional on not lobbying. From the FOC with respect to b, the optimal lobbying amounts are expressed as follows:

$$b^* = \Big(\theta\sigma\frac{\eta}{\kappa w}\tilde{\pi}^x(0;\boldsymbol{\psi})\Big)^{\frac{1}{1-\theta\sigma}}.$$

After substituting the optimal lobbying amounts, I obtain that

$$\pi^x(b^*;\boldsymbol{\psi}) = \Big((\theta\sigma)^{\frac{\theta\sigma}{1-\theta\sigma}} - (\theta\sigma)^{\frac{1}{1-\theta\sigma}}\Big)\Big(\frac{\eta}{\kappa w}\Big)^{\frac{\theta\sigma}{1-\theta\sigma}} \tilde{\pi}^x(0;\boldsymbol{\psi})^{\frac{1}{1-\theta\sigma}} - w(f + f_b + f_x).$$

Zero Profit Cutoff The zero profit cutoff productivity satisfies that $\pi(\bar{\phi}^e(\tau,\eta),\tau,\eta) = 0$. Using this condition, I can derive the zero profit cutoff as follows:

$$\bar{\phi}^e(\tau,\eta) = \left[\frac{\sigma f}{\frac{1}{\sigma}(\mu w)^{1-\sigma}P^{\sigma-1}E}\right]^{\frac{1}{\sigma-1}}. \tag{C.2}$$

Lobbying Cutoff When η is sufficiently high, non-exporters may participate in lobbying, that is, $\bar{\phi}^b(\tau,\eta) < \bar{\phi}^x(\tau,\eta)$. In such a case, the lobbying cutoff is implicitly defined by the following condition:

$$c\Big(\frac{\eta}{\kappa w}\Big)^{\frac{\theta\sigma}{1-\theta\sigma}}\Big(\frac{1}{\sigma}\Big(\mu\frac{w}{\bar{\phi}^b(\tau,\eta)}\Big)^{1-\sigma}P^{\sigma-1}E\Big)^{\frac{1}{1-\theta\sigma}} - wf_b = \frac{1}{\sigma}\Big(\mu\frac{w}{\bar{\phi}^b(\tau,\eta)}\Big)^{1-\sigma}\tau^\sigma P^{\sigma-1}E, \tag{C.3}$$

where c is a constant defined as $c := (\theta\sigma)^{\frac{\theta\sigma}{1-\theta\sigma}} - (\theta\sigma)^{\frac{1}{1-\theta\sigma}}$. In the case in which $\bar{\phi}^b(\tau,\eta) \geq \bar{\phi}^x(\tau,\eta)$ holds, the lobbying cutoff is implicitly defined by the following condition:

$$\begin{aligned} &c\Big(\frac{\eta}{\kappa w}\Big)^{\frac{\theta\sigma}{1-\theta\sigma}}\Big(\frac{1}{\sigma}\Big(\mu\frac{w}{\bar{\phi}^b(\tau,\eta)}\Big)^{1-\sigma}(P^{\sigma-1}E + \tau_x^{1-\sigma}P_f^{\sigma-1}E_f)\Big)^{\frac{1}{1-\theta\sigma}} - wf_b \\ &\qquad = \frac{1}{\sigma}\Big(\mu\frac{w}{\bar{\phi}^b(\tau,\eta)}\Big)^{1-\sigma}\tau^\sigma(P^{\sigma-1}E + \tau_x^{1-\sigma}P_f^{\sigma-1}E_f). \end{aligned} \tag{C.4}$$

Also note that after setting the common distortion $\bar{\tau}$ to one, only firms that satisfy the condition $b \geq 1$ participate in lobbying because of the maximum of the functional form of the output distortions (Equation (3.1)).

Export Cutoff In the case in which $\bar{\phi}^b(\tau,\eta) \geq \bar{\phi}^x(\tau,\eta)$ holds, the export cutoff satisfies that

$$\frac{1}{\sigma}\Big(\mu\frac{\tau_x w}{\bar{\phi}^x(\tau,\eta)}\Big)^{1-\sigma}\tau^\sigma P_f^{\sigma-1}E_f = wf_x.$$

From this condition, the export cutoff can be expressed as follows:

$$\bar{\phi}^x(\tau,\eta) = \left(\frac{wf_x}{\frac{1}{\sigma}(\mu\tau_x w)^{1-\sigma}P_f^{\sigma-1}E_f}\right)^{\frac{1}{\sigma-1}}. \tag{C.5}$$

In the case where $\bar{\phi}^b(\tau,\eta) < \bar{\phi}^x(\tau,\eta)$, the export cutoff satisfies

$$c\Big(\frac{\eta}{\kappa w}\Big)^{\frac{\theta\sigma}{1-\theta\sigma}}\Big(\frac{1}{\sigma}\Big(\mu\frac{w}{\bar{\phi}^x(\tau,\eta)}\Big)^{1-\sigma}(P^{\sigma-1}E+\tau_x^{1-\sigma}P_f^{\sigma-1}E_f)\Big)^{\frac{1}{1-\theta\sigma}} - wf_x$$
$$= c\Big(\frac{\eta}{\kappa w}\Big)^{\frac{\theta\sigma}{1-\theta\sigma}}\Big(\frac{1}{\sigma}\Big(\mu\frac{w}{\bar{\phi}^x(\tau,\eta)}\Big)^{1-\sigma}P^{\sigma-1}E\Big)^{\frac{1}{1-\theta\sigma}}.$$

From this condition, the export cutoff can be expressed as follows:

$$\bar{\phi}^x(\tau,\eta) = \left(\frac{wf_x}{c(\frac{\eta}{\kappa w})^{\frac{\theta\sigma}{1-\theta\sigma}}(\frac{1}{\sigma})^{\frac{1}{1-\theta\sigma}}(\mu w)^{\frac{1-\sigma}{1-\theta\sigma}}\Big((P^{\sigma-1}E+\tau_x^{1-\sigma}P_f^{\sigma-1}E)^{\frac{1}{1-\theta\sigma}}-(P^{\sigma-1}E)^{\frac{1}{1-\theta\sigma}}\Big)}\right)^{\frac{1-\theta\sigma}{\sigma-1}}. \tag{C.6}$$

Derivation of Equation (5.1) The total labor used for production can be written as follows:

$$L^p = M\Big[\int \frac{q(\boldsymbol{\psi})}{\phi}d\hat{G}(\boldsymbol{\psi}) + \int x(\boldsymbol{\psi})\frac{q(\boldsymbol{\psi})}{\phi}d\hat{G}(\boldsymbol{\psi})\Big].$$

Dividing both sides by Q, I can obtain that

$$\frac{L^p}{Q} = M\Big[\int \frac{1}{\phi}\frac{q(\boldsymbol{\psi})}{Q}d\hat{G}(\boldsymbol{\psi}) + \int x(\boldsymbol{\psi})\frac{1}{\phi}\frac{q(\boldsymbol{\psi})}{Q}d\hat{G}(\boldsymbol{\psi})\Big].$$

Using that $Q = M^{\frac{\sigma}{\sigma-1}}\Big[\int q(\boldsymbol{\psi})^{\frac{\sigma-1}{\sigma}}\Big]^{\frac{\sigma}{\sigma-1}}$,

$$\frac{L^p}{Q} = M^{-\frac{1}{\sigma-1}}\Big[\int \frac{1}{\phi}\frac{q(\boldsymbol{\psi})}{\tilde{q}}d\hat{G}(\boldsymbol{\psi}) + \int x(\boldsymbol{\psi})\frac{1}{\phi}\frac{q(\boldsymbol{\psi})}{\tilde{q}}d\hat{G}(\boldsymbol{\psi})\Big],$$

where $\tilde{q}$ is defined as follows:

$$\tilde{q} := \Big[\int q(\boldsymbol{\psi})^{\frac{\sigma-1}{\sigma}}d\hat{G}(\boldsymbol{\psi})\Big]^{\frac{\sigma}{\sigma-1}}.$$

Rearranging the terms, I can rewrite Q as follows:

$$Q = AL,$$

where

$$M^{\frac{1}{\sigma-1}} \times \Big[\int \frac{1}{\phi}\frac{q(\boldsymbol{\psi})}{\tilde{q}}d\hat{G}(\boldsymbol{\psi}) + \int x(\boldsymbol{\psi})\frac{1}{\phi}\frac{q(\boldsymbol{\psi})}{\tilde{q}}d\hat{G}(\boldsymbol{\psi})\Big]^{-1} \times \frac{L^p}{L}.$$

I also show that the allocative efficiency term coincides with the allocative efficiency term derived in Hsieh and Klenow (2009) in the closed economy without lobbying. Under the monopolistic competition with the CES demand, the second term can be rewritten as follows:

$$M^{-\frac{\sigma}{\sigma-1}}\left[\int \frac{1}{\phi}\left(\frac{p(\boldsymbol{\psi})}{P}\right)^{-\sigma} d\hat{G}(\boldsymbol{\psi})\right]^{-1}.$$

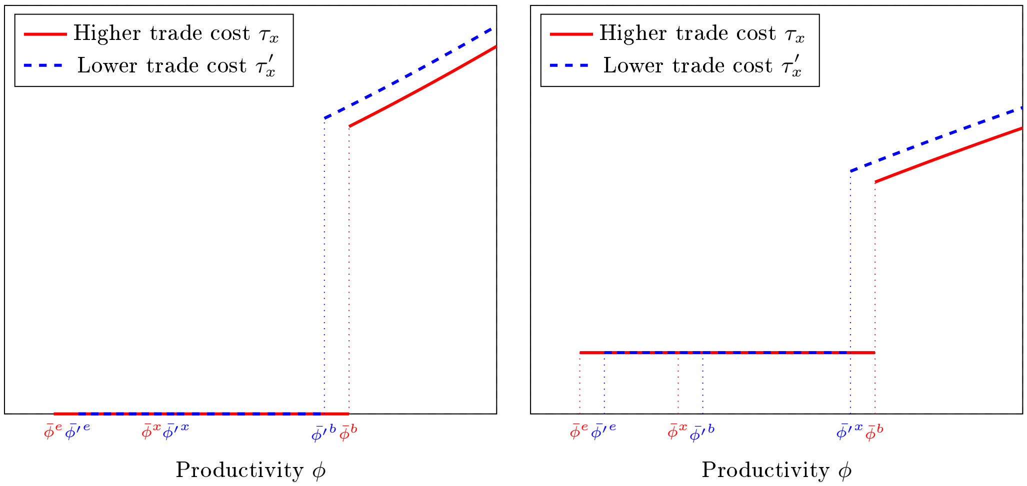
Using the ideal price index, this can be rewritten as follows:

$$A = \frac{\left[\int (\phi\tau)^{\sigma-1} d\hat{G}(\boldsymbol{\psi})\right]^{\frac{1}{\sigma-1}}}{\left[\int \tau \times \underbrace{\frac{(\mu w)^{1-\sigma}(\phi\tau)^{\sigma-1}P^{\sigma-1}E}{E}}_{=\omega(\boldsymbol{\psi})} d\hat{G}(\boldsymbol{\psi})\right]},$$

where $\omega(\boldsymbol{\psi})$ is the share of firms sales' to total expenditures. The denominator is the weighted average of τ where the weights are given by value-added shares of firms. Define $\overline{\text{TFPR}}$ as the denominator of the above expression. Because $\tau \propto \text{TFPR}$, I can obtain the TFP formula of Hsieh and Klenow (2009):

$$A \propto \left[\int \left(\phi \frac{\text{TFPR}}{\overline{\text{TFPR}}}\right)^{\sigma-1} d\hat{G}(\boldsymbol{\psi})\right]^{\frac{1}{\sigma-1}}.$$

C.2 Additional Figures



A. Lobbying expenditures, $w \times \kappa \frac{b^*}{\eta}$ B. Output distortions, $\tau \times \max\{\bar{\tau}, b^{\theta}\}$

Figure C1. When $\bar{\phi}^x(\tau, \eta) < \bar{\phi}^b(\tau, \eta)$, lower trade costs induce a subset of exporters to increase their lobbying more

Notes. This figure illustrates changes in firm lobbying and output distortions depending on their productivity level and changes in the entry, export, and lobbying cutoffs when trade costs become lower. This figure considers a special case in which the lobbying cutoff is higher than the export cutoff. Holding τ and η constant, Panels A and B plot firm lobbying expenditures and output distortions depending on their productivity ϕ. The x-axes are productivity ϕ.

Appendix D Quantification

D.1 Estimation of the Elasticity of Output Distortions to Lobbying

D.1.1 Derivation of the Bias

I derive the bias of the OLS estimates in Equation (4.3). As in the main text, I consider a simplified closed economy setup in which every firm is lobbying and operating. This setup can be achieved by letting $\tau_x \to \infty$, $\bar{\tau} = 0$, $f = 0$, and $f_b = 0$. These conditions are imposed to ensure that selection into production, exporting, and lobbying does not affect the bias. Because of the condition $\bar{\tau} = 0$, firms make positive profits only after lobbying, and because of the condition $f_b = 0$, every firm participating in lobbying, which ensures that there is no selection in lobbying conditional on production. Also, the condition $f = 0$ makes every firm participate in production once they pay the entry costs, which implies that there is no selection into production. Because of the closed economy condition, there is no selection into exporting conditional on production.

In this setup, firms' optimal lobbying amounts and expenditures are expressed as follows:

$$b^* \propto c^b \eta^{\frac{1}{1-\theta\sigma}} \phi^{\frac{\sigma-1}{1-\theta\sigma}} \tau^{\frac{\sigma}{1-\theta\sigma}}$$

and

$$B^* \propto c^B \eta^{\frac{\theta\sigma}{1-\theta\sigma}} \phi^{\frac{\sigma-1}{1-\theta\sigma}} \tau^{\frac{\sigma}{1-\theta\sigma}}$$

for some constants c^b and c^B common across all firms.

Using the above two equations, $\mathrm{Cov}(\ln B^*_{it}, \theta \ln \eta + \ln \tau)$ can be expressed as follows:

$$\mathrm{Cov}(\ln B^*_{it}, \theta \ln \eta_{it} + \ln \tau_{it}) = \mathrm{Cov}(\frac{\theta\sigma}{1-\theta\sigma} \ln \eta_{it} + \frac{\sigma-1}{1-\theta\sigma} \ln \phi_{it} + \frac{\sigma}{1-\theta\sigma} \ln \tau_{it}, \theta \ln \eta_{it} + \ln \tau_{it}),$$

which can be re-expressed as follows:

$$\frac{\theta^2\sigma}{1-\theta\sigma}\mathrm{Var}(\ln \eta_{it}) + \frac{\sigma}{1-\theta\sigma}\mathrm{Var}(\ln \tau_{it})$$
$$\frac{\theta(\sigma-1)}{1-\theta\sigma}\mathrm{Cov}(\ln \phi_{it}, \ln \eta_{it}) + \frac{2\theta\sigma}{1-\theta\sigma}\mathrm{Cov}(\ln \tau_{it}, \ln \eta_{it}) + \frac{\sigma-1}{1-\theta\sigma}\mathrm{Cov}(\ln \phi_{it}, \ln \tau_{it}).$$

Similarly, the bias of the sales regression model in Equation (4.2) can be expressed as follows:

$$\mathcal{B}^s(\psi_{it}) = \frac{1}{\mathrm{Var}(B^*_{it})} \frac{\theta\sigma}{1-\theta\sigma} \mathrm{Var}(\theta\sigma \ln \eta_{it} + (\sigma-1) \ln \phi_{it} + \sigma \ln \tau_{it}),$$

which can be re-expressed as follows:

$$\frac{1}{\mathrm{Var}(B^*_{it})}\frac{\theta\sigma}{1-\theta\sigma}\Bigg((\sigma-1)^2\mathrm{Var}(\ln\phi_{it})+\sigma^2\mathrm{Var}(\ln\tau_{it})+(\theta\sigma)^2\mathrm{Var}(\ln\eta_{it})$$

$$\sigma(\sigma-1)\mathrm{Cov}(\ln\phi_{it},\ln\tau_{it})+\theta\sigma(\sigma-1)\mathrm{Cov}(\ln\phi_{it},\ln\eta_{it})+\theta\sigma^2\mathrm{Cov}(\ln\tau_{it},\ln\eta_{it})\Bigg).$$

D.1.2 Marginal Revenue Product of Capital

To examine whether lobbying affects capital distortions, I run the following regression model analogous to the regression model in Equation (4.1):

$$\ln \frac{w_{n(i)j(i),t+1}L_{it}}{K_{i,t+1}} = \theta \text{asinh} B^*_{it} + \mathbf{X}'_{it}\boldsymbol{\gamma} + \delta_i + \delta_{j(i)t} + u_{it}, \tag{D.1}$$

where $\frac{w_{n(i)j(i),t+1}L_{it}}{K_{i,t+1}}$ are wage bills divided by capital measured by PPEGT. $\frac{w_{n(i)j(i),t+1}L_{it}}{K_{i,t+1}}$ capture capital distortions that increase MRPK disproportionately with MRPL (Hsieh and Klenow, 2009).

Table D1 reports the results. Columns (1) and (2) report the OLS and IV estimates, respectively. In both specifications, the estimates are statistically insignificant. These statistically insignificant results are consistent with Huneeus and Kim (2018) who also find insignificant results of lobbying on capital distortions.

Table D1: Lobbying and Capital Distortions

Dep.	$\ln \frac{w_{n(i)j(i),t+1}L_{it}}{K_{i,t+1}}$	
	OLS	IV
	(1)	(2)
asinhB^*_{it}	-0.011	0.017
	(0.007)	(0.026)
KP-F		32.16
N	1206	1206

Notes. This table reports the OLS and IV estimates of Equation (D.1). The dependent variable is the log of wage bills divided by capital. The OLS and IV estimates are reported in columns (1) and (2). The IV is the six-year average of a dummy variable that equals one in a given year if a Congress member of the state where a firm is headquartered becomes the chairperson of the House or Senate Appropriations Committee. 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 the quantiles of firms' 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.1.3 Cash Effective Tax Rates

If the model is misspecified, it is problematic to infer the MRPL as firm-specific distortions. To examine whether the findings are robust to model misspecification, I use the cash ETR developed by Dyreng et al. (2008) as an alternative proxy for firm-specific distortions. The ETR captures a firm's long-run tax avoidance activities, such as tax and investment credits.

The ETR can be constructed directly from Compustat rather than from the model, defined as

$$\text{ETR}_{it} = \frac{\sum_{h=1}^{6} \text{TXPD}_{i,t-h}}{\sum_{h=1}^{6} (\text{PI}_{i,t-h} - S\text{PI}_{i,t-h})}, \tag{D.2}$$

where TXPD is cash tax paid (Item 317), PI is pretax income (Item 122) and SPI is special items (Item 12) from Compustat. Following Dyreng et al. (2017), I only include samples with non-missing and non-negative values of TXPD, PI, and SPI. Following Hanlon and Slemrod (2009), 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. Dyreng et al. (2008) show that the long-run average is more reliable.

Because ETR is interpreted as firm-specific taxes, I use $\ln(1 - \text{ETR}_{i,t+1})$ as the alternative dependent variable, which is consistent with output distortions measured by the inverse of TFPR. Using this alternative dependent variable, I run the following regression model analogous to one in Equation (4.1):

$$\ln(1 - \text{ETR}_{i,t+1}) = \theta \text{asinh} B_{it}^{*} + \mathbf{X}_{it}' \boldsymbol{\gamma} + \delta_i + \delta_{j(i)t} + u_{it}. \tag{D.3}$$

Table D2 reports the regression results. The estimated OLS and IV coefficients are qualitatively and quantitatively similar to the estimates in columns (1) and (2) of Table 2. Consistent with the results in Table 2, the OLS estimate is downward-biased. The OLS estimate is statistically insignificant and close to zero, but once I correct the endogeneity problem with the IV, the coefficient is positive and significant under 5 percent. Also, the IV estimate is 0.077, within one standard deviation of the estimate in column (2) of Table 2.

Table D2: Lobbying and Cash Effective Tax Rates

Dep.	$\ln(1 - \mathrm{ETR}_{i,t+1})$	
	OLS	IV
	(1)	(2)
$\mathrm{asinh}B^{*}_{it}$	-0.003	0.077^{**}
	(0.003)	(0.030)
KP-F		32.16
Industry FE	Y	Y
State Control	Y	Y
N	1206	1206

Notes. This table reports the OLS and IV estimates of Equation (D.3). The dependent variable is the log of one minus the ETR defined in Equation (D.2). The OLS and IV estimates are reported in columns (1) and (2). The IV is the six-year average of a dummy variable that equals one in a given year if a Congress member of the state where a firm is headquartered becomes the chairperson of the House or Senate Appropriations Committee. 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 the 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.1.4 Event Study

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

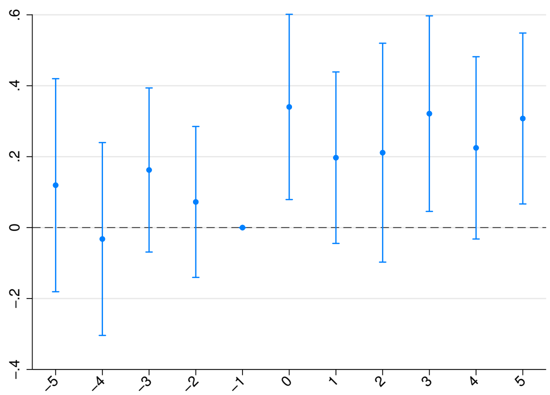
I conduct an event study to examine whether there are preexisting trends in lobbying expenditures before a local Congress member's appointment as the chairperson of the House or Senate Appropriations Committee. If there were reverse causality problems or preexisting confounding factors, it would violate 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.

I estimate the following event study regression:

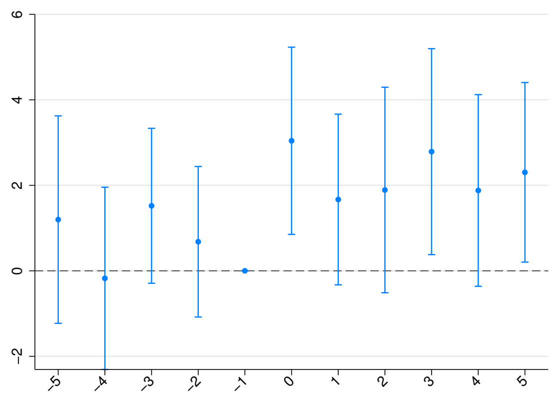
$$y_{it} = \sum_{\tau=-4}^{4} \beta_\tau \text{Chair}_{i\tau} + \delta_i + \delta_{jt} + \epsilon_{it}, \tag{D.4}$$

where the dependent variables are an inverse hyperbolic sine transformation of lobbying expenditures or a dummy of positive lobbying multiplied by 100. $\text{Chair}_{i,t-\tau}$ are the event study variables that are defined as $\text{Chair}_{i,\tau} := \mathbb{1}[t = \tau_i^{\text{Chair}} + \tau]$ 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 $\mathbb{1}[.]$ is the indicator function. $\text{Chair}_{i,-1}$ 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 the state-level, given that the chairpersonship shock is at the state-level.

Figure D1 illustrates estimated coefficients β_τ in Equation (D.4). Before 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 IV. After the appointment, the log one plus lobbying increases by 0.1 standard deviations, and the probability of lobbying increases by 2 percent relative to one year before the appointment.



A. Dep. asinh(Lobby)



B. Dep. $100 \times \mathbb{1}[\text{Lobby} > 0]$

Figure D1. Event Study. Lobbying and Appointment as the Chairperson of the House or Senate Appropriations Committee

Notes. Panels A and B present event study coefficients β_τ in Equation (D.4). The dependent variable is inverse hyperbolic sine transformation of lobbying expenditures 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.

D.1.5 Additional Robustness Checks

Table D3: Robustness. Alternative Transformation. Estimation Results of θ

Dep.	$\ln 1/\text{TFPR}$		$\ln \text{Sale}$	
	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)
Panel A. Log One Plus Lobbying, $\ln(1+B_{it}^*)$				
$\ln(1+B_{it}^*)$	-0.003	0.082^{**}	0.044^{***}	0.272^{***}
	(0.006)	(0.033)	(0.013)	(0.090)
KP-F		32.16		32.16
Panel B. Dummy of Positive Lobbying, $\mathbb{1}[B_{it}^*>0]$				
$\mathbb{1}[B_{it}^*>0]$	-0.039	1.021^{**}	0.510^{***}	3.405^{***}
	(0.075)	(0.420)	(0.159)	(1.162)
KP-F		24.26		24.26
Industry FE	Y	Y	Y	Y
State Control	Y	Y	Y	Y
N	1206	1206	1206	1206

Notes. Panels A and B of this table report the OLS and IV estimates of Equation (4.1) while using the one plus lobbying expenditures or the dummy variable of positive lobbying as the main independent variable instead of inverse hyperbolic sine transformations. The dependent variable is the log of inverse of TFPR and sales in columns (1) and (2) and columns (3) and (4), respectively. The OLS and IV estimates are reported in columns (1) and (3) and (2) and (4), respectively. The IV is the six-year average of a dummy variable that equals one in a given year if a Congress member of the state where a firm is headquartered becomes the chairperson of the House or Senate Appropriations Committee. State controls include corporate income tax, job creation tax credit, investment tax credit, R&D tax credit, property tax abatement, and transfers from the federal government. Firm controls include dummies indicating the 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.2 Identifying Moments

This section describes how the identifying moment in the data can be mapped to the counterparts of the model. In the calibration procedure, the internally calibrated parameters are all jointly determined, but I describe the identifying moment that is most relevant for each parameter.

- Mean productivity of the US relative to that of Foreign, $\mu_\phi^{\mathrm{US}}/\mu_\phi^F$
  - I normalize the mean productivity of Foreign to be one $\mu_\phi^F = 1$. I define the real GDP as:

$$\text{Real GDP} = \frac{M\Big(\int_{\phi \geq \bar{\phi}^e(\tau,\eta)} r(\boldsymbol{\psi}) d\hat{G}(\boldsymbol{\psi}) + \int_{\phi \geq \bar{\phi}^x(\tau,\eta)} r_x(\boldsymbol{\psi}) d\hat{G}(\boldsymbol{\psi})\Big)}{M\Big(\int_{\phi \geq \bar{\phi}^e(\tau,\eta)} p(\boldsymbol{\psi})^{1-\sigma} d\hat{G}(\boldsymbol{\psi})\Big)^{\frac{1}{1-\sigma}}},$$

    where r and r_x are domestic and export revenues, and the denominator is the defined PPI. Holding other parameters constant, the mean productivity of the US increases the US real GDP; therefore, this moment can pin down μ_ϕ^{US}.

- Standard deviation of log productivity, σ_ϕ
  - ϕ can be mapped to TFPQ in the data:

$$\phi \propto \text{TFPQ} := \frac{(\text{Value-Added})^{\frac{\sigma}{\sigma-1}}}{wL}.$$

    Therefore, the variance of the log TFPQ can pin down σ_ϕ.

- Standard deviation of log exogenous distortions, σ_τ
  - The residuals from Equation (4.1) can be mapped to $\theta \ln \eta + \ln \tau$. Therefore the variance of this residual can be mapped to

$$\theta^2 \sigma_\eta^2 + \theta \rho_{\tau\eta} \sigma_\eta \sigma_\tau + \sigma_\tau^2.$$

    The above relationship shows that conditional on θ, σ_η, and $\rho_{\tau\eta}$, the variance of the residuals is informative on σ_τ.

- Standard deviation of log lobbying efficiency, σ_η
  - The log of firm lobbying expenditures in dollar terms ($B_{it} := \frac{\kappa w b}{\eta}$) is proportional to

$$B_{it} \propto \frac{1}{1-\theta\sigma}((\sigma - 1)\ln \phi + \sigma \ln \tau + \theta \sigma \ln \eta).$$

Therefore, the variance of the log of firm lobbying expenditures can be mapped to

$$\frac{1}{(1-\theta\sigma)^2}\Big((\sigma-1)^2\sigma_\phi^2+\sigma^2\sigma_\tau^2+(\theta\sigma)^2\sigma_\eta^2 \\ +2(\sigma-1)\sigma\rho_{\phi\tau}\sigma_\phi\sigma_\tau+2(\sigma-1)\theta\sigma\rho_{\phi\eta}\sigma_\phi\sigma_\eta+2\sigma(\theta\sigma)\rho_{\tau\eta}\sigma_\tau\sigma_\eta\Big),$$

which is informative on σ_η conditioning on the other parameters.

- Correlation between log productivity and exogenous distortions, $\rho_{\phi\tau}$
  - The correlation between the log of TFPQ and the residuals from Equation (4.1) can be mapped to $\theta\rho_{\phi\eta}+\rho_{\phi\tau}$.
- Correlation between log productivity and lobbying efficiency, $\rho_{\phi\eta}$
  - The correlation between TFPQ and firm lobbying expenditures in dollar terms ($B_{it} := \frac{\kappa w b}{\eta}$) can be mapped to

$$\frac{\sigma-1}{1-\theta\sigma}\sigma_\phi^2+\frac{\sigma}{1-\theta\sigma}\rho_{\phi\tau}+\frac{\theta\sigma}{1-\theta\sigma}\rho_{\phi\eta}.$$

- Correlation between log exogenous distortions and lobbying efficiency, $\rho_{\tau\eta}$
  - The correlation between the residuals from Equation (4.1) and lobbying expenditures can be mapped to the numerator of the bias expressed (Equation (4.3)):

$$\frac{\theta^2\sigma}{1-\theta\sigma}\sigma_\eta^2+\frac{\sigma}{1-\theta\sigma}\sigma_\tau^2+\frac{\theta(\sigma-1)}{1-\theta\sigma}\sigma_\phi\sigma_\eta\rho_{\phi\eta}+\frac{2\theta\sigma}{1-\theta\sigma}\sigma_\tau\sigma_\eta\rho_{\tau\eta}+\frac{\sigma-1}{1-\theta\sigma}\sigma_\phi\sigma_\tau\rho_{\phi\tau}.$$

- Parameter related to the level of variable lobbying cost, κ
  - To identify this parameter, I target the fraction of the median sales of lobbying firms to the median sales of non-lobbying firms:

$$\frac{\mathrm{Med}_{\{\boldsymbol{\psi}|\phi\geq\bar{\phi}^b(\tau,\eta)\}}\{r(b^*;\boldsymbol{\psi})\}}{\mathrm{Med}_{\{\boldsymbol{\psi}|\phi<\bar{\phi}^b(\tau,\eta)\}}\{r(0;\boldsymbol{\psi})\}},$$

    where $r(b^*;\boldsymbol{\psi})$ and $r(0;\boldsymbol{\psi})$ are lobbying and non-lobbying firms' sales, respectively. Because κ only appears in lobbying firms' sales (Equation (3.3)), this moment can pin down κ.
- Fixed lobbying costs, f_b
  - f_b affects extensive margin of lobbying (Equations (C.3) and (C.4)). By targeting the probability of participating in lobbying, I can pin down f_b.
- Fixed export costs, f_x

- f_x affects extensive margin of exporting (Equations (C.5) and (C.6)). By targeting the probability of participating in exporting, I can pin down f_x.

- Fixed production costs, f
  - f affects production decisions of firms. Because only small-sized firms are affected by f, the difference between the median and 10p of log sales can pin down this parameter.

- Iceberg costs, τ_x
  - The aggregate US import shares can be expressed as follows:

$$\frac{M_f\left[\int x(\boldsymbol{\psi})\left(\mu\frac{\tau_x w_f}{\phi}\right)^{1-\sigma}\tau^{\sigma}\hat{G}_f(\boldsymbol{\psi})\right]P^{\sigma-1}E}{E},$$

  where subscript f denotes Foreign (China). Holding other variables constant, higher τ_x decreases the US import shares. Therefore, the US import shares pin down τ_x.

D.3 Algorithm

Solving for Equilibrium I normalize the wage of Home to 100. For given parameters, the solution of the model is characterized by the five unknowns $\{P, E, w^f, P^f, E^f\}$ that satisfies the following five nonlinear equations: the price indices for both Home and Foreign

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

the goods market clearing conditions for both Home and Foreign

$$E = wL + T,$$

and the balanced trade condition

$$M\left[\int p^x(\boldsymbol{\psi})q^x(\boldsymbol{\psi})d\hat{G}(\boldsymbol{\psi})\right] = M_f\left[\int p^x(\boldsymbol{\psi})q^x(\boldsymbol{\psi})d\hat{G}_f(\boldsymbol{\psi})\right].$$

Method of Moments The objective function is

$$\hat{\boldsymbol{\Theta}} = \arg\min_{\boldsymbol{\Theta}}\{(\mathbf{m} - \mathbf{m}(\boldsymbol{\Theta}))'\mathbf{W}(\mathbf{m} - \mathbf{m}(\boldsymbol{\Theta}))\},$$

which minimizes the normalized distances between the model moments and the data counterparts. I solve for $\hat{\boldsymbol{\Theta}}$ using the following steps:

- Step 1 Guess a set of parameters.
- Step 2 Based on the guess, solve for the equilibrium.
- Step 3 Evaluate the moments computed from the model and compare these moments to the data counterparts.
- Step 4 I first look for a range of plausible values of parameters using grid search. I repeat steps 1-3 for a given grid.
- Step 5 Once I find a range of plausible values of parameters, I find the parameter that minimizes the objective function subject to this range using the constrained nonlinear optimization algorithm.

D.4 Sensitivity Analysis

Table D4: Sensitivity Analysis. Foreign Parameters. Opening to Trade.

Parameters	$\rho^F_{\phi\tau}$		σ^F_{ϕ}		σ^F_{τ}	
	$\downarrow$ 1%	$\uparrow$ 1%	$\downarrow$ 1%	$\uparrow$ 1%	$\downarrow$ 1%	$\uparrow$ 1%
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Gains from Trade (%)						
$\triangle$ Welfare	2.02	2.02	2.02	2.03	2.03	2.02
Panel B. $\triangle$ *Avg. Lobbying Expenditures (%)*						
Exporters (A)	1.34	1.34	1.34	1.34	1.34	1.34
Non-exporters (B)	−18.08	−18.05	−18.03	−18.09	−18.09	−18.04
Diff. (A-B)	19.42	19.39	19.37	19.43	19.43	19.38

Notes. This table reports the results of the sensitivity analysis of the parameters related to the distribution of the foreign firm primitives.

Appendix E Welfare Formula for Gains from Trade

In this section, I derive a formula for gains from trade in the presence of lobbying and compare this formula to those derived by Arkolakis et al. (2012), Melitz and Redding (2015), and Bai et al. (2021) (henceforth ACR, MR, and BKL). By doing so, I can compare the welfare implications of lobbying with those examined by the previous studies.

For analytical tractability, I consider a special case in which every firm is lobbying and countries are symmetric. The case in which every firm is lobbying can be achieved by setting $f_b = 0$ and $\bar{\tau} = 0$. Because $\bar{\tau} = 0$, firms cannot make positive profits without lobbying. Therefore, with $f_b = 0$, every firm participates in lobbying conditional on production. The symmetric country setup is the setup studied in MR. In the symmetric setting, the aggregate variables of both countries take the same values in the equilibrium, simplifying the analysis. I suppress a subscript or superscript f for notational convenience. Also, without loss of generality, I set $\kappa = 1$ because once every firm participates in lobbying, the value of κ only affects equilibrium outcomes proportionately. These assumptions are stated as follows:

Assumption E.1. *(i) $f_b = 0$ and $\bar{\tau} = 0$ and (ii) countries are symmetric.*

Under Assumptions 1 and E.1, non-exporters and exporters' optimal lobbying amounts are

$$b^d = \left(\frac{\eta}{w}\right)^{\frac{1}{1-\theta\sigma}} (\theta\sigma)^{\frac{1}{1-\theta\sigma}} \left(\frac{1}{\sigma}\mu\left(\frac{w}{\phi}\right)^{\sigma-1} \tau^{\sigma} P^{\sigma} Q\right)^{\frac{1}{1-\theta\sigma}} \quad \text{and} \quad b^x = (1+\tau_x^{1-\sigma})^{\frac{1}{1-\theta\sigma}} b^d,$$

respectively. The zero profit cutoff and the export cutoff are expressed as $\bar{\phi}^e(\tau,\eta) = \hat{\phi}^e \tau^{\frac{-\sigma}{\sigma-1}} \eta^{\frac{-\theta\sigma}{\sigma-1}}$ and $\bar{\phi}^x(\tau,\eta) = \hat{\phi}^x \tau^{\frac{-\sigma}{\sigma-1}} \eta^{\frac{-\theta\sigma}{\sigma-1}}$, where

$$\hat{\phi}^e = \frac{c f^{\frac{1-\theta\sigma}{\sigma-1}}}{P^{\frac{\sigma}{\sigma-1}} Q^{\frac{1}{\sigma-1}}} \quad \text{and} \quad \hat{\phi}^x = \frac{c f_x^{\frac{1-\theta\sigma}{\sigma-1}}}{P^{\frac{\sigma}{\sigma-1}} Q^{\frac{1}{\sigma-1}} \left[(1+\tau_x^{1-\sigma})^{\frac{1}{1-\theta\sigma}} - 1\right]^{\frac{1-\theta\sigma}{\sigma-1}}}.$$

for a constant c.

For notational convenience, I define following two variables: for $\hat{\phi}^l < \hat{\phi}^x$,

$$\tilde{\lambda}(\hat{\phi}^l, \hat{\phi}^u) = \int\int\int_{\hat{\phi}^l \tau^{\frac{-\sigma}{\sigma-1}} \eta^{\frac{-\theta\sigma}{\sigma-1}}}^{\hat{\phi}^u \tau^{\frac{-\sigma}{\sigma-1}} \eta^{\frac{-\theta\sigma}{\sigma-1}}} \eta^{\frac{\theta(\sigma-1)}{1-\theta\sigma}} \tau^{\frac{\sigma-1}{1-\theta\sigma}} \phi^{\frac{(\sigma-1)(1-\theta)}{1-\theta\sigma}} g(\phi,\tau,\eta) d\phi d\tau d\eta$$

and

$$\tilde{S}(\hat{\phi}^l, \hat{\phi}^u) = \int\int\int_{\hat{\phi}^l \tau^{\frac{-\sigma}{\sigma-1}} \eta^{\frac{-\theta\sigma}{\sigma-1}}}^{\hat{\phi}^u \tau^{\frac{-\sigma}{\sigma-1}} \eta^{\frac{-\theta\sigma}{\sigma-1}}} \eta^{\frac{\theta\sigma}{1-\theta\sigma}} \tau^{\frac{\sigma}{1-\theta\sigma}} \phi^{\frac{\sigma-1}{1-\theta\sigma}} g(\phi,\tau,\eta) d\phi d\tau d\eta.$$

Using these variables, I define the share of the expenditure on domestic varieties as in ACR:

$$\lambda := \frac{\tilde{\lambda}(\hat{\phi}^e, \hat{\phi}^x) + (1+\tau_x^{1-\sigma})^{\frac{\theta(\sigma-1)}{1-\theta\sigma}} \tilde{\lambda}(\hat{\phi}^x, \infty)}{\tilde{\lambda}(\hat{\phi}^e, \hat{\phi}^x) + (1+\tau_x^{1-\sigma})^{\frac{\theta(\sigma-1)}{1-\theta\sigma}} \tilde{\lambda}(\hat{\phi}^x, \infty) + \tau_x^{1-\sigma}(1+\tau_x^{1-\sigma})^{\frac{\theta(\sigma-1)}{1-\theta\sigma}} \tilde{\lambda}(\hat{\phi}^x, \infty)} \tag{E.1}$$

and the share of variable labor used for producing domestic varieties as in BKL:

$$S := \frac{\tilde{S}(\hat{\phi}^e, \hat{\phi}^x) + (1+\tau_x^{1-\sigma})^{\frac{\theta\sigma}{1-\theta\sigma}} \tilde{S}(\hat{\phi}^x, \infty)}{\tilde{S}(\hat{\phi}^e, \hat{\phi}^x) + (1+\tau_x^{1-\sigma})^{\frac{\theta\sigma}{1-\theta\sigma}} \tilde{S}(\hat{\phi}^x, \infty) + \tau_x^{1-\sigma}(1+\tau_x^{1-\sigma})^{\frac{\theta\sigma}{1-\theta\sigma}} \tilde{S}(\hat{\phi}^x, \infty)}. \tag{E.2}$$

Unlike in ACR or BKL, trade costs show up in λ and S, because of exporters' disproportionately larger spending on lobbying due to larger market size (Figure 1).[23]

Additionally, I also define the domestic share of the expenditure on non-exporters' domestic varieties and the share of variable labor used by non-exporters:

$$\lambda_d := \frac{\tilde{\lambda}(\hat{\phi}^e, \hat{\phi}^x)}{\tilde{\lambda}(\hat{\phi}^e, \hat{\phi}^x) + (1+\tau_x^{1-\sigma})^{\frac{\theta(\sigma-1)}{1-\theta\sigma}} \tilde{\lambda}(\hat{\phi}^x, \infty)} \tag{E.3}$$

and

$$S_d := \frac{\tilde{S}(\hat{\phi}^e, \hat{\phi}^x)}{\tilde{S}(\hat{\phi}^e, \hat{\phi}^x) + (1+\tau_x^{1-\sigma})^{\frac{\theta\sigma}{1-\theta\sigma}} \tilde{S}(\hat{\phi}^x, \infty)}. \tag{E.4}$$

When τ_x goes to infinity, the economy reaches the autarky. In this autarky, λ_d and S_d converge to $\lambda_d^a := \tilde{\lambda}(\hat{\phi}^e, \hat{\phi}^x)/\tilde{\lambda}(\hat{\phi}^e, \infty)$ and $S_d^a := \tilde{S}(\hat{\phi}^e, \hat{\phi}^x)/\tilde{S}(\hat{\phi}^e, \infty)$, respectively. λ_d^a and S_d^a can be interpreted as non-exporters' domestic shares when exporters are lobbying at the autarky level (holding $\hat{\phi}^e$ and $\hat{\phi}^x$ constant).

Following ACR and BKL, I define two elasticities related to the extensive margin:

$$\gamma_\lambda(\hat{\phi}^e) := -(1-\theta\sigma) \times \frac{d \ln \tilde{\lambda}(\hat{\phi}^e, \infty)}{d \ln \hat{\phi}^e} \qquad \text{and} \qquad \gamma_s(\hat{\phi}^e) := -(1-\theta\sigma) \times \frac{d \ln \tilde{S}(\hat{\phi}^e, \infty)}{d \ln \hat{\phi}^e},$$

which is scaled by the term $1-\theta\sigma$. Unlike in cases of ACR and BKL, $\tilde{\lambda}(\hat{\phi}^e, \infty)$ and $\tilde{S}(\hat{\phi}^e, \infty)$ are not proportional to domestic firms' cumulative sales and variable labor used because of exporters' disproportionately larger lobbying expenditures. $\tilde{\lambda}(\hat{\phi}^e, \infty)$ and $\tilde{S}(\hat{\phi}^e, \infty)$ become proportional to domestic firms' cumulative sales and variable labor used only when $\theta = 0$ or $\tau_x \to \infty$.

[23] When $\theta = 0$, $\lambda = \frac{\tilde{\lambda}(\hat{\phi}^e, \infty)}{\tilde{\lambda}(\hat{\phi}^e, \infty) + \tau_x^{1-\sigma}\tilde{\lambda}(\hat{\phi}^x, \infty)}$ and $S = \frac{\tilde{S}(\hat{\phi}^e, \infty)}{\tilde{S}(\hat{\phi}^e, \infty) + \tau_x^{1-\sigma}\tilde{S}(\hat{\phi}^x, \infty)}$ as in BKL.

Proposition E.1. *Under Assumptions 1 and E.1, the change in welfare to local iceberg costs are*

$$d\ln W = \frac{1}{\gamma_s(\hat{\phi}^e)+\sigma-1}\Bigg\{ \underbrace{-d\ln\lambda + \overbrace{(d\ln\lambda_d - d\ln\lambda_d^a)}^{\textit{Lobbying: price index}}}_{\textit{(a) ACR}} + \underbrace{d\ln M_e}_{\textit{(b) MR}} +$$

$$+\underbrace{\left(\sigma-1+\frac{\sigma\gamma_\lambda(\hat{\phi}^e)}{\sigma-1}\right)\left(d\ln S + \overbrace{(d\ln S_d - d\ln S_d^a)}^{\textit{Lobbying: reallocation}}\right) - \left(\sigma-1+\frac{\sigma\gamma_s(\hat{\phi}^e)}{\sigma-1}\right)\left(d\ln\lambda + \overbrace{(d\ln\lambda_d - d\ln\lambda_d^a)}^{\textit{Lobbying: reallocation}}\right)}_{\textit{(c) BKL: reallocation}}$$

$$+ \underbrace{\frac{\sigma}{\sigma-1}(\gamma_s(\hat{\phi}^e) - \gamma_\lambda(\hat{\phi}^e))d\ln M_e}_{\textit{(d) BKL: entry distortion}}\Bigg\}$$

Proof. See Online Appendix Section E.1. □

For the welfare results in the presence of lobbying, I need to compute the two gaps: $d\ln\lambda_d - d\ln\lambda_d^a$ and $d\ln S_d - d\ln S_d^a$. $d\ln\lambda_d - d\ln\lambda_d^a$ is the gap between changes in the non-exporters' domestic expenditure shares and changes in those shares in the autarky (holding $\hat{\phi}^e$ and $\hat{\phi}^x$ constant). $d\ln S_d - d\ln S_d^a$ is similarly defined for the non-exporters' domestic labor shares. To compute these two gaps, I need information on the joint distribution of firm primitives. Therefore, the formula in Proposition E.1 is of little practical use because the case of two symmetric countries is very restrictive, and it is challenging to obtain information on firm primitives from the data. However, this formula is useful for explaining the consequences of lobbying and connecting the model with the previous studies.

Before explaining the role of these two gaps, I first summarize how the welfare results in Proposition E.1 can be connected to those studied in the previous papers.

- (BKL) When lobbying is not allowed ($\theta = 0$), $S_d = S_d^a$ and $\lambda_d = \lambda_d^a$ hold and, therefore, the lobbying terms drop out and the formula collapses to BKL in which exogenous distortions introduce reallocation effects and entry distortions. These reallocation effects and entry distortions are captured by terms (c) and (d), respectively.

- (MR) When lobbying is not allowed ($\theta = 0$) and there are no exogenous distortions, $\gamma_s(\hat{\phi}^e) = \gamma_\lambda(\hat{\phi}^e)$ and $S = \lambda$ hold. Therefore, as in MR, $d\ln W = \frac{1}{\gamma_s(\hat{\phi}^e)+\sigma-1}\{-d\ln\lambda + d\ln M_e\}$

- (ACR) When lobbying is not allowed ($\theta = 0$) and firms are heterogeneous only along productivity that follows the Pareto distribution with the shape parameter κ, $\gamma_s(\hat{\phi}^e) = \kappa - (\sigma-1)$ and $d\ln M_e = 0$. Therefore, as in ACR, $d\ln W = \frac{1}{\kappa}\{-d\ln\lambda\}$.

- (Lobbying and Pareto) When lobbying is allowed ($\theta > 0$) and firms are heterogeneous only along productivity that follows the Pareto distribution with the shape parameter κ as in ACR, $\gamma_\lambda(\hat{\phi}^e) = (1-\theta\sigma)\kappa - (\sigma-1)(1-\theta)$, $\gamma_s(\hat{\phi}^e) = (1-\theta\sigma)\kappa - (\sigma-1)$, and $\gamma_s(\hat{\phi}^e) > \gamma_\lambda(\hat{\phi}^e)$. Also,

$S \neq \lambda$, $S_d \neq S_d^a$, and $\lambda_d \neq \lambda_d^a$, and $d\ln M_e \neq 0$. Combining the above expressions with Equation (E.19), the welfare formula becomes

$$d\ln W = \frac{1}{(1-\theta\sigma)\kappa}\Bigg\{ - d\ln\lambda + (d\ln\lambda_d - d\ln\lambda_d^a) + d\ln M_e + \\ + \Big(\frac{\sigma(1-\theta\sigma)}{\sigma-1} - (1-\theta\sigma)\Big)\Big(d\ln S + (d\ln S_d - d\ln S_d^a)\Big) \\ - \Big(\frac{\sigma(1-\theta\sigma)}{\sigma-1} - 1\Big)\Big(d\ln\lambda + (d\ln\lambda_d - d\ln\lambda_d^a)\Big) - \theta\sigma d\ln M_e\Bigg\}.$$

Lower iceberg costs decrease the prices of foreign varieties and lower the aggregate price index, which is captured by the standard ACR term: $-d\ln\lambda$. In the presence of lobbying, however, in addition to the standard ACR term, lower iceberg costs also increase exporters' distortions through lobbying, which in turn affects the aggregate price index. This is captured by $d\ln\lambda_d - d\ln\lambda_d^a$, the gap between changes in the non-exporters' domestic expenditure shares and changes in those shares in the autarky. The gap summarizes that iceberg cost shocks disproportionately affect exporters' lobbying expenditures in the open economy when compared to the autarky.

In the case in which there are only exogenous distortions, but lobbying is not allowed, BKL showed that iceberg costs affect allocative efficiency. For example, as trade costs become lower, more subsidized but less productive firms can become exporters and more resources will be allocated to these less productive exporters, which can deteriorate allocative efficiency. BKL illustrated that the reallocation and entry distortion terms ((c) and (d)) are sufficient statistics to capture this resource allocation effect, and the gap between domestic and input shares ($d\ln S - d\ln\lambda$) is informative on allocative efficiency. For example, if lower trade costs make changes in required inputs exceed changes in sales ($d\ln S - d\ln\lambda < 0$), lower trade costs make more resources allocated more distorted firms, which deteriorates allocative efficiency.

In the presence of lobbying, however, two new terms appear in the original BKL terms ($d\ln\lambda_d - d\ln\lambda_d^a$ and $d\ln S_d - d\ln S_d^a$). Unlike BKL, distortions are endogenous outcomes of firm lobbying decisions and lower iceberg costs induce more resources to be allocated to exporters through the lobbying channel. $d\ln\lambda_d - d\ln\lambda_d^a$ and $d\ln S_d - d\ln S_d^a$ capture increases in exporters' domestic input and domestic expenditure shares due to lower iceberg costs, respectively. Because of exporters' lobbying, rather than $d\ln S - d\ln\lambda$, the gap between $d\ln S + d\ln S_d - d\ln S_d^a$ and $d\ln\lambda + d\ln\lambda_d - d\ln\lambda_d^a$ are informative on allocative efficiency.

To summarize, lobbying can affect gains from trade by influencing the aggregate price level and allocative efficiency. In particular, as iceberg costs become lower, exporters increase lobbying and their distortions, which leads exporters to have higher domestic market shares and more resources to be allocated to them.

E.1 Proof

This section presents the proof of Proposition E.1. Without loss of generality, I normalize wage w to one. The price index can be expressed as follows:

$$P^{1-\sigma} = \left(\frac{\sigma}{\sigma-1}w\right)^{\frac{(1-\sigma)(1-\theta)}{1-\theta\sigma}} \left(\frac{\theta\sigma}{\kappa w}\right)^{\frac{\theta(\sigma-1)}{1-\theta\sigma}} \left(\frac{1}{\sigma}\right)^{\frac{\theta(\sigma-1)}{1-\theta\sigma}} (P^\sigma Q)^{\frac{\theta(\sigma-1)}{1-\theta\sigma}}$$
$$\times M_e\left[\tilde{\lambda}(\hat{\phi}^e, \hat{\phi}^x) + (1+\tau_x^{1-\sigma})^{\frac{\theta(\sigma-1)}{1-\theta\sigma}}\tilde{\lambda}(\hat{\phi}^x, \infty) + \tau_x^{1-\sigma}(1+\tau_x^{1-\sigma})^{\frac{\theta(\sigma-1)}{1-\theta\sigma}}\tilde{\lambda}(\hat{\phi}^x, \infty)\right], \quad \text{(E.5)}$$

where λ is a share of expenditures on domestic varieties and λ_d is a share of domestic expenditures on non-exporters' varieties, defined in Equations (E.1) and (E.3), respectively. Equation (E.5) can be re-expressed as follows:

$$P^{1-\sigma} = \text{cons} \times M_e(P^\sigma Q)^{\frac{\theta(\sigma-1)}{1-\theta\sigma}} \frac{1}{\lambda}\frac{\lambda_d^a}{\lambda_d}\tilde{\lambda}(\hat{\phi}^e, \infty), \quad \text{(E.6)}$$

where cons is a collection of parameters, and cons and w are invariant to iceberg cost changes. Equation (E.6) is one of the two key equations for the proof.

The free entry condition implies that

$$p_e\Big((1-p_x)\mathbb{E}[\tilde{\pi}^d(b^d)] + p_x(\mathbb{E}[\tilde{\pi}^x(b^x)] - wf_x) - wf\Big) = wf_e,$$

where p_e is the probability of entry and p_x is the probability of exporting conditioning on entry. $\mathbb{E}[\tilde{\pi}^d(b^d)]$ and $\mathbb{E}[\tilde{\pi}^x(b^x)]$ are the expected operating profits of non-exporters and exporters conditional on the optimal amounts of lobbying. Rearranging, I can derive that

$$(1-p_x)\mathbb{E}[\tilde{\pi}^d] + p_x\mathbb{E}[\tilde{\pi}^x] = w\Big(\frac{f_e}{p_e} + f + p_x f_x\Big). \quad \text{(E.7)}$$

Labor used for production for non-exporters and exporters is

$$l_d = \frac{q_d}{\phi} = \frac{\sigma-1}{w}\Big(\frac{\eta}{w}\Big)^{\frac{\theta\sigma}{1-\theta\sigma}}(\theta\sigma)^{\frac{\theta\sigma}{1-\theta\sigma}}\tilde{\pi}^d(0)^{\frac{1}{1-\theta\sigma}} = \frac{\sigma-1}{w}\frac{1}{1-\theta\sigma}\tilde{\pi}^d(b^d) \quad \text{(E.8)}$$

and

$$l^x = \frac{q_d}{\phi} + \frac{\tau_x q_x}{\phi} = \frac{\sigma-1}{w}\Big(\frac{\eta}{w}\Big)^{\frac{\theta\sigma}{1-\theta\sigma}}(\theta\sigma)^{\frac{\theta\sigma}{1-\theta\sigma}}\tilde{\pi}^x(0)^{\frac{1}{1-\theta\sigma}} = \frac{\sigma-1}{w}\frac{1}{1-\theta\sigma}\tilde{\pi}^x(b^x), \quad \text{(E.9)}$$

where $\tilde{\pi}^d(0)$ and $\tilde{\pi}^x(0)$ are operating profits conditional on not lobbying:

$$\tilde{\pi}^d(0) = \frac{1}{\sigma}\Big(\frac{w}{\phi}\Big)^{1-\sigma}\tau^\sigma P^\sigma Q \qquad \text{and} \qquad \tilde{\pi}^x(0) = \frac{1}{\sigma}\Big(\frac{w}{\phi}\Big)^{1-\sigma}\tau^\sigma((1+\tau_x^{1-\sigma})P^\sigma Q.$$

Labor used for lobbying for non-exporters and exporters is

$$\frac{b^d}{\eta} = \eta^{\frac{\theta\sigma}{1-\theta\sigma}} \left(\frac{\theta\sigma}{w}\right)^{\frac{1}{1-\theta\sigma}} \tilde{\pi}^d(0)^{\frac{1}{1-\theta\sigma}} = \frac{1}{w}\frac{\theta\sigma}{1-\theta\sigma}\tilde{\pi}^d(b^d) \tag{E.10}$$

and

$$\frac{b^x}{\eta} = \eta^{\frac{\theta\sigma}{1-\theta\sigma}} \left(\frac{\theta\sigma}{w}\right)^{\frac{1}{1-\theta\sigma}} \tilde{\pi}^x(0)^{\frac{1}{1-\theta\sigma}} = \frac{1}{w}\frac{\theta\sigma}{1-\theta\sigma}\tilde{\pi}^x(b^x). \tag{E.11}$$

Labor market clearing condition implies that

$$M\Big((1-p_x)\mathbb{E}[l^d + \frac{b^d}{\eta}] + p_x\mathbb{E}[l^x + \frac{b^x}{\eta}] + f + p_x f_x\Big) + M_e f_e = L \tag{E.12}$$

Using Equations (E.8), (E.9), (E.10), and (E.11), I can obtain that

$$\left[\frac{\sigma-1}{w}\frac{1}{1-\theta\sigma} + \frac{1}{w}\frac{\theta\sigma}{1-\theta\sigma}\right]\Big((1-p_x)\mathbb{E}[\tilde{\pi}^d(b^d)] + p_x\mathbb{E}[\tilde{\pi}^x(b^x)]\Big) = (1-p_x)\mathbb{E}[l^d + \frac{b^d}{\eta}] + p_x\mathbb{E}[l^x + \frac{b^x}{\eta}]. \tag{E.13}$$

Combining the free entry and the labor market clearing conditions (Equations (E.7) and (E.13)), I can obtain the following expression for firm mass:

$$M = \frac{1-\theta\sigma}{\sigma}\frac{L}{(f + p_x f_x + \frac{f_e}{p_e})}. \tag{E.14}$$

Substituting Equations (E.14) and (E.13) into Equation (E.12), I can derive the following expression:

$$M\Big((1-p_x)\mathbb{E}[\tilde{\pi}^d(b^d)] + p_x\mathbb{E}[\tilde{\pi}^x(b^x)]\Big) = \frac{\sigma-1+\theta\sigma}{\sigma}L.$$

This can be rewritten as

$$\begin{aligned} &\frac{\sigma-1}{w} w^{-\frac{\theta\sigma}{1-\theta\sigma}} (\theta\sigma)^{\frac{\theta\sigma}{1-\theta\sigma}} \left(\frac{1}{\sigma}\mu\right)^{\frac{1}{1-\theta\sigma}} \\ &\qquad \times \left[\tilde{S}(\hat{\phi}^e, \hat{\phi}^x) + (1+\tau_x^{1-\sigma})^{\frac{\theta\sigma}{1-\theta\sigma}}\tilde{S}(\hat{\phi}^x, \infty) + \tau_x^{1-\sigma}(1+\tau_x^{1-\sigma})^{\frac{\theta\sigma}{1-\theta\sigma}}\tilde{S}(\hat{\phi}^x, \infty)\right] \\ &\qquad\qquad \times M_e P^{\frac{\sigma}{1-\theta\sigma}} Q^{\frac{1}{1-\theta\sigma}} = \frac{\sigma-1+\theta\sigma}{\sigma}L \end{aligned} \tag{E.15}$$

Define S and S_d as follows:

$$S := \frac{\tilde{S}(\hat{\phi}^e, \hat{\phi}^x) + (1+\tau_x^{1-\sigma})^{\frac{\theta\sigma}{1-\theta\sigma}}\tilde{S}(\hat{\phi}^x, \infty)}{\tilde{S}(\hat{\phi}^e, \hat{\phi}^x) + (1+\tau_x^{1-\sigma})^{\frac{\theta\sigma}{1-\theta\sigma}}\tilde{S}(\hat{\phi}^x, \infty) + \tau_x^{1-\sigma}(1+\tau_x^{1-\sigma})^{\frac{\theta\sigma}{1-\theta\sigma}}\tilde{S}(\hat{\phi}^x, \infty)}$$

and

$$S_d := \frac{\tilde{S}(\hat{\phi}^e, \hat{\phi}^x)}{\tilde{S}(\hat{\phi}^e, \hat{\phi}^x) + (1 + \tau_x^{1-\sigma})^{\frac{\theta\sigma}{1-\theta\sigma}} \tilde{S}(\hat{\phi}^x, \infty)}.$$

Also, let $S_d^a := \lim_{\tau_x \to \infty} \tilde{S}_d$. Then, Equation (E.15) can be rewritten as follows:

$$\frac{1}{S} \frac{S_d^a}{S_d} \tilde{S}(\hat{\phi}^e, \infty) M_e P^{\frac{\sigma}{1-\theta\sigma}} Q^{\frac{1}{1-\theta\sigma}} = cons, \tag{E.16}$$

where the right-hand side is a collection of parameters, L, and w that are invariant to iceberg costs. Equation (E.16) is the second key equation for the proof.

I totally differentiate Equations (E.6) and (E.16). Totally differentiating Equation (E.6) related to the price index, I can obtain the following expression:

$$(1-\sigma) d\ln P = \frac{\sigma\theta(\sigma-1)}{1-\theta\sigma} d\ln P + \frac{\theta(\sigma-1)}{1-\theta\sigma} d\ln Q + d\ln M_e - d\ln\lambda + d\ln\frac{\lambda_d^a}{\lambda_d} - \frac{1}{1-\theta\sigma}\gamma_\lambda(\hat{\phi}^e). \tag{E.17}$$

Similarly, totally differentiating Equation (E.16) related to the labor market clearing and the free entry conditions, I can obtain the following expression:

$$d\ln M_e + \frac{\sigma}{1-\theta\sigma} d\ln P + \frac{1}{1-\theta\sigma} d\ln Q - d\ln S + d\ln\frac{S_d^a}{S_d} - \frac{1}{1-\theta\sigma}\gamma_s(\hat{\phi}_e) = 0. \tag{E.18}$$

Changes in welfare are equivalent to changes in the aggregate quantities produced: $d\ln W = d\ln Q$. Combining Equations (E.17) and (E.18), I obtain the desired results:

$$\begin{aligned} d\ln W = \frac{1}{\gamma_s(\hat{\phi}^e) + \sigma - 1} \Bigg\{ & - d\ln\lambda + (d\ln\lambda_d - d\ln\lambda_d^a) + d\ln M_e + \\ & + \left(\sigma - 1 + \frac{\sigma\gamma_\lambda(\hat{\phi}^e)}{\sigma-1}\right)\Big(d\ln S + (d\ln S_d - d\ln S_d^a)\Big) \\ & - \left(\sigma - 1 + \frac{\sigma\gamma_s(\hat{\phi}^e)}{\sigma-1}\right)\Big(d\ln\lambda + (d\ln\lambda_d - d\ln\lambda_d^a)\Big) \\ & + \frac{\sigma}{\sigma-1}(\gamma_s(\hat{\phi}^e) - \gamma_\lambda(\hat{\phi}^e)) d\ln M_e \Bigg\}. \end{aligned} \tag{E.19}$$

□