Corporate Lobbying and Subsidies: Theory and Evidence

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To Ernestine and Waldemar Jesse

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Hannes Kammerer

Contents

List of Figures

List of Tables

Chapter 1

General Introduction

It is well known that special interest groups try to influence politics in their favor. Only recently, however, reliable US lobbying data became available, allowing to quantify the extent of lobbying activities.[1] In 2013, for instance, there were 12,278 active lobbyists registered in Washington D.C., accounting for more than 3.2 billion US-dollars in total lobbying spending.[2] Thus, lobbying is an influential and prospering business. However, it is fair to say that our knowledge and understanding of lobbying is still limited, in particular at the firm level.

While lobby groups are often thought of representing the interests of an entire industry, the fact that individual firms are involved in the process of lobbying has so far received little attention. In this thesis, I take a within-industry view on special interest groups and study the impact of corporate lobbying for subsidies. My thesis is a collection of three single-authored research papers, studying both theoretically and empirically different facets of the firm-level links between lobbying and subsidies. Chapter 2 and Chapter 4 are theoretical contributions analyzing lobbying for subsidies in a heterogeneous firms framework. In particular, I study lobbying for a production subsidy in a closed economy (Chapter 2) and lobbying for export subsidies in an open economy (Chapter 4). Chapter 3 is an empirical study in which I analyze the link between lobbying and subsidies at the US firm level. Appendices are included behind the respective chapter and references are collected in a joint bibliography at the end of the thesis.

The three research papers of this thesis are related to my master thesis, which I wrote in 2011 at the University of Mannheim under the supervision of Professor Dr. Eckhard Janeba (Kammerer, 2011). Being a requirement for the completion of the the Master of Economic Research at the University of Mannheim according to CDSE program rules the master thesis serves as a research proposal for a subsequent doctoral thesis. Therefore, all three papers of this thesis contain parts that also appear similar or even identical in Kammerer (2011). However, it is important to clarify that each chapter of this thesis differs substantially from Kammerer (2011) and that each chapter contains novel and independent contributions. In Kammerer (2011) I analyze a subsidy for both domestic sales and exports. Therefore, while relying on the same heterogeneous firms framework (i.e., Melitz (2003), Chaney (2008)), in comparison to this thesis the main results in Kammerer (2011) are completely different. Moreover, the empirical analysis of Chapter

[1] Comprehensive US lobbying data became available due to the Lobbying and Disclosure Act of 1995.
[2] See opensecrets.org.

3 relies on data that I collected after completing my master's degree. Thus, even though my master thesis has been the starting point of this thesis, the scientific contributions of each chapter are novel. Before moving on to the first paper, I briefly summarize the content of each chapter.

1.1 Lobbying for Subsidies with Heterogeneous Firms

When economists and political scientists talk about lobbying, there often prevails a pure *inter-industry* view. Accordingly, industry lobby groups are considered to represent the interests of all firms within an industry and to compete against each other to receive government favors, which are available to all firms of the represented industry (e.g., an import tariff protecting all firms within an industry as in Grossman and Helpman (1994)). However, recent empirical evidence reveals that even within narrowly defined industries there is a wide variation in lobby participation across firms and that the few firms engaging in lobbying are relatively large companies (e.g., Kerr et al. (forthcoming), Chapter 3 of this thesis). Moreover, across various countries and industries, recent empirical evidence shows that the few firms that receive subsidies are also rather large (e.g., Duguet (2004), Blanes and Busom (2004), Hussinger (2008), Aschhoff (2010), Wagner (2010)). In Chapter 2, I account for these empirical facts in a unified way by taking a novel and complementary *intra-industry* view on lobbying for subsidies.

In particular, in Chapter 2 I introduce a production subsidy in a closed economy monopolistic competition framework where firms are heterogeneous with respect to their productivity (Melitz, 2003). To receive this subsidy and to lobby for it, firms have to bear the associated *administrative* fixed costs. This model setup allows me to make explicit use of heterogeneity in firm productivity to study endogenous lobby formation within an industry.[3] Firms that receive subsidies sell at a lower price, which causes tougher market condition and harms non-receiving firms. This within-industry conflict creates lobbying incentives for large firms. In contrast to Bombardini (2008), who also studies lobby participation of firms, in my model firms participate in lobbying to receive benefits at the expense of firms within the same industry.

Due to the endogenous size and composition of the lobby group, comparative statics of the lobbying equilibrium deliver novel insights. For instance, if the government puts more weight on lobby contributions than on welfare, I show that less firm heterogeneity results in an endogenous increase of the subsidy. Thus, in contrast to Bombardini (2008), my model predicts that higher firm dispersion does not necessarily result in more political power of a lobby group. Similarly, if the government puts more weight on lobby contributions than on welfare, making it more difficult to join the lobby (i.e., higher lobby entry costs) unambiguously reduces the (relative) size of the lobby group, but increases the equilibrium subsidy rate. This finding qualifies the common assumption in the literature that lobby size is positively related to the political power of an interest

[3] Endogenous lobby formation at the industry level has been studied by Mitra (1999).

group (e.g., Acemoglu and Robinson (2001)). Thus, increasing the barriers to lobby or lower firm heterogeneity amplifies the within-industry conflict and a smaller lobby group can attain higher subsidies.

Subsidies are often justified by claiming to help small firms. The results of Chapter 2 show that even under modest barriers to participate, subsidies harm in particular the smallest firms of an industry. Hence, ignoring participation barriers, policymakers may obtain results directly opposing their initial intention.

1.2 Corporate Lobbying and Subsidies - Evidence from US Data

While there is a rapidly growing empirical literature on lobbying (e.g., Richter et al. (2009), Igan et al. (2011), Facchini et al. (2011), Ludema et al. (2010), Bombardini and Trebbi (2012), Hill et al. (2013), Chen et al. (2013) and Kerr et al. (forthcoming)), the firm-level links between lobbying and receiving subsidies have received little attention.[4] Chapter 3 contributes in filling this gap in the literature by providing firm-level evidence on the relationship between lobbying and a wide range of US subsidy programs.

To study lobbying for subsidies at the firm level, I create a uniquely rich panel data set linking firm-level information on lobbying and subsidies to firm characteristics.[5] In particular, for the period 1999-2010 I link Standard & Poor's Compustat data, which contains all publicly traded firms in the US, to US federal lobbying data, which is considered to be most comprehensive lobbying data set worldwide.[6] Moreover, I link three different sources of US firm-level data on subsidies. First, information on all subsidy programs contained in *Good Jobs First's* Subsidy-Tracker, which is the most comprehensive subsidy database in the US (goodjobsfirst.org). As a second source of subsidy data, I link information on all federal grants obtained directly from the US government (usaspending.gov). And as a third data source, I use information on investment tax credits provided by Compustat.

Given this comprehensive and unique panel data, I contribute to the existing literature by answering three research questions. First, I explore whether firms self-select into lobbying. Second, I analyze whether lobbying affects the likelihood to receive subsidies. Third, I quantify firm-specific returns to lobbying in terms of received subsidies.

For the first research question, I find that – even within narrowly defined industries and controlling for firm size – characteristics of lobbying and non-lobbying firms differ systematically, both on average (i.e., estimated by OLS) and by first-order stochastic

[4] Richter et al. (2009) study lobbying and corporate taxes. Igan et al. (2011) study lenders' risk behavior and their lobbying activities before the US mortgage crisis. Facchini et al. (2011) show that the number of work visa is positively affected by lobbying on immigration issues. Ludema et al. (2010) and Bombardini and Trebbi (2012) study lobbying in a trade policy context. Hill et al. (2013), Chen et al. (2013) study firm performance and lobbying. Kerr et al. (forthcoming) provide evidence of fixed costs to lobbying.

[5] Matching firm-level data sets without unique identifiers that link records is tedious and requires so-called fuzzy string matching methods, which, for example, take into account misspellings of firm names in different data sets.

[6] The US federal lobbying data I use are due to the Lobbying Disclosure Act of 1995 and are collected by the Senate Office of Public Records (SOPR). The Center for Responsive Politics (CRP) cleans the data and publishes them on its website opensecrets.org.

dominance (i.e., performing nonparametric Kolmogorov-Smirnov tests). For instance, lobbying firms have 24.4% higher sales and 3.7% higher TFP. Lobbying firms also experience significantly higher one-year-ahead growth rates in various firm characteristics, such as sales, TFP, value-added and employees. Using the full panel dimensions of my data and the variation in lobby entry and exit, I show that differences in firm characteristics predate lobby entry, and that initially lobbying firms do not experience higher average growth rates. Overall, I find evidence in favor of self-selection of firms into lobbying, justifying the theoretical heterogeneous firms approach in Chapter 2 and in Chapter 4.

For the second research question, I show that controlling for firm size, lobbying firms are up to 200% more likely to receive subsidies. Due to observing both the funding agency of a federal grant and the agencies a firm lobbied, I strengthen this result by analyzing the likelihood of receiving federal grants at the firm-year-agency level – the highest level of disaggregation in my data. I show that lobbying a particular federal agency significantly increases the likelihood of receiving a grant from exactly the same agency. Moreover, the estimated marginal effect of lobbying a particular federal agency is by an order of magnitude larger than the estimated effect of lobbying in general.

Answering the third research question, I first show that lobbying firms receive up to 51% higher subsidy payments. Measuring returns on lobby expenditures in terms of received subsidies, I find that one US-dollar more in lobbying expenses increases the amount of subsidies received by up to 9.65 US-dollars, or a return on investment of 865%. Of course, received subsidies are only an imperfect measure of the returns to lobbying. Accordingly, my estimates should be seen as lower bounds on the true returns to lobbying. One may also ask if such high returns are realistic and if so, why we do not observe more firms lobbying. First of all, in comparison to estimated returns on lobbying expenditures of $22,000\%$ in Alexander et al. (2009), my estimates lie within a smaller and more reasonable range. Second, even with high observed returns to lobbying, high fixed costs to lobbying may prevent firms from entering lobbying. Empirical evidence for considerable lobby fixed costs has been recently documented in Kerr et al. (forthcoming).

Thus, my empirical findings of Chapter 3 suggest that firms with better firm characteristics self-select into lobbying, that lobbying has a strong positive effect on the likelihood to be subsidized, and that in terms of subsidies there are substantial returns to lobbying.

1.3 Export Subsidies, Lobbying and Heterogeneous Firms

In Chapter 4, I present an open economy version of the model in Chapter 2 to study lobbying for export subsidies in a heterogeneous firms model of international trade. Predicting that large firms gain and small firms lose from trade liberalizations, recent international trade papers emphasize the importance of firm heterogeneity for international trade (e.g., Melitz (2003), Chaney (2008)).[7] However, so far international trade theory does not pay much attention to the fact that even within the group of exporters there is a wide variation with respect to participation in subsidy programs (Görg et al., 2008; Girma et al., 2009a and Girma et al., 2009b). By studying lobbying for export subsidies in a heterogeneous firms model of international trade, Chapter 4 fills this gap in the literature. In particular, I introduce lobbying for a unilateral export subsidy in a Melitz-type model with two countries to analyze its welfare implications, its within-industry impact across firms, and how it affects firms' export behavior and aggregate exports.

While specific export subsidies are banned by WTO agreements, we still observe that governments are eager to support exporters through different WTO-compliant export promotion policies.[8] For instance, US President Obama's National Export Initiative, which aims at doubling US exports within five years until 2015, requests increasing the activity of the Ex-Im Bank, the major US federal agency promoting exports. Therefore, studying lobbying for export subsidies remains highly relevant.

Similar to Chapter 2, in Chapter 4 I assume that there are administrative fixed costs for joining an interest group that lobbies for an export subsidy for its members. Lobbying is driven by both profit shifting across countries and profit shifting among home exporters. For sufficiently low administrative fixed costs, all exporters receive the export subsidy, which leads only to cross-country profit shifting. However, for sufficiently high administrative fixed costs only some exporters receive the export subsidy and there arises an additional within-exporter profit shifting effect. In this case, in addition to shifting profits from foreign firms to home firms, an export subsidy shifts profits from smaller home exporters to larger home exporters, leading to within-exporter resource reallocation. As a consequence, small firms stop exporting and, while overall trade flows increase, lobbying for export subsidies leads to a decline in export participation. This result is in line with recent empirical evidence finding no positive effect of subsidies on export participation (Bernard and Jensen, 2004b; Görg et al., 2008; Girma et al., 2009a and Girma et al., 2009b).

In my model, a unilateral export subsidy unambiguously decreases welfare in the granting country. However, by mitigating the mark-up distortion from monopolistic competition in the foreign country, lobbying for export subsidies can lead to global welfare gains.

Due to endogenous lobby formation, comparative statics of the lobbying equilibrium deliver interesting results. For instance, a trade liberalization (i.e., a decline in iceberg trade costs) leads to an endogenous decline of the export subsidy. Consequently, the positive trade effect is considerably dampened. I also show that increasing firm heterogeneity leads to a relatively large lobby group but to a decline in the export subsidy.

[7] See Bernard et al. (2012) for a recent survey on the empirical heterogeneous firms trade literature.

[8] See Lederman et al. (2010) for a survey on export promotion agencies.

Moreover, increasing lobby entry costs reduce the size of the lobby group but result in higher export subsidies. Because the profit shifting motive for lobbying is amplified if the mass of recipients declines, my model predicts that smaller lobby groups receive higher export subsidies.

Thus, besides showing that lobbying has a strong positive effect on the likelihood to be subsidized and on the received amount of subsidies, the empirical firm-level evidence of Chapter 3 also suggests that firms self-select into lobbying. Relying on this assumption, the heterogeneous firms models of Chapter 2 and Chapter 4 feature a novel intra-industry view on lobbying, which delivers surprising but plausible predictions that complement the conventional wisdom on lobbying. For instance, because lobbying incentives for subsidized firms are amplified, higher barriers to lobby can lead to an endogenous increase in subsidies.

Chapter 2

Lobbying for Subsidies with Heterogeneous Firms

2.1 Introduction

The influence of special interest groups on politics has always been of great interest to economists. Surprisingly, the public and scientific debate on lobbying is still dominated by an *inter-industry* view. Accordingly, special interest groups are supposed to lobby for an entire industry and compete against each other for government favors, which then become available to all firms of the represented industry (e.g., an import tariff for the steel industry). However, this traditional way of thinking neglects potential within-industry differences in lobbying incentives and benefits across firms. In this paper, I take a complementary *intra-industry* view on lobbying, which provides novel insights into the within-industry consequences of lobbying.

My approach is motivated by recent empirical studies, which show that large firms take a prominent role in shaping public policy by lobbying (Bombardini, 2008; Kerr et al., forthcoming). However, in particular those large firms are the ones that benefit heavily from government programs and subsidies. Given that the public-good character of subsidies can be very limited, lobbying for subsidies can generate firm-specific benefits (Rodrik, 1986). Even if subsidies are targeted at a narrowly defined industry, not all firms necessarily receive them. For instance, in the heavily subsidized US agricultural sector more than 60% of all farms do not receive any government payments (USDA, 2009).[1] A positive relationship between participation in R&D subsidy programs and firm size has also been documented for several countries.[2] For West Germany, Wagner (2010) shows that the few manufacturers receiving subsidies are systematically more productive and larger.

To account for these empirical facts, I focus on the impact of subsidies across firms within a single industry, when firms can decide to influence public policy by joining an

[1] This pattern prevails even at the narrowly defined 5-digit NAICS level (USDA, 2009, table 62). The distribution of US farm subsidies is also highly skewed: 20% (8%) of the farms receive 80% (58%) of the payments (Kirwan, 2007). Given that agricultural subsidies usually depend on the amount of crops produced, this skewness may not surprise. However, it is remarkable that the vast majority of farms are not subsidized at all.

[2] e.g., Duguet (2004) for France, Blanes and Busom (2004) for Spain and Hussinger (2008) and Aschhoff (2010) for Germany.

interest group. I incorporate a production subsidy in a monopolistic competition framework where firms are heterogeneous with respect to their productivity (Melitz, 2003). As a novel feature of my model, the subsidy, which is modeled as a reduction of a firm's variable production costs, is only granted to firms that bear the associated *administrative* fixed costs.[3] This assumption allows me to make explicit use of heterogeneity in firm productivity to endogenously determine firm participation in the subsidy program. Since receiving firms benefit from the subsidy and sell at a lower price, non-receiving firms suffer from tougher market conditions and a within-industry conflict arises. When the subsidy is endogenously determined in a lobbying game à la Grossman and Helpman (1994), this within-industry conflict creates incentives for large firms to lobby, such that the size and composition of the lobby is also endogenously determined.

In particular, I extent the standard two stage "Protection for Sale" lobbying game of Grossman and Helpman (1994) by an additional first stage where each firm decides to join a special interest group. Besides determining eligibility, the administrative fixed costs then also reflect a firm's lobby entry costs. Only firms with productivity above the *lobby cutoff* decide to become eligible and to join the lobby. This feature of the model is consistent with recent empirical evidence on lobbying, showing that there are considerable fixed costs associated with lobbying and that within an industry only few and large firms lobby (Kerr et al., forthcoming).

In my model, the optimal welfare maximizing subsidy rate depends on the trade-off between the markup distortion from monopolistic competition and a novel distortion caused by the administrative fixed costs. If these costs are negligible, the ex-ante welfare maximizing subsidy rate exactly compensates for the markup distortion in the economy. If the fixed costs distortion is large, an ex-ante welfare maximizing government should neglect the mark-up distortion from monopolistic competition and it should not introduce a subsidy. In contrast, a government that is influenced by lobby contributions will introduce a subsidy in equilibrium.

One popular justification for subsidies is to support small firms. The results of my paper show that even under modest barriers to participate, the introduction of a subsidy program harms especially the smallest firms in a market. Ignoring these barriers, policymakers may obtain results directly opposing their intention.

Comparative statics of the lobbying equilibrium depend on the within-industry conflict that drives lobbying. If the government values lobby contributions more than general welfare, increasing firm heterogeneity leads to a decline in the subsidy rate. This result qualifies findings in the literature that firm size dispersion is positively related to the political power of a lobby (e.g., Bombardini (2008)). Similarly, if the government values lobby contributions more than general welfare, higher lobby entry costs, while

[3]The administrative burden of applying for government programs is not negligible and is of great interests for policymakers. A recent example is the report by the "Farming Regulation Task Force" to the UK Government, which finds more than 200 unnecessary "red tape" burdens and highlights the importance of reducing paperwork for farmers (DEFRA, 2011).

unambiguously reducing the (relative) size of the lobby group, increase the equilibrium subsidy rate. This finding contrasts with the standard assumption in the literature that lobby size is positively related to the political power of an interest group (e.g., Acemoglu and Robinson (2001)).

The theoretical framework and the key mechanism underlying this paper are closely related to the heterogeneous firm literature of international trade. The monopolistic competition model of Melitz (2003) is a landmark in this literature.[4] A key feature of Melitz-type models is that with sufficiently high trade costs only very efficient firms decide to export. Similarly, in my model, with sufficiently high administrative fixed costs only the most efficient firms decide to receive subsidies and lobby.

Recent papers study the impact of public policies in heterogeneous firm models (e.g., Chor (2009), Demidova and Rodríguez-Clare (2009), Pflüger and Russek (2014), Pflüger and Suedekum (2013)). In these papers, policy instruments still affect all firms in the market in the same way. To the best of my knowledge, my paper is the first one that makes explicit use of firm heterogeneity to endogenize the set of firms that benefit from a policy instrument.

Due to data availability, there is so far little empirical evidence on the firm-level impact of production subsidies. Using a panel data set for German manufactures in the period 1999-2006, Wagner (2010) shows that while the fraction of subsidized firms is low, receiving firms in Western Germany are larger and were already more profitable before receiving subsidies.[5] These patterns confirm the theoretical predictions of my model.

Some authors also introduce lobbying in Melitz-type models. Abel-Koch (2010) and Rebeyrol and Vauday (2008) analyze fixed costs of production or entry as policy instruments. Chang and Willmann (2006) make use of the opposing interests of domestic and exporting firms to model lobbying for an import tariff. In contrast to my approach, these papers take the lobby itself or the mass of lobbying firms as exogenously given and firm heterogeneity is not exploited to endogenize lobby formation.

Endogenous lobby formation has been studied by Mitra (1999). While his paper looks at lobby formation across industries, I focus on lobby formation within an industry. In a related study, Bombardini (2008) analyzes lobby participation across firms. In her paper, firms can participate in lobbying for industry specific trade policies, which benefit all domestic firms within the industry. In contrast, in my model firms participate in lobbying to receive benefits at the expense of other firms within the industry. This

[4] Melitz (2003) extends the framework in Hopenhayn (1992) to monopolistic competition in a general equilibrium setting. See Redding (2011) for a comprehensive review on international trade theory and firm heterogeneity. Complementary, Bernard et al. (2012) review empirical evidence on firm heterogeneity in the context of international trade.

[5] Given the particular historical and economic situation in Germany, the results of Wagner (2010) differ for Western and Eastern Germany. In his dataset, only 3.35% of the manufacturing firms in Western Germany and 17.27% in Eastern Germany received subsidies in 2006. Subsidized manufacturers in Eastern Germany are also less productive and less human capital intensive firms.

within-industry conflict leads to novel and complementary insights into lobby participation across firms.[6]

A growing body of studies employ US firm-level lobbying data, which became available through the 1995 Lobbying Disclosure Act (e.g., Ansolabehere et al. (2002), Bombardini and Trebbi (2012), Chen et al. (2013), Ludema et al. (2010) and Igan et al. (2011)). As one of the most recent papers in this literature, Kerr et al. (forthcoming) provide novel firm-level evidence on lobbying behavior of publicly traded US firms. While only few firms are politically active, lobby participation and lobbying expenditures are positively correlated with firm size. As a main result, Kerr et al. (forthcoming) find evidence that there are fixed entry costs to lobbying. This supports the assumption made in my paper that there are barriers to start lobbying.

The rest of the paper is organized as follows. In Section 2.2, after presenting a baseline model with heterogeneous firms, I introduce a production subsidy and lobbying in the model. In Section 2.3 and Section 2.4, I work through the two cases with low and high administrative fixed costs. For both cases, I first derive the equilibrium for a given subsidy rate before analyzing the ex-ante welfare maximizing subsidy and the equilibrium of the lobbying game. Section 2.5 concludes.

2.2 Theoretical framework

In this section, I lay out a baseline model with heterogeneous firms before introducing a production subsidy and lobbying.

2.2.1 Baseline model

Preferences. There are two sectors in the economy: a differentiated goods sector and a sector where a homogenous numéraire good, X, is produced. One unit of this outside good is produced by one unit of labor input, such that the wage rate is fixed to one. For simplicity, the mass of labor in the economy is also normalized to one, such that total labor income is fixed to unity as well.[7] The quasilinear utility function of the representative consumer is given by

$$U(X, Q) = y \ln(Q) + X,$$

where $y > 0$. By utility maximization, y is the constant aggregate expenditure on all available differentiated varieties, $y = PQ$. The CES composite good Q consists of a

[6] My modeling approach differs in several other dimensions from Bombardini (2008). In Bombardini (2008), lobby entry of an additional firm raises the benefits of all members proportional to the entrant's firm size. This requires that each firm is of positive mass, such that individual contributions can change the political equilibrium. If the joint benefits from lobby entry of an additional firm lie below the lobby entry costs, the firm is not allowed to join the lobby. Bombardini (2008) uses specific factor model with a finite set of goods. Heterogeneity in firm size is due to different endowments of the specific factor. Therefore, firm-level differences in productivity are absent.

[7] I implicitly assume that aggregate labor demand in the differentiated goods sector is less than one, such that the differentiated goods are produced in equilibrium. All results hold if the mass of labor in the economy is greater than one.

continuum of available varieties $\omega \in \Omega$:

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

where $\sigma > 1$ denotes the elasticity of substitution between varieties, and $q(\omega)$ is the consumed quantity of variety ω. The sum of aggregate profits and labor income defines total income $Y = \Pi + 1$, which is spend on the differentiated goods and the outside good, such that $Y = y + X$. Utility maximization yields the standard CES-demand for variety ω:

$$q(\omega) = Ap(\omega)^{-\sigma}, \quad A = yP^{\sigma-1}, \tag{2.1}$$

where $p(\omega)$ denotes the price of variety ω, and P is the dual price index defined by

$$P = [\int_{\omega\in\Omega} p(\omega)^{1-\sigma} d\omega]^{\frac{1}{1-\sigma}}. \tag{2.2}$$

Technology and firm behavior. Firms use labor as input to produce their unique variety in a market with monopolistic competition. A firm draws its productivity φ (i.e., the inverse of its variable per-unit labor requirement) from a Pareto distribution with shape parameter $\theta > \sigma$ and scale parameter $b > 0$.[8] The cumulative distribution function is given by $V(\varphi) = 1 - \left(\frac{b}{\varphi}\right)^{\theta}$ such that the probability density function is $v(\varphi) = \frac{\theta b^{\theta}}{\varphi^{\theta+1}}$ for $\varphi \geq b$.[9] Low values of θ correspond to "fat tails" of the productivity distribution and therefore to greater firm heterogeneity. Following Chaney (2008), the set of *possible entrants*, J, is a fixed measure.[10] Only a subset of those firms will be active in equilibrium. The economy is in a steady state, such that firm entry equals firm exit. After a firm knows its productivity draw, it has to pay production fixed costs f to be an active producer. The sum of these fixed costs and variable costs from producing $q(\varphi)$ (i.e., $\frac{q(\varphi)}{\varphi}$) are a firm's total costs (i.e., total labor requirement) $l(\varphi) = \frac{q(\varphi)}{\varphi} + f$. Therefore, total profits of a firm are $\pi(\varphi) = p(\varphi)q(\varphi) - \frac{q(\varphi)}{\varphi} - f$.

Equilibrium. A firm sets the price of its variety to maximize total profits $\pi(\varphi)$. Due to CES demand (equation (2.1)), profit maximization leads to the standard constant markup pricing rule in the Dixit and Stiglitz (1977) framework: $p(\varphi) = \frac{\sigma}{\sigma-1}\frac{1}{\varphi}$. Equilibrium revenues of a firm are

$$r(\varphi) = A\left[p(\varphi)\right]^{1-\sigma} = A\left(\frac{\sigma-1}{\sigma}\right)^{\sigma-1}\varphi^{\sigma-1}.$$

With CES preferences, variable profits are proportional to revenues, $\pi^{var}(\varphi) = \frac{r(\varphi)}{\sigma}$, such that equilibrium profits of a firm are

$$\pi(\varphi) = \frac{r(\varphi)}{\sigma} - f = B\varphi^{\sigma-1} - f, \quad B = \frac{(\sigma-1)^{\sigma-1}}{\sigma^{\sigma}}A. \tag{2.3}$$

[8]Note that for aggregate sales (quantity) to be well defined, it must hold that $\theta > \sigma$.

[9]Given its productivity draw, each firm produces a single variety. However, several firms can have identical productivity draws.

[10]In Appendix 2.B, I relax this assumption by allowing for free entry. Under free entry, aggregate entry costs assure that there are no positive aggregate profits. However, in comparison to a model with a fixed measure of potential entrants, the mass of active firms and the mass of lobbying firms is exactly the same under free entry.

The productivity level of the marginal firm that makes zero profits is implicitly defined by $\pi(\varphi^*_{base}) = 0$. Using equation (2.3), the resulting *product market cutoff* is given by

$$\varphi^*_{base} = \left(\frac{f}{B}\right)^{\frac{1}{\sigma-1}}. \tag{2.4}$$

Therefore, the mass of active firms is $J_A = J(1 - V(\varphi^*_{base}))$. Note that henceforth the subscript "*base*" refers to variables of the baseline model. Using equations (2.2) and (2.4), the baseline price index and the baseline product market cutoff can be rewritten as functions of the model parameters:

$$P_{base} = \tilde{\kappa} f^{\frac{1}{\theta}\frac{\theta-\sigma+1}{\sigma-1}} \tag{2.5}$$

and

$$\varphi^*_{base} = \kappa f^{\frac{1}{\theta}}, \tag{2.6}$$

where $\kappa = \left(J\frac{\theta b^\theta}{\theta-\sigma+1}\frac{\sigma}{y}\right)^{\frac{1}{\theta}}$ and $\tilde{\kappa} = \kappa^{-1}(\frac{\sigma}{\sigma-1})\left(\frac{\sigma}{y}\right)^{\frac{1}{\sigma-1}}$. From equations (2.5) and (2.6) one can already see that the price index is increasing in θ, but the product market cutoff is decreasing in θ. Consequently, less firm heterogeneity, which leads to relatively less high productive firms, makes the composite good more expensive (i.e., the price index rises). Therefore, the product market cutoff declines and the marginal firm at the new cutoff has lower productivity. Due to the fixed expenditures on the differentiated goods, it is straightforward to show that aggregate profits in the economy are only a function of the parameters σ, θ and y:

$$\Pi = \int_{\omega\in\Omega} \pi(\varphi)d\omega = \frac{\sigma-1}{\sigma}\frac{y}{\theta}. \tag{2.7}$$

Due to quasilinear preferences, welfare is $W = Y + CS$, where $CS = y\ln(Q) - PQ = y\ln(\frac{y}{P}) - y$ denotes consumer surplus. Using the explicit expressions for aggregate profits (equation (2.7)) and for the price index (equation (2.5)), welfare in the baseline model can be rewritten as

$$W_{base} = \underbrace{\frac{\sigma-1}{\sigma}\frac{y}{\theta}}_{\text{agg. profits}\,\Pi} \underbrace{+1}_{\text{labor income}} + \underbrace{y\ln(y) - y\ln(\tilde{\kappa} f^{\frac{1}{\theta}\frac{\theta-\sigma+1}{\sigma-1}}) - y}_{\text{consumer surplus}\,CS}. \tag{2.8}$$

2.2.2 Introducing a production subsidy

The model presented so far is a simple autarky version of the Melitz (2003) and Chaney (2008) heterogeneous firms framework. I will now extend this baseline model by introducing a production subsidy, which firms can only receive after paying additional administrative fixed costs, f_s. Ex-ante no firm is excluded from the subsidy or directly picked by the government. However, depending on the level of these additional fixed costs, ex-post not all firms will necessarily receive subsidy payments.

I assume that the administrative fixed costs f_s contain two parts. On the one hand, for a given subsidy rate, they are *bureaucratic fixed costs* that have to be paid to receive government payments. The bureaucratic burden due to applications for government programs is not negligible. In particular for small firms, filling in paperwork and applying for government grants and subsidies can be very costly.[11] Similarly, acquiring information on the existence of suitable subsidy programs or uncertainty to receive payments after a long and cumbersome application process can also be seen as a part of these bureaucratic fixed costs. On the other hand, when the subsidy is endogenously determined, the administrative fixed costs f_s are considered to be *political fixed costs* that are necessary to enter a lobby. Fixed costs to lobby have been frequently used in the theoretical models of lobby formation (e.g., Mitra (1999), Bombardini (2008)). Recently, Kerr et al. (forthcoming) provide also first empirical evidence for lobby fixed costs.

Of course, lobbying and applying for subsidies are two different – although not mutually exclusive – firm activities. The assumption that there is one single fixed cost for both activities may seem strong. Taking this assumption literately, one should think of the fixed costs as allowing firms to apply for subsidies that are only granted to lobbying firms. A prominent and controversially discussed example for government payments that allow for such discrimination across firms are Congressional Earmarks in the US. However, there are many examples where lobbying produces spillovers to non-lobbying firms. In Appendix 2.D, I therefore relax the assumption that only lobbying firms can receive subsidies, and consider a more complex model with two distinct fixed costs for lobbying and for becoming eligible for subsidy payments. Even if the subsidy is not perfectly targetable to lobbying firms, I derive parameter conditions such that only lobbying firms receive subsidies. Therefore, I consider this to be a robust assumption that simplifies a more complex model.

I assume that the production subsidy $s \in (1, \bar{s})$ reduces a firm's variable costs by a factor of $\frac{1}{s}$, such that $s = 1$ corresponds to no cost reduction. The upper bound $\bar{s}$ is derived later in the paper. Similar to iceberg trade costs in international trade theory, using a subsidy on variable costs keeps the monopolistic competition model highly tractable.[12] However, beyond pure technical reasons, there are various real world examples of government policies that reduce firms' variable production costs. For instance, low interest government loans, wage and energy subsidies, or business tax credits reduce at least partially variable input costs. In Kammerer (2013b), lobbying for an export subsidy is analyzed. In the international trade context of Kammerer (2013b), a subsidy on variable export costs is equivalent to an export promoting policy that lowers variable transportation costs. Such policies, like export credits and export insurances, could be preferred by governments because they are less likely to be identified as WTO forbidden export subsidies. Therefore, modeling a subsidy on variable costs describes the nature of many government subsidy programs very well.

[11] For instance, the report by the UK "Farming Regulation Task Force" finds more than 200 unnecessary "red tape" burdens and highlights the importance of reducing paperwork for UK farmers (DEFRA, 2011).

[12] In Appendix 2.C, I consider an ad-valorem output subsidy as an alternative policy instrument. Because subsidy payments per firm still increase in firm sales and firm productivity, the selection mechanism that determines eligibility in my model still works. In general, more productive firms will select into subsidized production, if firm profits are supermodular in firm productivity and the subsidy rate.

In particular, given a subsidy s, the subsidized variable costs that a firm takes into account when maximizing its profits are $\frac{q_s(\varphi)}{s\varphi}$. Let f_s denote the administrative costs that have to be paid by each firm to receive the subsidy. Total costs of a subsidized firm are $l_s(\varphi) = \frac{q_s(\varphi)}{s\varphi} + f + f_s$, such that firm profits are $\pi_s(\varphi) = p_s(\varphi)q_s(\varphi) - \frac{q_s(\varphi)}{s\varphi} - f - f_s$.[13] As shown below, the combination of firm heterogeneity and additional administrative fixed costs leads to self-selection of firms into subsidized production, depending on firm productivity (i.e., only large and more efficient firms receive payments). The key mechanism is that subsidy payments per firm (not the subsidy rate s) increase with firm productivity and therefore with firm size, while the fixed costs to receive payments are the same for all firms.[14] As a consequence, in addition to the product market cutoff, there exists an eligibility cutoff φ_L^* with respect to firm productivity above which firms find it profitable to pay the administrative fixed costs to receive the subsidy. With the set of subsidized varieties given by Ω^s, the price index is defined by

$$P_s = [\int\limits_{\omega\in\neg\Omega^s} p(\omega)^{1-\sigma}d\omega + \int\limits_{\omega\in\Omega^s} p_s(\omega)^{1-\sigma}d\omega]^{\frac{1}{1-\sigma}}. \tag{2.9}$$

Given that a firm pays the fixed costs to receive subsidies, it will maximize its profits by setting the market price of its variety to $p_s(\varphi) = \frac{\sigma}{\sigma-1}\frac{1}{s\varphi}$. Equilibrium revenues and profits of a subsidized firm are then respectively,

$$r_s(\varphi) = A_s\left[p_s(\varphi)\right]^{1-\sigma} = A_s\left(\frac{\sigma-1}{\sigma}\right)^{\sigma-1}(\varphi s)^{\sigma-1}, \quad A_s = yP_s^{\sigma-1}$$

and

$$\pi_s(\varphi) = \frac{r_s(\varphi)}{\sigma} - f - f_s = B_s\,(\varphi s)^{\sigma-1} - f - f_s, \quad B_s = \frac{(\sigma-1)^{\sigma-1}}{\sigma^\sigma}A_s.$$

Define average productivity of eligible firms as

$$\tilde{\varphi}_L = [\frac{1}{1-V(\varphi_L^*)}\int_{\varphi_L^*}^{\infty}\varphi^{\sigma-1}v(\varphi)d\varphi]^{\frac{1}{\sigma-1}}, \tag{2.10}$$

where φ_L^* denotes the eligibility cutoff above which firms receive subsidies (derived explicitly later in the paper). Aggregate revenues and aggregate profits can be split up into revenues and profits of **E**ligible firms and **N**on-**E**ligible firms: $y = R_E + R_{NE}$ and $\Pi = \frac{\sigma-1}{\sigma}\frac{y}{\theta} = \Pi_E + \Pi_{NE}$. Then, $J_L = J(1 - V(\varphi_L^*))$ denotes the mass of firms that receives subsidies, and by using equation (2.10), aggregate revenues of all subsidized firms can be expressed as:

$$R_E = J_L r_s(\tilde{\varphi}_L). \tag{2.11}$$

Consequently, aggregate profits of eligible firms are $\Pi_E = J_L\pi_s(\tilde{\varphi}_L) = \frac{R_E}{\sigma} - J_L\,(f + f_s)$. Moreover, due to the Pareto distribution, the share of active firms that receive subsidies depends only on the Pareto shape parameter and the ratio of the cutoffs:

$$J_R = \frac{J_L}{J_A} = \left(\frac{\varphi^*}{\varphi_L^*}\right)^\theta. \tag{2.12}$$

[13] Here, I treat the subsidy rate as exogenous. When the subsidy is endogenously determined (Section 2.2.3), there are additional individual lobbying contributions that firms have to pay.

[14] In fact, with a variable costs subsidy, equilibrium subsidy payments per unit of output even decrease with firm size.

Subsidy payments per firm are the difference between the true variable costs for output $q_s(\varphi)$ and the subsidized variable costs: $\frac{s-1}{s}\frac{q_s(\varphi)}{\varphi} = (s-1)\left(\frac{\sigma-1}{\sigma}\right) r_s(\varphi)$. Aggregating over all receiving firms gives the government's total subsidy payments:

$$S = (s-1)\frac{\sigma-1}{\sigma}R_E. \tag{2.13}$$

For simplicity, I assume that the subsidy is financed by a lump-sum tax on labor income, such that the upper bound on the subsidy rate $\bar{s}$ is implicitly defined by $S = 1$. Welfare is then given by

$$W_s = \Pi + (1-S) + (y\ln(\frac{y}{P_s}) - y). \tag{2.14}$$

The welfare channels of the subsidy can already be seen from equation (2.14). Aggregate subsidy payments reduce net labor income and therefore welfare. Consumer surplus is also affected by the subsidy, because the price index changes. However, because aggregate profits remain constant, the subsidy only shifts profits among firms within the industry.

2.2.3 Introducing lobbying for a production subsidy

In this section, I present a lobbying game in which the subsidy rate is endogenously determined. Although the policy instrument of interest is a production subsidy in monopolistic competition, the lobbying framework I build on follows the menu auction approach by Bernheim and Whinston (1986) and is well known from the "Protection for Sale" model by Grossman and Helpman (1994). Recently, lobbying has been introduced in models with heterogeneous firms (e.g., Abel-Koch (2010), Rebeyrol and Vauday (2008), and Chang and Willmann (2006)). In contrast to these papers, the novel feature of my approach is to make explicit use of firm heterogeneity to determine the size and composition of the lobby endogenously. I extent the standard two stage "Protection for Sale" lobbying game by an additional first stage where each firm decides to join a special interest group that lobbies for a subsidy. Additionally to determining the set of eligible firms, the fixed costs f_s are now also considered to be *political* fixed costs that allow firms to join a lobby and to benefit from its lobbying achievements.[15] Therefore, in the lobbying game the eligibility cutoff is also the *lobby cutoff.* Because all firms with productivity above this cutoff join the lobby, the size and the composition of the lobby is an equilibrium object. Consequently, in an equilibrium of the lobbying game, the mass of lobbying firms has to induce a lobby contribution schedule that is consistent with the equilibrium subsidy rate.[16]

The driving force behind lobbying is a distributional conflict between receiving and non-receiving firms. By lobbying for an increase in the subsidy rate, receiving firms can benefit at the expense of non-receiving firms by selling at lower price and increasing their profits. This leads to a drop in the price index such that non-receiving firms lose

[15] The assumption that there is only a single fixed costs f_s for being eligible *and* for lobbying, is less restrictive as it might seem. In Appendix 2.D, I relax this assumption.

[16] Non-receiving firms would benefit from a decline in the subsidy rate. However, due to the lobby fixed costs the interests of small firms are not recognized by the government.

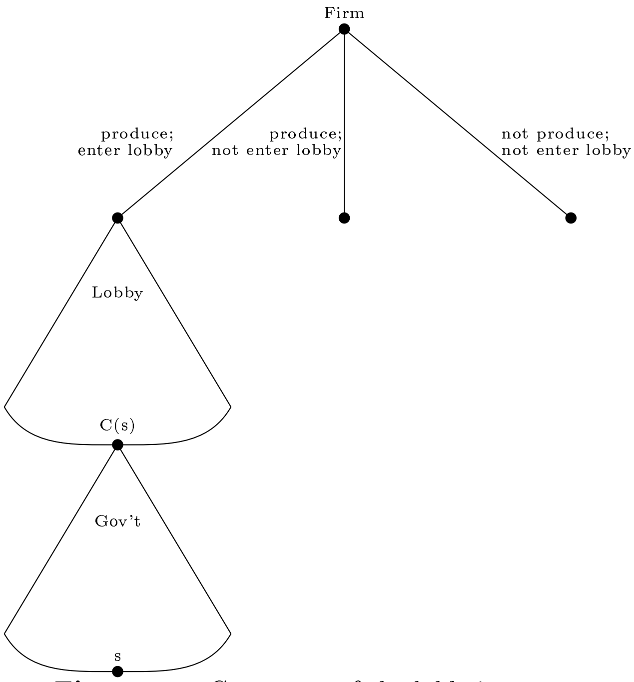


Figure 2.1: Game tree of the lobbying game

profits. If the administrative fixed costs are low, all firms receive subsidy payments and this within-industry conflict is absent. Therefore, receiving firms have no incentive to offer positive contributions to the government. I term this the *low costs case,* which will be extensively discussed in Section 2.3. In contrast, if the administrative fixed costs are high and only a subset of active firms receives payments, the arising within-industry conflict gives firms an incentive to influence the government by lobbying. In Section 2.4 this *high costs case* is analyzed in detail.

Timing and structure of the lobbying game. The timing of the lobbying game is as follows. In first stage, each firm decides whether to produce and to join the lobby (pay f_s and f); to produce but not to join the lobby (pay only f); or neither to produce nor to lobby. In the second stage, the lobby offers a joint contribution schedule $C(s)$. In the third stage, the government chooses the subsidy s (given $C(s)$) and firms set the profit maximizing price and produce either with or without the subsidy. Figure 2.1 shows the timing of the lobbying game graphically.

The government's objective function is

$$G = \alpha W(s) + C(s), \tag{2.15}$$

where $C(s)$ is the contribution schedule offered by the lobby and α is the relative weight that the government puts on general welfare. Given the timing of the game, when the government decides about the subsidy rate, firms already joined the lobby and the lobby determined its contribution schedule. Therefore, the government takes the number of lobbying firms and the contribution schedule as given. Similarly, when the lobby determines its contribution schedule, it maximizes the profits of its current members, taking the number of lobby members as given. Anticipating the optimal behavior of the lobby and the government, only firms with productivity above the product market cutoff, φ^*, decide to be active producers and only firms with productivity above the lobby cutoff, φ_L^*, will decide to join the lobby. For low levels of f_s there there is only one cutoff (see Section 2.3 for details).

The joint contribution schedule offered by the lobby, $C(s)$, has to be financed by individual member contributions $c(\varphi, s)$ such that $C(s) = \int_{\varphi_L^*} c(\varphi, s) dV(\varphi)$. I assume that these individual contribution are such that each lobby member still gains from joining the lobby:

Assumption 2.1. *If* $\varphi \geq \varphi_L^*$ then $c(\varphi, s) \leq \pi_s(\varphi) - \pi(\varphi)$.

With this assumption, it can never be the case that a firm with net-benefits from receiving the subsidy (after paying lobby entry costs) would like to exit the lobby because of additional individual contributions. In other words, even with additional individual lobby contributions, the functional form of the productivity cutoffs is the same as with an exogenous subsidy rate.[17] Note that I do not impose any further restrictions on how the lobby collects the individual contributions from its member firms.

Equilibrium of the lobbying game in the general case. Before analyzing different cases of lobbying game with explicit functional forms, I derive the equilibrium of the lobbying game in the general case. With a single lobby within the industry, a modified version of the second lemma in Bernheim and Whinston (1986) can be stated:

Definition 2.1. *A set* $\{C^o, s^o, \varphi^o, \varphi_L^o\}$ *is a subgame-perfect Nash equilibrium of the lobbying game if and only if:*

1. *only firms with* $\varphi > \varphi^o$ *produce and only firms with* $\varphi > \varphi_L^o$ *enter the lobby,*
2. $C^o \geq 0$ *is feasible for the lobby,*
3. $s^o \in \arg\max_{s \in [1,\bar{s}]} G = \{\alpha W(s) + C^o(s)\}$,
4. $\{\alpha W(s^o) + C^o(s^o)\} + \{\Pi_E(s^o) - C^o(s^o)\} \geq \{\alpha W(s) + C^o(s)\} + \{\Pi_E(s) - C^o(s)\}$ $\forall s \in [1, \bar{s}]$,
5. $\exists s^* \in [1, \bar{s}]$, *such that* $s^* \in \arg\max_{s \in [1,\bar{s}]} \{\alpha W(s) + C^o(s)\}$ *and* $C^o(s^*) = 0$.

Condition 1 is directly related to the additional first stage of the lobbying game, where heterogeneous firms select into producing and lobbying. Condition 2 states that the offered contribution schedule is non-negative and fulfills Assumption 2.1. The equilibrium subsidy must also maximize the government's objective (condition 3) and the joint welfare of government and the lobby (condition 4) on the set of feasible subsidy rates. For condition 5 to hold, there must exist a feasible subsidy rate that maximizes the government's objective, given that the contributions of the lobby are zero.

As a refinement of the set of all Nash Equilibria, I assume that the contribution schedules are truthful in the sense that they represent the true preferences of the lobby:

[17] To get an intuition for this assumption, consider the marginal firm that joins the lobby paying fixed costs f_s. This firm makes zero additional profits from subsidized production, and any additional contribution would force the firm to exit the lobby.

Assumption 2.2. *Aggregate contribution schedules are truthful:*

$$C^T = \max\left[\Pi_E - B_L, 0\right],$$

where Π_E are aggregate profits of the lobby members and B_L denotes the additional aggregate surplus of all lobbying firms, determined in equilibrium.

Bernheim and Whinston (1986) argue that truthful strategies may be focal within the Nash set, and they show that every best-response set contains a truthful strategy. With truthful contribution schedules the following corollary can be stated:

Corollary 2.1. *Under truthful contribution schedules, the equilibrium subsidy satisfies*

$$s^o = \arg\max_{s\in[1,\bar{s}]} \left\{\alpha W(s) + \Pi_E(s)\right\}.$$

Proof. See Appendix 2.A.1. □

Thus, with truthful contributions, the government behaves *as if* it maximizes a weighted sum of general welfare and joint lobby profits. The equilibrium contributions compensate the government for the weighted welfare loss induced from deviating from the subsidy rate that would maximize general welfare, s^*. It must therefore hold that $C^T(s^o) = \alpha\left[W(s^*) - W(s^o)\right]$. With truthful contributions (Assumption 2.2), the equilibrium lobby surplus is $B_L = \Pi_E(s^o) - \alpha\left[W(s^*) - W(s^o)\right]$. With welfare defined by $W = \Pi + 1 - S + CS$, where aggregate profits, Π, are constant, the first-order condition of the government maximization problem is given by

$$\frac{\partial G}{\partial s} = \alpha\left(\frac{\partial CS}{\partial s} - \frac{\partial S}{\partial s}\right) + \frac{\partial \Pi_E}{\partial s} = 0. \tag{2.16}$$

Note, when solving equation (2.16) the government takes the mass of active firms and the mass of lobby members as given.

To analyze the equilibrium of the lobbying game in detail, I will distinguish in the following between the low fixed costs case and the high fixed costs case. In both cases, I will first state the equilibrium expressions for a given subsidy rate, before deriving the optimal subsidy rate for a government that maximizes *ex-ante* general welfare taking entry and exit of firms into account. Subsequently, I derive the equilibrium of the lobbying game, where the government takes the mass of firms as given, when setting the subsidy rate.

2.3 The low administrative fixed costs case

If the administrative fixed costs are sufficiently low, all active firms find it profitable to receive subsidy payments. Henceforth, I call this the *low costs case.*

2.3.1 Equilibrium in the low costs case for a given subsidy

For a given subsidy rate s, if the administrative fixed costs are sufficiently low, all active firms will be subsidized. The precise parameter condition that separates the low costs case from the high costs case is given by equation 2.23, derived in Section 2.4.1. There is only one *eligibility and product market cutoff* (later also called *lobby cutoff*), defined by $\pi_s(\varphi^*_{L,low}) = 0$:

$$\varphi^*_{L,low} = s^{-1}\left(\frac{f+f_s}{B_s}\right)^{\frac{1}{\sigma-1}}. \tag{2.17}$$

Using this expression of the cutoff, the price index in the low costs case can be rewritten in terms of the model parameters:

$$P_{s,low} = \tilde{\kappa}\,(f+f_s)^{\frac{1}{\theta}\frac{\theta-\sigma+1}{\sigma-1}}\,s^{-1}, \tag{2.18}$$

where $\tilde{\kappa} = \kappa^{-1}(\frac{\sigma}{\sigma-1})\left(\frac{\sigma}{y}\right)^{\frac{1}{\sigma-1}}$. Note that the elasticity of the price index with respect to the subsidy rate is given by $\epsilon_{P_{s,low}} = -1$, such that there is a perfect "pass-through" of the subsidy on the price index. The cutoff $\varphi^*_{L,low}$ can also be rewritten in terms of model parameters:

$$\varphi^*_{L,low} = \kappa\,[f+f_s]^{\frac{1}{\theta}}\,, \tag{2.19}$$

where $\kappa = \left(J\frac{\theta b^\theta}{\theta-\sigma+1}\frac{\sigma}{y}\right)^{\frac{1}{\theta}}$. In contrast to the administrative fixed costs, the subsidy rate does not appear in equation (2.19). For rising administrative fixed costs, the cutoff increases such that less firms are subsidized and active. Therefore, if $f_s \to 0$, the mass of active firms increases and converges to the value of the baseline model. Given that in the low costs case all active firms are subsidized and the upper bound of the government's budget is one, for total aggregate subsidy payments it must hold that $S_{low} = (s-1)\frac{\sigma-1}{\sigma}y \leq 1$. Therefore, the highest subsidy rate that the government is able to finance is $\bar{s}_{low} = 1 + \frac{\sigma}{\sigma-1}\frac{1}{y}$ The following lemma summarizes the results for the low costs case with a given subsidy rate:

Lemma 2.1. *In the low costs case with a given subsidy rate s, there is a unique eligibility and product market cutoff $\varphi^*_{L,low}$ and*

1. *the price index lies below the baseline value, $P_{s,low} < P_{base}$;*
2. *$\varphi^*_{L,low}$ lies above the baseline value, $\varphi^*_{L,low} > \varphi^*_{base}$;*
3. *$\varphi^*_{L,low}$ is invariant to a change in the subsidy rate, but a rise in f_s, in f, in σ or in firm heterogeneity leads to an increase of $\varphi^*_{L,low}$ and to a decline of $J_A = J_L$.*

Proof. See Appendix 2.A.2. □

The first statement of Lemma 2.1 follows directly from the comparison of equation (2.5) and equation (2.18). It shows that, despite the additional administrative fixed costs, the introduction of the subsidy has a positive effect on consumer surplus. However, due to the perfect pass-through of the subsidy on the price index, the only reason why introducing the subsidy program reduces available varieties (second statement) is the presence of the administrative fixed costs.

To give an intuition for the third statement of Lemma 2.1, in Figure 2.2 firms' profits are plotted as a function of firm productivity. The subsidy increases variable profits, such that bearing the relatively low administrative fixed cost is profitable for all active firms. Consequently, for all productivity levels associated with positive profits, the π_s-line lies above the π-line. Thus, there is only a single productivity cutoff, $\varphi^*_{L,low}$,

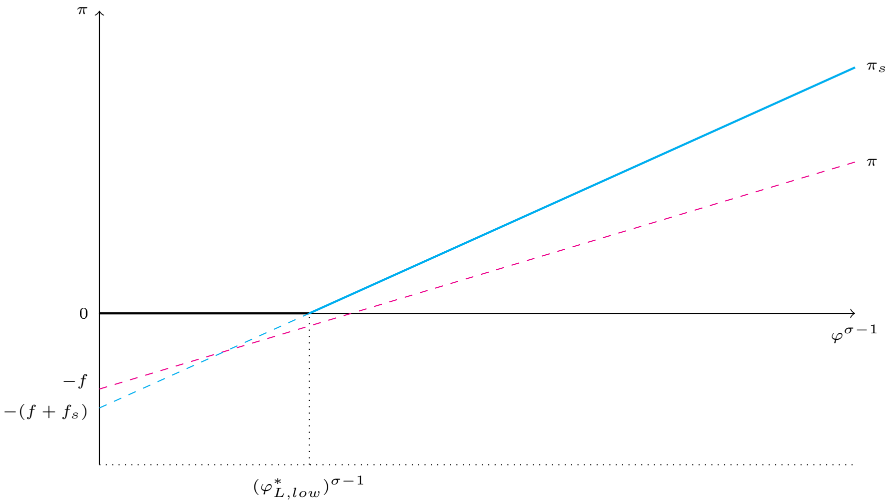


Figure 2.2: Firm profits in the low costs case

at which the marginal (subsidized) firm makes zero profits.[18] A lower subsidy rate or higher fixed costs have a direct effect as well as counteracting indirect effect on profits. The price index increases (indirect effect), such that the π_s-line (ceteris paribus) rotates upwards. However, firm profits also decrease directly through higher fixed costs (shifts π_s-line downwards) or through a lower subsidy rate (rotates π_s-line downwards). The net effect on the cutoff is exactly zero for a decreasing subsidy rate, while the net effect of increasing fixed costs is positive.

2.3.2 Ex-ante welfare maximizing production subsidy

As a benchmark, consider a government that does not take into account any lobby contributions, but maximizes only general welfare from an *ex-ante* perspective. The objective function of the government is then $G = W_s$ and it chooses to the ex-ante optimal subsidy rate before firms enter the market and claim eligibility (i.e., taking firm entry behavior into account). One can show that the derivative of aggregate subsidy payments with respect to s is a constant that is independent of the administrative fixed costs, $\frac{\partial S_{low}}{\partial s} = \frac{\sigma-1}{\sigma}y$. Moreover, using the expression for the price index (equation (2.18)), the marginal gain in consumer surplus is convex and decreasing in s: $\frac{\partial CS_{low}}{\partial s} = \frac{y}{s}$. Therefore, the first-order condition for an interior welfare optimum is

$$\frac{\partial W_{low}}{\partial s} = \frac{\partial CS_{low}}{\partial s} - \frac{\partial S_{low}}{\partial s} = \frac{y}{s} - \frac{\sigma-1}{\sigma}y = 0.$$

The unique interior solution is given by $s^* = \frac{\sigma}{\sigma-1}$, such that the optimal subsidy exactly compensates for the markup distortion. Total subsidy payments evaluated at the interior optimum are $S^*_{low} = \frac{y}{\sigma}$.[19] Note that the interior welfare optimum is identical to the global welfare optimum in a model without any administrative fixed costs. However, the interior solution in the low costs case may be welfare dominated by a corner solution at $s = 1$. To see this more explicitly, consider the difference between the interior welfare

[18] Note that the intersection of the dashed-red line and the x-axis is not the baseline cutoff, which would lie to the left of $\varphi^*_{L,low}$ (Lemma 2.1, statement 2). The decline of the price index, induced by the introduction of the subsidy, leads to a downward rotation of the π-line.

[19] With labor income normalized to unity, this solution is always feasible if $\sigma > y$.

optimum in the low costs case and welfare in the baseline case (equation (2.8)):

$$W^*_{low} - W_{base} = y \ln\left(\frac{P_{base}}{P_{s^*,low}}\right) - \frac{y}{\sigma}, \tag{2.20}$$

where $P_{s^*,low} = P_{base}\frac{\sigma-1}{\sigma}\left(1+\frac{f_s}{f}\right)^{\frac{1}{\theta}\frac{\theta-\sigma+1}{\sigma-1}}$. While the second term of equation (2.20) (total subsidy payments) is constant, the first term (difference in consumer surplus) is decreasing in f_s. Therefore, if the administrative fixed costs are sufficiently high, the interior optimum might not longer be a global optimum. The following proposition gives the precise condition when this is the case:

Proposition 2.1. *In the low costs case, if* $f_s < f\left(\exp\left[\frac{\ln(\frac{\sigma}{\sigma-1})-\frac{1}{\sigma}}{\frac{1}{\theta}\frac{\theta-\sigma+1}{\sigma-1}}\right]-1\right)$, $s^* = \frac{\sigma}{\sigma-1}$ *is the unique interior solution maximizing (ex-ante) welfare. Otherwise* $s^* = 1$ *maximizes welfare.*

Proof. See Appendix 2.A.3. □

Proposition 2.1 is driven by the trade-off between the markup distortion and a novel distortion associated with the administrative fixed costs. To get rid of the markup distortion, the government would like to introduce a subsidy. However, the administrative fixed costs associated with this subsidy cause an additional distortion in the economy. If the negative welfare impact of the administrative fixed costs distortion is too large, a welfare maximizing government should not introduce a subsidy. For low values of f_s, the positive impact of the administrative fixed costs on the price index is modest and the difference between baseline and low costs price index is quite large. Therefore, the resulting increase in consumer surplus is large enough to compensate for the financing of the subsidy (i.e., equation (2.20) is positive). However, if f_s increases above a certain threshold, the price index is too close to its baseline value. Therefore, consumer surplus increases little, and the introduction of any subsidy reduces welfare. In the low costs case, consumer surplus is the only channel through which an increase in f_s affects welfare. Therefore, the next corollary follows directly from Proposition 2.1:

Corollary 2.2. *In the low costs case, (ex-ante) welfare is decreasing in* f_s.

Proof. See Appendix 2.A.4. □

For the special case where the administrative fixed costs converge to zero, the low costs case nests the "traditional" inter-industry view on production subsidies. Accordingly, all firms in the market receive the subsidy without a cost and a markup-compensating subsidy rate is optimal. Consequently, without administrative fixed costs, introducing a subsidy would not have an effect on the cutoff and on firms' profits. Consumer surplus, however, would substantially increase because all varieties are sold at marginal costs. However, even for positive but modest levels of administrative fixed costs, the induced anti-variety effect makes the interior optimal subsidy rate welfare inferior to a corner solution without a subsidy (Proposition 2.1).

2.3.3 Lobbying in the low costs case

Equilibrium of the lobbying game in the low costs case. Consider a government that takes lobby contribution into account and maximizes its objective function (equation (2.15)) by choosing the optimal subsidy rate within the lobbying game (i.e., taking entry behavior of firms as given). Given that the lobby cutoff (equation (2.19)) is invariant with respect to s, the derivatives of consumer surplus and total subsidy payments are $\frac{\partial CS_{low}}{\partial s} = \frac{y}{s}$ and $\frac{\partial S_{low}}{\partial s} = \frac{\sigma-1}{\sigma}y$, respectively. Therefore, with constant aggregate profits, $\frac{\partial \Pi_E}{\partial s} = \frac{\partial \Pi}{\partial s} = 0$, the first-order condition of the lobbying game, equation (2.16), leads to the interior solution $s^o = \frac{\sigma}{\sigma-1}$. Because the government implements the subsidy rate that maximizes *ex-ante* general welfare, $s^* = s^o = \frac{\sigma}{\sigma-1}$, lobby contributions are zero in equilibrium. The following proposition summarizes the equilibrium of the lobbying game in the low costs case:

Proposition 2.2. *In the low costs case with lobbying, there exists a unique equilibrium of the lobbying game, such that*

1. *all firms with $\varphi > \varphi^o_{L,low} = \kappa\left[f + f_s\right]^{\frac{1}{\theta}}$ produce and enter the lobby,*
2. *lobby contributions are $C^T(s^o) = 0$,*
3. *the government implements the interior (welfare) optimum $s^o = s^* = \frac{\sigma}{\sigma-1}$.*

Given that all active firms join the lobby, the relative mass of lobbying firms $J_R = \frac{J_L}{J_A}$ is one. In Figure 2.3, which shows the equilibrium of the low costs case graphically, J_R is depicted by the function $h(s) = 1$. The optimal subsidy rate is depicted by the function $z(J_R) = \frac{\sigma}{\sigma-1}$, such that the unique equilibrium is given by the intersection $(s = \frac{\sigma}{\sigma-1}, J_R = 1)$. In the low costs case, an increase in the subsidy rate is not particularly beneficial for some active firms at the expense of others, such that there is no within-industry conflict across firms. Without this conflict, lobbying incentives are limited and the government implements the interior *ex-ante* welfare maximizing subsidy rate.

2.4 The high administrative fixed costs case

If the administrative fixed costs are sufficiently high, only a subset of active firms decide to receive the subsidy. Henceforth, I call this the *high costs case*.

2.4.1 Equilibrium in the high costs case for a given subsidy

For a given subsidy rate s, the marginal firm that enters the product market makes zero profits, $\pi(\varphi^*) = 0$. For sufficiently high administrative fixed costs this marginal firm will not receive subsidies. The corresponding *product market cutoff* is

$$\varphi^* = \left(\frac{f}{B_s}\right)^{\frac{1}{\sigma-1}}. \tag{2.21}$$

For the marginal firm that decides to receive subsidies, profits from subsidized production equal profits from non-subsidized production: $\pi_s(\varphi^*_L) = \pi(\varphi^*_L)$. The *eligibility*

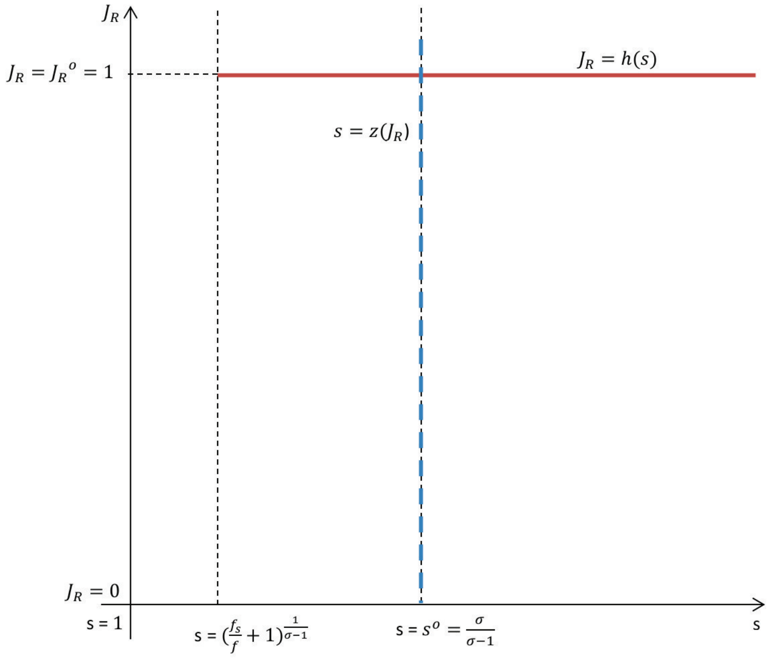


Figure 2.3: Lobbying equilibrium, low costs case

cutoff[20] is therefore

$$\varphi_L^* = \left(\frac{f_s}{(s^{\sigma-1}-1)B_s}\right)^{\frac{1}{\sigma-1}}. \tag{2.22}$$

The ratio of the cutoffs depends only on the fixed costs, the subsidy rate and the elasticity of substitution, $\frac{\varphi_L^*}{\varphi^*} = \left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{\frac{1}{\sigma-1}}$. The relative mass of lobbying firms is therefore $J_R = \frac{J_L}{J_A} = \left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{-\frac{\theta}{\sigma-1}}$. There are active firms that do not receive subsidies if the administrative fixed costs are sufficiently high:[21]

$$f_s > f(s^{\sigma-1}-1). \tag{2.23}$$

Using the cutoffs (equation (2.21) and (2.22)), the price index in the high costs case can be rewritten as a function of the model parameters:

$$P_{s,high} = \tilde{\kappa}[f^{\frac{\sigma-\theta-1}{\sigma-1}} + \left(s^{\sigma-1}-1\right)^{\frac{\theta}{\sigma-1}} f_s^{\frac{\sigma-\theta-1}{\sigma-1}}]^{-\frac{1}{\theta}}, \tag{2.24}$$

where $\tilde{\kappa} = \kappa^{-1}(\frac{\sigma}{\sigma-1})\left(\frac{\sigma}{y}\right)^{\frac{1}{\sigma-1}}$. For $f_s \to \infty$, the price index in the high costs case converges (from below) to the baseline value. An increase in the subsidy rate leads to a decline in the price index. However, with only a subset of active firms subsidized, the "pass-through" of the subsidy on the price index is now incomplete (i.e., $\left|\epsilon_{P_{s,high}}\right| < 1$).[22] Using the expression of the price index (equation (2.24)) together with equation (2.21) and equation (2.22), the cutoffs can also be expressed in terms of model parameters:

$$\varphi^* = \kappa[f + f_s\left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{-\frac{\theta}{\sigma-1}}]^{\frac{1}{\theta}} \tag{2.25}$$

[20] In the lobbying game, this will be the *lobby cutoff*.
[21] This condition implies reasonable levels of administrative fixed costs. For instance, if $s = 1.05$ and $\sigma = 2$, administrative fixed costs have to be at least 5% of production fixed costs.
[22] See Appendix 2.A.5 for an explicit expression of $\epsilon_{P_{s,high}}$.

and

$$\varphi_L^* = \kappa[f\left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{\frac{\theta}{\sigma-1}} + f_s]^{\frac{1}{\theta}}, \tag{2.26}$$

where $\kappa = \left(J\frac{\theta b^\theta}{\theta-\sigma+1}\frac{\sigma}{y}\right)^{\frac{1}{\theta}}$. The following lemma summarizes the results for the high costs case with a given subsidy rate s.

Lemma 2.2. *In the high costs case with a given subsidy rate s, there is both a product market cutoff φ^* and a eligibility cutoff φ_L^* and*

1. *the price index lies below the baseline value $P_{s,high} < P_{base}$;*
2. *φ^* lies above the baseline value $\varphi^* > \varphi_{base}^*$;*
3. *a rise in s or f, or a decline in f_s increases φ^* and J_L but decreases φ_L^* and J_A;*
4. *a rise in firm heterogeneity increases both φ^* and φ_L^*.*

Proof. See Appendix 2.A.8. □

From the first statement of Lemma 2.2 it follows directly that the introduction of the subsidy has still a positive impact on consumer surplus. Similar to the low costs case, the introduction of the subsidy reduces available varieties (second statement). However, in contrast to the low costs case, the cutoffs depend not only on the fixed costs but also on the subsidy rate. While an increase in the subsidy leads to more eligible firms, it reduces the total mass of active firms. Because the least efficient firms exit, there are less varieties available.

To get an intuition for the third statement of Lemma 2.2, in Figure 2.4 firm profits are plotted as a function of firm productivity. Bearing the relatively high administrative fixed costs is not profitable for all active firms such that some relatively less efficient firms produce without the subsidy (π-line). The product market cutoff lies at the intersection of the π-line and the x-axis, while the eligibility cutoff lies at the intersection of the π-line and the π_s-line. An increase in the subsidy rate rotates the π_s-line upwards, because the positive direct effect on firms' profits is stronger than the negative indirect effect from the decreasing price index. The π-line rotates downwards, because non-eligible firms' profits are only negatively affected through the decreasing price index. As a result, the product market cutoff increases, and the eligibility cutoff decreases. An increase in the administrative fixed costs has the opposite effect. It shifts the π_s-line downwards and makes subsidized production for the marginal firm at the eligibility cutoff unprofitable (eligibility cutoff increases). Because of the associated increase in the price index, the π-line rotates upwards and more firms find it profitable to be active (product market cutoff declines).

Even though both cutoffs increase in firm heterogeneity (fourth statement of Lemma 2.2), the mass of firms that receive subsidies may increase:

Lemma 2.3. *A rise in firm heterogeneity decreases J_A and increases J_R. If the subsidy rate is sufficiently high, there is a hump-shaped relationship between firm heterogeneity and J_L.*

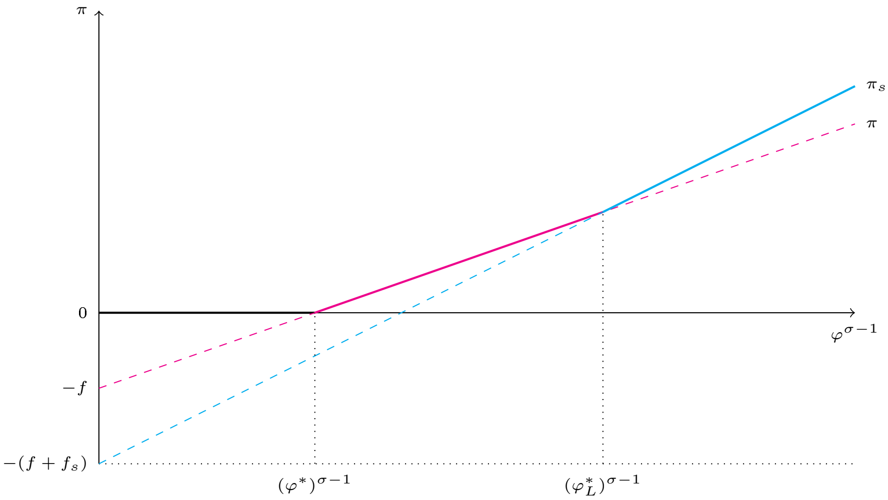


Figure 2.4: Firm profits in the high costs case

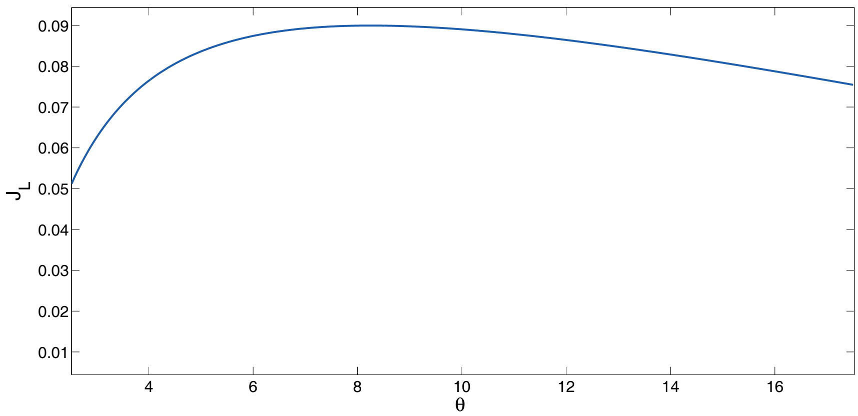


Figure 2.5: Mass of subsidized firms and firm heterogeneity, Matlab simulation ($\sigma = 2.5$, $s = 2$)

Proof. See Appendix 2.A.9 □

There are two counteracting effects that determine the impact of an increase in firm heterogeneity on the mass of firms. First, more dispersion in firm productivity implies more high productive firms (i.e., fatter tail of the Pareto distribution) in the economy. Therefore, conditional on the relevant cutoff, the mass of firms to the right of this cutoff increases. Second, because of the associated decline in the price index, the relevant cutoff increases and there is a negative effect on the mass of firms. For the total mass of active firms J_A, the second effect always dominates. However, for the mass of firms that receive subsidies J_L, the first effect can dominate the second one. In particular, if the subsidy is sufficiently high, starting from a low value a rise in firm heterogeneity increases J_L.[23] For high values of firm dispersion, however, more heterogeneity leads to a decline of J_L. Figure 2.5 shows this result graphically.

To compare the high costs case with the low costs case, Figure 2.6 shows the cutoffs as a function of the administrative fixed costs. For low levels of f_s, the eligibility and product market cutoff, $\varphi^*_{L,low}$, starts at the baseline value, φ^*_{base}, and is increasing in

[23]See proof in Appendix 2.A.9 for the exact threshold condition on s. If s lies below this threshold, the mass of firms that receive subsidies is always increasing in firm heterogeneity, $\frac{\partial J_L}{\partial \theta} < 0$.

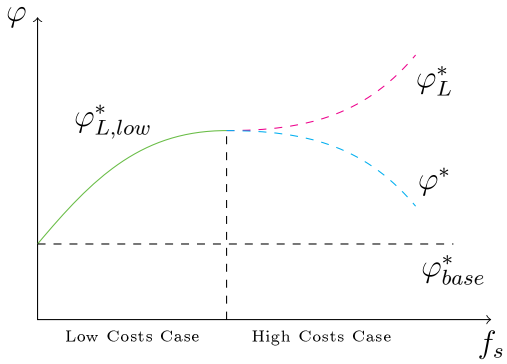


Figure 2.6: Productivity cutoffs and administrative fixed costs

f_s. For high fixed costs, $f_s > f(s^{\sigma-1}-1)$, there are two cutoffs. The product market cutoff, φ^*, is decreasing in f_s and converges to the baseline cutoff for $f_s \to \infty$. However, the eligibility cutoff, φ^*_L, is increasing in f_s. For $f_s \to f(s^{\sigma-1}-1)$, the two cutoffs of the high costs case converge to the single cutoff of the low costs case. In the high costs case, the subsidy causes an within-industry conflict between receiving and non-receiving firms. Figure 2.6 demonstrates the extensive margin component of this conflict: lower administrative fixed costs (or a higher subsidy rate) reduce the mass of active firms (i.e., φ^* increases) and increase the mass of receiving firms (i.e., φ^*_L declines).

The subsidy relocates profits from less efficient firms to more efficient firms, because the latter are able to pay the administrative fixed costs. Thus, receiving firms do not just gain from the subsidy, they also benefit at the expense of non-receiving firms. Through the associated drop in the price index, an increase in the subsidy rate results in a negative externality for other firms, especially for non-receiving competitors.

In the high-costs case, total subsidy payments are $S_{high} = (s-1)\frac{\sigma-1}{\sigma}R_E$.[24] Given the budget constraint of the government, the upper bound on the subsidy rate is implicitly defined by $\bar{s}_{high} = 1 + \frac{\sigma}{\sigma-1}\frac{1}{R_E}$. Thus, any subsidy rate that can be financed in the low costs case could also be financed in the high costs case. Intuitively, high fixed costs allow to highly subsidize a small mass of receiving firms. Because aggregate revenues of receiving firms are now a function of the subsidy rate, the derivative of S_{high} with respect to s is

$$\frac{\partial S_{high}}{\partial s} = \frac{\sigma-1}{\sigma}R_E + (s-1)\frac{\sigma-1}{\sigma}\frac{\partial R_E}{\partial s}. \tag{2.27}$$

The second term of this expression contains two additional channels that affect S_{high}. First, at the intensive margin, already receiving firms increase their revenues. Second, at the extensive margin, there are some firms that start subsidized production (φ^*_L decreases). In contrast to the low costs case, total subsidy payments depend on the administrative fixed costs, on the production fixed costs and on firm heterogeneity (i.e., the Pareto shape parameter θ):

Corollary 2.3. *In the high costs case, total subsidy payments decrease in the administrative fixed costs,* $\frac{\partial S_{high}}{\partial f_s} < 0$. *However, total subsidy payments increase in the production*

[24] Explicit expressions for R_E, $\frac{\partial R_E}{\partial s}$, Π_E and Π_{NE} are given in Appendix 2.A.5.

fixed costs, $\frac{\partial S_{high}}{\partial f} > 0$ *and in firm heterogeneity (i.e., lower* θ*)* $\frac{\partial S_{high}}{\partial \theta} < 0$.
Proof. See Appendix 2.A.6. □

Higher administrative fixed costs lead to less firms that receive the subsidies, but the receiving firms are on average more productive. Facing a higher price index, these firms increase their sales and the subsidy payments per firm also increase. However, the negative effect on the extensive margin (less firms subsidized) is stronger, such that total subsidy payments decrease, $\frac{\partial S_{high}}{\partial f_s} < 0$. In contrast, higher production fixed costs increase total subsidy payments, $\frac{\partial S_{high}}{\partial f} > 0$. Due to the associated rise in the price index, more firms receive subsidies and these firms also increase their sales. An increase in the Pareto shape parameter leads to less firm heterogeneity (i.e., thinner tails of the Pareto distribution). Aggregate revenues of receiving firms decrease and total subsidy payments also decline, $\frac{\partial S_{high}}{\partial \theta} < 0$.

Using the expression of the price index in the high costs case (equation (2.24)), the derivative of consumer surplus with respect to s is

$$\frac{\partial CS_{high}}{\partial s} = \frac{R_E}{s}. \tag{2.28}$$

Note that R_E is not constant but converges to zero for $s \to 1$. Thus, the derivative of consumer welfare is no longer a convex and decreasing function in s.

2.4.2 Ex-ante welfare maximizing production subsidy

Consider the benchmark case where the government chooses the *ex-ante* welfare maximizing subsidy rate before firms enter the market and claim eligibility (i.e., taking firm entry behavior into account). Using the derivatives of consumer surplus and of total subsidy payments (equation (2.28) and equation (2.27)), the first-order condition for an interior welfare optimum is

$$\frac{\partial W_{high}}{\partial s} = \frac{\partial CS_{high}}{\partial s} - \frac{\partial S_{high}}{\partial s} = \frac{R_E}{s} - \frac{\sigma-1}{\sigma}R_E - (s-1)\frac{\sigma-1}{\sigma}\frac{\partial R_E}{\partial s} = 0. \tag{2.29}$$

If the third term of the first-order condition was zero, the markup compensating subsidy rate would be an interior optimum. Thus, the optimal subsidy rate crucially depends on the marginal effect on receiving firms' aggregate revenues $\frac{\partial R_E}{\partial s}$. To analyze the properties of the optimal subsidy rate, the first-order condition can be rewritten by using the elasticity of R_E with respect to s, $\epsilon_{R_E,s} = \frac{\partial R_E}{\partial s}\frac{s}{R_E} \geq 0$.[25] The interior optimum is then implicitly defined by

$$s^* = \frac{\frac{\sigma}{\sigma-1} + \epsilon_{R_E,s}}{1+\epsilon_{R_E,s}}. \tag{2.30}$$

Note that the right-hand side of this equation is also a function of s. Thus, an interior solution would be a fixed point that solves equation (2.30). From equation (2.30),

[25]Note that $\epsilon_{R_E,s}$ can be decomposed into an intensive margin and an extensive margin:

$$\epsilon_{R_E,s} = \underbrace{(\sigma-1)\left(1-\frac{R_E}{y}\right)}_{\text{intensive margin}} + \underbrace{(\theta-\sigma+1)\frac{R_E}{J_R y}\frac{f}{f_s}}_{\text{extensive margin}}.$$

two properties of the optimal subsidy rate are immediately apparent. First, the markup compensating subsidy rate, $s = \frac{\sigma}{\sigma-1}$, can be obtained only if $\epsilon_{R_E,s} = 0$. Second, it is never optimal to set the subsidy above the markup compensating level, because $\epsilon_{R_E,s} \geq 0$. In comparison to the low costs case, the marginal loss is relatively higher than the marginal gain from an increase in the subsidy rate, because of the additional third term in equation (2.29). Therefore, the optimal subsidy rate cannot be greater than the interior optimum of the low costs case, $s = \frac{\sigma}{\sigma-1}$. Thus, even though a higher subsidy rate would lead to additional subsidized varieties, it is never optimal to set the subsidy rate above the markup compensating level. A next step is to analyze whether an interior solution with $s \leq \frac{\sigma}{\sigma-1}$ exists. As the following Lemma shows, because $\epsilon_{R_E,s}$ is strictly increasing and unbounded in θ, there does not exist an interior solution.[26]

Proposition 2.3. *In the high costs case, for any $\theta > \sigma$, $s^* = 1$ maximizes ex-ante welfare.*

Proof. See Appendix 2.A.10. □

Proposition 2.3 is quite different from the corresponding welfare result in the low costs case (Proposition 2.1). Recall, in the low costs case there is always an interior solution, which for increasing administrative fixed costs is dominated by a corner solution at $s = 1$. In contrast, Proposition 2.3 states that in the high costs case, there does not even exist any interior solution. This is due to the fact that aggregate revenues of receiving firms increase in the subsidy rate, which increases the marginal loss in subsidy payments.

The welfare impact of an increase in the administrative fixed costs also differs from the low costs case. The following corollary can be stated:

Corollary 2.4. *In the high costs case, if θ is sufficiently high, welfare is increasing in the administrative fixed costs, $\frac{\partial W_{high}}{\partial f_s} > 0$.*

Proof. See Appendix 2.A.7. □

In comparison to the low costs case, an increase in the administrative fixed costs affects welfare through two channels. First, positively through decreasing total subsidy payments (Corollary 2.3). Second, negatively through a decline in consumer surplus, because the price index rises. However, the latter channel will be dampened through an effect on the extensive margin, because the product market cutoff decreases and more varieties are available. This positive variety effect will be more pronounced, the thinner the tails of the Pareto distribution (i.e., high θ). Thus, in contrast to the low costs case, welfare in the high costs case is not necessarily decreasing in the administrative fixed costs.

[26] From equation (2.30), it is apparent that an interior solution requires that for any value of s, $\epsilon_{R_E,s}$ is sufficiently low. Otherwise, the left-hand side of equation (2.30) would always be strictly larger than the right-hand side, which converges to 1 for $s \to 1$. Because $\epsilon_{R_E,s}$ is strictly increasing in θ, the elasticity can be so large that equation (2.30) does not hold at any interior point. Note that $\theta > \sigma$ is necessary for aggregate quantity to be well-defined.

The impact of an increase in the administrative fixed costs on receiving firms' individual profits differs with firm size and productivity. While all receiving firms suffer directly from increasing fixed costs, the largest and most efficient firms benefit indirectly from the associated increase in the price index. For these firms, the increase in variable profits overcompensates the loss from additional fixed costs.[27] Therefore, an interesting policy implication emerges: large receiving firms have an interest in increasing the administrative fixed costs, such that less efficient firms decide to be no longer subsidized.

Hence, the analysis of the high costs case delivers new insights into the sensitivity of the ex-ante optimal subsidy rate. If high administrative fixed costs induce only some active firms to claim eligibility for the subsidy, any subsidy reduces welfare. Therefore, an *ex-ante* welfare maximizing government should completely neglect the initial markup distortion. However, an increase of the subsidy is associated with a within-industry conflict between receiving and non-receiving firms. While general welfare is reduced by the introduction and an increase of a subsidy, large firms still gain. These results motivate the analysis of lobbying for the subsidy in the following section.

2.4.3 Lobbying in the high costs case

Equilibrium of the lobbying game in the high costs case. Consider a government that is influenced by lobbying and sets the optimal subsidy rate within the lobbying game (i.e., taking entry behavior of firms as given). Taking the mass of lobbying and active firms as given, the government chooses a subsidy rate that solves equation (2.16). Define $\tilde{\epsilon}_{R_E,s}$ as the elasticity of aggregate lobby revenues with respect to the subsidy rate, holding the mass of lobbying and active firms fixed. The following Lemma describes the optimal behavior of the government:

Lemma 2.4. *In the high costs case, the government implements* $s^o = \frac{\frac{\sigma}{\sigma-1}+\left(1+\frac{1}{\sigma-1}\frac{1}{\alpha}\right)\tilde{\epsilon}_{R_E,s}}{1+\tilde{\epsilon}_{R_E,s}}$ *in the lobbying game.*

Proof. See Appendix 2.A.11. □

The optimal choice of the subsidy rate depends crucially on the elasticity $\tilde{\epsilon}_{R_E,s}$. In Appendix 2.A.11, I show that this elasticity can be written as $\tilde{\epsilon}_{R_E,s} = (\sigma-1)\left(1-\frac{R_E}{y}\right)$. This expression shows very intuitively that $\tilde{\epsilon}_{R_E,s}$ is a decreasing function of the relative aggregated lobby revenues $\frac{R_E}{y}$ and that it is therefore also a decreasing function of the relative mass of lobbying firms J_R. If the relative mass of lobbying firms converges to one (i.e., $R_E \to y$), the positive effect on aggregate lobby revenues due to an increase in the subsidy rate is exactly compensated by the associated drop in the price index (i.e., the economy converges to the low costs case). Therefore, the elasticity $\tilde{\epsilon}_{R_E,s}$ converges to zero and the mark-up compensating subsidy rate is optimal. However, if the relative mass of lobbying firms converges to zero (i.e., $R_E \to 0$), the impact of the subsidy on the price index is negligible and the elasticity $\tilde{\epsilon}_{R_E,s}$ converges to $(\sigma-1)$. In this case,

[27] Variable profits are increasing in the price index, which is monotonically increasing in f_s. Therefore, there exists a productivity cutoff φ_{f_s}, defined by $\frac{\partial \pi_s(\varphi_{f_s})}{\partial f_s} = 0$, such that for all firms with $\varphi > \varphi_{f_s}$, the gain in variable profits dominates the (direct) loss from an increase in f_s.

the optimal subsidy is $s^o = \frac{\sigma}{\sigma-1} + \frac{1}{\sigma}\left(\frac{1-\alpha}{\alpha}\right)$. Therefore, we have established the following Corollary:

Corollary 2.5. *The optimal subsidy rate s^o lies above (below) the mark-up compensating rate $s = \frac{\sigma}{\sigma-1}$, if and only if $\alpha < 1$ ($\alpha > 1$).*

If the government puts less weight on general welfare than on lobby contributions, $\alpha < 1$, the optimal subsidy is greater than the mark-up compensating level. A government that does not put any weight on general welfare (i.e., $\alpha \to 0$) will choose the highest feasible subsidy rate it is able to finance, $s^o = \bar{s}$. If the government puts more weight on welfare than on lobby contributions, $\alpha > 1$, the subsidy will be below the mark-up compensating rate. For a government that maximizes only general welfare *within* the lobbying game, and that does not take the lobby contributions into account (i.e., $\alpha \to \infty$), we get:

$$\lim_{\alpha\to\infty} s^o = \frac{\frac{\sigma}{\sigma-1} + \tilde{\epsilon}_{R_E,s}}{1+\tilde{\epsilon}_{R_E,s}}. \tag{2.31}$$

With $\tilde{\epsilon}_{R_E,s} \in (0, \sigma-1)$, it follows from equation (2.31) that $\lim_{\alpha\to\infty} s^o \in \left(\frac{\sigma}{\sigma-1} - \frac{1}{\sigma}, \frac{\sigma}{\sigma-1}\right)$. Therefore, the subsidy that maximizes general welfare within the lobbying game lies strictly below the mark-up compensating rate and above the corner solution $s = 1$. The *ex-post* welfare maximizing subsidy rate within the lobbying game, defined by equation (2.31), differs considerably from the *ex-ante* welfare maximizing subsidy rate implied by equation (2.30). Once firms have paid the administrative fixed costs, it is no longer optimal to implement the corner solution as Lemma 2.3 would suggest for an ex-ante welfare maximizing government.

Denote φ^o and φ_L^o the equilibrium product market cutoff and lobby cutoff, respectively (i.e., equation (2.25) and equation (2.26) evaluated at s^o). Anticipating the optimal behavior of the lobby and the government, a firm with productivity φ decides to be an active producer only if $\varphi > \varphi^o$, and to join the lobby only if $\varphi > \varphi_L^o$. Let the function $h(s)$ denote the relative mass of lobby members as a function of the subsidy rate:

$$h(s) = J_R = \left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{-\frac{\theta}{\sigma-1}}. \tag{2.32}$$

Let $z(J_R)$ denote the subsidy rate set by the government as a function of the relative mass of lobby members:

$$z(J_R) = s = \frac{\frac{\sigma}{\sigma-1} + \left(1 + \frac{1}{\sigma-1}\frac{1}{\alpha}\right)\tilde{\epsilon}_{R_E,s}}{1+\tilde{\epsilon}_{R_E,s}}. \tag{2.33}$$

At an equilibrium of the lobbying game, $z(J_R)$ and $h(s)$ intersect in the (s, J_R) space. Figure 2.7 depicts the equilibrium graphically for the case $\alpha < 1$, and the following proposition shows that the equilibrium of the lobbying game is unique.

Proposition 2.4. *If $f_s > f(\left(\frac{\sigma}{\sigma-1}\right)^{\sigma-1} - 1)$ (high costs case), there exists a unique equilibrium of the lobbying game, such that*

1. *all firms with $\varphi > \varphi^o$ produce and all firms with $\varphi > \varphi_L^o$ enter the lobby,*

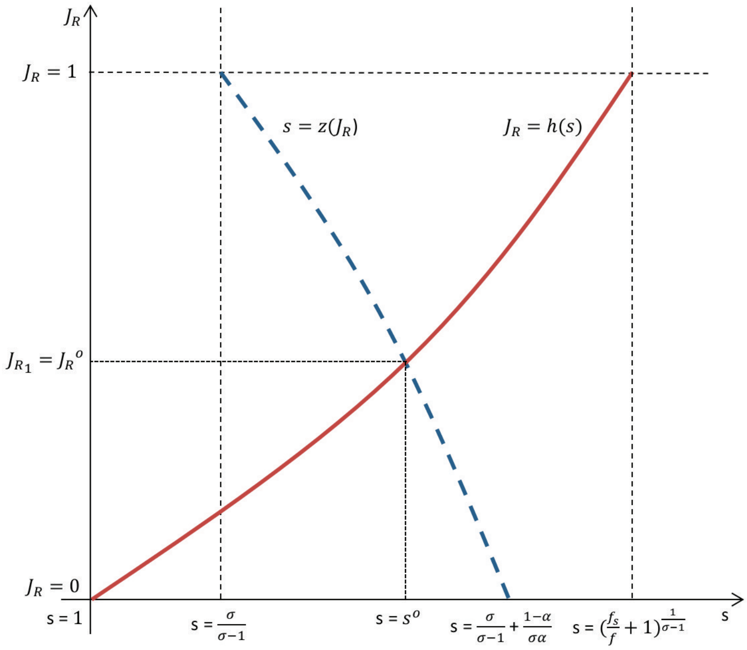


Figure 2.7: Lobbying equilibrium, high costs case ($\alpha < 1$)

2. *lobby contributions are* $C^T(s^o) = \alpha(y \ln(\frac{P_{s^o}}{P_{s^*}}) + S_{s^o} - S_{s^*})$,
3. *the government implements* $s^o = \frac{\frac{\sigma}{\sigma-1} + (1 + \frac{1}{\sigma-1}\frac{1}{\alpha})\tilde{\epsilon}_{R_E,s}}{1+\tilde{\epsilon}_{R_E,s}}$.

Proof. See Appendix 2.A.12. □

Comparative statics of the lobbying game.

Varying the welfare weight α. The relative number of lobbying firms J_R does not directly depend on α, only indirectly through a change in the subsidy rate. An increase in the welfare weight, however, shifts the $z(J_R)$ curve (equation (2.33)) to the left, such that for any given level of J_R the optimal subsidy rate declines. This leads to a lower equilibrium subsidy rate and therefore to a decline in the relative mass of lobbying firms. The following lemma summarizes the effects of an increase in α, while Figure 2.8 shows the result graphically for the case where $\alpha < 1$.

Lemma 2.5. *Increasing the welfare weight α decreases both the relative mass of lobbying firms and the optimal subsidy rate.*

Proof. See Appendix 2.A.13. □

Varying the administrative fixed costs f_s. Because the government moves after firms joined the lobby, a change in the fixed costs f_s does not have a direct effect on the optimal decision of the government $\frac{\partial z(J_R;f_s)}{\partial f_s} = 0$. However, there is an indirect effect on the subsidy rate via the relative mass of lobbying firms: $\frac{ds}{df_s} = \frac{\partial z(J_R;f_s)}{\partial J_R}\frac{\partial h(s;f_s)}{\partial f_s}$. The direct negative effect on the relative mass of lobbying firms is $\frac{\partial h(s;f_s)}{\partial f_s} = -\frac{\theta}{\sigma-1}\frac{J_R}{f_s} < 0$. Therefore, the $h(s; f_s)$ curve shifts downwards and only the sign of $\frac{\partial z(J_R;f_s)}{\partial J_R}$ determines the total equilibrium effect on the subsidy rate. The following Lemma summarizes the effects of an increase in the administrative fixed costs:

Lemma 2.6. *Increasing the administrative fixed costs f_s always decreases the relative*

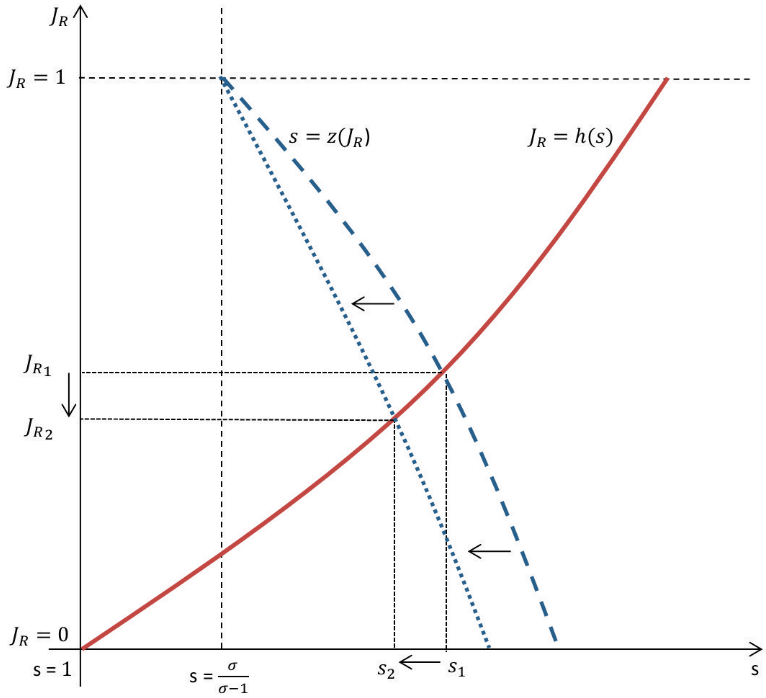


Figure 2.8: Comparative statics high costs case ($\alpha < 1$): increasing α

mass of lobbying firms, but increases the optimal subsidy rate if $\alpha < 1$ *and decreases the optimal subsidy rate if* $\alpha > 1$.

Proof. See Appendix 2.A.14. □

If the government puts a relatively low weight on general welfare, $\alpha < 1$, a decline in the relative number of lobbying firms leads to an increase in the subsidy rate. This effect is entirely due to the change in the relative number of lobbying firms. In this case, making lobbying harder by increasing the barriers to lobby, leads to less firms that lobby but to a higher subsidy rate. Figure 2.9 shows the result graphically for the case where $\alpha < 1$.

Varying firm heterogeneity θ. An increase in θ is associated with a thinner tail of the Pareto distribution and less firm heterogeneity. This has a direct negative effect on the relative mass of lobbying firms, shifting the $h(s)$ curve downwards. However, holding the (relative) mass of lobbying firms constant, less firm heterogeneity leads to a decline of average productivity and therefore to a decline in average revenues of lobbying firms. Therefore, $\tilde{\epsilon}_{R_E,s}$ increases even if the mass of lobbying firms is constant. This effect shifts the $z(J_R)$ curve to the right if $\alpha < 1$, and to the left if $\alpha > 1$. The following lemma summarizes the equilibrium effects of a decline in firm heterogeneity and Figure 2.10 shows the result graphically for the case where $\alpha < 1$.

Lemma 2.7. *If* $\alpha > 1$, *decreasing firm heterogeneity (i.e., increasing* θ*) decreases both the relative mass of lobbying firms and the optimal subsidy rate. However, if* $\alpha < 1$, *decreasing firm heterogeneity increases the optimal subsidy rate and has an ambiguous effect on the relative mass of lobbying firms.*

Proof. See Appendix 2.A.15 □

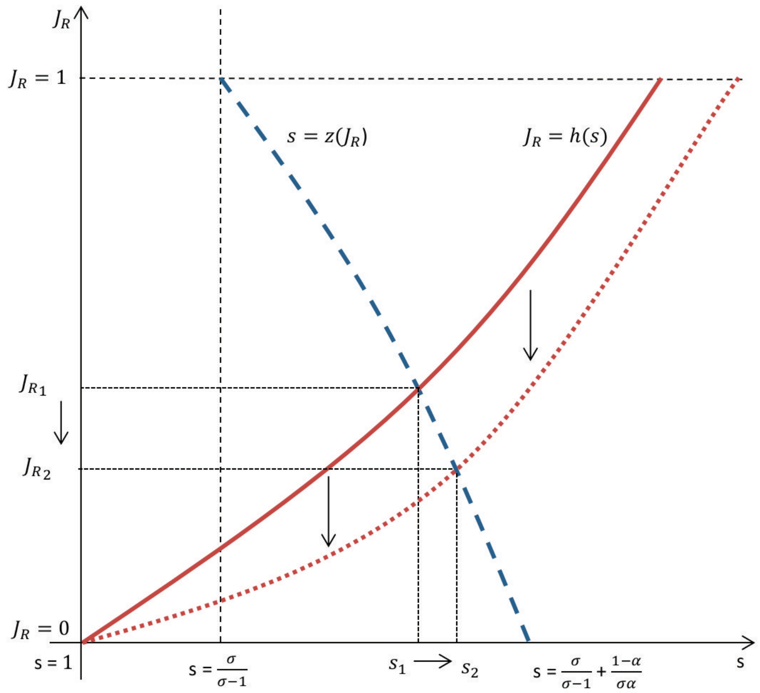


Figure 2.9: Comparative statics high costs case ($\alpha < 1$): increasing f_s

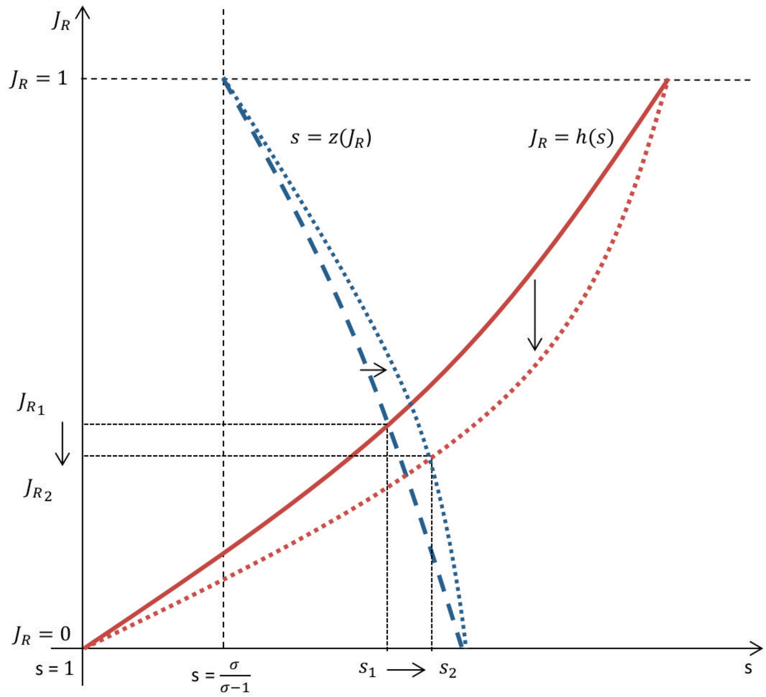


Figure 2.10: Comparative statics high costs case ($\alpha < 1$): increasing θ

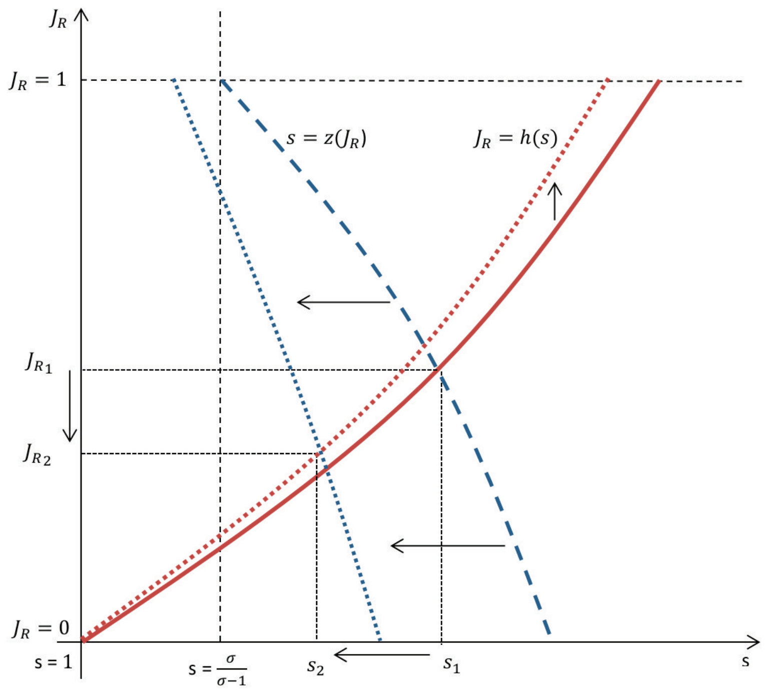


Figure 2.11: Comparative statics high costs case ($\alpha < 1$): increasing σ

Varying the elasticity of substitution σ. An increase in σ leads to more heterogeneity in the sales distribution, because high productive firms benefit more from a higher elasticity of substitution. Therefore, there will be relatively more firms in the lobby, such that the $h(s)$ curve shifts upwards. Considering the limits of the $z(J_R)$ function, we see that $\lim_{J_R \to 1} z(J_R) = \frac{\sigma}{\sigma-1}$ and $\lim_{J_R \to 0} z(J_R) = \frac{\sigma}{\sigma-1} + \frac{1}{\sigma}\frac{1-\alpha}{\alpha}$. Thus, the $z(J_R)$ curve shifts to the left. The following lemma summarizes the equilibrium effects of an increase in σ, while Figure 2.11 shows the result graphically for the case where $\alpha < 1$.

Lemma 2.8. *If $\alpha < 1$, increasing the elasticity of substitution σ decreases the optimal subsidy rate and has an ambiguous effect on the relative mass of lobbying firms.*

Proof. See Appendix 2.A.16. □

Simulation results. To visualize the comparative static results for various values of the welfare weight α, I simulate the model using MATLAB. In particular, I set the following parameter values: $\theta = 3$, $\sigma = 2.5$, $f_s = 2$, $f = 1$, $J = 1$, $b = 1$, $y = 1$. Figures 2.12, 2.13 and 2.14 show the impact of an increase in f_s , θ and σ respectively, on the optimal subsidy rate in the lobbying game and on the relative lobby size. In Figure 2.12, the relative lobby size is always decreasing in f_s, and the optimal subsidy rate increases in f_s if $\alpha < 1$ (Lemma 2.6). In Figure 2.13, both the subsidy and the relative lobby size decrease in θ if $\alpha > 1$. For $\alpha < 1$, the optimal subsidy rate increases in θ, while the relative lobby size either increases (e.g., $\alpha = 0.001$) or decreases (e.g., $\alpha = 0.5$) (Lemma 2.7). In Figure 2.14, the optimal subsidy rate decreases in σ, if $\alpha < 1$ but can increase if $\alpha > 1$ (e.g., $\alpha = 1000$) (Lemma 2.8).

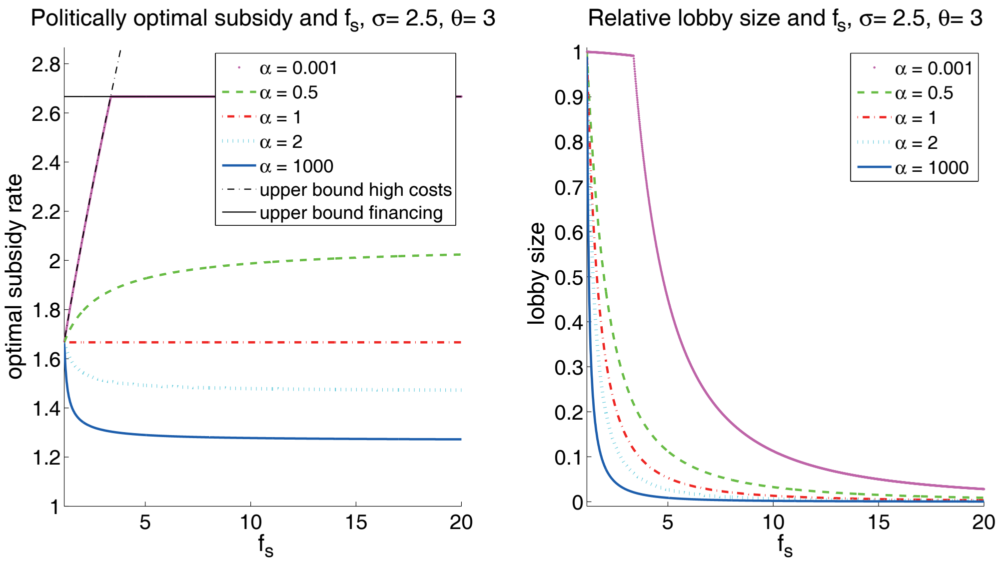


Figure 2.12: Simulated comparative statics high costs case: increasing f_s

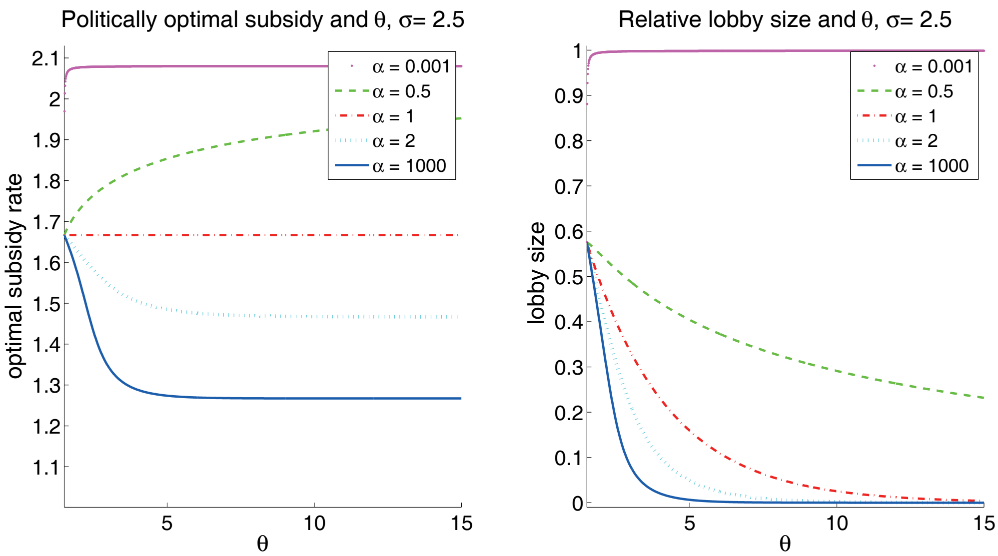


Figure 2.13: Simulated comparative statics high costs case: increasing θ

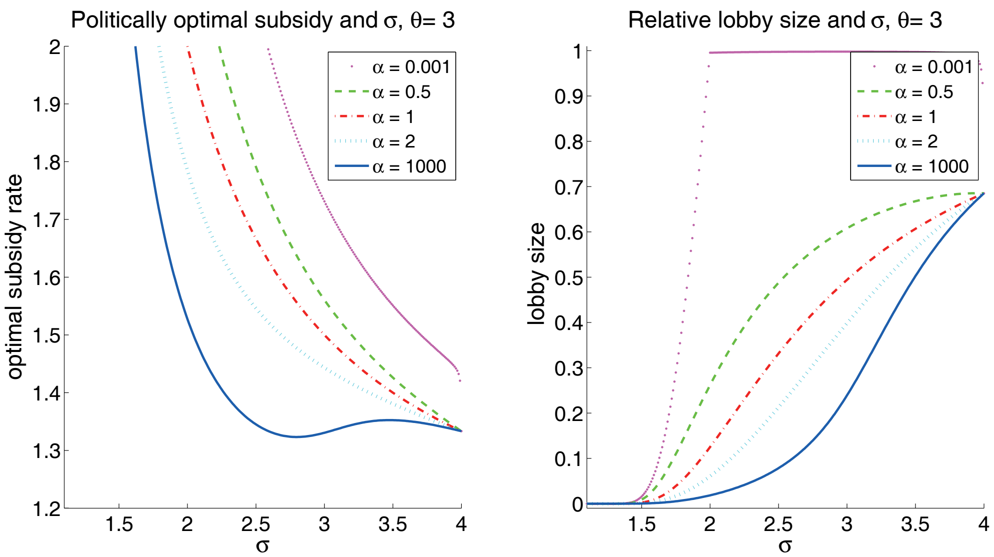


Figure 2.14: Simulated comparative statics high costs case: increasing σ

2.5 Conclusion

In this paper, heterogeneous firms have to bear administrative fixed costs to receive a production subsidy. The benefits from the subsidy increase with firm productivity, such that the set of receiving firms is endogenously determined. When receiving firms are allowed to lobby for a higher subsidy rate, this mechanism results in an endogenous set of lobbying firms.

In the model, the welfare impact of a production subsidy depends crucially on the level of the associated administrative fixed costs. If these costs are too high, a welfare maximizing government should neglect the mark-up distortion from monopolistic competition and it should not introduce a subsidy. Moreover, if the fixed costs to receive the subsidy are high, such that only the most efficient firms are subsidized, a rise in the subsidy harms small firms. This creates a distributional within-industry conflict across firms, which is the driving force behind lobbying in the model.

An increase in the barriers to lobby unambiguously reduces the size of the lobby. However, if the government values lobby contributions highly, increasing the barriers to lobby or less firm heterogeneity increases the equilibrium subsidy rate. These results stand in contrast to conventional wisdom that lobby power and lobby size are positively related.

This is the first paper, to the best of my knowledge, that makes explicit use of heterogeneity in firm productivity to endogenize lobby formation. However, this paper goes beyond a pure technical contribution in an important class of economic models. Given the importance of within-industry reallocation, highlighted in the heterogeneous firm literature of international trade, this paper shows that the within-industry impact of firm-specific government policies should no longer be ignored. While the paper takes a first step in explaining within-industry variation in firm eligibility and lobbying theoretically, further research – in particular on the empirical side – will be necessary for a better understanding of the within-industry effects of firm-specific policy instruments.

Appendix

2.A Proofs and explicit expressions

2.A.1 Proof of Corollary 2.1

Corollary. *Under truthful contribution schedules, the equilibrium subsidy satisfies*

$$s^o = \arg\max_{s\in[1,\bar{s}]} \{\alpha W(s) + \Pi_E(s)\}.$$

Proof. The proof is similar to the one in Grossman and Helpman (1994)(p. 840, footnote 7). By condition 3 of Definition 2.1 we have

$$G^o = \alpha W(s^o) + C(s^o) \geq G = \alpha W(s) + C(s)\, \forall s \in [1, \bar{s}].$$

By truthfulness, we have

$$C^T(s^o) = \Pi_E(s^o) - B_L^o$$

and

$$C^T(s) \geq \Pi_E(s) - B_L^o\, \forall s \in [1, \bar{s}].$$

Therefore,

$$\alpha W(s^o) + \Pi_E(s^o) - B_L^o \geq \alpha W(s) + C^T(s) \geq \alpha W(s) + \Pi_E(s) - B_L^o.$$

Hence,

$$\alpha W(s^o) + \Pi_E(s^o) \geq \alpha W(s) + \Pi_E(s)\, \forall s \in [1, \bar{s}].$$

□

2.A.2 Proof of Lemma 2.1

Lemma. *In the low costs case with a given subsidy rate s, there is a unique eligibility and product market cutoff $\varphi^*_{L,low}$ and*

1. *the price index lies below the baseline value, $P_{s,low} < P_{base}$;*
2. *$\varphi^*_{L,low}$ lies above the baseline value, $\varphi^*_{L,low} > \varphi^*_{base}$;*
3. *$\varphi^*_{L,low}$ is invariant to a change in the subsidy rate, but a rise in f_s, in f, in σ or in firm heterogeneity leads to an increase of $\varphi^*_{L,low}$ and to a decline of $J_A = J_L$.*

Proof. Here, I only show that $\frac{\partial \varphi^*_{L,low}}{\partial \theta} < 0$, $\frac{\partial J_A}{\partial \theta} = \frac{\partial J_L}{\partial \theta} > 0$ and $\frac{\partial \varphi^*_{L,low}}{\partial \sigma} > 0$. With

$$J_L = J_A = J\left(\frac{\varphi^*_{L,low}}{b}\right)^{-\theta} = (1 - \frac{\sigma-1}{\theta})\frac{y}{\sigma}\left(f + f_s\right)^{-1}$$

we get $\frac{\partial J_L}{\partial \theta} = (\frac{\sigma-1}{\theta^2})\left(\frac{\sigma}{y}\left[f + f_s\right]\right)^{-1} > 0$. However, the derivative can also be written as

$$\frac{\partial J_L}{\partial \theta} = -J_L\left(\ln\left(\frac{\varphi^*_{L,low}}{b}\right) + \theta\frac{\partial \ln\left(\varphi^*_{L,low}\right)}{\partial \theta}\right) > 0.$$

For $\frac{\partial J_L}{\partial \theta} > 0$ it is necessary that $\frac{\partial \ln\left(\varphi^*_{L,low}\right)}{\partial \theta} < 0$. Therefore, $\frac{\partial \varphi^*_{L,low}}{\partial \theta} < 0$. Take the derivative of the productivity cutoff to get:

$$\frac{\partial \varphi^*_{L,low}}{\partial \sigma}\frac{\sigma}{\varphi^*_{L,low}} = \frac{1}{\theta}\left(\frac{\theta+1}{\theta+1-\sigma}\right) > 0.$$

□

2.A.3 Proof of Proposition 2.1

Proposition. *In the low costs case, if $f_s < f\left(\exp\left[\frac{\ln(\frac{\sigma}{\sigma-1}) - \frac{1}{\sigma}}{\frac{1}{\theta}\frac{\theta-\sigma+1}{\sigma-1}}\right] - 1\right)$, $s^* = \frac{\sigma}{\sigma-1}$ is the unique interior solution maximizing ex-ante welfare. Otherwise $s^* = 1$ maximizes welfare.*

Proof. The first part of the proposition has already been shown in the paper. For the second part, consider the difference between welfare in the low costs case and in the baseline case at any s:

$$W_{low} - W_{base} = y\ln(s) - (s-1)\frac{\sigma-1}{\sigma}y - \frac{y}{\theta}\frac{\theta-\sigma+1}{\sigma-1}\ln\left(\frac{f+f_s}{f}\right). \tag{2.34}$$

Note that the first term reflects the positive effect of the subsidy on consumer surplus (all varieties are cheaper). The second term are total subsidy payments and therefore the direct costs that the government has to pay for the subsidy. The third term reflects the novel distortion due to administrative fixed costs. For $f_s = 0$ only the first two terms would remain. At the interior optimum, $s^* = \frac{\sigma}{\sigma-1}$, equation (2.34) can be rewritten to

$$W_{low} - W_{base} = y\ln(\frac{\sigma}{\sigma-1}) - \frac{y}{\sigma} - \frac{y}{\theta}\frac{\theta-\sigma+1}{\sigma-1}\ln\left(\frac{f+f_s}{f}\right).$$

Then, with $(\sigma-1)\ln\left(\frac{\sigma}{\sigma-1}\right) < 1$, in the two limits of the low costs case, we get respectively,

$$\lim_{f_s \to f\left(\left(\frac{\sigma}{\sigma-1}\right)^{\sigma-1}-1\right)} W_{low} - W_{base} = \frac{\sigma-1}{\theta}y\ln\left(\frac{\sigma}{\sigma-1}\right) - \frac{y}{\sigma} < 0$$

and

$$\lim_{f_s\to 0} W_{low} - W_{base} = y\ln\left(\frac{\sigma}{\sigma-1}\right) - \frac{y}{\sigma} > 0.$$

Therefore, by monotonicity and continuity of $W_{low} - W_{base}$ in f_s, there is a level of fixed costs, $f_s^* \in (0, f(s^{\sigma-1}-1))$, such that $W_{low} - W_{base} = 0$ at $s^* = \frac{\sigma}{\sigma-1}$. By using equation (2.34) we get for any s:

$$W_{low} - W_{base} = y\ln(s) - (s-1)\frac{\sigma-1}{\sigma}y - \frac{y}{\theta}\frac{\theta-\sigma+1}{\sigma-1}\ln\left(\frac{f+f_s}{f}\right) = 0$$

$$\iff f_s^* = f\left(\exp\left[\frac{y\ln(s) - (s-1)\frac{\sigma-1}{\sigma}y}{\frac{y}{\theta}\frac{\theta-\sigma+1}{\sigma-1}}\right] - 1\right).$$

Evaluated at $s^* = \frac{\sigma}{\sigma-1}$, we get

$$f_s^* = f\left(\exp\left[\frac{y\ln(\frac{\sigma}{\sigma-1}) - \frac{y}{\sigma}}{\frac{y}{\theta}\frac{\theta-\sigma+1}{\sigma-1}}\right] - 1\right).$$

For f_s^*, welfare of the baseline case and the interior welfare optimum of the low costs case are equal. By strict monotonicity of W_{low} with respect to f_s (Corollary 2.2), it follows that for lower values of f_s, the interior welfare optimum of the low costs case is above the baseline value of welfare, and vice versa for greater values of f_s. Thus, only for low values of f_s, the interior optimal subsidy, $s^* = \frac{\sigma}{\sigma-1}$, is welfare improving. For high values, this is not longer true. Note that in the low costs case, there are always values of f_s such that $f_s^* < f_s < f(s^{\sigma-1}-1)$. This is, f_s^* lies never above the value of administrative fixed costs that defines the low costs case. To see this more explicitly, by using the derived expression, $f_s^* < f(s^{\sigma-1}-1)$ can be rewritten to $\frac{\theta}{\sigma} > \frac{\ln(s)}{(s-1)}$. With $\frac{\theta}{\sigma} > 1$ and $\frac{1}{1-s}\ln(s) < 1$, this inequality is always fulfilled. □

2.A.4 Proof of Corollary 2.2

In the low costs case, the derivative of welfare with respect to the administrative fixed costs is always negative and given by

$$\frac{\partial W_{low}}{\partial f_s} = -\frac{\theta-\sigma+1}{\theta(\sigma-1)}\frac{y}{f+f_s} < 0.$$

2.A.5 Explicit expressions for Section 2.4

With $R_E = J\int_{\varphi_L^*} r_s(\varphi)v(\varphi)d\varphi$, aggregate revenues of all receiving firms can be rewritten in terms of the model parameters

$$R_E = \frac{y}{1-s^{1-\sigma}}[\left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{\frac{\theta}{\sigma-1}}\frac{f}{f_s}+1]^{-1}, \tag{2.35}$$

R_E is increasing in s and its derivative with respect to s is

$$\frac{\partial R_E}{\partial s} = R_E\frac{s^{-1}}{s^{\sigma-1}-1}\left[(1-\sigma)+\theta\frac{R_E}{y}\left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{\frac{\theta-\sigma+1}{\sigma-1}}\right] > 0.$$

Using the expressions for φ_L^*, φ^* and $P_{s,high}$, aggregate profits of non-receiving and receiving firms are respectively,

$$\Pi_{NE} \quad = \frac{y}{\sigma}\frac{\theta-\sigma+1}{\theta} \quad \frac{\left[\frac{\sigma-1}{\theta-\sigma+1}\left(\frac{f}{f_s}\right)^{\frac{\sigma-\theta-1}{\sigma-1}}(s^{\sigma-1}-1)^{-\frac{\theta}{\sigma-1}} - \frac{\theta}{\theta-\sigma+1}\left(s^{\sigma-1}-1\right)^{-1}+\frac{f}{f_s}\right]}{[(s^{\sigma-1}-1)^{-\frac{\theta}{\sigma-1}}\left(\frac{f}{f_s}\right)^{\frac{\sigma-\theta-1}{\sigma-1}}+1]}$$

and

$$\Pi_E = \frac{y}{\sigma}\frac{\theta-\sigma+1}{\theta}\frac{\left[\frac{1}{1-s^{1-\sigma}}\frac{\theta}{\theta-\sigma+1}-\frac{f+f_s}{f_s}\right]}{[(s^{\sigma-1}-1)^{-\frac{\theta}{\sigma-1}}\left(\frac{f}{f_s}\right)^{\frac{\sigma-\theta-1}{\sigma-1}}+1]}.$$

The sum of both equations is simply $\Pi = \frac{\sigma-1}{\sigma}\frac{y}{\theta}$.

With $\left(\frac{f_s}{f(s^{\sigma-1}-1)}\right) > 1$ and $\frac{\theta-\sigma+1}{\sigma-1} > 0$, the absolute value of the elasticity of the price index with respect to s is less than 1:

$$\left|\epsilon_{P_{s,high}}\right| = \frac{s^{\sigma-1}}{s^{\sigma-1}-1}\left[\left(s^{\sigma-1}-1\right)^{-\frac{\theta}{\sigma-1}}\left(\frac{f_s}{f}\right)^{\frac{\theta-\sigma+1}{\sigma-1}}+1\right]^{-1} < 1.$$

Intuitively, if only a subset of firms is subsidized, the price index becomes less sensitive to a change in the subsidy rate. Note that in the limit where all active firms are subsidized, the elasticity converges to 1.

2.A.6 Proof of Corollary 2.3

Corollary. *In the high costs case, total subsidy payments decrease in the administrative fixed costs,* $\frac{\partial S_{high}}{\partial f_s} < 0$*. However, total subsidy payments increase in the production fixed costs,* $\frac{\partial S_{high}}{\partial f} > 0$ *and in firm heterogeneity (i.e., lower θ)* $\frac{\partial S_{high}}{\partial \theta} < 0$.

Proof. Using R_E, S_{high} can be expressed in terms of the model parameters:

$$S_{high} = (s-1)\frac{\sigma-1}{\sigma}y\frac{1}{1-s^{1-\sigma}}[\left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{\frac{\theta}{\sigma-1}}\frac{f}{f_s}+1]^{-1}.$$

Therefore, $\frac{\partial S_{high}}{\partial \theta} < 0$. The derivatives with respect to f_s and f are

$$\frac{\partial S_{high}}{\partial f_s} = -\frac{\theta-\sigma+1}{\sigma}[\left(\frac{f_s}{f}\right)^{-\frac{\theta-\sigma+1}{\sigma-1}}(s^{\sigma-1}-1)^{\frac{\theta}{\sigma-1}}+1]^{-1}\frac{S_{high}}{f_s} < 0$$

and

$$\frac{\partial S_{high}}{\partial f} = -\frac{\theta-\sigma+1}{\sigma}[\left(\frac{f_s}{f}\right)^{-\frac{\theta-\sigma+1}{\sigma-1}}(s^{\sigma-1}-1)^{\frac{\theta}{\sigma-1}}+1]^{-1}\frac{S_{high}}{f} > 0.$$

□

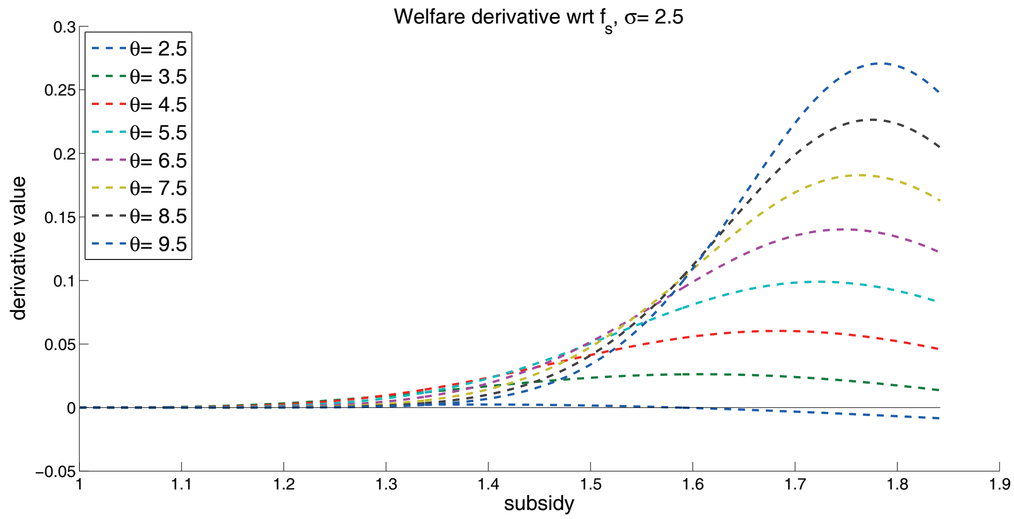


Figure 2.15: $\frac{\partial W_{high}}{\partial f_s}$ evaluated at different values of the Pareto shape parameter θ

2.A.7 Proof of Corollary 2.4

Corollary. *In the high costs case, if θ is sufficiently high, welfare is increasing in the administrative fixed costs, $\frac{\partial W_{high}}{\partial f_s} > 0$.*

Proof. Note that $\frac{\partial W_{high}}{\partial f_s} = \frac{\partial CS_{high}}{\partial f_s} - \frac{\partial S_{high}}{\partial f_s}$. Taking the derivative of CS_{high} gives

$$\frac{\partial CS_{high}}{\partial f_s} = \frac{y}{\theta}\frac{\sigma-\theta-1}{\sigma-1}\frac{(s^{\sigma-1}-1)^{\frac{\theta}{\sigma-1}}\, f_s^{\frac{\sigma-\theta-1}{\sigma-1}-1}}{f^{\frac{\sigma-\theta-1}{\sigma-1}} + (s^{\sigma-1}-1)^{\frac{\theta}{\sigma-1}}\, f_s^{\frac{\sigma-\theta-1}{\sigma-1}}}.$$

Taking the derivative of S_{high} gives

$$\frac{\partial S_{high}}{\partial f_s} = -(s-1)\frac{\sigma-1}{\sigma}\frac{\theta-\sigma+1}{\sigma-1}(s^{\sigma-1}-1)^{-\frac{\theta}{\sigma-1}}\left(\frac{f_s}{f}\right)^{\frac{\theta-\sigma+1}{\sigma-1}-1} R_E[(s^{\sigma-1}-1)^{-\frac{\theta}{\sigma-1}}\left(\frac{f_s}{f}\right)^{\frac{\theta-\sigma+1}{\sigma-1}}+1]^{-1}.$$

Therefore,

$$\begin{aligned}\frac{\partial W_{high}}{\partial f_s} &= \left[(s^{\sigma-1}-1)^{-\frac{\theta}{\sigma-1}}\left(\frac{f_s}{f}\right)^{\frac{\theta-\sigma+1}{\sigma-1}}+1\right]^{-1}\frac{\theta-\sigma+1}{\sigma-1}f_s^{-1}\\ &\quad\left[(s-1)\frac{\sigma-1}{\sigma}R_E(s^{\sigma-1}-1)^{-\frac{\theta}{\sigma-1}}\left(\frac{f_s}{f}\right)^{\frac{\theta-\sigma+1}{\sigma-1}}f-\frac{y}{\theta}\right].\end{aligned}$$

Thus $\frac{\partial W_{high}}{\partial f_s} > 0$ only if

$$(s-1)\frac{\sigma-1}{\sigma}\frac{s^{\sigma-1}}{s^{\sigma-1}-1}f[\left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{-\frac{\theta}{\sigma-1}}\frac{f_s}{f}+1]^{-1} > \frac{1}{\theta}.$$

The right-hand side of this inequality is strictly decreasing in θ, while the left-hand side is strictly increasing in θ. Therefore, it exists a unique θ above which the derivative of welfare with respect to f_s is positive. In Figure 2.15, $\frac{\partial W_{high}}{\partial f_s}$ is plotted against the subsidy rate, for varying values of θ. While the derivative could be negative for small values of θ (close to σ), for sufficiently high values of θ, an increase in the administrative fixed costs has a positive welfare effect. □

2.A.8 Proof of Lemma 2.2

Lemma. *In the high costs case with a given subsidy rate s, there is both a product market cutoff φ^* and a eligibility cutoff φ_L^* and*

1. *the price index lies below the baseline value $P_{s,high} < P_{base}$;*

2. *φ^* lies above the baseline value $\varphi^* > \varphi^*_{base}$;*
3. *a rise in s or f, or a decline in f_s increases φ^* and J_L but decreases φ^*_L and J_A;*
4. *a rise in firm heterogeneity increases both φ^* and φ^*_L.*

Proof. Here, I show statement 3 and 4. In the high costs case, with $\kappa = \left(J\frac{\theta b^\theta}{\theta-\sigma+1}\frac{\sigma}{y}\right)^{\frac{1}{\theta}}$, the derivatives of the cutoffs with respect to f_s and s are given by:

$$\frac{\partial \varphi^*_L}{\partial f_s} = \frac{\kappa}{\theta}[\left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{\frac{\theta}{\sigma-1}} f + f_s]^{\frac{1-\theta}{\theta}}(\frac{\theta}{\sigma-1}\left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{\frac{\theta}{\sigma-1}}\frac{f}{f_s}+1) > 0,$$
$$\frac{\partial \varphi^*}{\partial f_s} = -\frac{\kappa}{\theta}[f + \left(\frac{f_s}{(s^{\sigma-1}-1)f}\right)^{-\frac{\theta}{\sigma-1}} f_s]^{\frac{1-\theta}{\theta}}\frac{\theta-\sigma+1}{\sigma-1}\left(\frac{f_s}{(s^{\sigma-1}-1)f}\right)^{-\frac{\theta}{\sigma-1}} < 0,$$
$$\frac{\partial \varphi^*_L}{\partial s} = -\left(\varphi^*_L\right)^{1-\theta}\left(\frac{1}{f(s^{\sigma-1}-1)}\right)^{\frac{\theta+\sigma-1}{\sigma-1}}(f_s)^{\frac{\theta}{\sigma-1}} s^{\sigma-2} < 0,$$

and

$$\frac{\partial \varphi^*}{\partial s} = \kappa[f + \left(\frac{(s^{\sigma-1}-1)f}{f_s}\right)^{\frac{\theta}{\sigma-1}} f_s]^{\frac{1}{\theta}-1} s^{\sigma-2}(s^{\sigma-1}-1)^{\frac{\theta-\sigma+1}{\sigma-1}} f^{\frac{\theta}{\sigma-1}} f_s^{\frac{\sigma-1-\theta}{\sigma-1}} > 0.$$

Note that $\frac{\partial J_A}{\partial \theta} = -J_A\left(\ln\left(\frac{\varphi^*}{b}\right) + \theta\frac{\partial \ln(\varphi^*)}{\partial\theta}\right) > 0$ requires $\frac{\partial \varphi^*}{\partial\theta} < 0$ and therefore $\frac{\partial \varphi^*_L}{\partial\theta} = \frac{\partial \varphi^*}{\partial\theta}\left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{\frac{1}{\sigma-1}} < 0.$ □

2.A.9 Proof of Lemma 2.3

Lemma. *A rise in firm heterogeneity decreases J_A and increases J_R. If the subsidy rate is sufficiently high, there is a hump-shaped relationship between firm heterogeneity and J_L.*

Proof. The derivative of J_L with respect to θ is

$$\frac{\partial J_L}{\partial\theta} = -J_L\left[\underbrace{\theta\frac{\partial \ln(\varphi^*_L)}{\partial\theta}}_{<0} + \underbrace{\ln(\frac{\varphi^*_L}{b})}_{>0}\right]. \tag{2.36}$$

Therefore, $\frac{\partial J_L}{\partial\theta} \le 0$ iff $\theta\frac{\partial \ln(\varphi^*_L)}{\partial\theta} + \ln(\frac{\varphi^*_L}{b}) \ge 0$. In equation (2.36) the first term in brackets is due to the decline in the lobby cutoff and the second term is due to the change in the density. For $\ln(\frac{\varphi^*_L}{b})$ we get

$$\ln(\frac{\varphi^*_L}{b}) = \frac{1}{\theta}\ln\left(J\frac{\sigma}{y}\right) + \frac{1}{\theta}\ln\left(\frac{1}{1-\frac{\sigma-1}{\theta}}\right) + \frac{1}{\theta}\ln[\exp\left[\frac{\theta}{\sigma-1}\ln\left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)\right] f + f_s] \tag{2.37}$$

Therefore,

$$\theta\frac{\partial \ln(\varphi^*_L)}{\partial\theta} = -\frac{1}{\theta}\ln\left(J\frac{\sigma}{y}\frac{1}{1-\frac{\sigma-1}{\theta}}\right) - \frac{1}{\theta}\frac{\frac{\sigma-1}{\theta}}{\theta-\sigma+1} - \frac{1}{\theta}\ln[\left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{\frac{\theta}{\sigma-1}} f + f_s]$$
$$+\frac{\left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{\frac{\theta}{\sigma-1}} f}{\left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{\frac{\theta}{\sigma-1}} f + f_s}[\frac{1}{\sigma-1}\ln\left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)]. \tag{2.38}$$

Combining equations (2.38) and equation (2.37) we can rewrite $\theta\frac{\partial \ln(\varphi^*_L)}{\partial\theta} + \ln(\frac{\varphi^*_L}{b}) \ge 0$ as

$$\ln\left(\frac{f_s}{f(s^{\sigma-1}-1)}\right) \ge \left[\left(\frac{\sigma-1}{\theta}\right)^2\frac{1}{\theta-\sigma+1}\right]\left(1 + \left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{-\frac{\theta}{\sigma-1}}\frac{f_s}{f}\right). \tag{2.39}$$

Note that the left-hand side of inequality (2.39) is strictly decreasing in s but independent of θ, while the right-hand side is strictly increasing in s but decreasing in θ. Therefore, $\forall s \in (1, \left(\frac{f_s}{f}+1\right)^{\frac{1}{\sigma-1}})$, $\frac{\partial J_L}{\partial \theta} < 0$ if θ is sufficiently high.

For any $s \in (1, \left(\frac{f_s}{f}+1\right)^{\frac{1}{\sigma-1}})$, if $\theta \to \sigma$ the right-hand side of equation (2.39) converges to its maximum. Define $\tilde{s} \in (1, \left(\frac{f_s}{f}+1\right)^{\frac{1}{\sigma-1}})$ as the subsidy rate such that in the limit where $\theta \to \sigma$, equation (2.39) holds with equality:

$$\ln\left(\frac{f_s}{f(\tilde{s}^{\sigma-1}-1)}\right) = \left[\left(1-\frac{1}{\sigma}\right)^2\right]\left(1+\left(\frac{f_s}{f(\tilde{s}^{\sigma-1}-1)}\right)^{-\frac{\sigma}{\sigma-1}}\frac{f_s}{f}\right).$$

Given the model restriction $\theta > \sigma$, for any $s \leq \tilde{s}$ it is always the case that $\frac{\partial J_L}{\partial \theta} \leq 0$ (i.e., inequality (2.39) holds). Therefore, it is a necessary condition for $\frac{\partial J_L}{\partial \theta} > 0$ that $s \in (\tilde{s}, \left(\frac{f_s}{f}+1\right)^{\frac{1}{\sigma-1}})$. However, by the definition of $\tilde{s}$, for any $s \in (\tilde{s}, \left(\frac{f_s}{f}+1\right)^{\frac{1}{\sigma-1}})$ there exists always a value of θ sufficiently close to σ such that $\frac{\partial J_L}{\partial \theta} > 0$ (i.e., inequality (2.39) does not hold). □

2.A.10 Proof of Proposition 2.3

Proposition. *In the high costs case, for any $\theta > \sigma$, $s^* = 1$ maximizes ex-ante welfare.*

Proof. Consider the first-order condition:

$$\begin{aligned}\frac{\partial W_{high}}{\partial s} &= \frac{\partial CS_{high}}{\partial s} - \frac{\partial S_{high}}{\partial s} = 0 \qquad (2.40)\\ &= \frac{R_E}{s} - \frac{\sigma-1}{\sigma}R_E - (s-1)\frac{\sigma-1}{\sigma}\frac{\partial R_E}{\partial s} = 0,\end{aligned}$$

where $R_E = y\frac{1}{1-s^{1-\sigma}}[\left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{\frac{\theta}{\sigma-1}}\frac{f}{f_s}+1]^{-1}$. Rewrite the first-order condition and define

$$FOC := 1 - \frac{\sigma-1}{\sigma}s - (s-1)\frac{\sigma-1}{\sigma}\epsilon_{R_E,s} = 0, \qquad (2.41)$$

where $\epsilon_{R_E,s} = \frac{1}{s^{\sigma-1}-1}\left[(1-\sigma) + \theta s^{\sigma-1}[\left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{-\frac{\theta}{\sigma-1}}\frac{f_s}{f}+1]^{-1}\right]$.

From equation (2.41) and with $\epsilon_{R_E,s} \geq 0$, it is immediately apparent that any $s > \frac{\sigma}{\sigma-1}$ can never be a solution to the first-order condition. Moreover, because with $\frac{f_s}{f(s^{\sigma-1}-1)} > 1$, $\epsilon_{R_E,s}$ is strictly increasing, continuous and unbounded in θ, for any $s \in (1, \frac{\sigma}{\sigma-1}]$, there will always exist a value of θ that implements s as a solution of the first-order condition. However, by the same argument, for sufficiently high values of θ the first-order condition will no longer be fulfilled at any interior point. I will now clarify this last point, by showing that for $\theta > \sigma$, $FOC < 0 \,\forall s \in (1, \frac{\sigma}{\sigma-1}]$.

Rewrite the first-order condition to:

$$\frac{1}{s} - \frac{\sigma-1}{\sigma} - \frac{\sigma-1}{\sigma}\left[\frac{\left(\frac{s-1}{s}\right)}{s^{\sigma-1}-1}(1-\sigma) + \theta\frac{\left(\frac{s-1}{s}\right)}{s^{\sigma-1}-1}s^{\sigma-1}[\left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{-\frac{\theta}{\sigma-1}}\frac{f_s}{f}+1]^{-1}\right] = 0.$$

Then, $FOC < 0$ if:

$$\frac{1}{s} < \frac{\sigma-1}{\sigma} + \frac{\sigma-1}{\sigma}\left[\frac{\left(\frac{s-1}{s}\right)}{s^{\sigma-1}-1}(1-\sigma) + \theta\frac{\left(\frac{s-1}{s}\right)}{s^{\sigma-1}-1}s^{\sigma-1}[\left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{-\frac{\theta}{\sigma-1}}\frac{f_s}{f}+1]^{-1}\right]. \qquad (2.42)$$

That inequality (2.42) holds, is not immediately apparent. Therefore, I will now construct an auxiliary line that lies weakly above the left-hand side of inequality (2.42). Then, I will show that the right-hand side of inequality (2.42) lies strictly above this line.

Evaluating the left-hand side of this inequality (equation (2.42)), we see that at $s = 1$ the left-hand side is $\frac{1}{s} = 1$ and at $s = \frac{\sigma}{\sigma-1}$ the left-hand side is $\frac{1}{s} = \frac{\sigma-1}{\sigma}$. A line through the points $(1, 1)$ and $(\frac{\sigma}{\sigma-1}, \frac{\sigma-1}{\sigma})$ is defined by

$$\mathsf{l}(s) = 1 - (s-1)\frac{\sigma-1}{\sigma}.$$

Then, it follows that:

$$\frac{1}{s} \leq 1 - (s-1)\frac{\sigma-1}{\sigma},$$

with equality only at $s = 1$ and $s = \frac{\sigma}{\sigma-1}$, because $\frac{1}{s}$ is a convex function.

Therefore for inequality (2.42) to hold, it is sufficient to show that

$$1 - (s-1)\frac{\sigma-1}{\sigma} \quad <$$

$$\frac{\sigma-1}{\sigma} + \frac{\sigma-1}{\sigma}\left[\frac{(\frac{s-1}{s})}{s^{\sigma-1}-1}(1-\sigma) + \theta\frac{(\frac{s-1}{s})}{s^{\sigma-1}-1}s^{\sigma-1}[\left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{-\frac{\theta}{\sigma-1}}\frac{f_s}{f}+1]^{-1}\right]$$

$$\iff \frac{\sigma}{\sigma-1} - s < \frac{(\frac{s-1}{s})}{s^{\sigma-1}-1}(1-\sigma) + \theta\frac{(\frac{s-1}{s})}{s^{\sigma-1}-1}s^{\sigma-1}[\left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{-\frac{\theta}{\sigma-1}}\frac{f_s}{f}+1]^{-1}$$

$$\iff \frac{\sigma}{\sigma-1} - s < \frac{(\frac{s-1}{s})}{s^{\sigma-1}-1}\left[(1-\sigma) + \theta s^{\sigma-1}[\left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{-\frac{\theta}{\sigma-1}}\frac{f_s}{f}+1]^{-1}\right]. \quad (2.43)$$

At $s = \frac{\sigma}{\sigma-1}$, inequality (2.43) always holds, because the left-hand side is 0 and the right-hand side is strictly positive. Taking the limit for $s \to 1$ of both sides of inequality (2.43) we get

$$\lim_{s\to 1}\frac{\sigma}{\sigma-1} - s = \frac{1}{\sigma-1} \leq \quad (2.44)$$

$$-1 + \frac{\theta}{\sigma-1} = \lim_{s\to 1}(\frac{s-1}{s})\frac{1}{s^{\sigma-1}-1}\left[(1-\sigma) + \theta s^{\sigma-1}[\left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{-\frac{\theta}{\sigma-1}}\frac{f_s}{f}+1]^{-1}\right].$$

Inequality (2.44) holds strictly only for $\theta > \sigma$. For $\theta = \sigma$ inequality (2.44) holds with equality and inequality (2.43) is no longer fulfilled but holds with equality. Thus, for inequality (2.43) to hold at the limit $s \to 1$, it is necessary and sufficient to have $\theta > \sigma$.

So far, I have established that it is necessary and sufficient to have $\theta > \sigma$ for $FOC < 0$ at the limit points (i.e., for $s \to 1$ and at $s = \frac{\sigma}{\sigma-1}$). I will now show, that $\theta > \sigma$ is also sufficient for $FOC < 0$ at any $s \in (1, \frac{\sigma}{\sigma-1}]$.

Note, that the right-hand side of inequality (2.43) is strictly increasing, continuous and unbounded in θ. Therefore, for $\theta > \sigma$ we get from the right-hand side of inequality (2.43):

$$\frac{(\frac{s-1}{s})}{s^{\sigma-1}-1}\left[(1-\sigma) + \sigma s^{\sigma-1}[\left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{-\frac{\sigma}{\sigma-1}}\frac{f_s}{f}+1]^{-1}\right] <$$

$$\frac{(\frac{s-1}{s})}{s^{\sigma-1}-1}\left[(1-\sigma) + \theta s^{\sigma-1}[\left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{-\frac{\theta}{\sigma-1}}\frac{f_s}{f}+1]^{-1}\right].$$

Then, for inequality (2.43) to hold, it is sufficient to show that

$$\frac{\sigma}{\sigma-1} - s \quad \leq \quad \frac{(\frac{s-1}{s})}{s^{\sigma-1}-1}\left[(1-\sigma) + \sigma s^{\sigma-1}[\left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{-\frac{\sigma}{\sigma-1}}\frac{f_s}{f}+1]^{-1}\right], \quad (2.45)$$

where the inequality holds with equality for $s \to 1$, as shown above. Then, for the inequality (2.45) to hold, it is to show that

$$\iff \frac{\sigma}{\sigma-1} - s \leq (\frac{s-1}{s})\frac{1}{s^{\sigma-1}-1}\left[(1-\sigma)+\sigma s^{\sigma-1}[\left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{-\frac{\sigma}{\sigma-1}}\frac{f_s}{f}+1]^{-1}\right]$$

$$\iff \frac{\sigma}{\sigma-1} - s \leq \sigma\frac{(\frac{s-1}{s})}{s^{\sigma-1}-1}s^{\sigma-1}[\left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{-\frac{\sigma}{\sigma-1}}\frac{f_s}{f}+1]^{-1} - (\sigma-1)\frac{(\frac{s-1}{s})}{s^{\sigma-1}-1}$$

$$\iff \frac{1}{\sigma-1}+1-s \leq \frac{(\frac{s-1}{s})}{s^{\sigma-1}-1}+\sigma\frac{(\frac{s-1}{s})}{s^{\sigma-1}-1}s^{\sigma-1}[\left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{-\frac{\sigma}{\sigma-1}}\frac{f_s}{f}+1]^{-1}-\sigma\frac{(\frac{s-1}{s})}{s^{\sigma-1}-1}. \tag{2.46}$$

For $s > 1$ and $\sigma > 1$, the term $\frac{(\frac{s-1}{s})}{s^{\sigma-1}-1}$ is continuous and decreasing in s. With $\lim_{s\to 1}\frac{(\frac{s-1}{s})}{s^{\sigma-1}-1} = \frac{1}{\sigma-1}$, it must then hold that $\frac{1}{\sigma-1} \leq \frac{(\frac{s-1}{s})}{s^{\sigma-1}-1}$, with equality only for $s \to 1$. Then, for inequality (2.46) to hold, it is left to show that

$$1-s \leq \sigma\frac{(\frac{s-1}{s})}{s^{\sigma-1}-1}\left[s^{\sigma-1}[\left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{-\frac{\sigma}{\sigma-1}}\frac{f_s}{f}+1]^{-1}-1\right]$$

$$\iff (s-1) \geq -\sigma\frac{(\frac{s-1}{s})}{s^{\sigma-1}-1}\left[s^{\sigma-1}[\left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{-\frac{\sigma}{\sigma-1}}\frac{f_s}{f}+1]^{-1}-1\right]$$

$$\iff 1 \geq \frac{\sigma(\frac{1}{s})}{s^{\sigma-1}-1}\left[1-s^{\sigma-1}[\left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{-\frac{\sigma}{\sigma-1}}\frac{f_s}{f}+1]^{-1}\right].$$

The last inequality will necessarily hold, if the term in brackets is negative:

$$1 \leq s^{\sigma-1}[\left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{-\frac{\sigma}{\sigma-1}}\frac{f_s}{f}+1]^{-1}$$

$$\iff (s^{\sigma-1}-1)^{\frac{\sigma}{\sigma-1}}\left(\frac{f_s}{f}\right)^{-\frac{\sigma}{\sigma-1}}\frac{f_s}{f} \leq (s^{\sigma-1}-1)$$

$$\iff \left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{-\frac{1}{\sigma-1}} \leq 1.$$

The last inequality holds by definition of the high costs case, $\frac{f_s}{f(s^{\sigma-1}-1)} > 1$. Thus, for $\theta > \sigma$ we get $FOC < 0$.

Moreover, because $\epsilon_{R_E,s} = 0$ for $\theta = \sigma - 1$, such that the unique solution of the first-order condition is $s = \frac{\sigma}{\sigma-1}$, and because I have established that for $\theta > \sigma$ there cannot be an interior solution, we get that for $\sigma \geq \theta \geq \sigma - 1$ any interior solution with $s \in (1, \frac{\sigma}{\sigma-1}]$ is feasible. Figure 2.16 shows the first-order condition for various values of θ. While the first-order condition has a unique solution for $\sigma \geq \theta \geq \sigma - 1$, the first-order condition does not have an interior root for any $\theta > \sigma$. It can be observed that even for subsidy rates arbitrarily close to 1 the first-order condition is negative if $\theta > \sigma$.

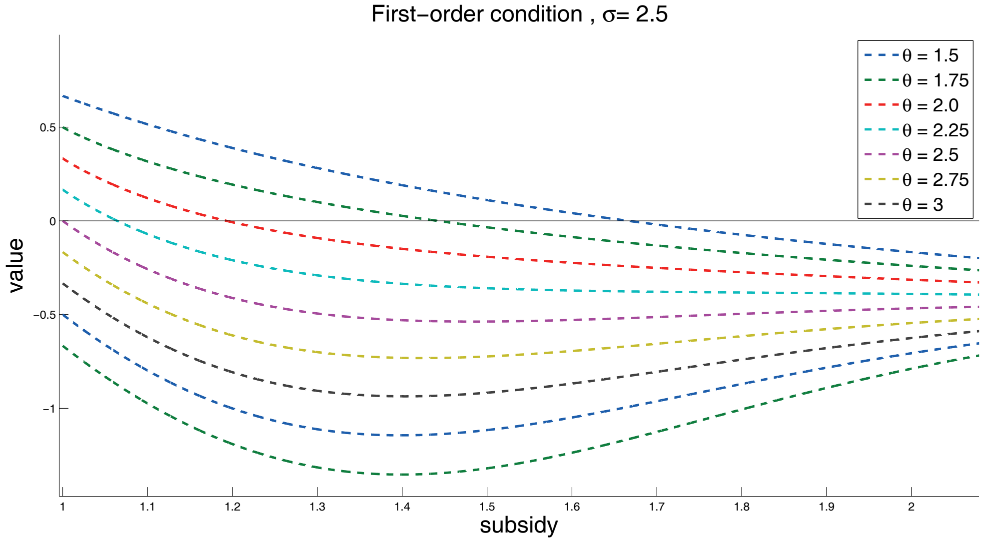


Figure 2.16: First-order condition (welfare maximization) for different values of θ

□

2.A.11 Proof of Lemma 2.4

Lemma. *In the high costs, the government implements* $s^o = \frac{\frac{\sigma}{\sigma-1}+\left(1+\frac{1}{\sigma-1}\frac{1}{\alpha}\right)\tilde{\epsilon}_{R_E,s}}{1+\tilde{\epsilon}_{R_E,s}}$ *in the lobbying game.*

Proof. With $S_{high} = (s-1)\frac{\sigma-1}{\sigma}R_E$ we get

$$\frac{\partial S}{\partial s} = R_E\frac{\sigma-1}{\sigma} - (s-1)\frac{\sigma-1}{\sigma}\frac{\partial R_E}{\partial s}. \tag{2.47}$$

Consumer surplus changes, because the subsidized firms can sell at lower price and decrease the price index. However, because the cutoffs are already given when the government sets the subsidy, the effect on the price comes only from producers that are in the lobby. With $CS = y\ln(y_i) - y\ln(P_s) - y$, by

$$P_s = \kappa_p\left[(\varphi^*)^{\sigma-\theta-1} + \left(s^{\sigma-1}-1\right)(\varphi_L^*)^{\sigma-\theta-1}\right]^{\frac{1}{1-\sigma}},$$

where $\kappa_p = \left(J\frac{\theta b^\theta}{\theta-\sigma+1}\right)^{\frac{1}{1-\sigma}}\left(\frac{\sigma}{\sigma-1}\right)$ we get

$$CS = y\ln(y_i) - y\ln(\kappa_p\left[(\varphi^*)^{\sigma-\theta-1} + \left(s^{\sigma-1}-1\right)(\varphi_L^*)^{\sigma-\theta-1}\right]^{\frac{1}{1-\sigma}}) - y.$$

Holding the cutoffs fixed, we get:

$$\frac{\partial CS}{\partial s} = \frac{y}{s}s^{\sigma-1}\left[\left(\frac{\varphi^*}{\varphi_L^*}\right)^{\sigma-\theta-1} + \left(s^{\sigma-1}-1\right)\right]^{-1}.$$

With $\frac{\varphi_L^*}{\varphi^*} = \left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{\frac{1}{\sigma-1}}$ we get:

$$\frac{\partial CS}{\partial s} = \frac{y}{s}\frac{s^{\sigma-1}}{s^{\sigma-1}-1}\left[\frac{1}{(s^{\sigma-1}-1)}\left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{\frac{\theta-\sigma+1}{\sigma-1}} + 1\right]^{-1}.$$

With $R_E = y\frac{s^{\sigma-1}}{s^{\sigma-1}-1}[\left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{\frac{\theta}{\sigma-1}}\frac{f}{f_s}+1]^{-1}$ we can rewrite:

$$\frac{\partial CS}{\partial s} = \frac{R_E}{s}. \tag{2.48}$$

Note that $\frac{\partial CS}{\partial s}$ is the same even if the cutoffs are allowed to change with the subsidy rate. Then, the lobby and product cutoffs would change, but the effects would cancel out each other. Moreover, joint profits of the lobby members are given by,

$$\Pi_E = \frac{J_L r_s(\tilde{\varphi}_L)}{\sigma} - J_L(f_s + f),$$

where $\tilde{\varphi}_L$ denotes average productivity of the lobby members. However, given that the lobby takes the number of members as fixed, we get:

$$\frac{\partial \Pi_E}{\partial s} = \frac{J_L}{\sigma}\frac{\partial r_s(\tilde{\varphi}_L)}{\partial s},$$

or equivalently,

$$\frac{\partial \Pi_E}{\partial s} = \frac{1}{\sigma}\frac{\partial R_E}{\partial s}. \tag{2.49}$$

Combining equation (2.47), (2.48) and (2.49) gives the FOC:

$$\frac{\partial G}{\partial s} = \alpha\left(\frac{R_E}{s} - R_E\frac{\sigma-1}{\sigma} - (s-1)\frac{\sigma-1}{\sigma}\frac{\partial R_E}{\partial s}\right) + \frac{1}{\sigma}\frac{\partial R_E}{\partial s} = 0.$$

$$\iff \frac{\partial G}{\partial s} = \alpha\left(\frac{R_E}{s} - R_E\frac{\sigma-1}{\sigma} - (s-1)\frac{\sigma-1}{\sigma}J_L\frac{\partial r_s(\tilde{\varphi}_L)}{\partial s}\right) + \frac{J_L}{\sigma}\frac{\partial r_s(\tilde{\varphi}_L)}{\partial s} = 0.$$

$$\iff \frac{\sigma}{\sigma-1} - s - (s-1)\frac{\partial R_E}{\partial s}\frac{s}{R_E} + \frac{1}{\sigma-1}\frac{1}{\alpha}\frac{\partial R_E}{\partial s}\frac{s}{R_E} = 0.$$

$$s^o = \frac{\frac{\sigma}{\sigma-1} + \left(1 + \frac{1}{\sigma-1}\frac{1}{\alpha}\right)\tilde{\epsilon}_{R_E,s}}{1 + \tilde{\epsilon}_{R_E,s}}, \tag{2.50}$$

where $\tilde{\epsilon}_{R_E,s} = \frac{\partial R_E}{\partial s}\frac{s}{R_E}$ is the elasticity of aggregate lobby revenues wrt to the subsidy rate, holding the cutoffs and the number of lobby members fixed. Holding J_L fixed, we get

$$\begin{aligned}\tilde{\epsilon}_{R_E,s} = \frac{\partial R_E}{\partial s}\frac{s}{R_E} &= \frac{s}{R_E}J_L\frac{\partial r_s(\tilde{\varphi}_L)}{\partial s} \\ &= \frac{s}{R_E}J_L\left(\frac{\sigma}{\sigma-1}\frac{1}{\tilde{\varphi}_L}\right)^{1-\sigma} y\frac{\partial\left(\frac{s^{\sigma-1}}{P_s^{1-\sigma}}\right)}{\partial s}.\end{aligned}$$

With $P_s = \kappa_p\left[(\varphi^*)^{\sigma-\theta-1} + (s^{\sigma-1}-1)(\varphi_L^*)^{\sigma-\theta-1}\right]^{\frac{1}{1-\sigma}}$ we get

$$\frac{s^{\sigma-1}}{P_s^{1-\sigma}} = \kappa_p^{\sigma-1}\left[(\varphi^*)^{\sigma-\theta-1} + \left(s^{\sigma-1}-1\right)(\varphi_L^*)^{\sigma-\theta-1}\right]^{-1} s^{\sigma-1},$$

such that

$$\begin{aligned}\frac{\partial\left(\frac{s^{\sigma-1}}{P_s^{1-\sigma}}\right)}{\partial s} &= -\kappa_p^{\sigma-1}\left[(\varphi^*)^{\sigma-\theta-1} + \left(s^{\sigma-1}-1\right)(\varphi_L^*)^{\sigma-\theta-1}\right]^{-2} s^{\sigma-1}(\sigma-1)\frac{1}{s}\left(s^{\sigma-1}\right)(\varphi_L^*)^{\sigma-\theta-1} \\ &\quad +\kappa_p^{\sigma-1}\left[(\varphi^*)^{\sigma-\theta-1} + \left(s^{\sigma-1}-1\right)(\varphi_L^*)^{\sigma-\theta-1}\right]^{-1}(\sigma-1)\frac{1}{s}\left(s^{\sigma-1}\right) \\ \iff \frac{\partial\left(\frac{s^{\sigma-1}}{P_s^{1-\sigma}}\right)}{\partial s} &= \kappa_p^{\sigma-1}\left[(\varphi^*)^{\sigma-\theta-1} + \left(s^{\sigma-1}-1\right)(\varphi_L^*)^{\sigma-\theta-1}\right]^{-1} s^{\sigma-1}\frac{(\sigma-1)}{s} \\ &\quad \left(-\left(s^{\sigma-1}\right)(\varphi_L^*)^{\sigma-\theta-1}\left[(\varphi^*)^{\sigma-\theta-1} + \left(s^{\sigma-1}-1\right)(\varphi_L^*)^{\sigma-\theta-1}\right]^{-1} + 1\right) \\ \iff \frac{\partial\left(\frac{s^{\sigma-1}}{P_s^{1-\sigma}}\right)}{\partial s} &= \frac{s^{\sigma-1}}{P_s^{1-\sigma}}\frac{(\sigma-1)}{s}\left(1 - \frac{s^{\sigma-1}}{(s^{\sigma-1}-1)}\left[\frac{(\varphi^*)^{\sigma-\theta-1}}{(s^{\sigma-1}-1)(\varphi_L^*)^{\sigma-\theta-1}} + 1\right]^{-1}\right).\end{aligned}$$

Therefore,

$$\tilde{\epsilon}_{R_E,s} = \frac{s}{R_E} J_L r_s(\tilde{\varphi}_L) \frac{(\sigma-1)}{s} \left(1 - \frac{s^{\sigma-1}}{(s^{\sigma-1}-1)} \left[\frac{(\varphi^*)^{\sigma-\theta-1}}{(s^{\sigma-1}-1)(\varphi_L^*)^{\sigma-\theta-1}} + 1\right]^{-1}\right)$$

$$\iff \tilde{\epsilon}_{R_E,s} = (\sigma-1) \left(1 - \frac{s^{\sigma-1}}{(s^{\sigma-1}-1)} \left[\frac{(\varphi^*)^{\sigma-\theta-1}}{(s^{\sigma-1}-1)(\varphi_L^*)^{\sigma-\theta-1}} + 1\right]^{-1}\right).$$

With $\frac{\varphi_L^*}{\varphi^*} = \left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{\frac{1}{\sigma-1}}$ we get

$$\iff \tilde{\epsilon}_{R_E,s} = (\sigma-1) \left(1 - \frac{s^{\sigma-1}}{(s^{\sigma-1}-1)} \left[\frac{1}{(s^{\sigma-1}-1)} \left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{\frac{\theta-\sigma+1}{\sigma-1}} + 1\right]^{-1}\right).$$

By $\frac{R_E}{y} = \frac{s^{\sigma-1}}{s^{\sigma-1}-1}[\left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{\frac{\theta}{\sigma-1}} \frac{f}{f_s} + 1]^{-1}$ we get

$$\iff \tilde{\epsilon}_{R_E,s} = (\sigma-1)\left(1 - \frac{R_E}{y}\right) \leq (\sigma-1).$$

□

2.A.12 Proof of Proposition 2.4

Proposition. *If $f_s > f((\frac{\sigma}{\sigma-1})^{\sigma-1} - 1)$ (high costs case), there exists a unique equilibrium of the lobbying game, such that*

1. *all firms with $\varphi > \varphi^o$ produce and all firms with $\varphi > \varphi_L^o$ enter the lobby,*
2. *lobby contributions are $C^T(s^o) = \alpha(y \ln(\frac{P_{s^o}}{P_{s^*}}) + S_{s^o} - S_{s^*})$,*
3. *the government implements $s^o = \frac{\frac{\sigma}{\sigma-1} + \left(1 + \frac{1}{\sigma-1}\frac{1}{\alpha}\right)\tilde{\epsilon}_{R_E,s}}{1+\tilde{\epsilon}_{R_E,s}}$.*

Proof. Condition $1-3$ are given in text. The relative mass of lobbying firms, $h(s) = J_R$, is a strictly increasing function of s, with $\lim_{s\to 1} z(J_R) = 0$ and $\lim_{s\to\left(\frac{f_s}{f}+1\right)^{\frac{1}{\sigma-1}}} z(J_R) = 1$. Moreover, $\lim_{J_R\to 0} z(J_R) = \frac{\sigma}{\sigma-1} + \frac{1}{\sigma}\left(\frac{1-\alpha}{\alpha}\right) > 0$ and $\lim_{J_R\to 1} z(J_R) = \frac{\sigma}{\sigma-1} < 1$. Therefore, $z(J_R)$ is strictly increasing in J_R for $\alpha < 1$ and strictly decreasing in J_R if $\infty > \alpha > 1$, and for any $\alpha < \infty$ there is a unique interior intersection of $z(J_R)$ and $h(s)$. □

2.A.13 Proof of Lemma 2.5

Lemma. *Increasing the welfare weight α decreases both the relative mass of lobbying firms and the optimal subsidy rate.*

Proof. Taking the total derivative of s with respect to α gives:

$$\frac{ds}{d\alpha} = \frac{\partial z(J_R;\alpha)}{\partial\alpha} + \frac{\partial z(J_R;\alpha)}{\partial J_R}\frac{\partial h(s;\alpha)}{\partial\alpha}.$$

With $\frac{\partial h(s;\alpha)}{\partial\alpha} = 0$ and $\frac{\partial z(J_R;\alpha)}{\partial\alpha} = -\frac{1}{\alpha^2}\frac{\left(\frac{1}{\sigma-1}\right)\tilde{\epsilon}_{R_E,s}}{1+\tilde{\epsilon}_{R_E,s}} < 0$ we get $\frac{ds}{d\alpha} < 0$. Taking the total derivative of J_R with respect to α gives:

$$\frac{dJ_R}{d\alpha} = \frac{\partial h(s;\alpha)}{\partial\alpha} + \frac{\partial h(s;\alpha)}{\partial s}\frac{\partial z(J_R;\alpha)}{\partial\alpha}.$$

With $\frac{\partial h(s;\alpha)}{\partial\alpha} = 0$, $\frac{\partial h(s;\alpha)}{\partial s} > 0$ and $\frac{\partial z(J_R;\alpha)}{\partial\alpha} < 0$ we get $\frac{dJ_R}{d\alpha} < 0$. □

2.A.14 Proof of Lemma 2.6

Lemma. *Increasing the administrative fixed costs f_s decreases always the relative mass of lobbying firms, but increases the optimal subsidy rate if $\alpha < 1$ and decreases the optimal subsidy rate if $\alpha > 1$.*

Proof. $\frac{dJ_R}{df_s} < 0$ was shown in the main text. Note that $z(J_R; f_s) > \frac{\sigma}{\sigma-1}$ iff $\alpha < 1$. Moreover,
$$\frac{\partial z(J_R;f_s)}{\partial \tilde{\epsilon}_{R_E,s}} = \left(1+\frac{1}{\sigma-1}\frac{1}{\alpha}-\frac{\sigma}{\sigma-1}\frac{1}{1+\tilde{\epsilon}_{R_E,s}}-\left(1+\frac{1}{\sigma-1}\frac{1}{\alpha}\right)\frac{\tilde{\epsilon}_{R_E,s}}{1+\tilde{\epsilon}_{R_E,s}}\right)[1+\tilde{\epsilon}_{R_E,s}]^{-1} > 0$$
if
$$\left(1+\frac{1}{\sigma-1}\frac{1}{\alpha}\right)\left[\frac{1}{1+\tilde{\epsilon}_{R_E,s}}\right] > \frac{\sigma}{\sigma-1}\frac{1}{1+\tilde{\epsilon}_{R_E,s}},$$
which holds only if$\alpha < 1$. With $\frac{\partial \tilde{\epsilon}_{R_E,s}}{\partial J_R} < 0$ iff $\alpha < 1$, we get
$$\frac{\partial z(J_R;f_s)}{\partial J_R} = \underbrace{\frac{\partial z(J_R;f_s)}{\partial \tilde{\epsilon}_{R_E,s}}}_{>0}\underbrace{\frac{\partial \tilde{\epsilon}_{R_E,s}}{\partial J_R}}_{<0} < 0.$$
Therefore,
$$\begin{aligned}\frac{ds}{df_s} &= \frac{\partial z(J_R;f_s)}{\partial f_s}+\frac{\partial z(J_R;f_s)}{\partial J_R}\frac{\partial h(s;f_s)}{\partial f_s}\\ &= \underbrace{\frac{\partial z(J_R;f_s)}{\partial f_s}}_{=0}+\underbrace{\underbrace{\frac{\partial z(J_R;f_s)}{\partial \tilde{\epsilon}_{R_E,s}}}_{>0}\underbrace{\frac{\partial \tilde{\epsilon}_{R_E,s}}{\partial J_R}}_{<0}\underbrace{\frac{\partial h(s;f_s)}{\partial f_s}}_{<0}}_{>0} > 0.\end{aligned}$$
By the same argument if $\alpha > 1$ then $\frac{ds}{df_s} < 0$. □

2.A.15 Proof of Lemma 2.7

Lemma. *If $\alpha > 1$, decreasing firm heterogeneity (i.e., increasing θ) decreases both the relative mass of lobbying firms and the optimal subsidy rate. However, if $\alpha < 1$, decreasing firm heterogeneity increases the optimal subsidy rate and has an ambiguous effect on the relative mass of lobbying firms.*

Proof. There is a direct negative effect on J_R:
$$\frac{\partial h(s;\theta)}{\partial \theta} = \frac{J_R}{\theta}\ln(J_R) < 0.$$
However, holding the (relative) mass of firms in the lobby constant, an increase in θ leads to a decline in average productivity of lobbying firms, $\tilde{\varphi}_L = \left(\frac{\theta}{\theta+1-\sigma}\right)^{\frac{1}{\sigma-1}}\varphi_L^*$, and therefore to a decline in average revenues of lobbying firms. This leads to an increase of $\tilde{\epsilon}_{R_E,s}$ for a constant relative mass of lobbying firms. Therefore, $\frac{\partial z(J_R;\theta)}{\partial \theta} < 0$ if $\alpha > 1$ and $\frac{\partial z(J_R;\theta)}{\partial \theta} > 0$ if $\alpha > 1$. With $\frac{\partial z(J_R;\theta)}{\partial \tilde{\epsilon}_{R_E,s}} > 0$ if and only if $\alpha < 1$, it holds that $\frac{\partial z(J_R;\theta)}{\partial J_R} = \underbrace{\frac{\partial z(J_R;\theta)}{\partial \tilde{\epsilon}_{R_E,s}}}_{>0}\underbrace{\frac{\partial \tilde{\epsilon}_{R_E,s}}{\partial J_R}}_{<0} < 0$. Thus, the total effect on the subsidy is positive for $\alpha < 1$:
$$\frac{ds}{d\theta} = \underbrace{\frac{\partial z(J_R;\theta)}{\partial \theta}}_{>0}+\underbrace{\frac{\partial z(J_R;\theta)}{\partial J_R}}_{<0}\underbrace{\frac{\partial h(s;\theta)}{\partial \theta}}_{<0} > 0.$$
By the same argument if $\alpha > 1$ then $\frac{ds}{d\theta} < 0$. For $\alpha > 1$, the total effect on the relative mass of lobbying firms is unambiguously negative:
$$\frac{dJ_R}{d\theta} = \underbrace{\frac{\partial h(s;\theta)}{\partial \theta}}_{<0}+\underbrace{\frac{\partial h(s;\theta)}{\partial s}}_{>0}\underbrace{\frac{\partial z(J_R;\theta)}{\partial \theta}}_{<0} < 0.$$
However, for $\alpha < 1$ the positive indirect effect through the increase in the subsidy could

dominate the negative direct effect of an increase in θ:

$$\frac{dJ_R}{d\theta}=\underbrace{\frac{\partial h(s;\theta)}{\partial\theta}}_{<0}+\underbrace{\frac{\partial h(s;\theta)}{\partial s}}_{>0}\underbrace{\frac{\partial z(J_R;\theta)}{\partial\theta}}_{>0}=?$$

□

2.A.16 Proof of Lemma 2.8

Lemma. *If $\alpha<1$, increasing the elasticity of substitution σ decreases the optimal subsidy rate and has an ambiguous effect on the relative mass of lobbying firms.*

Proof. The direct effect of an increase in σ on the relative mass of lobbying firms is given by:

$$\frac{\partial h(s;\sigma)}{\partial\sigma}=J_R\left[J_R^{-\frac{1}{\sigma-1}}+\frac{\theta}{\sigma-1}\ln(s)\frac{s^{\sigma-1}}{s^{\sigma-1}-1}\right]>0.$$

Therefore, the $h(s)$ curve shifts upwards. Take the limits of the $z(J_R)$ curve:

$$\lim_{J_R\to1}z(J_R)=\frac{\sigma}{\sigma-1}$$

$$\lim_{J_R\to0}z(J_R)=\frac{\sigma}{\sigma-1}+\frac{1}{\sigma}\frac{1-\alpha}{\alpha}.$$

Thus, the $z(J_R)$ curve shifts to the left, $\frac{\partial z(J_R;\sigma)}{\partial\sigma}<0$. For $\alpha<1$, $\frac{\partial z(J_R;\sigma)}{\partial J_R}<0$, such that $\frac{\partial z(J_R;\sigma)}{\partial J_R}\frac{\partial h(s;\sigma)}{\partial\sigma}<0$ and therefore:

$$\frac{ds}{d\sigma}=\underbrace{\frac{\partial z(J_R;\sigma)}{\partial\sigma}}_{<0}+\underbrace{\frac{\partial z(J_R;\sigma)}{\partial J_R}\frac{\partial h(s;\sigma)}{\partial\sigma}}_{<0}<0.$$

With $\alpha<1$ an increase in σ has a negative effect on the equilibrium subsidy rate. For $\alpha<1$, the total effect on the relative mass of lobbying firms is ambiguous:

$$\frac{dJ_R}{d\sigma}=\underbrace{\frac{\partial h(s;\sigma)}{\partial\sigma}}_{>0}+\underbrace{\frac{\partial h(s;\sigma)}{\partial s}}_{>0}\underbrace{\frac{\partial z(J_R;\sigma)}{\partial\sigma}}_{<0}=?$$

For $\alpha>1$ we get $\frac{\partial z(J_R;\sigma)}{\partial J_R}>0$ and

$$\frac{ds}{d\sigma}=\underbrace{\frac{\partial z(J_R;\sigma)}{\partial\sigma}}_{<0}+\underbrace{\underbrace{\frac{\partial z(J_R;\sigma)}{\partial J_R}}_{>0}\underbrace{\frac{\partial h(s;\sigma)}{\partial\sigma}}_{>0}}_{>0}=?$$

For $\alpha>1$ the total effect on the relative mass of lobbying firms is also ambiguous:

$$\frac{dJ_R}{d\sigma}=\underbrace{\frac{\partial h(s;\sigma)}{\partial\sigma}}_{>0}+\underbrace{\frac{\partial h(s;\sigma)}{\partial s}}_{>0}\underbrace{\frac{\partial z(J_R;\sigma)}{\partial\sigma}}_{<0}=?$$

□

2.B Free entry

In the main body of the paper, I follow Chaney (2008) and assume that there is a fixed measure of potential entrants in the market. Now, I relax this assumption by allowing for free entry, such that the mass of entrants, J_e, is endogenously determined as in Melitz (2003).[28] I assume that there is an unbounded mass of *prospective* entrants from which

[28] Note that Arkolakis et al. (2008) show that with a Pareto distribution of productivity and CES preferences, the model with a fixed measure of entrants (proportional to country size), and the model with free entry are isomorphic. In equilibrium, under free entry aggregate profits are no longer positive but equal to aggregate entry costs.

a mass of J_e decides to enter the market. To enter and to obtain its productivity draw, a firm has to pay sunk entry cost f_e. Conditional on entry, firms that make negative profits immediately exit and do not produce, such that the mass of active firms J_A is a subset of the mass of entrants J_e. With probability δ a producing firm has to exit. In a steady state, firm exit equals firm entry: $(1-V(\varphi^*))J_e = \delta J_A$. The wage rate is fixed to one and for simplicity the total mass of labor in the economy is also normalized to unity.

2.B.1 Baseline model

Define average productivity as $\tilde{\varphi} = \left[\int_{\varphi^*}^{\infty} \varphi^{\sigma-1} v(\varphi) d\varphi\right]^{\frac{1}{\sigma-1}}$. Under Pareto, $V(\varphi) = 1 - \left(\frac{b}{\varphi}\right)^{\theta}$, we get

$$\tilde{\varphi} = \left(\frac{\theta}{\theta+1-\sigma}\right)^{\frac{1}{\sigma-1}} \varphi^*. \tag{2.51}$$

By the zero profit condition, $\pi(\varphi^*) = 0 \Longleftrightarrow r(\varphi^*) = \sigma f$, we get $r(\tilde{\varphi}) = r(\varphi^*)\left(\frac{\tilde{\varphi}}{\varphi^*}\right)^{\sigma-1} = \sigma f\left(\frac{\theta}{\theta+1-\sigma}\right)$. Average profits are

$$\pi(\tilde{\varphi}) = \frac{r(\tilde{\varphi})}{\sigma} - f = f\left[\left(\frac{\tilde{\varphi}}{\varphi^*}\right)^{\sigma-1} - 1\right]. \tag{2.52}$$

The free entry condition states that the net value from entry has to be zero, $\frac{1-V(\varphi^*)}{\delta}\pi(\tilde{\varphi}) - f_e = 0$:

$$\pi(\tilde{\varphi}) = \frac{\delta f_e}{1-V(\varphi^*)}. \tag{2.53}$$

Combining (2.52) and (2.53) and (2.51) gives the product market cutoff

$$\varphi^* = \left[b^{\theta}\frac{f}{\delta f_e}\left(\frac{\sigma-1}{\theta+1-\sigma}\right)\right]^{\frac{1}{\theta}}.$$

By $J_A = \frac{y}{r(\tilde{\varphi})}$, the equilibrium mass of active firms is

$$J_A = \left(\frac{\theta+1-\sigma}{\sigma\theta}\right)\frac{y}{f}.$$

The number of entrants is proportional to the size of the differentiated goods sector, y and depends only on σ, θ, y and f_e:

$$J_e = \frac{\delta J_A}{1-V(\varphi_{ii}^*)} = \frac{\sigma-1}{\sigma\theta}\frac{y}{f_e}.$$

Thus, under free entry the mass of active firms is the same as in a model with a fixed measure of potential entrants.

2.B.2 Model with costly production subsidy

Assume that firms can receive a subsidy $s > 1$ on variable costs by paying fixed costs f_s. Define aggregate productivity as

$$\tilde{\varphi}_A = \{\frac{1}{J_A}[J_A(\tilde{\varphi})^{\sigma-1} + J_L\left(s^{\sigma-1}-1\right)(\tilde{\varphi}_L)^{\sigma-1}]\}^{\frac{1}{\sigma-1}},$$

where average productivity of subsidized firms is

$$\tilde{\varphi}_L = \left[\int_{\varphi_L^*}^{\infty} \varphi^{\sigma-1}\frac{v(\varphi)}{1-V(\varphi_L^*)}d\varphi\right]^{\frac{1}{\sigma-1}} = \left(\frac{\theta}{\theta+1-\sigma}\right)^{\frac{1}{\sigma-1}} \varphi_L^*$$

and average productivity of all producing firms is

$$\tilde{\varphi} = \left[\int_{\varphi^*}^{\infty} \varphi^{\sigma-1} \frac{v(\varphi)}{1-V(\varphi_L^*)} d\varphi\right]^{\frac{1}{\sigma-1}} = \left(\frac{\theta}{\theta+1-\sigma}\right)^{\frac{1}{\sigma-1}} \varphi^*.$$

By the zero profit condition:

$$\pi(\varphi^*) = 0 \Longleftrightarrow r(\varphi^*) = \sigma f.$$

By the lobby cutoff condition:

$$\pi_s(\varphi_L^*) - \pi(\varphi_L^*) = 0 \Longleftrightarrow r(\varphi_L^*) = \frac{\sigma f_s}{(s^{\sigma-1}-1)}.$$

Therefore, $\varphi_L^* = \left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{\frac{1}{\sigma-1}} \varphi^*$, such that $\tilde{\varphi}_L = \left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{\frac{1}{\sigma-1}} \tilde{\varphi}$. Average revenues are

$$r(\tilde{\varphi}_A) = \frac{y}{J_A} = r(\tilde{\varphi}) + \frac{1-V(\varphi_L^*)}{1-V(\varphi^*)} \left(s^{\sigma-1}-1\right) r(\tilde{\varphi}_L).$$

By the zero profit condition and the lobby cutoff condition, $r(\tilde{\varphi}_L) = r(\tilde{\varphi}) \left(\frac{\tilde{\varphi}_L}{\tilde{\varphi}}\right)^{\sigma-1} = r(\tilde{\varphi}) \left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)$ and $r(\tilde{\varphi}) = r(\varphi^*) \left(\frac{\tilde{\varphi}}{\varphi^*}\right)^{\sigma-1} = \sigma f \left(\frac{\theta}{\theta+1-\sigma}\right)$. Therefore, with $\frac{1-V(\varphi_L^*)}{1-V(\varphi^*)} = \left(\frac{\varphi^*}{\varphi_L^*}\right)^{\theta}$ we get

$$r(\tilde{\varphi}_A) = \sigma f \left(\frac{\theta}{\theta+1-\sigma}\right) \left[1 + \left(\frac{f_s}{f}\right)^{\frac{\sigma-1-\theta}{\sigma-1}} (s^{\sigma-1}-1)^{\frac{\theta}{\sigma-1}}\right].$$

Average profits are defined as $\pi(\tilde{\varphi}_A) = \frac{r(\tilde{\varphi}_A)}{\sigma} - f - \frac{1-V(\varphi_L^*)}{1-V(\varphi^*)} f_s$. Thus,

$$\pi(\tilde{\varphi}_A) = \frac{\theta}{\theta+1-\sigma} f \left[1 + \left(\frac{f_s}{f}\right)^{\frac{\sigma-1-\theta}{\sigma-1}} (s^{\sigma-1}-1)^{\frac{\theta}{\sigma-1}}\right] - f - \left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{-\frac{\theta}{\sigma-1}} f_s. \tag{2.54}$$

The free entry condition is given by

$$\pi(\tilde{\varphi}_A) = \frac{\delta f_e}{1-V(\varphi^*)} = \frac{\delta f_e}{\left(\frac{b}{\varphi^*}\right)^{\theta}}. \tag{2.55}$$

Combining equation 2.54 and 2.55 leads to the product market cutoff:

$$\varphi^* = \left[b^{\theta} \frac{f}{\delta f_e} \left(\frac{\sigma-1}{\theta+1-\sigma}\right) \left[1 + \left(\frac{f_s}{f}\right)^{\frac{\sigma-1-\theta}{\sigma-1}} (s^{\sigma-1}-1)^{\frac{\theta}{\sigma-1}}\right]\right]^{\frac{1}{\theta}}$$

and to the lobby cutoff

$$\varphi_L^* = \left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{\frac{1}{\sigma-1}} \left[b^{\theta} \frac{f}{\delta f_e} \left(\frac{\sigma-1}{\theta+1-\sigma}\right) \left[1 + \left(\frac{f_s}{f}\right)^{\frac{\sigma-1-\theta}{\sigma-1}} (s^{\sigma-1}-1)^{\frac{\theta}{\sigma-1}}\right]\right]^{\frac{1}{\theta}}.$$

Average revenues are

$$r(\tilde{\varphi}_A) = \frac{\theta\sigma}{\theta+1-\sigma} f \left[1 + \left(\frac{f_s}{f}\right)^{\frac{\sigma-1-\theta}{\sigma-1}} (s^{\sigma-1}-1)^{\frac{\theta}{\sigma-1}}\right].$$

By $J_A = \frac{y}{r(\tilde{\varphi}_A)}$ the mass of active firms is

$$J_A = \frac{\theta+1-\sigma}{\theta\sigma} \frac{y}{f} \left[1 + \left(\frac{f_s}{f}\right)^{\frac{\sigma-1-\theta}{\sigma-1}} (s^{\sigma-1}-1)^{\frac{\theta}{\sigma-1}}\right]^{-1}.$$

With $\frac{\varphi_L^*}{\varphi^*} = \left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{\frac{1}{\sigma-1}}$, the mass of lobbying firms, defined by $J_L = J_A \frac{(1-V(\varphi_L))}{(1-V(\varphi^*))} = J_A \left(\frac{\varphi^*}{\varphi_L^*}\right)^{\theta}$, is given by

$$J_L = \frac{\theta + 1 - \sigma}{\sigma\theta} \frac{y}{f_s} \left[\left(\frac{f_s}{f(s^{\sigma-1}-1)}\right)^{\frac{\theta}{\sigma-1}} \left(\frac{f}{f_s}\right) + 1 \right]^{-1}.$$

The mass of entrants is the same as in the case without subsidy:

$$J_e = \frac{\delta J_A}{1 - V(\varphi_{ii}^*)} = \frac{\sigma - 1}{\theta\sigma} \frac{y}{f_e}.$$

Again, under free entry and with a fixed measure of potential entrants, the mass of active firms and lobbying firms is identical.

2.C Alternative instrument: ad-valorem output subsidy

Alternatively to a subsidy on variable costs, one could consider an ad-valorem output subsidy. After paying administrative fixed costs f_s, a firm becomes eligible for an ad-valorem subsidy $s > 1$. At a market price of p_s a firms receives a producer price per unit sold of $s \cdot p_s$. Therefore, a subsidized firm maximizes $\pi_s = sp_s q_s(\varphi) - \frac{q_s(\varphi)}{\varphi} - f - f_s$ which yields a market price of $p_s = \frac{\sigma}{(\sigma-1)} \frac{1}{s\varphi}$. Hence, the per-unit *producer* price is the same as in the model without a subsidy: $s \cdot p_s = \frac{\sigma}{\sigma-1} \frac{1}{\varphi}$. Quantity sold, revenues and profits of a firm with productivity draw φ are given by:

$$q_s(\varphi) = s^{\sigma} \frac{\left(\frac{\sigma}{\sigma-1}\frac{1}{\varphi}\right)^{-\sigma}}{P_s^{1-\sigma}} y, \quad r_s(\varphi) = s^{\sigma} \frac{\left(\frac{\sigma}{\sigma-1}\frac{1}{\varphi}\right)^{1-\sigma}}{P_s^{1-\sigma}} y, \text{ and } \pi_s(\varphi) = s^{\sigma} \frac{\left(\frac{\sigma}{\sigma-1}\frac{1}{\varphi}\right)^{1-\sigma}}{P_s^{1-\sigma}} \frac{y}{\sigma} - f - f_s.$$

Firm revenues can be split up into a "market" and a "government" component:

$$r_s(\varphi) = sp_s q_s(\varphi) = \underbrace{pq_s(\varphi)}_{\text{market revenue}} + \underbrace{(s-1)pq_s(\varphi)}_{\text{subsidy payments}}.$$

The subsidy payments per firm can be rewritten as

$$\begin{aligned}
(s-1)p_s q_s(\varphi) &= (s-1)\left(\frac{\sigma}{\sigma-1}\frac{1}{s\varphi}\right) s^{\sigma} \frac{\left(\frac{\sigma}{\sigma-1}\frac{1}{\varphi}\right)^{-\sigma}}{P_s^{1-\sigma}} y \\
&= \frac{s-1}{s} s^{\sigma} \frac{\left(\frac{\sigma}{(\sigma-1)}\frac{1}{\varphi}\right)^{1-\sigma}}{P_s^{1-\sigma}} y \\
&= \frac{s-1}{s} r_s(\varphi).
\end{aligned}$$

The low costs case. The product market and eligibility cutoff is defined by $\pi_s(\varphi_{L,low}^*) = 0$:

$$\varphi_{L,low}^* = \frac{\sigma}{\sigma-1} \left(\frac{\sigma}{y} \frac{1}{P_s^{\sigma-1}} \frac{f + f_s}{s^{\sigma}}\right)^{\frac{1}{\sigma-1}}.$$

The price index is given by

$$P_{s,low} = \tilde{\kappa} \left(f + f_s\right)^{\frac{1}{\theta}\frac{\theta+1-\sigma}{\sigma-1}} s^{-\frac{1}{\theta}\frac{\sigma\theta-\sigma+1}{\sigma-1}},$$

where $\tilde{\kappa} = \left(\frac{J\theta b^{\theta}}{\theta+1-\sigma}\left(\frac{\sigma}{\sigma-1}\right)^{-\theta}\left(\frac{\sigma}{y}\right)^{\frac{-\theta-1+\sigma}{\sigma-1}}\right)^{-\frac{1}{\theta}}$. The cutoff can then be rewritten as

$$\varphi_{L,low}^* = \kappa \left(\frac{f + f_s}{s}\right)^{\frac{1}{\theta}},$$

where $\kappa = \left(J\frac{\theta b^\theta}{\theta-\sigma+1}\frac{\sigma}{y}\right)^{\frac{1}{\theta}}$. Total subsidy payments are given by $S_{low} = (s-1)y$. With $\frac{\partial S_{low}}{\partial s} = y$ and $\frac{\partial CS}{\partial s} = y\frac{1}{\theta}\frac{\sigma\theta-\sigma+1}{\sigma-1}\frac{1}{s}$, the FOC for an interior welfare maximum is given by

$$\frac{\partial CS}{\partial s} - \frac{\partial S_{low}}{\partial s} = \frac{1}{\theta}\frac{\sigma\theta-\sigma+1}{\sigma-1}\frac{y}{s} - y = 0.$$

The welfare maximizing subsidy is given by the markup minus the inverse of the Pareto shape parameter:

$$s^* = (\frac{\sigma}{\sigma-1} - \frac{1}{\theta}).$$

For large values of θ (less firm heterogeneity), the subsidy increases, and, for $\theta \to \infty$, the subsidy compensated exactly for the markup distortion. For finite θ, the subsidy is always below the markup. More firm heterogeneity (low θ) is associated with a lower optimal subsidy. For $\sigma - 1 = \theta$, we get $s^* = 1$. Thus, for $\infty > \theta > \sigma - 1$, the optimal subsidy lies in the interval $(1, \frac{\sigma}{\sigma-1})$.

The high costs case. The eligibility cutoff is defined by $\pi_s(\varphi_L^*) = \pi(\varphi_L^*)$:

$$\varphi_L^* = \left(\frac{\sigma}{\sigma-1}\right)\left(\frac{\sigma}{P_s^{\sigma-1}y}\frac{f_s}{(s^\sigma-1)}\right)^{\frac{1}{\sigma-1}}.$$

The product market cutoff is defined by $\pi(\varphi^*) = 0$:

$$\varphi^* = \left(\frac{\sigma}{\sigma-1}\right)\left(\frac{\sigma}{P_s^{\sigma-1}y}f\right)^{\frac{1}{\sigma-1}}.$$

Hence, $\varphi_L^* > \varphi^*$ if $f_s > f(s^\sigma - 1)$. Further,

$$\varphi_L^* = \varphi^*\left(\frac{f_s}{f(s^\sigma-1)}\right)^{\frac{1}{\sigma-1}}.$$

The price index is given by

$$P_{s,high} = \tilde{\kappa}[f^{\frac{\sigma-\theta-1}{\sigma-1}} + (s^{\sigma-1}-1)(s^\sigma-1)^{\frac{\theta+1-\sigma}{\sigma-1}} f_s^{\frac{\sigma-\theta-1}{\sigma-1}}]^{-\frac{1}{\theta}},$$

where $\tilde{\kappa} = \left(\frac{J\theta b^\theta}{\theta+1-\sigma}\left(\frac{\sigma}{\sigma-1}\right)^{-\theta}\left(\frac{\sigma}{y}\right)^{\frac{-\theta-1+\sigma}{\sigma-1}}\right)^{-\frac{1}{\theta}}$. Using this expression, the cutoffs can be rewritten to

$$\varphi_L^* = \kappa[\left(\frac{f_s}{f(s^\sigma-1)}\right)^{\frac{\theta}{\sigma-1}} f + (\frac{s^{\sigma-1}-1}{s^\sigma-1})f_s]^{\frac{1}{\theta}},$$

where $\kappa = \left(J\frac{\theta b^\theta}{\theta-\sigma+1}\frac{\sigma}{y}\right)^{\frac{1}{\theta}}$. With $\varphi_L^* = \varphi^*\left(\frac{f_s}{f(s^\sigma-1)}\right)^{\frac{1}{\sigma-1}}$ we get

$$\varphi^* = \kappa[f + \left(\frac{f_s}{f(s^\sigma-1)}\right)^{-\frac{\theta}{\sigma-1}}(\frac{s^{\sigma-1}-1}{s^\sigma-1})f_s]^{\frac{1}{\theta}},$$

where $\kappa = \left(J\frac{\theta b^\theta}{\theta-\sigma+1}\frac{\sigma}{y}\right)^{\frac{1}{\theta}}$. Total subsidy payments are given by

$$\begin{aligned} S_{high} &= J\frac{s-1}{s}\int_{\varphi_L} r_s(\varphi)v(\varphi)d\varphi \qquad (2.56)\\ &= \frac{s-1}{s}s^\sigma y\left[(s^{\sigma-1}-1) + \left(\frac{f_s}{f\,(s^\sigma-1)}\right)^{\frac{\theta-\sigma+1}{\sigma-1}}\right]^{-1}. \end{aligned}$$

2.D A model with lobby fixed costs and eligibility fixed costs and an imperfectly targetable subsidy rate

In model of the main paper, fixed costs to receive subsidies and fixed costs to lobby are the same. A firm cannot receive the subsidy without being in the lobby and therefore, there is no free-rider problem. In the following, I relax this assumption. I show that even if the subsidy is not perfectly targetable to lobbying firms, under certain parameter restrictions, only lobbying firms receive the subsidy.

A free-rider problem would arise if a firm could benefit from the subsidy without being in the lobby. For example, one could think of two distinct fixed costs. First, application or eligibility fixed costs f_E (e.g., paperwork or red-tape). Second, an additional fixed costs, f_L, to be politically active and to join a lobby that lobbies for an increase in the subsidy rate. If the available subsidy rate is the same for a firm that also pays the additional lobby fixed costs, no firm will find it profitable to do so. In this case, the free-rider problem prevents the lobby from being established. However, if the positive spillovers from lobbying are sufficiently low, such that the subsidy rate for lobbying firms is larger than the subsidy rate for non-lobbying firms, the free-rider problem disappears, even if there are two distinct fixed costs for lobbying and for eligibility. In the following, I will show that a model with two distinct fixed costs for eligibility and lobbying nests my approach with a single fixed costs, even if firm that are eligible but do not lobby receive a fraction of the subsidy. If the subsidy is sufficiently targetable to individual firms, lobbying still generates a sufficiently high benefit, such that there is a lobby cutoff.

In particular, suppose that lobbying for the subsidy leads also to a benefit for non-lobbying firms, such that lobbying firm benefit from the full subsidy rate s while non-lobbying firm that pay only the eligibility fixed costs receive δs, where $\delta \in [\frac{1}{s}, 1]$. The parameter δ can be interpreted as *targetability* of the subsidy. If δ is high, lobbying for the subsidy does not generate much additional benefits for a firm. In this case, the subsidy is not easily targetable to lobbying firms and there are large spillovers to non-lobbying firms. Bearing the additional lobbying fixed costs is then only profitable for a small fraction of high productive firms. In the extreme case where $\delta = 1$, the lobby will not be established, because lobbying does not generate additional benefits. For low values of δ, however, targetability of the subsidy is high and being eligible without lobbying is relatively unattractive. In the other limit case, where $\delta \to \frac{1}{s}$, all firms that are eligible also lobby, because being eligible without lobbying does not generate much benefit.

In the following, I will derive conditions on δ, such that there will be some firms that lobby and others that receive the subsidy without lobbying. I will show that there exist upper and lower bounds $\underline{\delta} < \delta < \bar{\delta}$, such that for interior values of δ with $\frac{1}{s} < \underline{\delta} < \delta < \bar{\delta} < 1$ there are three cutoffs: a lobby cutoff, a eligibility cutoff and a product market cutoff. However, for sufficiently low values of δ, such that $\frac{1}{s} \leq \delta \leq \underline{\delta}$ there are only two cutoffs, a lobby and eligibility cutoff and a product market cutoff. Therefore, if $\frac{1}{s} \leq \delta \leq \underline{\delta}$ the model outlined here simplifies to the main model of the paper.

Profits of a firm that does not receive subsidy payments are given by:

$$\pi(\varphi) = \frac{\left(\frac{\sigma}{\sigma-1}\frac{1}{\varphi}\right)^{1-\sigma}}{P_s^{1-\sigma}}\frac{y}{\sigma} - f.$$

Profits of a firm that receives a fraction of the subsidy but does not lobby are given by:

$$\pi_{\delta s}(\varphi) = \frac{(\frac{\sigma}{\sigma-1}\frac{1}{\delta s\varphi})^{1-\sigma}}{P_s^{1-\sigma}}\frac{y}{\sigma} - f - f_E.$$

Profits of a firm that receives the full subsidy rate and lobbies are given by:

$$\pi_s(\varphi) = \frac{(\frac{\sigma}{\sigma-1}\frac{1}{s\varphi})^{1-\sigma}}{P_s^{1-\sigma}}\frac{y}{\sigma} - f - f_E - f_L.$$

The product market cutoff is defined by $\pi(\varphi^*) = 0$:

$$\varphi^* = (\frac{\sigma}{\sigma-1})\left(\frac{f\sigma}{y}P_{s,high}^{1-\sigma}\right)^{\frac{1}{\sigma-1}}.$$

The eligibility cutoff is defined by

$$\pi_{s\delta}(\varphi_E^*) = \pi(\varphi_E^*).$$

The lobby cutoff is defined by

$$\pi_s(\varphi_L^*) = \pi_{s\delta}(\varphi_L^*).$$

If δ is sufficiently low or f_E sufficiently high, there will only be a single lobby cutoff defined by:

$$\pi_s(\varphi_{L,old}^*) = \pi(\varphi_{L,old}^*).$$

However, for sufficiently high δ (sufficiently low f_E), the eligibility cutoff is given by $\pi_{s\delta}(\varphi_E^*) = \pi(\varphi_E^*)$:

$$\varphi_E^* = (\frac{\sigma}{\sigma-1})\left(\frac{f_E}{((\delta s)^{\sigma-1}-1)}\frac{\sigma}{y}P_{s,high}^{1-\sigma}\right)^{\frac{1}{\sigma-1}}.$$

Then, $\varphi_E^* > \varphi^*$, if the following condition holds:

$$\delta < \bar{\delta} = \frac{1}{s}\left(\left(\frac{f_E}{f}\right)+1\right)^{\frac{1}{\sigma-1}}.$$

Thus, if δ is sufficiently low, there exists a production cutoff and a eligibility cutoff. Note that by $\frac{1}{s} < \frac{1}{s}\left(\left(\frac{f_E}{f}\right)+1\right)^{\frac{1}{\sigma-1}}$ such a value of $\bar{\delta}$ always exists within the interval $[\frac{1}{s}, 1]$. For $\delta = \frac{1}{s}\left(\left(\frac{f_E}{f}\right)+1\right)^{\frac{1}{\sigma-1}}$ we get $\varphi_E^* = \varphi^*$ and for $\delta > \frac{1}{s}\left(\left(\frac{f_E}{f}\right)+1\right)^{\frac{1}{\sigma-1}}$ we get $\varphi_E^* < \varphi^*$.

The lobby cutoff is given by $\pi_s(\varphi_L^*) = \pi_{s\delta}(\varphi_L^*)$:

$$\varphi_L^* = (\frac{\sigma}{\sigma-1})\left(\frac{f_L}{s^{\sigma-1}(1-\delta^{\sigma-1})}\frac{\sigma}{y}P_{s,high}^{1-\sigma}\right)^{\frac{1}{\sigma-1}}.$$

Then, $\varphi_L^* > \varphi_E^*$ if

$$\delta > \underline{\delta} = \left(\frac{s^{\sigma-1}f_E + f_L}{s^{\sigma-1}(f_L+f_E)}\right)^{\frac{1}{\sigma-1}} < 1.$$

Note that by $\left(\frac{s^{\sigma-1}f_E+f_L}{s^{\sigma-1}(f_L+f_E)}\right)^{\frac{1}{\sigma-1}} < 1$ such a value of $\underline{\delta}$ always exists within the interval $[\frac{1}{s}, 1]$. Equivalently, we could write: $f_E < f_L\frac{(\delta s)^{\sigma-1}-1}{s^{\sigma-1}(1-\delta^{\sigma-1})}$. Thus, if $\delta > \underline{\delta}$, the lobby cutoff lies above the eligibility cutoff. Therefore, for $\delta \in (\left(\frac{s^{\sigma-1}f_E+f_L}{s^{\sigma-1}(f_L+f_E)}\right)^{\frac{1}{\sigma-1}}, \frac{1}{s}\left(\left(\frac{f_E}{f}\right)+1\right)^{\frac{1}{\sigma-1}})$, there are three distinct cutoffs: a product market cutoff, an eligibility cutoff and a lobby cutoff. Note that this interval is non-empty, if $f < \frac{f_L+f_E}{(s^{\sigma-1}-1)}$.

However, for $\delta = \underline{\delta}$ the eligibility cutoff and a lobby cutoff are the same and for $\delta < \underline{\delta}$, there is a single lobby and eligibility cutoff defined by $\pi_s(\varphi^*_{L,old}) = \pi(\varphi^*_{L,old})$:

$$\varphi^*_{L,old} = (\frac{\sigma}{\sigma-1})\left(\frac{f_L + f_E}{(s^{\sigma-1}-1)}\frac{\sigma}{y}P^{1-\sigma}_{s,high}\right)^{\frac{1}{\sigma-1}}.$$

Denote $f_s = f_L + f_E$, to see that $\varphi^*_{L,old}$ is identical to the lobby and eligibility cutoff in the main paper. If δ is low, then the subsidy is very firm-specific and highly targetable, such that spillovers from lobbying are small. There does always exists a $\underline{\delta} \in [\frac{1}{s}, 1]$ below which all firms that receive the subsidy are also lobbying. In this case we get a single eligibility and lobbying cutoff. Therefore, even in a model with two distinct fixed costs for lobbying and eligibility, for any $\delta \in [\frac{1}{s}, \underline{\delta}]$ the model reduces to one with a single eligibility and lobbying cutoff. Thus, the model with distinct eligibility and lobbying fixed costs and imperfect targetability nests the model with a single eligibility and lobbying fixed cost and perfect targetability.

Chapter 3

Corporate Lobbying and Subsidies – Evidence from US Data

3.1 Introduction

> "It is to be regretted that the rich and powerful too often bend the acts of government to their selfish purposes.", *Andrew Jackson, 7th President of the United States, July 10, 1832.*

More than 180 years ago, President Jackson already observed that wealthy groups in society are especially prone to influence politics in favor of their interest. Nowadays, mainly big corporations are accused of abusing their political connections to benefit from favorable regulations and to receive unwarranted subsidies. Prominent examples of this *corporate welfare* are regularly covered in the media and cause public sensation.[1] However, even though there is a rapidly growing empirical literature on lobbying in economics and political science (e.g., Richter et al. (2009), Igan et al. (2011), Facchini et al. (2011), Ludema et al. (2010), Bombardini and Trebbi (2012), Hill et al. (2013), Chen et al. (2013) and Kerr et al. (forthcoming)), the link between an individual firm's lobbying activities and its received subsidies has so far received only little attention and is not yet fully explored.[2] Thus, besides conventional wisdom little is known, and the economic literature still lacks a comprehensive treatment and understanding of firms' lobbying activities for subsidies.

This is the first empirical paper that provides firm-level evidence on the links between lobbying and a wide range of US subsidy programs.[3] For the period 1999-2010, I create

[1] The Huffington Post (2014) gives ten recent examples of corporate welfare, including yearly subsidies of $243 billion to the fast food industry or $3 billion for corporate jets. The New York Times reports that 48 companies received more than $100 million in state grants since 2007. For instance, GM received $1.77 billion; Shell received $1.68 billion; Ford received $1.58 billion; Chrysler received $1.4 billion; General Electric received $381 million; Amazon received $348 million; Microsoft received $312 million (nytimes.com, retrieved 06.02.2014).

[2] Richter et al. (2009) study lobbying and corporate taxes. Igan et al. (2011) study lenders' risk behavior and their lobbying activities before the US mortgage crisis. Facchini et al. (2011) show that the number of work visa is positively affected by lobbying on immigration issues. Ludema et al. (2010) and Bombardini and Trebbi (2012) study lobbying in a trade policy context. Hill et al. (2013), Chen et al. (2013) study firm performance and lobbying. Kerr et al. (forthcoming) provide evidence of fixed costs to lobbying.

[3] At the time this paper was written, Adelino and Dinc (forthcoming) started to study the relationship between lobbying and government transfers, focusing only on the 2009 Stimulus Act. In contrast, the scope of my paper is much broader, considering richer subsidy data collected from three different sources and covering a period of 12 years.

a uniquely rich firm panel linking firm characteristics of all publicly traded firms in the US and US federal lobbying data, which is considered to be the most comprehensive lobbying data worldwide, to three main sources of US firm-level data on subsidies (i.e., all subsidy programs contained in the Subsidy-Tracker database, all federal grants and investment tax credits).[4] This comprehensive panel data allows me to contribute to the existing literature by answering three research questions. First, I shed light on the question whether larger and more productive firms self-select into lobbying or whether lobbying boosts firm growth. Second, I explore whether lobbying has an effect on the likelihood to receive subsidies. Third, I quantify firm-specific returns to lobbying in terms of received subsidies.

To answer the first research question, I start my empirical analysis by showing that lobbying firms differ systematically from non-lobbying firms in various firm characteristics, both on average (estimated by OLS) and by first-order stochastic dominance (performing nonparametric Kolmogorov-Smirnov tests). I document a considerable *lobby premium* in the levels of firm characteristics. In particular, controlling for firm size (i.e., employees), industry and year fixed effects, lobbying firms sell 24.4% more, have 13.5% higher value-added, 24.7% higher capital, 27.9% higher investment and 3.7% higher TFP. Moreover, lobbying firms also experience significantly higher one-year-ahead growth rates in sales, TFP, value-added and employees.

For subsidized firms, while there is less evidence for a premium in growth rates, I also find evidence for a premium in the levels of firm characteristics. Due to data availability, there are still only few firm-level studies on subsidies to which these findings can be compared. For German manufacturing, Wagner (2010) provides evidence that there are only few and mostly large firms that receive subsidies. Similar results can be found in papers studying R&D subsidy programs for different European countries (e.g., Duguet (2004) for France, Blanes and Busom (2004) for Spain and Hussinger (2008) and Aschhoff (2010) for Germany). Therefore, the premium in levels of firm characteristics for subsidized firms found in my US data is in line with previous findings in the empirical literature.

As the first study in the empirical lobbying literature, this paper goes beyond analyzing only differences in the first moment of firm distributions (i.e., comparing means using OLS estimation) by also testing for first-order stochastic dominance to detect differences in the entire distribution of firm characteristics (i.e., performing nonparametric Kolmogorov-Smirnov tests). The econometric methods and the empirical design I apply to study the premium in firm characteristics are related to recent empirical firm-level

[4] The US federal lobbying data I use are due to the Lobbying Disclosure Act of 1995 and are collected by the Senate Office of Public Records (SOPR). The Center for Responsive Politics (CRP) cleans the data and publishes them on its website opensecrets.org. Federal grants data are directly obtained from the US federal government, usaspending.gov. Information on investment tax credits are obtained from Standard & Poor's Compustat data. Good Jobs First's Subsidy-Tracker is the most comprehensive subsidy database in the US (see goodjobsfirst.org).

studies, mainly in the field of empirical international trade. For instance, performing Kolmogorov-Smirnov tests, first-order stochastic dominance of exporters has first been shown by Delgado et al. (2002).[5] Moreover, in contrast to all previous empirical studies on lobbying, the rich panel structure of my data enables me to apply semi-parametric estimation techniques developed in Olley and Pakes (1996) to estimate time-varying total factor productivity (TFP) at the firm level.[6] This allows me to draw conclusions on reliable and comprehensive measures of firm productivity.

While previous papers also document a size premium for lobbying firms (e.g., Kerr et al. (forthcoming)), findings in the literature on the link between lobbying and firm performance/growth are more ambiguous. For instance, in contrast to Hill et al. (2013) and Chen et al. (2013), the findings in Skaife et al. (2013) suggest that lobbying does not create future shareholder wealth or abnormal stock returns. Also, results in Adelino and Dinc (forthcoming) indicate that firms spend more on lobbying during financially hard times. In general, observing that firms with better characteristics are engaged in lobbying, it is not clear ex-ante if lobbying improved firm characteristics or if firms with better characteristics self-selected into lobbying. Both hypotheses, while not being mutually exclusive, may lead to different policy implications. In order to find support in the data for one hypothesis or the other, I follow Bernard and Jensen (1999, 2004) and adopt an empirical design that is novel to the lobbying literature by dividing firms into four groups with respect to their lobbying status in two consecutive years.[7] Relying on the variation in entry and exit to lobbying allows me to disentangle the lobby premium and to show that there is a clear ranking in terms of firm characteristics. Continuing lobbying firms have better characteristics than both lobby starters and lobby stoppers, who themselves (while being similar to each other) have better characteristics than non-lobbying firms. Again, performing nonparametric Kolmogorov-Smirnov tests, I show that this ranking holds not just on average but for the entire distribution of firm characteristics. Disentangling the lobby premium in one period ahead growth rates, I find that the expected positive effects for starters and continuing lobbying firms and the expected negative effect for lobby stoppers are only confirmed in the employee growth regression. For all other firm characteristics, the effect of the lobby status on growth rates is ambiguous and less robust. These findings suggest that starters and continuing lobbying firms do not experience a robust positive growth premium across all firm char-

[5] See Conover (1999) for details on the Kolmogorov-Smirnov test. Other empirical trade papers testing for first-order stochastic dominance are Girma et al. (2004), Girma et al. (2005), Wagner (2006), Arnold and Hussinger (2010) and Vogel and Wagner (2010). Surveys by Wagner (2007), Wagner (2012) and Bernard et al. (2012) provide an overview of methods applied in empirical international trade.

[6] Kim (2013), while outlining the Olley and Pakes (1996) method in the Appendix, uses only value-added per worker as productivity measure in all of his estimations. The Olley and Pakes (1996) method accounts for both simultaneity of input choices and for self-selection due to firm exit, and has been applied in various empirical firm-level studies (e.g., Pavcnik (2002), De Loecker (2007), Keller and Yeaple (2009)). As entry and exit rates are substantial in my data, the Olley and Pakes (1996) method is well suited to consistently estimate TFP.

[7] Bernard and Jensen (1999, 2004) divide firms with respect to their export status into four groups of starters, stoppers, non-exporters and continuing exporters.

acteristics, and that there is evidence for a (fuzzy) lobby cutoff in firm characteristics, at which firms start or stop lobbying.

To explore further whether lobby starters differed already before starting to lobby, I focus on all firms that did not lobby in the first year of the data (i.e., in 1999) and compare future lobby starters to firms that remain non-lobbying. I show that future lobby starters had already been superior in TFP (and in other firm characteristics) and experienced higher long-run growth rates *before* starting to lobby. Therefore, superior characteristics of lobbying firms predate their entry into lobbying. Moreover, I do not find robust evidence that a firm's initial lobby status has a positive effect on (long-run) growth rates. These findings suggest that there is self-selection into lobbying, implying that firm performance/characteristics may have a causal effect on lobbying (and not the other way round).

As a second contribution, I also shed light on the question whether lobbying has an impact on the likelihood to receive subsidies. Within narrowly defined industries (4-digits NAICS) and controlling for year fixed effects and firm size, lobbying firms are much more likely to be subsidized. In particular, comparing the marginal effect of lobbying to the unconditional likelihood to receive subsidies, lobbying firms are up to 200% more likely to receive subsidies.[8]

While the estimated marginal effects of lobbying on the likelihood to receive subsidies are all highly significant, one may still be in doubt about the existence of a causal effect. While it is impossible to observe in the lobbying data how much lobby effort was put specifically into lobbying for subsidies, I observe both the agency that funds a particular federal grant and the agencies a firm lobbied. In order to make a causal relationship more plausible and to strengthen my findings, I analyze the likelihood of receiving federal grants at the firm-year-agency level – the highest level of disaggregation in my data. In fact, I can show that lobbying a particular federal agency significantly increases the likelihood of receiving a grant from exactly the same agency. In comparison to the marginal effect of lobbying in general, the marginal effect of lobbying a particular federal agency is by an order of magnitude larger.

Disentangling the likelihood of receiving subsidies with respect to a firm's lobby status, I find that continuing lobbying firms are much more likely to be subsidized than both lobby starters and lobby stoppers, and that the latter two groups are also significantly more likely to be subsidized than non-lobbying firms. However, the marginal effect of lobbying is driven by continuing lobbying firms, and in comparison to these firms, starting to lobby is not associated with an additional increase in the likelihood of receiving subsidies.

A third contribution of this paper is to quantify firm-specific returns to lobbying in

[8] I perform several robustness checks in Appendix 3.A.2. Estimating a Probit model (instead of a linear probability model) and including interaction terms does not change the results qualitatively.

terms of subsidies.[9] Controlling for firm size, industry and year fixed effects, I find that lobbying firms receive on average between 24% and 51% more in subsidy payments. Returns on lobby expenditures are also substantial. Overall, one US-dollar more in a firm's lobbying expenses increases the amount of received subsidies by up to 9.65 US-dollars, or in other words, yields a return on investment of 865%. At first glance, this number may seem too high, but in comparison to previous findings in the literature it is not. For instance, using a tax law change on repatriated earnings, Alexander et al. (2009) estimate returns on lobbying expenditures of about 22,000%.[10] By using this specific variation in the tax code, the research design in Alexander et al. (2009) suffers from a comparably small sample size of just 93 lobbying firms. In contrast, results in my paper rely on 12 years of information, identifying 13,693 observations that lobby and 11,994 observation that receive subsidies.

To summarize, my findings suggest that firms with better firm characteristics self-select into lobbying, that lobbying has a statistically significant and economically relevant positive effect on the likelihood to receive subsidies, and that returns to lobbying in terms of subsidies are huge.

This paper is organized as follows. In Section 3.2 I give an overview of the data and describe how I estimate TFP at the firm level. Section 3.3 analyzes the premium in firm characteristics for lobbying firms and for subsidized firms. In Section 3.4, I study the link between lobbying and the likelihood of receiving subsidies. In Section 3.5, I provide estimates for the returns to lobbying in terms of received subsidies. Section 3.6 concludes.

3.2 Data

3.2.1 Data sources

I combine a variety of different data sources to create a rich panel data set linking firm characteristics to lobbying data and to subsidy data at the firm level.

Compustat. For all companies that are publicly traded in the US, Standard&Poor's *Compustat North America* database provides annual information on firm characteristics (e.g., sales, employees, industry identifier, company name).[11] As Table 3.1 shows, for the period 1999-2010, the Compustat sample is an unbalanced panel that contains 16,315 unique firm entries, which add up to 107,887 firm-year observations. Compustat does not contain much information on firms' received subsidies. The only variable available

[9] Measuring returns to lobbying only n terms of subsidies understates the true benefits from lobbying, such that my results should be seen as lower bounds on the true returns to lobbying.

[10] Even higher estimates can be found in public press articles. Comparing lobbying expenditures by Lockheed Martin since 1999 ($55 million) to its defense contracts ($90 billion), Fortune Magazine (2006) calculates a return on lobbying of 163,536%. Similarly, according to Fortune Magazine (2006) Boeing's return on lobbying expenditures was 142,000% in the same period.

[11] I obtained Compustat data from Wharton Research Data Services (WRDS), wrds-web.wharton.upenn.edu. Compustat North America contains more than 300 annual items, taken from firms' Income Statement, Balance Sheet, Statement of Cash Flows, and supplemental data.

in Compustat related to subsidies is *Investment Tax Credits* (ITC), which includes *"... the amortized portion of tax savings (brought about by the purchase of machinery and equipment, and/or the creation of new jobs) that reduces the current year's tax liability."* (Standard and Poor's, 2004, p. 256). As the detailed list in Table 3.49 in Appendix 3.C shows, the ITC variable includes a wide range of different tax credit programs (e.g., R&D tax credits, energy tax credits, new job tax credits). Within my Compustat sample, 6,978 firm-year observations (1,926 unique firms) make use of ITC in the period 1999-2010. See Appendix 3.C for further details on the Compustat sample.

Lobbying. Due to the Lobbying Disclosure Act of 1995 (LDA), US lobbyists[12] are required to report their lobbying activities in great detail to the Senate Office of Public Records (SOPR).[13] Most importantly, lobbying reports contain information about lobbying issues[14], the amount of payments a registered lobbyist received from a particular client[15], and the federal agency that was lobbied. To check for consistency of the reported data, SOPR compares lobbying expenditures of clients and lobby revenues of lobbyists. Because of this, and due the mandatory reporting requirements, US lobbying data are the most comprehensive and consistent lobbying data worldwide. Appendix 3.E.1 contains two extracts of a lobby registration report and a quarterly lobbying activity report, receptively, showing the comprehensiveness of US lobbying disclosure. The lobbying data I use start in 1999 and are provided by the Center for Responsive Politics (CRP), a non-profit organization based in Washington DC, which cleans the raw SOPR data, adds additional information and publishes the data on its website, opensecrets.org.[16] See Appendix 3.E.1 for further details on the lobbying data and for variable descriptions provided by CRP.[17]

Subsidy-Tracker. Firm-level data on subsidies are still rare. Recently*, Good Jobs First* a Washington D.C. based think-tank, started to collect firm-level data for a wide

[12]In its Lobbying Disclosure Act Guidance, the Senate Office of Public Records defines a lobbyist as: *"Any individual (1) who is either employed or retained by a client for financial or other compensation (2) whose service include more than one lobbying contracts; and (3) whose lobbying activities constitute 20 percent or more of his or her services' time on behalf of that client during any three-month period."* (The Senate Office of Public Records, 2010, p. 4).

[13]Starting in 1998, all filings are publicly available at the SOPR website, senate.gov. To prevent the issue of misreporting in the first year of available data, I restrict my data to the period 1999-2010. For this period, the legal (biannual) threshold for reporting lobbying expenditures is 10.000 US-dollar (for 2008-2010 the quarterly threshold is 5000 US-dollar). I account for left-censoring of lobby expenditures by running a Tobit model as robustness check.

[14]Appendix 3.E.1 contains a list of all 79 general issues a lobbyist can indicate in a report. Reports often contain additional information on the specific lobbying issue.

[15]In its Lobbying Disclosure Act Guidance, the Senate Office of Public Records defines a client as: *"Any person or entity that employs or retains another person for financial or other compensation to conduct lobbying activities on behalf of the person or entity. An organization employing its own lobbyists is considered its own client for reporting purposes."* (The Senate Office of Public Records, 2010, p. 3).

[16]CRP links subsidiaries to parent firms, which allows me to calculate total lobby expenditures for parent firms. A firm's lobby expenditures are individual payments. Contributions to industry lobby groups are not reported. However, a lobbyist may be hired by several clients to lobby for a single issue.

[17]Before firm-level lobbying data became available, most studies used PAC contributions to proxy lobbying activities (e.g., Goldberg and Maggi (1999), Gawande and Bandyopadhyay (2000) and Bombardini (2008)). See Ansolabehere et al. (2003) for a survey on US campaign contributions. Ansolabehere et al. (2002) study the relationship between PAC contributions and lobbying.

range of US subsidy programs.[18] Publicly available at the *Subsidy-Tracker* website, goodjobsfirst.org, these data provide the most comprehensive firm-level information on subsidies in the US. Starting in 1973, Subsidy-Tracker data covers more than 430 subsidy programs adding up to more than 248,000 distinct observations. See Appendix 3.F.1 for more details and for a list of variable definitions for the Subsidy-Tracker data. Table 3.60 in Appendix 3.F.1 provides details on the contained subsidy types and further summary information on the Subsidy-Tracker data.

Federal Grants. I obtain additional firm-level information about federal grants directly from the US Federal Government. Due to the Federal Funding Accountability and Transparency Act (FFATA) of 2006, the Office of Management and Budget (OMB) publishes firm-level data on federal grants on the website usaspending.gov. The disclosed data start in 2000 and contain detailed award information (e.g., name and location of receiving entity, funding amount, transaction type, funding agency) from more than 30 departments and agencies of the executive branch of the US Federal Government. Combining the provided information about the funding agency of a federal grant with the detailed lobbying data allows me to conduct my empirical analysis in Section 3.4 even at the highly disaggregated firm-year-agency level. See Appendix 3.G.1 for further details on federal grants data and on public disclosure of US federal spending.

Other data. To deflate nominal variables, I use industry Producer Price Indices (PPI) provided by the Bureau of Economic Analysis (BEA), up to the 6-digit NAICS level.[19] Annual average wages at the industry level are obtained from the Bureau of Labor Statistics (BLS).[20] See Appendix 3.C for details.

3.2.2 Merging data sources and descriptive statistics

Merging Compustat data with firm-level data on lobbying and subsidies is difficult, mainly because the different data sets lack unique identifiers that link records. Therefore, I employ so called *fuzzy string matching* methods that are explicitly developed to find the approximately closest match of a record in another data set (e.g., when typos or coding errors make exact matching impossible). In particular, I make use of STATA's built-in commands *merge* and *reclink* to connect the different data sources by applying so-called bigram string matching methods (see Appendix 3.D for details).[21] Fuzzy string matching delivers a list of potential matches, which has to be verified manually. This has been done carefully by using additional information, such as the business description, the industry classifier, the state, the city and the zip code of a company. Whenever a proposed match was not clearly a true match, further company information was acquired by using Internet search engines. If any doubt remained, the company was not marked as

[18] See Table 3.60 in Appendix 3.F for a list of the different Subsidy-Tracker subsidy programs covered in my data.
[19] Producer price index data are taken from US Industry Economic Accounts, available online at bea.gov.
[20] Average wage data are taken from the Quarterly Census of Employment and Wages Program (QCEW), available online at ftp.bls.gov.
[21] For details on the reclink command, see Blasnik (2010).

Table 3.1: Panel data overview

				Annual average (1999-2010)		
Firm type	Obs.	% all obs.	Unique firms	Obs.	entry rate	exit rate
All	107887	100.00%	16315	8991	4.94%	7.83%
Lobbying	13693	12.69%	2710	1141	1.69%	4.32%
Lobby starters	1968	1.82%	1722	164	0.00%	5.79%
Not lobbying	94194	87.31%	15573	7850	5.41%	8.34%
Lobby stoppers	1281	1.19%	1118	107	0.00%	7.73%
No subsidy	95893	88.88%	15924	7991	5.24%	8.17%
Any subsidy	11994	11.12%	3500	1000	2.51%	5.13%
Subsidy-Tracker	4245	3.93%	1681	354	1.60%	3.91%
No Subsidy-Tracker	103642	96.07%	16265	8637	5.07%	7.99%
Federal Grants	2040	1.89%	730	170	3.53%	3.82%
No Federal Grants	105847	98.11%	16296	8821	4.96%	7.90%
ITC	6978	6.47%	1926	582	2.61%	5.75%
No ITC	100909	93.53%	16003	8409	5.10%	7.97%

Notes: Lobby starters did not lobby in period *t-1* but lobby in period *t*. Lobby stoppers lobbied in period *t-1* but do not lobby in period *t*. Entry/exit rates are with respect to firm entry/exit of the Compustat sample. ITC denotes *Investment Tax Credit* from Compustat. For details on variable meanings and data sources, see Appendix.

a match. Table 3.56 in Appendix 3.D provides examples of manually rejected matches.

The results from merging all data sources are summarized in Table 3.1. Matching lobbying data with Compustat, overall 13,693 out of 107,887 firm-year observations could be identified as lobbying firms.[22] From Subsidy-Tracker data, 4,245 firm-year observations were matched to Compustat.[23] From federal grants data, 2,040 firm-year observations could be identified in Compustat.[24] Together with Compustat's Investment Tax Credits (ITC) variable, there are 11,994 observations that could benefit at least from one of the different subsidy measures. Note that there are only 1,269 observations that are identified to receive subsidies from multiple data sources. This shows the importance of matching Compustat data with different sources of subsidy data, and that the applied fuzzy string matching algorithms are quite flexible in finding correct matches.

Table 3.2 shows summary statistics of the main variables of interest (in levels) in the combined panel data. Compustat firms are all publicly traded and therefore relatively big enterprises (e.g., average sales are more than 2 billion US-dollar, more than 8000 employees on average). The distributions of firm characteristics, received subsidies and lobby expenditures are highly skewed with mean values substantially above the median.[25] On average, subsidized firms receive between 1.89 (Subsidy-Tracker) and 10.99 (ITC) million US-dollar in subsidies. Given the information provided in Table 3.2, it is straightforward to calculate total annual average subsidies received by firms in my sample (i.e., calculating $\frac{Mean*Obs.}{12}$ for each subsidy group). In total, annual averages of received subsidies are more than 668 million US-dollar from Subsidy-Tracker, more than

[22] The share of identified firms is close to Kerr et al. (forthcoming) who identify 11% of observations (3,260 out of 29,340 firms) in their sample in the period 1998-2006. See Appendix 3.E for further details on matching lobby data to Compustat.

[23] Appendix 3.F provides further details on matching Subsidy-Tracker data to Compustat.

[24] Appendix 3.G provides further details on matching federal grants data to Compustat.

[25] Skewed data are likely to violate the OLS assumption of normally distributed error terms. I account for this by using log values if necessary.

Table 3.2: Summary statistics

Variable	Obs.	Mean	Median	Std. Dev.
Firm characteristics				
Sales in \$m	107839	2092.37	122.33	9805.87
Value-added in \$m	94147	860.32	56.19	4001.04
Capital in \$m	105158	857.93	22.37	4098.58
Investment in \$m	102149	150.11	4.63	873.37
Employees in 1000s	94184	8.17	0.58	37.14
Subsidy amount in \$m				
Subsidy-Tracker	4245	1.89	0.08	20.69
Federal Grants	2040	4.22	0.55	18.97
ITC	6978	10.99	0.76	81.42
All subsidies	11994	7.78	0.48	67.47
Lobbying				
Yearly expenditures in \$m	13690	0.62	0.13	1.61

Notes: All monetary variables are in constant 1999 US\$ (millions), deflated by the industry PPI. Subsidy amounts indicate either subsidies from Subsidy-Tracker, ITC, Federal Grants or the sum of all of those (all subsidies). Value-added is *Operating Income Before Depreciation plus Labor Cost*. Capital is *Property, Plant and Equipment*. Investment is *Capital Expenditures*.

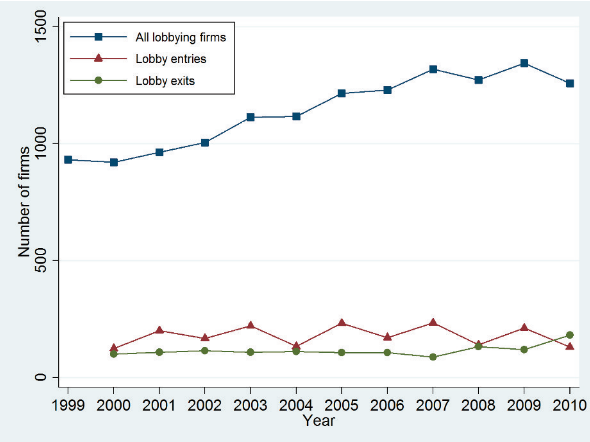


Figure 3.1: Lobby entry and exit, 1999-2010

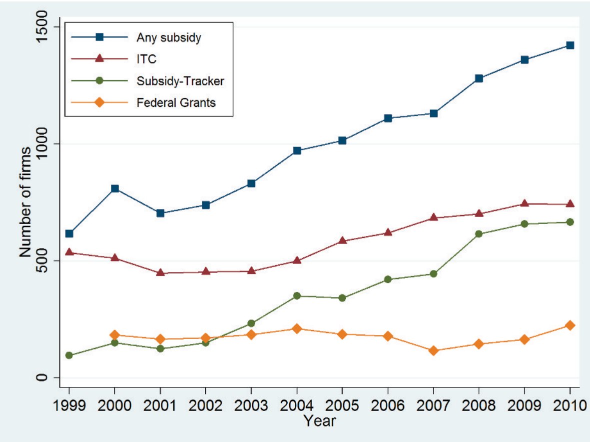


Figure 3.2: Number of subsidized firms, 1999-2010

717 million US-dollar from Federal Grants, more than 6.3 billion US-dollar due to ITC, and overall more than 7.7 billion US-dollar. Average lobby expenditures per lobbying firm are 610.000 US-dollar. In total, this number translates into annual average lobby expenditures of more than 695 million US-dollar. Thus, expressed in per-firm values as well as in total annual averages, my data set covers a substantial amount of subsidies and lobby expenditures.

Figure 3.1 displays the number of firms participating in lobbying and lobby entry/exit over time. From 1999-2010, the overall number of lobbying firms increases. However, there is also a considerable number of firms entering and exiting lobbying. In the empirical analysis in Section 3.3, I make use of this entry/exit variation to disentangle the effects of lobbying. Figure 3.2 depicts the number of Compustat firms that receive subsidies through ITC, through subsidy programs listed by Subsidy-Tracker or through Federal Grants. For all sources of subsidy information, the number of receiving firms increases in the period 1999-2010.

3.2.3 Estimating firm-level TFP

Before investigating the relationship between lobbying, receiving subsidies and firm productivity, it is important to get reliable estimates of firm TFP.[26] To obtain time-varying TFP at the firm level, the panel structure of my data allows me to rely on the semi-parametric estimation techniques developed in Olley and Pakes (1996).[27] The Olley and Pakes (1996) approach of estimating production functions improves OLS estimation in two important dimensions. First, OLS estimates could be biased due to simultaneity of input choices. Variable inputs (labor) may depend positively on current period's firm productivity, leading to an upward bias in the estimated coefficients. Olley and Pakes (1996) solve this problem by using investment (assumed to be strictly increasing in productivity) to proxy unobserved productivity shocks. Second, OLS estimates could also be biased due to self-selection induced by firm exit. A firm's productivity and its capital stock are likely to be negatively correlated, because firms with low capital stock exit the market even with high productivity shocks. This leads to a downward bias in the OLS estimate of the capital coefficient. Olley and Pakes (1996) accounted for this selection bias by explicitly modeling an exit rule. As Table 3.1 shows, firm entry and exit rates in Compustat are quite substantial.[28] Therefore, applying the Olley and Pakes (1996) approach is important for a reliable estimation of TFP in my data.[29] Given a particular industry, let y_{it}, l_{it} and k_{it} denote log values of value-added, labor and capital inputs of firm i at time t. Given a Cobb-Douglas production function, a firm's total factor productivity in log values is

$$TFP_{it} = y_{it} - \hat{\beta}_l \cdot l_{it} - \hat{\beta}_k \cdot k_{it},$$

where $\hat{\beta}_l$ and $\hat{\beta}_k$ are the coefficients for capital and labor, estimated with the Olley and Pakes (1996) procedure. My results are robust to using the Levinsohn and Petrin (2003) approach, where intermediate inputs (instead of investment) are used as proxy variable. In Appendix 3.B, I report estimated coefficients for a 2-digit NAICS Cobb-Douglas production function for both the Olley and Pakes (1996) method (Table 3.47) and the Levinsohn and Petrin (2003) method (Table 3.48). As the scatter plot in Figure 3.6 in Appendix 3.B shows, TFP estimates of both methods are highly correlated ($\rho = 0.93$). Ackerberg et al. (2006) provide a thorough critique of both approaches and highlight collinearity problems, in particular for the Levinsohn and Petrin (2003) methodology. Therefore, I decided to use TFP from an Olley and Pakes (1996) estimation. For more

[26] Alternatively to estimating TFP, value-added per worker (or sales per worker) could be used as a proxy for (labor) productivity. However, these measures of firm productivity may be less reliable than TFP, because they neglect the influence of other inputs (e.g., capital) on productivity. See Syverson (2011) for a survey on the determinants of firm-level productivity differences and for limitations of different firm productivity measures.

[27] See Keller and Yeaple (2009) for a study conducting an Olley and Pakes (1996) estimation with Compustat data. I use the command `opreg`, that implements the Olley and Pakes (1996) method in Stata (Yasar et al., 2008).

[28] Firms not longer observed in Compustat are not longer publicly traded but may still be in business.

[29] To apply standard Olley and Pakes (1996) methods, I implicitly treat TFP as being independent from lobbying. See De Loecker (2007) for a modified and more involved version of the Olley and Pakes (1996) framework, which could be used to control for the lobby status of a firm.

Table 3.3: Lobby premium and subsidy premium in levels

	Premium coefficient (levels)				
	Lobby	Subsidy-Tracker	Federal Grants	ITC	Any subsidy
Sales	0.244***	0.149***	-0.034	0.254***	0.195***
	(0.0201)	(0.0237)	(0.0353)	(0.0224)	(0.0173)
TFP	0.037***	-0.033***	-0.133***	0.086***	0.024**
	(0.0125)	(0.0129)	(0.0292)	(0.0142)	(0.0108)
Value-added	0.135***	0.118***	-0.029	0.217***	0.155***
	(0.0158)	(0.0158)	(0.0328)	(0.0169)	(0.0126)
Capital	0.247***	0.233***	0.272***	0.277***	0.279***
	(0.0246)	(0.0257)	(0.0482)	(0.0266)	(0.0204)
Investment	0.279***	0.265***	0.319***	0.333***	0.339***
	(0.0238)	(0.0276)	(0.0516)	(0.0268)	(0.0210)
Employees	2.138***	2.003***	0.965***	0.721***	1.182***
	(0.0513)	(0.0661)	(0.1257)	(0.0590)	(0.0466)

Notes: The dependent variable in all regressions is the respective firm characteristic in logs. The dummy *Lobby* equals one if a firm lobbied in year t. Subsidy dummies indicate either subsidies from Subsidy-Tracker, ITC, Federal Grants or the combination of those (any subsidy) in year t. Number of observations between 77501 and 91383. Adjusted R-squared between 0.25 and 0.89. All regressions include 4-digit NAICS fixed effects and year fixed effects. All regressions include log firm employment to control for size, except for the employee regression. Robust standard errors are denoted in parentheses and are clustered at the firm level. Monetary variables are in constant 1999 US$ (millions), deflated by the industry PPI. TFP is firm-level total factor productivity obtained from an Olley and Pakes (1996) estimation of an industry production function at the 2-digit NAICS level. Value-added is *Operating Income Before Depreciation plus Labor Cost.* Capital is *Property, Plant and Equipment.* Investment is *Capital Expenditures.* * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

details on TFP estimation techniques, see Appendix 3.B.

3.3 Premium in characteristics for lobbying/subsidized firms

3.3.1 Premia in levels

OLS estimation. In a first step, I explore whether there is a lobby premium and/or a subsidy premium in the levels of firm characteristics. Therefore, I compare lobbying firms with non-lobbying firms, and subsidized firms with not-subsidized firms, with respect to their firm characteristics, controlling for other observables. I estimate the following equations by OLS:

$$\ln Y_{ijt} = \beta_0 + \beta_1 \cdot D_{it} + \beta_2 \cdot \ln Emp_{it} + \alpha_j + \lambda_t + \epsilon_{ijt}, \tag{3.1}$$

where $\ln Y_{ijt}$ is the log value of firm i's characteristic in industry j, observed in year t. The dummy variable D_{it} indicates whether in year t a firm is either lobbying (when I consider the lobby premium) or whether a firm receives a subsidy (when I consider the subsidy premium). Log employees ($\ln Emp_{it}$) controls for firm size, α_j are 4-digit NAICS industry fixed effects to control for time-invariant industry differences, and λ_t are year fixed effects to account for aggregate shocks across all industries. Standard errors are clustered at the firm level to account for intragroup error correlation (Moulton, 1986).

For the sake of brevity, Table 3.3 reports only the 30 estimated premium coefficients β_1 from estimating equation (3.1) for the respective firm characteristics (i.e., sales, TFP, value-added, capital, investment and employees). The R^2 is relatively high across all regressions (between 0.25 and 0.89), indicating a good model fit.

For the lobby premium (first column), all coefficients are positive and statistically significant at the one percent level. Moreover, the estimated lobby premium is also economically relevant. Within narrowly defined industries (4-digit NAICS), and controlling for year fixed effects and firm size (log employees), lobbying firms sell 24.4% more, have 13.5% higher value-added, 24.7% higher capital, 27.9% higher investment and they are 3.7% more productive.[30]

For the subsidy premium, results are more nuanced. Firms identified by the Subsidy-Tracker dummy (column 2), while dominating in all other firm characteristics, are significantly less productive. Firms receiving federal grants (column 3) are also significantly less productive, while investing more and using more capital than their non-subsidized counterparts. However, for ITC and for the pooled subsidy dummy (columns 4 and 5), there is a positive and statistically significant premium across all firm characteristics.

In Appendix 3.A.1, I also report results from t-tests showing that subsidized and lobbying firms have better firm characteristics in the pooled sample. Moreover, in Appendix 3.A.1 I also report results from estimating equation (3.1) without controlling for firm size. In this case, all positive premium coefficient are statistically significant at the one percent level. Overall, these results suggest that *on average* lobbying and subsidized have better firm characteristics.

Nonparametric Kolmogorov-Smirnov test. Figure 3.3 and Figure 3.4 show the *relative* empirical cumulative distribution functions of various firm characteristics for lobbying/non-lobbying firms and for subsidized/not-subsidized firms, respectively. To account for compositional effects, the distributions are already normalized and relative to the respective 4-digit NAICS industry-year mean. Both lobbying firms and subsidized firms not only have better firm characteristics on average (as shown in Table 3.3), Figures 3.3 and 3.4 also suggest that their distributions first-order statistically dominate the distributions of non-lobbying firms and not-subsidized firms, respectively.

To test for first-order stochastic dominance, I perform nonparametric two-sample Kolmogorov-Smirnov tests.[31] Denote $F^1(x)$ the CDF of firm characteristic x for firms that are identified ($D_{it} = 1$) as lobbying or receiving subsidies, respectively. Similarly, denote $F^0(x)$ the CDF of firm characteristic x for firms that are *not* identified ($D_{it} = 0$). To test for first-order stochastic dominance, I evaluate a two-sided Kolmogorov-Smirnov test and a one-sided Kolmogorov-Smirnov test. Equality of distributions can be tested by a two-sided Kolmogorov-Smirnov test. The null and alternative hypotheses are

$$H_0 : F^1(x) - F^0(x) = 0 \, \forall x \in \mathfrak{R} \text{ vs. } H_1 : F^1(x) - F^0(x) \neq 0 \text{ for some } x \in \mathfrak{R}.$$

The corresponding two-sided test statistic is $KS_2 = \max_x |F^1(x) - F^0(x)|$. The hypothesis that $F^1(x)$ lies to the right of $F^0(x)$ is tested by the one-sided Kolmogorov-Smirnov

[30] Estimates of β_1 are large, such that a log approximation of the premium understates the effect. The mathematically precise premium is $100^*(\exp(\beta_1) - 1)\%$.

[31] I pool observations across all years. Technically, the two-sample Kolmogorov-Smirnov requires independence, which is likely to be violated in a pooled sample. I account for this issue by normalizing variables with respect to their industry-year mean. Performing Kolmogorov-Smirnov tests for each year separately delivers similar results (not reported here). See chapter 6.3 in Conover (1999) for further details on the Kolmogorov-Smirnov test.

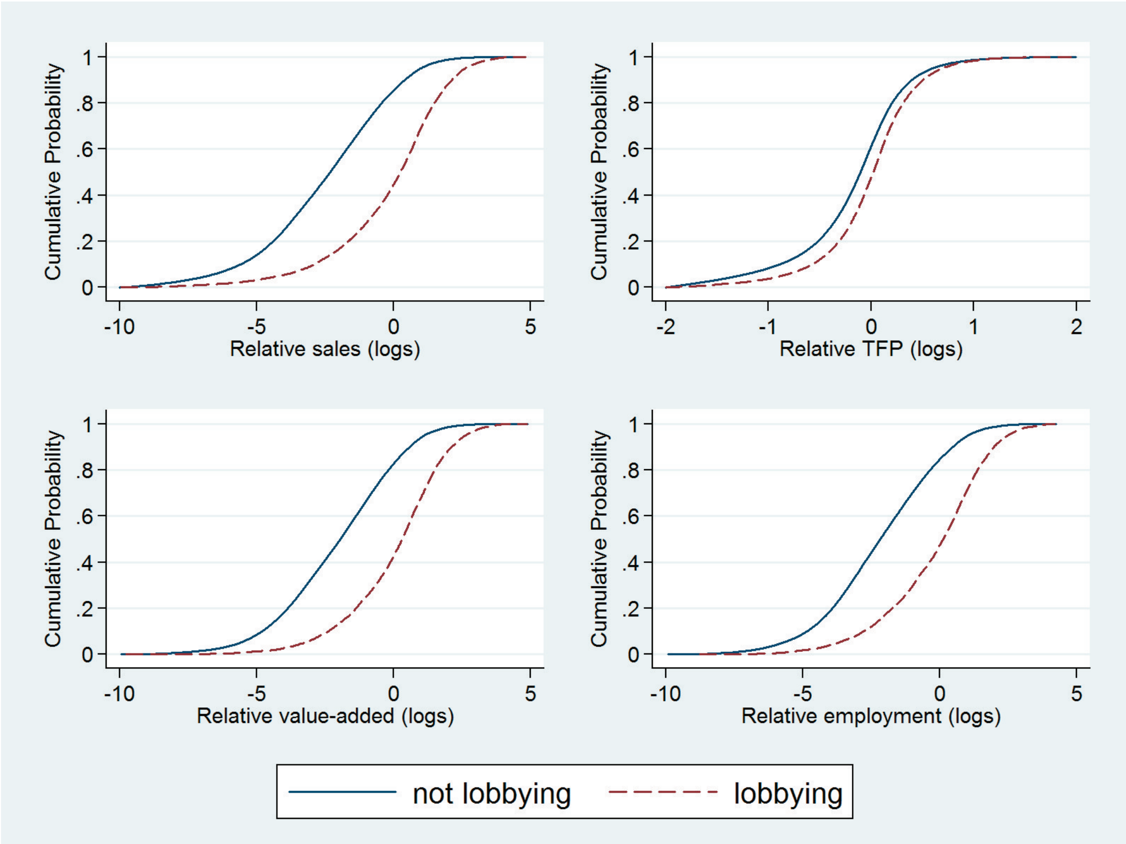


Figure 3.3: Empirical distributions relative to industry-year mean: lobbying/not-lobbying

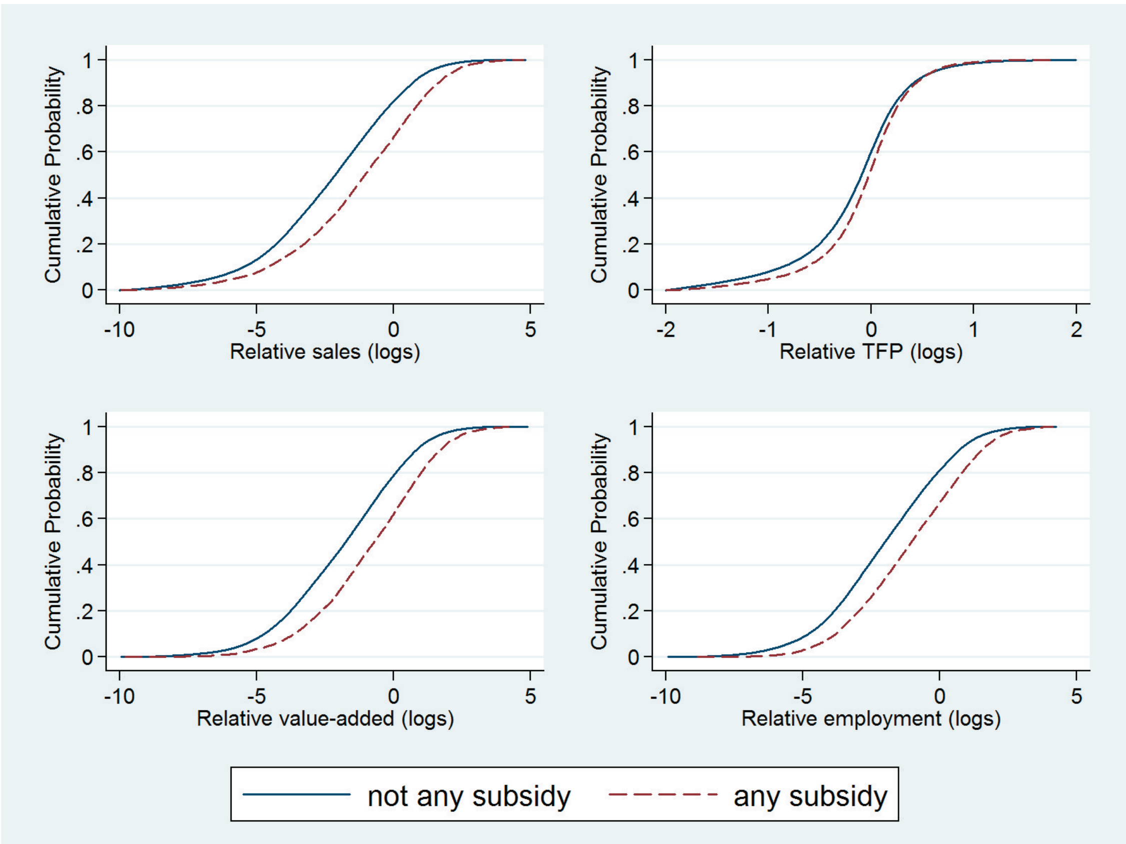


Figure 3.4: Empirical distributions relative to industry-year mean: subsidized/not-subsidized

Table 3.4: Kolmogorov-Smirnov test for first-order stochastic dominance

	Lobby	Subsidy-Tracker	Federal Grants	ITC	Any subsidy
Sales					
$H_0 : F^1 \leq F^0$	0.00	-0.00	-0.05***	-0.00	-0.00
$H_0 : F^1 = F^0$	0.44***	0.40***	0.17***	0.11***	0.18***
N^1/N^0	13690/ 94149	4244/103595	1927/105912	6978/100861	11993/ 95846
TFP					
$H_0 : F^1 \leq F^0$	-0.00	-0.01	-0.04**	-0.00	-0.01
$H_0 : F^1 = F^0$	0.15***	0.12***	0.09***	0.09***	0.10***
N^1/N^0	11823/ 66703	3816/ 74710	1268/ 77258	5701/ 72825	9802/ 68724
Value-added					
$H_0 : F^1 \leq F^0$	-0.00	-0.00	-0.00	-0.00	-0.00
$H_0 : F^1 = F^0$	0.42***	0.36***	0.29***	0.10***	0.18***
N^1/N^0	12153/ 70452	3891/ 78714	1285/ 81320	5717/ 76888	9908/ 72697
Capital					
$H_0 : F^1 \leq F^0$	-0.00	0.00	-0.00	-0.00	0.00
$H_0 : F^1 = F^0$	0.42***	0.38***	0.17***	0.08***	0.16***
N^1/N^0	13326/ 89013	4166/ 98173	1916/100423	6964/ 95375	11892/ 90447
Investment					
$H_0 : F^1 \leq F^0$	-0.00	-0.00	-0.00	-0.00	-0.00
$H_0 : F^1 = F^0$	0.41***	0.38***	0.17***	0.09***	0.16***
N^1/N^0	13031/ 82530	4120/ 91441	1896/ 93665	6917/ 88644	11780/ 83781
Employees					
$H_0 : F^1 \leq F^0$	-0.00	-0.00	-0.00	-0.00	-0.00
$H_0 : F^1 = F^0$	0.40***	0.38***	0.16***	0.10***	0.16***
N^1/N^0	13023/ 79562	4050/ 88535	1806/ 90779	6537/ 86048	11261/ 81324

Notes: Reported test statistics are from two-sample Kolmogorov-Smirnov tests for first-order stochastic dominance between the firm characteristics distributions of two groups of firms. Test results for the one-sided null hypothesis $F^0 \leq F^1$ are omitted. Firm characteristics in logs, relative to industry-year mean at 4-digit NAICS level. The dummy *Lobby* equals one if a firm lobbied in year t. Subsidy dummies indicate either subsidies from Subsidy-Tracker, ITC, Federal Grants or the combination of those (any subsidy) in year t. Monetary variables are in constant 1999 US$ (millions), deflated by the industry PPI. TFP is firm-level total factor productivity obtained from an Olley and Pakes (1996) estimation of an industry production function at the 2-digit NAICS level. Value-added is *Operating Income Before Depreciation plus Labor Cost.* Capital is *Property, Plant and Equipment.* Investment is *Capital Expenditures.* * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

test. The null and alternative hypotheses are

$$H_0 : F^1(x) - F^0(x) \leq 0 \, \forall x \in \mathfrak{R} \text{ vs. } H_1 : F^1(x) - F^0(x) > 0 \text{ for some } x \in \mathfrak{R}.$$

The corresponding one-sided test statistic is $KS_1 = \max_x\{F^1(x) - F^0(x)\}$.[32] For first-order stochastic dominance of $F^1(x)$ over $F^0(x)$ to hold, the null hypothesis of the two-sided test has to be rejected and the null hypothesis of the one-sided test ($F^1(x) \leq F^0(x)$) must not be rejected.

The results of the Kolmogorov-Smirnov tests, which are reported in Table 3.4, confirm the predictions from Figures 3.3 and 3.4. For lobbying, first-order stochastic dominance holds for all considered firm characteristics. Except for sales and TFP of firms that receive federal grants, first-order stochastic dominance holds also for all subsidy measures and across all firm characteristics. Thus, these findings suggest that lobbying firms and subsidized firms have better firm characteristics, not only on average (i.e., estimated by OLS) but also by first-order stochastic dominance, such that the entire distribution of firm characteristics differ.

[32]Similarly, for testing whether $F^0(x)$ first-order stochastic dominates $F^1(x)$ the one-sided hypotheses are given by: $H_0 : F^0(x) - F^1(x) \leq 0 \, \forall x \in \mathfrak{R}$ vs. $H_1 : F^0(x) - F^1(x) > 0$ for some $x \in \mathfrak{R}$. The corresponding test statistic is given by $KS_0 = \max_x\{F^0(x) - F^1(x)\}$.

Table 3.5: Lobby premium and subsidy premium in $t+1$ growth rates

	Premium coefficient (growth)				
	Lobby	Subsidy-Tracker	Federal Grants	ITC	Any subsidy
Sales	0.010*	-0.001	0.034**	0.007	0.008
	(0.0051)	(0.0067)	(0.0168)	(0.0073)	(0.0058)
TFP	0.008**	0.003	0.012	-0.007	-0.002
	(0.0040)	(0.0060)	(0.0116)	(0.0051)	(0.0043)
Value-added	0.020***	0.015**	0.025	0.003	0.011*
	(0.0050)	(0.0072)	(0.0161)	(0.0066)	(0.0054)
Capital	-0.003	0.005	0.006	0.009	0.011**
	(0.0052)	(0.0063)	(0.0131)	(0.0070)	(0.0054)
Investment	0.001	-0.004	0.036*	-0.007	0.002
	(0.0072)	(0.0103)	(0.0201)	(0.0096)	(0.0078)
Employees	0.020***	0.025***	0.018*	0.013***	0.020***
	(0.0039)	(0.0047)	(0.0099)	(0.0050)	(0.0039)

Notes: The dependent variable in all regressions is the first difference of the respective firm characteristic in logs in year *t+1*. The dummy *Lobby* equals one if a firm lobbied in year *t*. Subsidy dummies indicate either subsidies from Subsidy-Tracker, ITC, Federal Grants or the combination of those (any subsidy) in year *t*. Number of observations between 63137 and 77279. Adjusted R-squared between 0.02 and 0.03. All regressions include 4-digit NAICS fixed effects and year fixed effects. All regressions include log firm employment to control for size. Robust standard errors are denoted in parentheses and are clustered at the firm level. Monetary variables are in constant 1999 US$ (millions), deflated by the industry PPI. TFP is firm-level total factor productivity obtained from an Olley and Pakes (1996) estimation of an industry production function at the 2-digit NAICS level. Value-added is *Operating Income Before Depreciation plus Labor Cost.* Capital is *Property, Plant and Equipment.* Investment is *Capital Expenditures.* * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

3.3.2 Premia in growth rates

Premia in short-run growth rates. If lobbying and subsidized firms have better firm characteristics in levels, it is important to explore whether these firms also experience higher growth rates. Therefore, I test whether today's lobby-status is related to future growth rates. I estimate the following equation by OLS:

$$\Delta \ln Y_{ij,t+1} = \beta_0 + \beta_1 \cdot D_{it} + \beta_2 \cdot \ln Emp_{it} + \alpha_j + \lambda_t + \epsilon_{ijt}, \tag{3.2}$$

where $\Delta \ln Y_{ijt+1}$ is the log change (yearly growth rate) of the firm characteristic of interest in year $t+1$. The dummy variable D_{it} indicates whether in year t a firm is either lobbying (when I consider the lobby premium) or whether a firm receives a subsidy (when I consider the subsidy premium). Log employees are denoted by $\ln Emp_{it}$, α_j are industry fixed effects and λ_t are year fixed effects. Standard errors are clustered at the firm level.

Table 3.5 summarizes the results from estimating equation (3.2) by showing the respective growth premium coefficient β_1. For lobbying (first column), premium coefficients are only statistically significant for sales, TFP, value-added and employees. For the subsidy premia (columns 2-5), results are even more ambiguous. For all regressions, the R^2 is relatively small and varies between 0.02 and 0.03. As a robustness check, in Appendix 3.A.1 I report regression results for growth rates in year t as dependent variable. In this case, except for TFP, there is a negative lobby premium for all firm characteristics and results for subsidies are also not conclusive. Thus, in comparison to the estimated premium in levels of firm characteristics, the estimated premium in growth rates for lobbying firms are less robust. To further explore the relationship be-

Table 3.6: Premium in long-run growth rates (1999-2010) for initially lobbying firms

Dep. Variable: Average Growth Rate	Sales	TFP	Value-added	Capital	Investment	Employees
Lobby in 1999	0.006	0.001	0.011**	0.011**	0.011*	-0.010**
	(0.0055)	(0.0024)	(0.0046)	(0.0055)	(0.0067)	(0.0042)
Log employees in 1999	-0.008***	-0.001	-0.009***	-0.004***	-0.006***	
	(0.0014)	(0.0008)	(0.0012)	(0.0013)	(0.0016)	
R-squared	0.16	0.29	0.25	0.13	0.16	0.11
Observations	3571	2924	3053	3401	2939	3429
4-digit NAICS FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The dependent variable in all regressions is the average growth rate of the respective firm characteristic in the period 1999 – 2010. The dummy *Lobby in 1999* equals one if a firm lobbied in 1999. All regression include 4-digit NAICS fixed effects. Robust standard errors are denoted in parentheses. Monetary variables are in constant 1999 US$ (millions), deflated by the industry PPI. TFP is firm-level total factor productivity obtained from an Olley and Pakes (1996) estimation of an industry production function at the 2-digit NAICS level. Investment is *Capital Expenditures*. Capital is *Property, Plant and Equipment*. Value-added is *Operating Income Before Depreciation plus Labor Cost*. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

tween lobbying and firm growth, in a next step I analyze whether initially lobbying firms experience different growth rates.

Initial lobby status and (long-run) firm performance. If lobbying improves firm performance, then the initial lobby status of a firm should have a significant effect on future growth rates. To further explore the relationship between lobbying and firm growth, I study the effect of lobbying on (long-run) average growth rates by estimating the following equation:

$$\%\Delta Y_{ij,T} = \frac{\ln Y_{ij,T} - \ln Y_{ij,1999}}{T - 1999} = \beta_0 + \beta_1 \cdot Lobby_{i,1999} + \beta_2 \cdot \ln Emp_{i,1999} + \alpha_j + \epsilon_{ij}, \quad (3.3)$$

where $\%\Delta Y_{ij,T}$ denotes the average growth rates in firm characteristic $Y_{ij,T}$ between 1999 and year T. The coefficient of the dummy $Lobby_{i,1999}$ measures the premium in long-run average growth rates for firms lobbying in 1999, relative to non-lobbying firms in 1999. Industry fixed effects are denoted by α_j. A similar estimation strategy for the growth effects of the initial export status of a firm can be found in Bernard and Jensen (1999).

Table 3.6 summarizes the results for the case $T = 2010$, which is the longest feasible horizon in my data set.[33] Only for value-added, capital and investment, firms that were already lobbying in 1999 experience statistically significant higher long-run growth rates. The estimated coefficients for sales and TFP are positive but not statistically significant, and for employees the estimated coefficient is even significantly negative. In Appendix 3.A.1, Tables 3.21 – 3.24 show that estimating equation (3.3) for different time horizons T or different initial years (i.e., 2002, 2005 or 2008) delivers similar results. These findings show that across firm characteristics there is no robust positive relationship between the initial lobby status of a firm and its future average growth rates, suggesting that lobbying does not explain superior firm performance.

[33] The number of observations in Table 3.6 drops dramatically, because I consider only firms observed in 2010 and 1999.

3.3.3 Disentangling the lobby premium: starters, stoppers and continuing lobbying firms

Lobby premium in levels – disentangled.

OLS estimation. By estimating the lobby premium using a dummy variable for lobbying in period t (estimating equation (3.1)), I mix firms that continue to lobby in period t with those that *stop* during period t. Also, I mix firms that continue *not* to lobby in period t with those that *start* lobbying during period t. Consequently, lobby entry and exit may confound the estimated coefficients. To address this issue, I now distinguish between the lobby status of a firm in two consecutive periods $[t-1, t]$ and form four different groups of firms. This approach is related to Bernard and Jensen (1999), who distinguish firms with respect to export status. In the period 1999-2010 I observe $1,968$ lobby starters $[0,1]$; $1,281$ lobby stoppers $[1,0]$; $10,519$ observations that continue lobbying in two consecutive periods $[1,1]$ and $77,041$ observations that were neither lobbying in two consecutive periods $[0,0]$. The fourth group will also be the base group in the further analysis. Similar to the findings in Kerr et al. (forthcoming), lobbying in my data is highly persistent over time. Conditional on lobbying previous year, the probability that a firm lobbies in the current year is 89% and the average duration of continuous lobbying is 4.3 years. I estimate the following equation by OLS:

$$\ln Y_{ijt} = \beta_0 + \beta_1 \cdot Starter_{it} + \beta_2 \cdot Stopper_{it} + \beta_3 \cdot Continue_{it} + \beta_4 \cdot \ln Emp_{it} + \alpha_j + \lambda_t + \epsilon_{ijt}, \tag{3.4}$$

where $\ln Y_{ijt}$ denotes log values of firm characteristic Y_{ijt}. The dummy variables $Starter_{it}$, $Stopper_{it}$ and $Continue_{it}$ equal one if a firms starts, stops or continues lobbying in two consecutive periods $[t-1, t]$, respectively. Industry and year fixed effects are denoted by α_j and λ_t, respectively. Standard errors are clustered at the firm level.

Table 3.7 shows the regression results of estimating equation (3.4). Recall that reported coefficient are relative to the base group of firms that do not lobby in two consecutive periods. Except the coefficient for $Stopper_{it}$ in the TFP regression, all estimated coefficients are positive and in most cases statistically highly significant, showing that starters, stoppers and continuing lobbying firms have better firm characteristics than non-lobbying firms. Except for the investment regression, the coefficients of $Continue_{it}$ is always greater (or equal) than the coefficients of $Starter_{it}$ and $Stopper_{it}$. Thus, Table 3.7 suggests that continuing lobbying firms are the driving force behind the lobby premium, and in comparison to this group, there is no additional premium in firm characteristics attached to the event of starting to lobby.

Nonparametric Kolmogorov-Smirnov test. Figure 3.5 displays the *relative* empirical cumulative distribution function of firm sales by the lobby status of a firm (i.e., for lobby starters/stoppers, for continuing lobbying firms and for firms that do not lobby in two consecutive years).[34] To account for compositional effects, the distribution is normalized and relative to the 4-digit NAICS industry-year mean. Figure 3.5 suggests

[34] Empirical distributions for other firm characteristics (not shown here) show identical sorting patterns.

Table 3.7: Disentangling the lobby premium: start, stop and continue lobbying

Dep. Variable (in logs):	Sales	TFP	Value-added	Capital	Investment	Employees
Starter [0,1]	0.216***	0.033**	0.109***	0.247***	0.307***	1.390***
	(0.0225)	(0.0162)	(0.0188)	(0.0264)	(0.0293)	(0.0481)
Stopper [1,0]	0.217***	-0.023	0.058**	0.222***	0.230***	1.248***
	(0.0284)	(0.0236)	(0.0274)	(0.0340)	(0.0362)	(0.0603)
Continue [1,1]	0.269***	0.033**	0.134***	0.256***	0.281***	2.315***
	(0.0218)	(0.0136)	(0.0173)	(0.0274)	(0.0264)	(0.0561)
Log employees	1.028***	0.075***	1.022***	1.072***	1.062***	
	(0.0052)	(0.0034)	(0.0046)	(0.0062)	(0.0059)	
R-squared	0.86	0.47	0.89	0.86	0.81	0.34
Observations	91369	77501	80220	88154	82562	91383
Clusters	14388	12662	13037	13992	13572	14392
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
4-digit NAICS FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The dependent variable in all regressions is the respective firm characteristic in logs. The base group are firms that did not lobby in two consecutive years. The dummy *Continue* indicates a firm that lobbies in two consecutive years. The dummy *Starter* indicates a firm that lobbied in year t but did not lobby in year t-*1*. The dummy *Stopper* indicates a firm that lobbied in year t-*1* but did not lobby in year t. All regressions include 4-digit NAICS fixed effects and year fixed effects. All regressions include log firm employment to control for size, except for the employee regression. Robust standard errors are denoted in parentheses and are clustered at the firm level. Monetary variables are in constant 1999 US$ (millions), deflated by the industry PPI. TFP is firm-level total factor productivity obtained from an Olley and Pakes (1996) estimation of an industry production function at the 2-digit NAICS level. Value-added is *Operating Income Before Depreciation plus Labor Cost*. Capital is *Property, Plant and Equipment*. Investment is *Capital Expenditures*.* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

a ranking of distributions of the four groups and implies a sorting pattern that goes beyond the already reported differences in means (i.e., the results of Table 3.7). To test for first-order stochastic dominance, I run Kolmogorov-Smirnov tests for a variety of firm characteristics (see Section 3.3.1 for details on the Kolmogorov-Smirnov test).

Table 3.8 shows the results of the respective Kolmogorov-Smirnov tests. Comparing stoppers and non-lobbying firms, and comparing continuing and lobby starters, across all firm characteristics the null hypothesis of the one-sided Kolmogorov-Smirnov test is never rejected, while the null hypothesis of the two-sided test is always rejected, indicating first-order stochastic dominance. As suggested by Figure 3.5, the hypothesis of equality of distributions for starters and stoppers is almost never rejected (only for TFP at the ten percent level). Thus, for almost all firm characteristics first-order stochastic dominance holds for starters/stoppers over non-lobbying firms and for continuing lobbying firms over starters/stoppers (and therefore also over non-lobbying firms).

Figure 3.5 and the results of the Kolmogorov-Smirnov tests suggest that there is a clear ranking of the distributions with respect to their lobby-status, hinting towards a (fuzzy) lobby cutoff at which firms start/stop lobbying. Due to uncertainty and measurement error, it is unlikely to observe empirically a clear-cut lobby threshold in real world data. Therefore, it is even more remarkable that in Figure 3.5 the cumulative distribution functions of lobby starters and lobby stoppers lie between the cumulative distribution functions of non-lobbying and continuing lobbying firms.

Table 3.8: Kolmogorov-Smirnov test: starter, stopper and continuing lobbying

Lobby status[t-1,t]:	Stop[1,0] vs Not[0,0]	Start[0,1] vs Stop[1,0]	Continue[1,1] vs Start[0,1]
Sales			
$H_0 : F^1 \leq F^0$	-0.00	-0.00	0.00
$H_0 : F^1 = F^0$	0.28***	0.03	0.21***
N^1/N^0	1280/77013	1967/ 1280	10518/ 1967
TFP			
$H_0 : F^1 \leq F^0$	-0.00	-0.00	-0.00
$H_0 : F^1 = F^0$	0.08***	0.05*	0.06***
N^1/N^0	1056/57001	1601/ 1056	9335/ 1601
Value-added			
$H_0 : F^1 \leq F^0$	-0.00	-0.01	-0.00
$H_0 : F^1 = F^0$	0.26***	0.04	0.19***
N^1/N^0	1085/60244	1656/ 1085	9580/ 1656
Capital			
$H_0 : F^1 \leq F^0$	-0.00	-0.01	-0.00
$H_0 : F^1 = F^0$	0.27***	0.04	0.19***
N^1/N^0	1247/72881	1915/ 1247	10249/ 1915
Investment			
$H_0 : F^1 \leq F^0$	-0.00	-0.01	-0.00
$H_0 : F^1 = F^0$	0.25***	0.04	0.19***
N^1/N^0	1205/68005	1874/ 1205	10056/ 1874
Employees			
$H_0 : F^1 \leq F^0$	-0.00	-0.00	-0.00
$H_0 : F^1 = F^0$	0.24***	0.03	0.20***
N^1/N^0	1204/67383	1862/ 1204	10152/ 1862

Notes: Reported test statistics are from two-sample Kolmogorov-Smirnov tests for first-order stochastic dominance between the firm characteristics distributions of two groups of firms. Test results for the one-sided null hypothesis $F^0 \leq F^1$ are omitted. Firm characteristics in logs, relative to industry-year mean at 4-digit NAICS level. The dummy *Continue* (*Not*) indicates a firm that did (not) lobby in two consecutive years. The dummy *Start* indicates a firm that lobbied in year *t* but did not lobby in year *t-1*. The dummy *Stop* indicates a firm that lobbied in year *t-1* but did not lobby in year *t*. Monetary variables are in constant 1999 US$ (millions), deflated by the industry PPI. TFP is firm-level total factor productivity obtained from an Olley and Pakes (1996) estimation of an industry production function at the 2-digit NAICS level. Value-added is *Operating Income Before Depreciation plus Labor Cost*. Capital is *Property, Plant and Equipment*. Investment is *Capital Expenditures*.* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

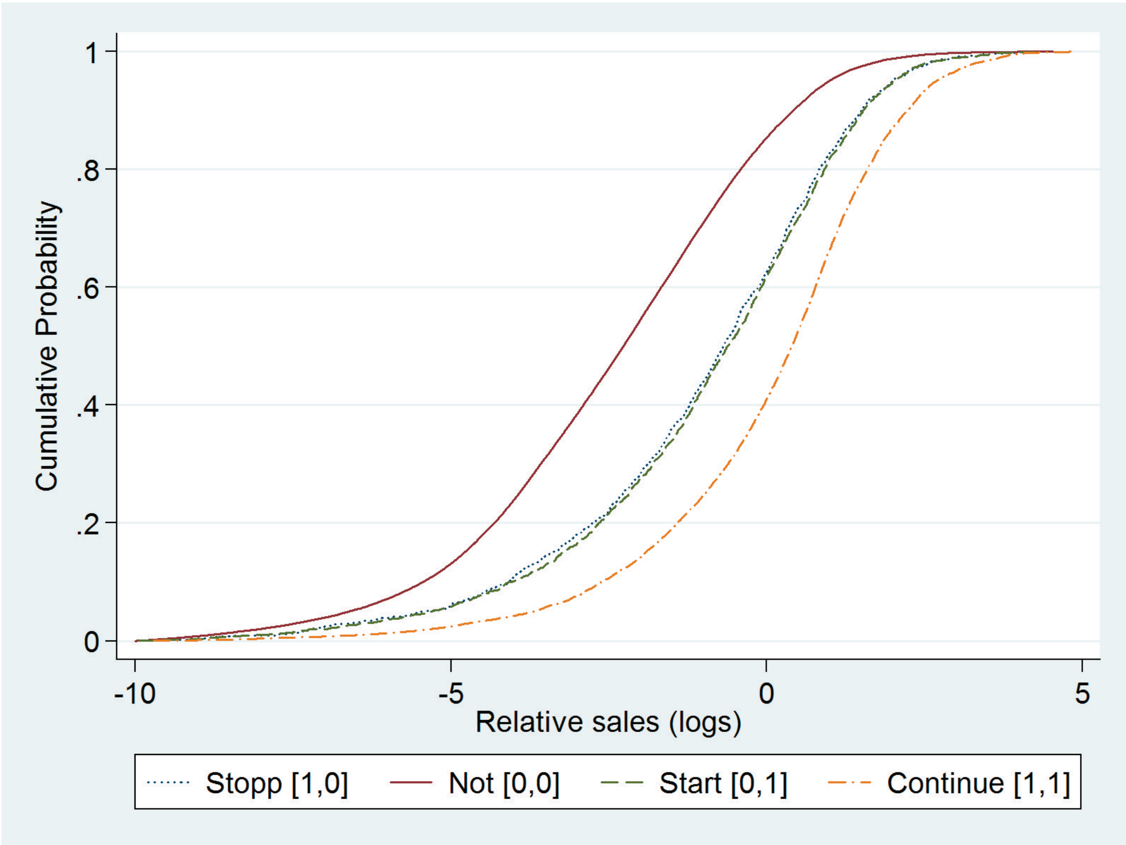


Figure 3.5: Empirical distribution of firm sales by lobby status, relative to industry-year mean

Lobby premium in growth rates – disentangled. In a next step, I disentangle the differences in growth rates for lobbying firms by estimating the following equation:

$$\Delta \ln Y_{ijt+1}=\beta_0+\beta_1 \cdot Starter_{it}+\beta_2 \cdot Stopper_{it}+\beta_3 \cdot Continue_{it}+\beta_4 \cdot \ln Emp_{it}+\alpha_j+\lambda_t+\epsilon_{ijt} \tag{3.5}$$

where $\Delta \ln Y_{ijt+1}$ denotes the one period ahead log difference in firm characteristic Y. The dummy variables $Starter_{it}$, $Stopper_{it}$ and $Continue_{it}$ equal one if a firms starts, stops or continues lobbying in two consecutive periods $[t-1, t]$, respectively. Industry and year fixed effects are denoted by α_j and λ_t, respectively. Standard errors are clustered at the firm-level.

Results from estimating equation (3.5) are reported in Table 3.9. In comparison to the estimation results of equation (3.2) (see Table 3.5) where only a lobby dummy was included, the results in Table 3.9 are much more nuanced. If lobbying had a positive effect on firm growth, one would expect positive coefficients for starters and continuing lobbying firms and the estimated coefficients for lobby stoppers should have a negative sign. However, in Table 3.9 this prediction holds only for the employee growth regression, where lobby starters experience even higher growth rates than continuing lobbying firms. For all other firm characteristics results are not as predicted. In the case of capital growth and investment growth, all coefficients are insignificant, confirming the findings of Table 3.5. For value added growth rates, starters and continuing lobbying firms experience statistically significantly higher growth rates, while lobby stoppers experience growth

Table 3.9: Disentangling the lobby growth premium in $t+1$: start, stop and continue lobbying

Dependent Variable: Growth Rate	Sales	TFP	Value-added	Capital	Investment	Employees
Starter [0,1]	0.017	-0.001	0.023*	0.015	0.015	0.030***
	(0.0110)	(0.0113)	(0.0127)	(0.0117)	(0.0216)	(0.0076)
Stopper [1,0]	-0.042***	0.017	0.015	-0.010	0.007	-0.002
	(0.0140)	(0.0164)	(0.0168)	(0.0116)	(0.0266)	(0.0092)
Continue [1,1]	-0.004	0.009**	0.018***	-0.001	0.008	0.018***
	(0.0050)	(0.0043)	(0.0052)	(0.0055)	(0.0075)	(0.0041)
Log employees	-0.009***	-0.004***	-0.016***	0.002*	0.005***	-0.013***
	(0.0015)	(0.0010)	(0.0013)	(0.0013)	(0.0017)	(0.0010)
R-squared	0.02	0.02	0.04	0.02	0.04	0.03
Observations	77279	63137	65423	74358	68689	75761
Clusters	12720	10649	10993	12333	11833	12519
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
4-digit NAICS FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The dependent variable in all regressions is the first log difference of the respective firm characteristic in year *t+1*. The base group are firms that did not lobby in two consecutive years. The dummy *Continue* indicates a firm that lobbies in two consecutive years. The dummy *Starter* indicates a firm that lobbied in year *t* but did not lobby in year *t-1*. The dummy *Stopper* indicates a firm that lobbied in year *t-1* but did not lobby in year *t*. All regressions include 4-digit NAICS fixed effects and year fixed effects. All regressions include log firm employment to control for size. Robust standard errors are denoted in parentheses and are clustered at the firm level. Monetary variables are in constant 1999 US$ (millions), deflated by the industry PPI. TFP is firm-level total factor productivity obtained from an Olley and Pakes (1996) estimation of an industry production function at the 2-digit NAICS level. Value-added is *Operating Income Before Depreciation plus Labor Cost.* Capital is *Property, Plant and Equipment.* Investment is *Capital Expenditures.* * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

rates that are not statistically different from the ones of non-lobbying firms. Considering sales growth, lobby starters and continuing lobbying firms do not experience statistically significant growth rates, implying that the overall positive growth premium is mainly due to the negative growth rates of lobby stoppers. In contrast, Table 3.9 also shows that the positive lobby premium for TFP growth is mainly driven by continuing lobby firms and not by lobby starters, which experience a (insignificant) drop in TFP growth rates. Thus, disentangling the lobby premium in growth rates gives a much more nuanced picture on the interaction of lobbying and firm growth, suggesting that there is no robust relationship between the lobby status and firm growth.

3.3.4 Pre lobby-entry premium in firm characteristics

Pre lobby-entry premium in levels. To shed more light on the hypothesis whether firms with better characteristics start lobbying (self-selection hypothesis), I analyze pre lobby-entry differences between future lobby starters and firms that remain non-lobbying. Studying pre lobby-entry differences is only possible with panel data covering a long period of time and with sufficient variation in lobby entry. Covering a period of 12 years with 1,968 lobby starters, my data fulfills both requirements.

In particular, I consider the subsample of all firms that did *not* lobby in the initial year of my data set (i.e., in 1999) and estimate the following equation:

$$\ln Y_{ij,1999} = \beta_0 + \beta_1 \cdot Lobby_{iT} + \beta_2 \cdot \ln Emp_{i,1999} + \alpha_j + \epsilon_{ij}, \tag{3.6}$$

where $Lobby_{iT}$ is a lobby dummy variable that equals one if firm i is lobbying in year T. Consequently, the coefficient β_1 measures the premium in firm characteristics in 1999

Table 3.10: Ex-ante lobby premium in 1999 for future lobby starters

Dep. Variable (in logs):	Sales	TFP	Value-added	Capital	Investment	Employees
Lobby in 2010	0.127***	0.070**	0.132***	0.071	0.189***	1.629***
	(0.0488)	(0.0345)	(0.0378)	(0.0434)	(0.0512)	(0.0963)
Log employees in 1999	1.021***	0.076***	1.015***	1.066***	1.057***	
	(0.0086)	(0.0062)	(0.0078)	(0.0088)	(0.0101)	
R-squared	0.83	0.45	0.88	0.85	0.79	0.29
Observations	8159	6847	7074	7888	6969	8162
4-digit NAICS FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The dependent variable in all regressions is the respective log firm characteristic in 1999. The dummy *Lobby in 2010* equals one if a firm lobbied in year *2010*. All regression include 4-digit NAICS fixed effects. Robust standard errors are denoted in parentheses. Monetary variables are in constant 1999 US$ (millions), deflated by the industry PPI. TFP is firm-level total factor productivity obtained from an Olley and Pakes (1996) estimation of an industry production function at the 2-digit NAICS level. Value-added is *Operating Income Before Depreciation plus Labor Cost*. Capital is *Property, Plant and Equipment*. Investment is *Capital Expenditures*. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

for future lobby starters. Industry fixed effects are denoted by α_j.[35]

Table 3.10 summarizes the results from estimating equation (3.6) for $T = 2010$, the longest feasible horizon in my data set. Among all non-lobbying firms in 1999, firms that start lobbying until 2010 (and are still lobbying in 2010) already had better firm characteristics in 1999. Controlling for firm size and industry fixed effects, future lobby starters are on average 7.0 percentage points more productive (in TFP) and sell 12.7 percentage points more, showing that these estimates are also economically relevant. Thus, better firm characteristics of lobbying firms predate their lobby entry, providing evidence in favor of a selection-into-lobbying hypothesis.

To show the robustness of these findings, in Appendix 3.A.1 I estimate different specification of equation (3.6). Tables 3.25 – 3.28 in Appendix 3.A.1 show that neither varying the horizon T nor changing the initial period to 2002, 2005 or 2008 change the results qualitatively. Across all specifications, there is robust evidence for an ex-ante lobby premium in the levels of firms characteristics.

Pre lobby-entry premium in growth rates. To explore the relationship between future lobby entry and firm growth, I again restrict the sample to non-lobbying firms in the initial year of my data set (i.e., in 1999) and estimate the following equation:

$$\%\Delta Y_{i,T-1} = \frac{\ln Y_{i,T-1} - \ln Y_{i,1999}}{(T-1) - 1999} = \beta_0 + \beta_1 \cdot Lobby_{iT} + \beta_2 \cdot \ln Emp_{i,1999} + \alpha_j + \epsilon_{ij}, \quad (3.7)$$

where $\%\Delta Y_{i,T-1}$ is average firm growth between 1999 and $T-1$, such that the coefficient of the dummy variable $Lobby_{iT}$ measures the ex-ante premium in average growth rates for future lobby starters for the $(T-1) - 1999$ years since 1999. Industry fixed effects are denoted by α_j.[36]

Table 3.11 summarizes the results from estimating equation (3.7) for $T = 2010$, the longest feasible horizon in my data set. Among all non-lobbying firms in 1999, firms that start lobbying until 2010 (and are still lobbying in 2010) experience faster average

[35] See Bernard and Jensen (1999) for a similar estimation approach in the case of an ex-ante export premium.
[36] A similar estimation strategy can be found in Bernard and Jensen (1999) who show that firms already experience faster growth rates before entering exporting.

Table 3.11: Ex-ante growth premium (1999-2009) for future lobby starters

Dep. Variable: Average Growth Rate	Sales	TFP	Value-added	Capital	Investment	Employees
Lobby in 2010	0.067***	0.007*	0.047***	0.066***	0.066***	0.033***
	(0.0075)	(0.0038)	(0.0067)	(0.0077)	(0.0092)	(0.0058)
Log employees in 1999	-0.012***	-0.002**	-0.014***	-0.009***	-0.009***	
	(0.0017)	(0.0009)	(0.0015)	(0.0016)	(0.0020)	
R-squared	0.16	0.27	0.26	0.16	0.15	0.12
Observations	3302	2541	2655	3137	2664	3143
4-digit NAICS FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The dependent variable in all regressions is the average growth rate of the respective firm characteristic in the period 1999 – 2009. The dummy *Lobby in 2010* equals one if a firm lobbied in year *2010*. All regression include 4-digit NAICS fixed effects. Robust standard errors are denoted in parentheses. Monetary variables are in constant 1999 US$ (millions), deflated by the industry PPI. TFP is firm-level total factor productivity obtained from an Olley and Pakes (1996) estimation of an industry production function at the 2-digit NAICS level. Value-added is *Operating Income Before Depreciation plus Labor Cost*. Capital is *Property, Plant and Equipment*. Investment is *Capital Expenditures*. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

growth between 1999 and 2009. Given that β_1 measures growth rate differentials, the magnitudes of the estimated coefficients in Table 3.11 are substantial. For instance, over the entire period $1999 - 2009$ the estimated ex-ante premium of 6.7 percentage points in sale growth (first column) accrues to a differences in firm sales of 73.7 percentage points. Thus, higher growth rates in firm characteristics of lobbying firms also predate their lobby entry.

Given the long period of time considered, there will be some initially non-lobbying firms that start lobbying before 2010. If lobbying had truly a positive effect on firm growth, the estimated coefficient of $Lobby_{iT}$ could be confounded. This issue is likely to be of more importance with a long time horizon. To account for this, in Appendix 3.A.1 I perform robustness checks by varying both the time horizon T and the initial period (i.e., using 2002, 2005 and 2008 instead of 1999). As Tables 3.29 – 3.32 in Appendix 3.A.1 show, estimating these different specifications of equation (3.7) leads to similar results.

To summarize, in Section 3.3 I find a premium in the levels of firms characteristics for lobbying firms and for subsidized firms. This result holds not just on average but also by first-order stochastic dominance. Disentangling the lobby premium in the levels of firm characteristics with respect to firms' lobby status, I show that the lobby premium is due to continuing lobbying firms, and compared to these firms lobby starters do not experience an additional premium. With respect to firm growth, results are more nuanced. Lobbying firms experience faster future growth only in some firm characteristics. Disentangling the lobby premium in one period ahead growth rates, I find that the expected positive effects for starters and continuing lobbying firms and the expected negative effect for lobby stoppers are only confirmed in the employee growth regression. For all other firm characteristics, the effect of the lobby status on growth rates is ambiguous and less robust. Looking closer at the relationship between lobbying and firm growth, I cannot find evidence that the initial lobby status has a clear and robust effect on long-run growth rates. To the contrary, I find evidence for a pre lobby-entry premium in both levels and average growth rates, suggesting that differences between lobbying and non-lobbying firms predate lobby entry. Thus, I conclude that firms with superior characteristics self-select into lobbying.

3.4 Lobbying and the likelihood of receiving subsidies

3.4.1 Linear probability model

To explore whether lobbying firms are more likely to receive subsidies, I run a linear probability model with the following specification:

$$D_{ijt} = \beta_0 + \beta_1 \cdot Lobby_{it} + \beta_2 \cdot \ln Emp_{it} + \alpha_j + \lambda_t + \epsilon_{ijt}, \tag{3.8}$$

where D_{ijt} is a subsidy dummy that indicates either a subsidy from Subsidy-Tracker, ITC, Federal Grants or the combination of those (any subsidy). $Lobby_{it}$ is the lobby dummy that equals one if a firm lobbies in year t and $\ln Emp_{it}$ denotes log employees of a firm. Industry and year fixed effects are denoted by α_j and λ_t, respectively. Standard errors are clustered at the firm level.

Table 3.12 summarizes the results from estimating equation (3.8). Across all types of subsidies, lobbying significantly increases the likelihood of being subsidized at the one percent level. In particular, lobbying increases the likelihood to be identified in the Subsidy-Tracker data by 7.6 percentage points, to receive a federal grant by 3.9 percentage points, to benefit from ITC by 2.5 percentage points and to receive any subsidy by 10.7 percentage points. These estimated marginal effects are large and also economically relevant. To interpret the economic relevance of these results, one can compare the estimated marginal effects with the unconditional likelihood to receive a particular subsidy (reported in Table 3.1). For instance, the unconditional likelihood to receive any subsidy is only 11.12% in my sample. Therefore, an increase of 10.7 percentage points in the likelihood to receive any subsidy makes a firm $\frac{10.7}{11.12} * 100\% \approx 96\%$ more likely to receive any subsidy. Similarly, lobbying firms are even $\frac{3.9}{1.89} * 100\% \approx 206\%$ more likely to receive a federal grant.

In Appendix 3.A.2, I perform several robustness checks for the linear probability model. First, I show that my results are robust to estimating equation (3.8) including an interaction term of the lobby dummy and firm size (log employees). In fact, I show that the positive effect of lobbying is increasing in firm size. Second, to account for the the fact that the success of lobbying may also depend on the lobbying behavior of other firms within the same industry, I estimate equation (3.8) controlling for the industry share of lobbying firms in a given year. As Table 3.34 in Appendix 3.A.2 shows, taking the industry share of lobbying firms into account, across all types of subsidies I still find a significant and positive coefficient for the lobby dummy. Moreover, for Subsidy-Tracker data, federal grants and all subsidies combined, the interaction effect of the lobby dummy and the industry lobby share is positive and significant, indicating that lobbying firms are even more likely to receive subsidies if a large fraction of firms within the same

Table 3.12: Likelihood to receive subsidies and lobbying

Dependent Variable: Dummy for	Subsidy-Tracker	Federal Grants	ITC	Any subsidy
Lobby	0.076***	0.039***	0.025***	0.107***
	(0.0051)	(0.0042)	(0.0061)	(0.0074)
Log employees	0.014***	0.002***	0.009***	0.021***
	(0.0007)	(0.0006)	(0.0009)	(0.0010)
Constant	-0.015	-0.013***	-0.012	-0.035
	(0.0204)	(0.0024)	(0.0143)	(0.0304)
R-squared	0.10	0.06	0.10	0.14
Observations	91383	91383	91383	91383
Clusters	14392	14392	14392	14392
Year FE	Yes	Yes	Yes	Yes
4-digit NAICS FE	Yes	Yes	Yes	Yes

Notes: The dependent variable is a dummy that indicates either a subsidy from Subsidy-Tracker, ITC, Federal Grants or the combination of those (any subsidy) in year t. The dummy *Lobby* equals one if a firm lobbied in year t. All regressions include 4-digit NAICS fixed effects and year fixed effects. Robust standard errors are denoted in parentheses and are clustered at the firm level. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

industry is engaged in lobbying. As a third robustness check, I also estimate a Probit model. It is well know that linear probability models, while usually delivering reliable marginal effects, may lead to negative predicted probabilities. However, as Tables 3.35 and 3.36 in Appendix 3.A.2 show, the sign and significance level of the marginal effects are robust to estimating a Probit model both with and without an interaction term. For the research questions of this paper, marginal effects are much more relevant than predicted probabilities. Therefore, taking into account potential limitations, I rely on linear probability models for the rest of the paper.

3.4.2 Linear probability model – disentangled

To investigate whether lobby starters/stoppers or continuing lobbying firms are more likely to receive subsidies, I run a linear probability model with the following specification:

$$D_{ijt} = \beta_0 + \beta_1 \cdot Starter_{it} + \beta_2 \cdot Stopper_{it} + \beta_3 \cdot Continue_{it} + \beta_4 \cdot \ln Emp_{it} + \alpha_j + \lambda_t + \epsilon_{ijt}, \quad (3.9)$$

where D_{ijt} is a subsidy dummy that indicates either a subsidy from Subsidy-Tracker, ITC, Federal Grants or the combination of those (any subsidy). The dummy variables $Starter_{it}$, $Stopper_{it}$ and $Continue_{it}$ equal one if a firms starts, stops or continues lobbying in two consecutive periods $[t-1, t]$, respectively. Industry and year fixed effects are denoted by α_j and λ_t, respectively. Standard errors are clustered at the firm level.

Results from estimating equation (3.9) are shown in Table 3.13. Across all subsidy measures and in comparison to non-lobbying firms, starters, stoppers and continuing lobbying firms are all more likely to be subsidized. Moreover, the magnitude of the estimated coefficients is much larger for continuing lobbying firms than for both starters and stoppers. For instance, the coefficient of continuing lobbying firms is 4.9 times the coefficient of stoppers in the Subsidy-Tracker regression, and it is 3.3 times the coefficient of starters in the Federal Grants regression. Thus, disentangling lobbying and

Table 3.13: Disentangling the likelihood to receive subsidies and lobbying

Dependent Variable: Dummy for	Subsidy-Tracker	Federal Grants	ITC	Any subsidy
Starter [0,1]	0.033***	0.015***	0.009	0.051***
	(0.0063)	(0.0043)	(0.0070)	(0.0092)
Stopper [1,0]	0.019***	0.019***	0.006	0.044***
	(0.0073)	(0.0057)	(0.0085)	(0.0112)
Continue [1,1]	0.094***	0.050***	0.027***	0.128***
	(0.0062)	(0.0052)	(0.0071)	(0.0086)
Log employees	0.014***	0.002***	0.009***	0.020***
	(0.0007)	(0.0006)	(0.0009)	(0.0010)
Constant	-0.007	-0.009***	-0.009	-0.024
	(0.0199)	(0.0021)	(0.0144)	(0.0299)
R-squared	0.11	0.06	0.10	0.14
Observations	91383	91383	91383	91383
Clusters	14392	14392	14392	14392
Year FE	Yes	Yes	Yes	Yes
4-digit NAICS FE	Yes	Yes	Yes	Yes

Notes: The dependent variable is a dummy that indicates either a subsidy from Subsidy-Tracker, ITC, Federal Grants or the combination of those (any subsidy) in year t. The base group are firms that did not lobby in two consecutive years. The dummy *Continue* indicates a firm that lobbies in two consecutive years. The dummy *Starter* indicates a firm that lobbied in year t but did not lobby in year t-*1*. The dummy *Stopper* indicates a firm that lobbied in year t-*1* but did not lobby in year t. All regressions include 4-digit NAICS fixed effects and year fixed effects. Robust standard errors are denoted in parentheses and are clustered at the firm level. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

the likelihood of being subsidized suggests that the positive marginal effect of lobbying (as shown in Table 3.12) is mainly due to continuing lobbying firms, and in comparison to these firms, lobby starters do not experience an additional increase in the likelihood of receiving subsidies.

3.4.3 Linear probability model – agency level

As previous results in Sections 3.4.1 and 3.4.2 have shown, the positive relationship between lobbying and the likelihood to receive subsidies is quite strong. However, one may still be in doubt about the existence of a causal effect. Due to my rich dataset, I observe not only the federal agency that a firm lobbied, but also the federal agency that is actually funding a particular federal grant. This allows me to go a step further and to estimate a linear probability model, not just at the firm-year level, but also at the firm-year-agency level.[37] At this high level of disaggregation, I define two additional dummy variables for my further analysis. The first dummy variable indicates the funding agency of a federal grant. The second dummy variable indicates whether a firm lobbied a funding agency in a given year. Given these dummy variables, I estimate the following linear probability model:

$$GrantAgency_{ijta} = \beta_0 + \beta_1 \cdot LobbyAgency_{ita} + \beta_2 \cdot \ln Emp_{it} + \alpha_j + \lambda_t + \mu_a + \epsilon_{ijta}, \quad (3.10)$$

where the dummy variable $GrantAgency_{ijta}$ equals one if in year t firm i receives a grant from agency a. The dummy variable $LobbyAgency_{ita}$ equals one if in year t firm i

[37] See Table 3.64 in Appendix 3.G for a list of involved federal agencies and for the number of grants funded by each agency.

Table 3.14: Likelihood to receive federal grant from lobbied agency

Dependent Variable: *Grant Agency* Dummy	(1)	(2)	(3)	(4)
Lobby Agency	0.028***	0.028***	0.027***	0.026***
	(0.0034)	(0.0033)	(0.0033)	(0.0033)
Log employees		0.000***	0.000***	0.000***
		(0.0000)	(0.0000)	(0.0000)
Lobby			0.001***	0.001***
			(0.0002)	(0.0002)
Constant	0.001***	-0.001***	-0.001***	-0.002***
	(0.0000)	(0.0002)	(0.0001)	(0.0002)
R-squared	0.01	0.01	0.01	0.01
Observations	2049853	1736277	1736277	1736277
Clusters	16315	14392	14392	14392
Year FE	No	Yes	Yes	Yes
4-digit NAICS FE	No	Yes	Yes	Yes
Agency FE	No	No	No	Yes

Notes: The dependent variable in all specifications is a dummy that equals one if a firm received a federal grant from agency a in year t. The dummy *Lobby Agency* equals one if a firm lobbied agency a in year t. The dummy *Lobby* equals one if a firm lobbied in year t. Robust standard errors are denoted in parentheses and are clustered at the firm level. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

lobbied funding agency a. Industry, year and agency fixed effects are denoted by α_j, λ_t and μ_a, respectively. Standard errors are clustered at the firm level.

The results from estimating equation (3.10) are shown in Table 3.14. Firms lobbying a funding agency are 2.6-2.8 percentage points more likely to receive a federal grant from exactly the same agency. All coefficients are statistically significant at the one percent level and robust to including year, industry and agency fixed effects, firm size and a dummy for lobbying in general. This (general) lobby dummy accounts for the fact that some lobbying firms do not lobby a funding agency. To bring the magnitude of this results into perspective, one can compare the coefficients of the general lobby dummy and the lobby agency dummy. Despite being highly significant, the coefficient of the (general) lobby dummy is by an order of magnitude smaller than the coefficient of the $LobbyAgency_{ita}$ dummy. Thus, lobbying a particular agency is much more important for receiving a federal grant from it than just being engaged in lobbying at all. In Appendix 3.A.2, where I estimate an alternative linear probability model summarizing the agency information at the firm-year level, I also find a statistically significant positive link between lobbying funding agencies and receiving grants.

To summarize, in Section 3.4 I find a strong and robust relationship between lobbying and the likelihood to receive subsidies. Compared to the unconditional likelihood to be subsidized, lobbying firms are up to 200% more likely to receive a federal grant. Disentangling the marginal effect of lobbying with respect to firms' lobby status shows that the positive marginal effect of lobbying is driven by continuing lobbying firms. Moreover, focusing on federal grants I estimate a linear probability model at the highly

Table 3.15: Returns to lobbying: premium in the amount of subsidies

Dependent Variable: Subsidy amount (in logs)	Subsidy-Tracker	Federal Grants	ITC	Any subsidy
Lobby	0.511***	0.245	0.241**	0.309***
	(0.1174)	(0.1494)	(0.0960)	(0.0889)
Log employees	0.319***	0.108***	0.636***	0.335***
	(0.0323)	(0.0279)	(0.0235)	(0.0214)
R-squared	0.18	0.19	0.42	0.17
Observations	3145	1806	6537	10463
Clusters	1359	644	1817	3118
Year FE	Yes	Yes	Yes	Yes
2-digit NAICS FE	Yes	Yes	Yes	Yes

Notes: The dependent variable is the log amount of subsidies in US$ (millions) received by a firm from Subsidy-Tracker, ITC, Federal Grants or the sum of those (any subsidy) in year t. *Lobby* is a dummy that equals one if a firms lobbied in year t. All regressions include 2-digit NAICS fixed effects and year fixed effects. Monetary variables are in constant 1999 US$ (millions), deflated by the industry PPI. Robust standard errors are denoted in parentheses and are clustered at the firm level. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

disaggregated firm-year-agency level, showing that lobbying a particular federal agency has a statistically significant and relevant positive effect on the likelihood of receiving a grant from exactly the same agency.

3.5 Subsidies and the returns to lobbying

In my data, I also observe lobby expenditures and the amount of received subsidies at the firm level. This allows me to measure firm specific returns to lobbying in terms of received subsidies. One should keep in mind that by measuring returns to lobbying only in terms of subsidies, I neglect many other potential benefits from lobbying (e.g., trade protection, beneficial changes in government regulation). Therefore, the following estimates should be seen as lower bounds on the true returns to lobbying.[38]

Amount of subsidies and lobbying. Before estimating the returns per dollar spend on lobbying, I first analyze whether among the group of receiving firms, lobbying firms receive higher subsidy payments. I therefore estimate the following equation by OLS:

$$\ln SubsidyAmount_{ijt} = \beta_0 + \beta_1 \cdot Lobby_{it} + \beta_2 \cdot \ln Emp_{it} + \alpha_j + \lambda_t + \epsilon_{ijt}, \qquad (3.11)$$

where $\ln SubsidyAmount_{ijt}$ is the log amount of received subsidies and the dummy variable $Lobby_{it}$ equals one if firm i lobbied in year t. Industry and year fixed effects are denoted by α_j and λ_t, respectively. Standard errors are clustered at the firm level.

Results from estimating equation (3.11) are shown in Table 3.15. All coefficients for the lobby dummy are positive and, except the regression for Federal Grants, also statistically significant. In particular, among subsidized firms, lobbying firms receive between 24% and 51% more in subsidies. Thus, even after controlling for industry and year fixed effects and for firm size, lobbying has a substantial positive influence on the level of received subsidies.

[38]In general, statistically significant correlations between state-level subsidies and federal lobbying expenditures should not be interpreted as being causal. However, firms lobbying on the federal level may also be politically well connected at the state level.

The outcome of an individual firm's lobbying activities could be influenced by lobbying activities of other firms. To control for such spillovers, I estimate equation (3.11) controlling for the industry share of lobbying firms. As Table 3.41 in Appendix 3.A.3 shows, the estimated coefficients for the lobby dummy change only slightly and the significance levels remain the same. In Appendix 3.A.3, where I show results from regressing the amount of received subsidies (in levels) on a subsidy dummy, I document a positive relationship across all subsidy types. As Table 3.39 in Appendix 3.A.3 shows, controlling for firm size, industry and year fixed effects, on average lobbying firms receive between 369.000 US-dollar (for ITC) and 6.6 million US-dollar (for all subsidies combined) more in subsidies.

Returns on lobby expenses. In order to estimate the returns on firms' lobby expenses, I focus again on the subset of all subsidized firms and study the link between a firm's lobby expenditures and the amount of subsidies it receives. Therefore, I estimate the following equation by OLS:

$$SubsidyAmount_{ijt} = \beta_0 + \beta_1 \cdot LobbyExp_{it} + \beta_2 \cdot \ln Emp_{it} + \alpha_j + \lambda_t + \epsilon_{ijt}, \qquad (3.12)$$

where $SubsidyAmount_{ijt}$ is the amount of subsidies received and $LobbyExp_{it}$ are lobby expenditures of firm i in year t. Industry and year fixed effects are denoted by α_j and λ_t, respectively. Standard errors are clustered at the firm level.

Results from estimating equation (3.12) are shown in Table 3.16. Across all subsidy measures, the effect of lobby expenditures on the amount of subsidies is positive and, except for the coefficient for ITC, also statistically significant. One additional US-dollar more in lobbying expenditures increases the amount of received subsidies by up to 9.65 US-dollars (last column), or in other words, yields a return on investment of 865%. The magnitude of the estimated coefficients is remarkable. In particular, if one takes into account that subsidies are just one out of many potential benefits from lobbying and that the estimated coefficients are therefore only lower bounds on the true returns to lobbying.

Even though a return on investment of 865% seems to be quite high, it is smaller than previous findings in the literature. Using a tax law change on repatriated earnings, Alexander et al. (2009) estimate returns on lobbying expenditures of about $22,000\%$. By using this specific variation in the tax code, which in general is an appealing empirical identification strategy, the research design in Alexander et al. (2009) suffers from a comparably small sample size of just 93 lobbying firms. In contrast, my findings rely on large sample evidence with data covering a period of 12 years, identifying $13,693$ observations that lobby and $11,994$ observation that receive subsidies. In comparison to Alexander et al. (2009), my estimates lie in a more reasonable range. However, one may still ask why we do not observe more firms lobbying if returns to lobbying are really this high. One plausible explanation could be high fixed costs to lobbying, which prevent firms from entering lobbying even though expected returns are high. This explanation

Table 3.16: Returns to lobbying: amount of subsidies and lobbying expenditures

Dependent Variable: Subsidy amount	Subsidy-Tracker	Federal Grants	ITC	Any subsidy
Lobby expenditures	1.658**	0.828*	5.418	9.650**
	(0.7708)	(0.4919)	(6.6825)	(4.5627)
Employees	0.004	0.011	0.753***	0.037
	(0.0046)	(0.0123)	(0.2454)	(0.0368)
R-squared	0.02	0.14	0.10	0.04
Observations	3156	1816	6552	10499
Clusters	1367	650	1824	3139
Year FE	Yes	Yes	Yes	Yes
2-digit NAICS FE	Yes	Yes	Yes	Yes

Notes: The dependent variable is the amount of subsidies in US$ (millions) received by a firm from Subsidy-Tracker, ITC, Federal Grants or the sum of those (any subsidy) in year t. *Lobby expenditures* is the amount a firms spent on lobbying in year t. All regressions include 2-digit NAICS fixed effects and year fixed effects. Monetary variables are in constant 1999 US$ (millions), deflated by the industry PPI. Employees in 1000s. Robust standard errors are denoted in parentheses and are clustered at the firm level. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

is also empirically supported by the findings in Kerr et al. (forthcoming), which provide first empirical evidence that lobbying in the US is associated with substantial fixed costs.

To account for the the fact that individual lobbying success may also depend on lobbying activities of other firms within the same industry, I perform two robustness checks by estimating equation (3.12) either controlling for the industry share of lobbying firms or controlling for the average lobbying expenditures within an industry. As Tables 3.44 and 3.45 in Appendix 3.A.3 show, in both cases the estimated coefficients on individual lobby expenditures change only slightly. In Appendix 3.A.3, I account for the skewness of the data by estimating a log-log version of equation (3.12). The estimated elasticities are all positive and significant at the one percent level, showing the robustness of my results. In Appendix 3.A.3, I also show the robustness of my results by estimating equation (3.12) considering the full sample (and not just the subset of subsidized firms), and by estimating a Tobit model to account for left-censoring of the dependent variable. In both cases, marginal effects are smaller (as one would expect) but remain statistically significant.

To summarize, in Section 3.5 I find that lobbying firms receive up to 51% more in subsidy payments, and that lobby expenses yield a return on investment of up to 865%. These estimates are in line with previous findings in the empirical lobbying literature and robust to various specifications.

3.6 Conclusion

For the period 1999-2010, I collect uniquely rich panel data to study the link between lobbying and receiving subsidies at the US firm-level. This comprehensive panel data allows me to contribute to the literature in three ways. First, I consider the question whether firms self-select into lobbying or whether lobbying boosts firm growth. Second, I explore whether lobbying firms are more likely to receive subsidies. Third, I quantify firm-specific returns to lobbying in terms of received subsidies.

I show that even within narrowly defined industries there is a premium in the levels of firms characteristics for lobbying firms and for subsidized firms. This result holds not just on average (i.e., running OLS estimations) but also by first-order stochastic dominance (i.e., performing Kolmogorov-Smirnov tests), showing that these groups of firms differ not just in the first moment but in the entire distribution of all considered firm characteristics. Disentangling the lobby premium with respect to firms' lobby status, I show that the lobby premium is mainly due to continuing lobbying firms and compared to these firms, lobby starters do not experience an additional premium. Moreover, Kolmogorov-Smirnov tests confirm a clear ranking of distributions with respect to firms' lobby status. Across all considered firm characteristics, the distribution of continuing lobbying firms first-order stochastically dominates the distributions of lobby starters and lobby stoppers, and the distributions of the latter two groups first-order stochastically dominate the distribution of firms that did not lobby in two consecutive years. This finding suggests that there is a lobby threshold above which firms engage in lobbying.

With respect to firm growth, results are more nuanced. Lobbying firms experience faster future growth only in some of the considered firm characteristics. Disentangling the lobby premium in one period ahead growth rates, I find that except for employees the expected pattern of a positive effect for starters and continuing lobbying firms and a negative effect for lobby stoppers is not confirmed across all firm characteristics. Looking closer at the relationship between lobbying and firm growth, I cannot find evidence that the initial lobby status has a clear and robust effect on (long-run) growth rates. To the contrary, I find evidence for a pre lobby-entry premium in both levels and average growth rates, suggesting that differences between lobbying and non-lobbying firms predate lobby entry. Thus, I conclude that firms with superior characteristics self-select into lobbying.

I also document a strong and robust positive relationship between lobbying and the likelihood to receive subsidies. Controlling for firm size, industry and year fixed effects, lobbying firms are up to 200% more likely to receive subsidies. Disentangling the marginal effect of lobbying with respect to firms' lobby status, I show that the positive marginal effect of lobbying is driven by continuing lobbying firms. Moreover, focusing on federal grants I estimate a linear probability model at the highly disaggregated firm-year-agency level. My results show that lobbying a particular federal agency has a statistically significant and relevant positive effect on the likelihood of receiving a grant from exactly the same agency.

Measured in terms of subsidies, returns to lobbying are substantial. On average, lobbying firms receive up to 51% higher subsidy payments. Moreover, one extra US-dollar spend on lobbying increases the amount of received subsidies by up to 9.65 US-dollars, or in other words, yields a return on investment of 865%.

Overall, my results suggest that firms with better firm characteristics self-select into lobbying, that lobbying has a statistically significant and economically relevant positive effect on the likelihood to receive subsidies, and that – even if only measured in terms of subsidies – returns to lobbying are huge.

Appendix

3.A Robustness checks and additional tables

3.A.1 Lobbying and subsidy premium

To show that lobbying firms and subsidized firms are different from non-lobbying firms and not-subsidized firms, respectively, Table 3.17 provides results from a t-test of mean differences in firm characteristics for the pooled sample. Lobbying firms and subsidized firms have significantly higher sales and value-added, use more capital, invest more and have more employees. Due to compositional effects across years and industries, pooling all observations can lead to misleading results. In the main body of the paper, I account for this by including industry and year fixed effects or by normalizing variables by the respective industry-year mean. Table 3.18 shows the results of regressing firm characteristics (in logs) on a lobby dummy (or on a subsidy dummy) without controlling for firm size. Table 3.19 shows the results of regressing yearly growth rates of firm characteristics (log changes) in period t on a lobby dummy (or on a subsidy dummy), controlling for log employees. Table 3.20 shows the results disentangling yearly growth rates of firm characteristics (log changes) in period t, considering lobby starters, stoppers and continuing lobbying firms. Table 3.21 shows the results of estimating equation (3.3) varying the time horizon between $T = 2000$ and $T = 2010$. Table 3.25 shows the results of estimating equation (3.6) varying the time horizon between $T = 2000$ and $T = 2010$. Table 3.29 shows the results of estimating equation (3.7) varying the time horizon between $T = 2001$ and $T = 2010$.

Table 3.17: Pooled t-test: mean comparison of firm characteristics in levels

	Mean of firm characteristic		
	Yes	No	Difference
Sales			
Lobby	8578.29	1149.27	7429.03***
Subsidy-Tracker	11147.49	1721.41	9426.08***
Federal Grants	8455.44	1976.60	6478.84***
ITC	2966.42	2031.90	934.52***
Any subsidy	5525.37	1662.81	3862.57***
Value-added			
Lobby	3180.46	486.27	2694.19***
Subsidy-Tracker	4031.20	717.27	3313.93***
Federal Grants	3191.11	814.48	2376.64***
ITC	1357.93	823.10	534.83***
Any subsidy	2160.36	683.00	1477.37***
Capital			
Lobby	3179.46	518.18	2661.28***
Subsidy-Tracker	3182.30	761.91	2420.40***
Federal Grants	3252.25	813.35	2438.90***
ITC	1195.93	833.91	362.02***
Any subsidy	1915.71	722.74	1192.97***
Investment			
Lobby	530.21	92.62	437.59***
Subsidy-Tracker	583.93	131.50	452.43***
Federal Grants	617.03	141.16	475.87***
ITC	245.22	143.15	102.06***
Any subsidy	358.26	122.60	235.67***
Employees in 1000s			
Lobby	27.43	5.07	22.36***
Subsidy-Tracker	37.65	6.85	30.81***
Federal Grants	25.14	7.84	17.30***
ITC	8.48	8.15	0.33
Any subsidy	18.51	6.77	11.74***

Notes: The compared variables are firm characeristics in levels. The dummy *Lobby* equals one if a firm lobbied in year t. Subsidy dummies indicate either subsidies from Subsidy-Tracker, ITC, Federal Grants or the combination of those (any subsidy) in year t. Monetary variables are in constant 1999 US$ (millions), deflated by the industry PPI. TFP is firm-level total factor productivity obtained from an Olley and Pakes (1996) estimation of an industry production function at the 2-digit NAICS level. Value-added is *Operating Income Before Depreciation plus Labor Cost*. Capital is *Property, Plant and Equipment*. Investment is *Capital Expenditures*. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 3.18: Lobby premium and subsidy premium (not controlling for firm size)

	Premium coefficient (levels)				
	Lobby	Subsidy-Tracker	Federal Grants	ITC	Any subsidy
Sales	2.550***	2.329***	0.985***	1.051***	1.469***
	(0.0561)	(0.0742)	(0.1424)	(0.0679)	(0.0525)
TFP	0.187***	0.106***	-0.028	0.125***	0.104***
	(0.0124)	(0.0134)	(0.0309)	(0.0144)	(0.0110)
Value-added	2.214***	1.974***	1.361***	0.753***	1.251***
	(0.0523)	(0.0669)	(0.1491)	(0.0665)	(0.0505)
Capital	2.555***	2.411***	1.265***	1.040***	1.519***
	(0.0582)	(0.0768)	(0.1411)	(0.0718)	(0.0552)
Investment	2.487***	2.352***	1.273***	1.040***	1.508***
	(0.0562)	(0.0741)	(0.1393)	(0.0693)	(0.0533)
Employees	2.138***	2.003***	0.965***	0.721***	1.182***
	(0.0513)	(0.0661)	(0.1257)	(0.0590)	(0.0466)

Notes: The dependent variable in all regressions is the respective firm characteristic in logs. The dummy *Lobby* equals one if a firm lobbied in year t. Subsidy dummies indicate either subsidies from Subsidy-Tracker, ITC, Federal Grants or the combination of those (any subsidy) in year t. Number of observations between 77501 and 106132. Adjusted R-squared between 0.18 and 0.44. All regressions include 4-digit NAICS fixed effects and year fixed effects. Robust standard errors are denoted in parentheses and are clustered at the firm level. Monetary variables are in constant 1999 US$ (millions), deflated by the industry PPI. TFP is firm-level total factor productivity obtained from an Olley and Pakes (1996) estimation of an industry production function at the 2-digit NAICS level. Value-added is *Operating Income Before Depreciation plus Labor Cost.* Capital is *Property, Plant and Equipment.* Investment is *Capital Expenditures.* * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 3.19: Lobby premium and subsidy premium in period t growth rates

	Premium coefficient (growth)				
	Lobby	Subsidy-Tracker	Federal Grants	ITC	Any subsidy
Sales	-0.025***	-0.039***	0.021	0.002	-0.007
	(0.0053)	(0.0069)	(0.0148)	(0.0067)	(0.0054)
TFP	0.006	-0.001	0.025**	-0.008	-0.003
	(0.0040)	(0.0042)	(0.0114)	(0.0055)	(0.0040)
Value-added	-0.022***	-0.021***	0.010	0.003	-0.004
	(0.0050)	(0.0056)	(0.0138)	(0.0067)	(0.0050)
Capital	-0.036***	-0.030***	0.005	0.012*	0.003
	(0.0054)	(0.0062)	(0.0125)	(0.0067)	(0.0052)
Investment	-0.044***	-0.020*	-0.006	-0.013	-0.007
	(0.0072)	(0.0101)	(0.0191)	(0.0094)	(0.0077)
Employees	-0.054***	-0.045***	-0.022**	0.001	-0.016***
	(0.0040)	(0.0047)	(0.0088)	(0.0047)	(0.0037)

Notes: The dependent variable in all regressions is the first difference of the respective firm characteristic in logs in year t. The dummy *Lobby* equals one if a firm lobbied in year t. Subsidy dummies indicate either subsidies from Subsidy-Tracker, ITC, Federal Grants or the combination of those (any subsidy) in year t. Number of observations between 63137 and 79557. Adjusted R-squared between 0.02 and 0.04. All regressions include 4-digit NAICS fixed effects and year fixed effects. All regressions include log firm employment to control for size. Robust standard errors are denoted in parentheses and are clustered at the firm level. Monetary variables are in constant 1999 US$ (millions), deflated by the industry PPI. TFP is firm-level total factor productivity obtained from an Olley and Pakes (1996) estimation of an industry production function at the 2-digit NAICS level. Value-added is *Operating Income Before Depreciation plus Labor Cost.* Capital is *Property, Plant and Equipment.* Investment is *Capital Expenditures.* * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 3.20: Disentangling the lobby premium in period t growth rates

Dependent Variable: Growth rate	Sales	TFP	Value-added	Capital	Investment	Employees
Starter [0,1]	0.026**	0.005	0.006	0.042***	0.002	-0.005
	(0.0120)	(0.0107)	(0.0121)	(0.0122)	(0.0197)	(0.0075)
Stopper [1,0]	-0.050***	0.024	-0.026	-0.080***	-0.112***	-0.071***
	(0.0132)	(0.0155)	(0.0165)	(0.0121)	(0.0242)	(0.0103)
Continue [1,1]	-0.038***	0.007*	-0.028***	-0.056***	-0.059***	-0.067***
	(0.0054)	(0.0039)	(0.0051)	(0.0057)	(0.0073)	(0.0043)
Log employees	0.010***	-0.004***	0.008***	0.026***	0.032***	0.029***
	(0.0014)	(0.0010)	(0.0013)	(0.0014)	(0.0018)	(0.0012)
R-squared	0.02	0.02	0.03	0.03	0.04	0.04
Observations	79557	63137	65442	76539	70717	75760
Clusters	13061	10649	10996	12676	12163	12519
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
4-digit NAICS FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The dependent variable in all regressions is the first log difference of the respective firm characteristic in year t. The base group are firms that did not lobby in two consecutive years. The dummy *Continue* indicates a firm that lobbies in two consecutive years. The dummy *Starter* indicates a firm that lobbied in year t but did not lobby in year *t-1*. The dummy *Stopper* indicates a firm that lobbied in year *t-1* but did not lobby in year t. All regressions include 4-digit NAICS fixed effects and year fixed effects. All regressions include log firm employment to control for size. Robust standard errors are denoted in parentheses and are clustered at the firm level. Monetary variables are in constant 1999 US$ (millions), deflated by the industry PPI. TFP is firm-level total factor productivity obtained from an Olley and Pakes (1996) estimation of an industry production function at the 2-digit NAICS level. Value-added is *Operating Income Before Depreciation plus Labor Cost*. Capital is *Property, Plant and Equipment*. Investment is *Capital Expenditures*. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 3.21: Premium in average growth rates ($1999 - T$) for initially lobbying firms

	Sales	TFP	Value-added	Capital	Investment	Employees
Premium T=2000, if lobby 1999	0.033*	-0.019	0.010	0.011	0.025	-0.007
	(0.0184)	(0.0173)	(0.0200)	(0.0171)	(0.0308)	(0.0125)
Premium T=2001, if lobby 1999	0.030**	-0.007	0.021*	0.020	0.037*	0.011
	(0.0129)	(0.0098)	(0.0124)	(0.0129)	(0.0210)	(0.0093)
Premium T=2002, if lobby 1999	0.028***	-0.005	0.014	0.019**	0.027*	0.005
	(0.0103)	(0.0078)	(0.0101)	(0.0096)	(0.0159)	(0.0071)
Premium T=2003, if lobby 1999	0.027***	-0.005	0.014	0.017**	0.020	0.003
	(0.0090)	(0.0059)	(0.0086)	(0.0085)	(0.0128)	(0.0062)
Premium T=2004, if lobby 1999	0.018**	-0.008	0.004	0.011	0.007	-0.011*
	(0.0080)	(0.0050)	(0.0076)	(0.0080)	(0.0111)	(0.0059)
Premium T=2005, if lobby 1999	0.017**	0.006	0.019***	0.014**	0.011	-0.014**
	(0.0074)	(0.0040)	(0.0064)	(0.0072)	(0.0101)	(0.0055)
Premium T=2006, if lobby 1999	0.020***	0.001	0.015**	0.015**	0.016*	-0.012**
	(0.0067)	(0.0040)	(0.0065)	(0.0068)	(0.0094)	(0.0050)
Premium T=2007, if lobby 1999	0.017**	-0.000	0.009	0.012*	0.010	-0.013***
	(0.0067)	(0.0035)	(0.0062)	(0.0065)	(0.0084)	(0.0049)
Premium T=2008, if lobby 1999	0.011*	0.002	0.014**	0.012*	0.008	-0.012**
	(0.0066)	(0.0030)	(0.0057)	(0.0064)	(0.0085)	(0.0047)
Premium T=2009, if lobby 1999	0.011*	0.002	0.013**	0.015**	0.011	-0.008*
	(0.0058)	(0.0029)	(0.0051)	(0.0059)	(0.0077)	(0.0043)
Premium T=2010, if lobby 1999	0.006	0.001	0.011**	0.011**	0.011*	-0.010**
	(0.0055)	(0.0024)	(0.0046)	(0.0055)	(0.0067)	(0.0042)

Notes: The dependent variable in all regressions is the average growth rate of the respective firm characteristic in the period 1999 – T. The dummy *Lobby in 1999* equals one if a firm lobbied in 1999. Number of observations between 2924 and 8059. Adjusted R-squared between 0.02 and 0.23. All regression include 4-digit NAICS fixed effects. All regressions include log firm employment to control for firm size, except for the employee regression. Robust standard errors are denoted in parentheses. All regressions include log firm employment to control for size, except for the employee regression. Monetary variables are in constant 1999 US$ (millions), deflated by the industry PPI. TFP is firm-level total factor productivity obtained from an Olley and Pakes (1996) estimation of an industry production function at the 2-digit NAICS level. Value-added is *Operating Income Before Depreciation plus Labor Cost.* Capital is *Property, Plant and Equipment.* Investment is *Capital Expenditures.* * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 3.22: Premium in average growth rates $(2002 - T)$ for initially lobbying firms

	Sales	TFP	Value-added	Capital	Investment	Employees
Premium T=2003, if lobby 2002	0.002	0.022	0.037**	-0.002	0.014	-0.011
	(0.0147)	(0.0162)	(0.0177)	(0.0149)	(0.0326)	(0.0121)
Premium T=2004, if lobby 2002	0.009	0.021**	0.026**	0.001	-0.005	-0.027***
	(0.0112)	(0.0099)	(0.0117)	(0.0113)	(0.0202)	(0.0089)
Premium T=2005, if lobby 2002	0.015*	0.014*	0.021**	0.007	-0.009	-0.029***
	(0.0084)	(0.0073)	(0.0093)	(0.0096)	(0.0151)	(0.0069)
Premium T=2006, if lobby 2002	0.006	0.012**	0.021***	0.010	0.012	-0.024***
	(0.0082)	(0.0060)	(0.0081)	(0.0088)	(0.0119)	(0.0060)
Premium T=2007, if lobby 2002	0.005	0.005	0.011	-0.000	-0.003	-0.024***
	(0.0072)	(0.0054)	(0.0073)	(0.0080)	(0.0102)	(0.0054)
Premium T=2008, if lobby 2002	0.002	0.003	0.006	0.002	0.006	-0.022***
	(0.0064)	(0.0050)	(0.0070)	(0.0077)	(0.0096)	(0.0051)
Premium T=2009, if lobby 2002	0.000	0.007	0.007	0.004	0.010	-0.019***
	(0.0061)	(0.0045)	(0.0060)	(0.0068)	(0.0088)	(0.0046)
Premium T=2010, if lobby 2002	-0.005	0.007**	0.007	0.001	0.000	-0.019***
	(0.0055)	(0.0032)	(0.0050)	(0.0064)	(0.0075)	(0.0044)

Notes: The dependent variable in all regressions is the average growth rate of the respective firm characteristic in the period 1999 – T. The dummy *Lobby in 1999* equals one if a firm lobbied in 1999. Number of observations between 3400 and 7210. Adjusted R-squared between 0.00 and 0.19. All regression include 4-digit NAICS fixed effects. All regressions include log firm employment to control for firm size, except for the employee regression. Robust standard errors are denoted in parentheses. All regressions include log firm employment to control for size, except for the employee regression. Monetary variables are in constant 1999 US$ (millions), deflated by the industry PPI. TFP is firm-level total factor productivity obtained from an Olley and Pakes (1996) estimation of an industry production function at the 2-digit NAICS level. Value-added is *Operating Income Before Depreciation plus Labor Cost*. Capital is *Property, Plant and Equipment*. Investment is *Capital Expenditures*. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 3.23: Premium in average growth rates $(2005 - T)$ for initially lobbying firms

	Sales	TFP	Value-added	Capital	Investment	Employees
Premium T=2006, if lobby 2005	0.005	0.024**	0.034**	0.004	0.041	-0.010
	(0.0169)	(0.0123)	(0.0144)	(0.0159)	(0.0279)	(0.0093)
Premium T=2007, if lobby 2005	0.012	0.001	0.008	-0.002	0.042**	-0.013*
	(0.0128)	(0.0093)	(0.0113)	(0.0123)	(0.0191)	(0.0076)
Premium T=2008, if lobby 2005	0.008	-0.001	-0.001	-0.002	0.019	-0.013**
	(0.0096)	(0.0083)	(0.0099)	(0.0100)	(0.0139)	(0.0065)
Premium T=2009, if lobby 2005	-0.003	0.004	0.003	-0.002	0.020*	-0.015***
	(0.0092)	(0.0053)	(0.0070)	(0.0085)	(0.0121)	(0.0054)
Premium T=2010, if lobby 2005	-0.005	0.003	0.004	0.001	0.005	-0.017***
	(0.0072)	(0.0044)	(0.0059)	(0.0081)	(0.0102)	(0.0051)

Notes: The dependent variable in all regressions is the average growth rate of the respective firm characteristic in the period 1999 – T. The dummy *Lobby in 1999* equals one if a firm lobbied in 1999. Number of observations between 4136 and 6924. Adjusted R-squared between 0.01 and 0.17. All regression include 4-digit NAICS fixed effects. All regressions include log firm employment to control for firm size, except for the employee regression. Robust standard errors are denoted in parentheses. All regressions include log firm employment to control for size, except for the employee regression. Monetary variables are in constant 1999 US$ (millions), deflated by the industry PPI. TFP is firm-level total factor productivity obtained from an Olley and Pakes (1996) estimation of an industry production function at the 2-digit NAICS level. Value-added is *Operating Income Before Depreciation plus Labor Cost*. Capital is *Property, Plant and Equipment*. Investment is *Capital Expenditures*. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 3.24: Premium in average growth rates $(2008 - T)$ for initially lobbying firms

	Sales	TFP	Value-added	Capital	Investment	Employees
Premium T=2009, if lobby 2008	0.026	-0.007	-0.014	0.008	0.056*	-0.013
	(0.0178)	(0.0172)	(0.0186)	(0.0146)	(0.0298)	(0.0081)
Premium T=2010, if lobby 2008	-0.004	0.017	0.007	-0.002	0.002	-0.018***
	(0.0123)	(0.0105)	(0.0110)	(0.0115)	(0.0183)	(0.0067)

Notes: The dependent variable in all regressions is the average growth rate of the respective firm characteristic in the period 1999 – T. The dummy *Lobby in 1999* equals one if a firm lobbied in 1999. Number of observations between 4778 and 6243. Adjusted R-squared between 0.01 and 0.13. All regression include 4-digit NAICS fixed effects. All regressions include log firm employment to control for firm size, except for the employee regression. Robust standard errors are denoted in parentheses. All regressions include log firm employment to control for size, except for the employee regression. Monetary variables are in constant 1999 US$ (millions), deflated by the industry PPI. TFP is firm-level total factor productivity obtained from an Olley and Pakes (1996) estimation of an industry production function at the 2-digit NAICS level. Value-added is *Operating Income Before Depreciation plus Labor Cost.* Capital is *Property, Plant and Equipment.* Investment is *Capital Expenditures.* * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 3.25: Ex-ante lobby premium in 1999, varying horizon T

	Pre-entry premium in 1999					
	Sales	TFP	Value-added	Capital	Investment	Employees
Lobby in T=2000	0.121	-0.009	0.080	0.214**	0.296***	1.570***
	(0.0760)	(0.0456)	(0.0654)	(0.0882)	(0.1036)	(0.1885)
Lobby in T=2001	0.181***	0.032	0.098**	0.202***	0.248***	1.346***
	(0.0569)	(0.0457)	(0.0498)	(0.0616)	(0.0682)	(0.1349)
Lobby in T=2002	0.214***	0.068*	0.119***	0.136**	0.187***	1.409***
	(0.0476)	(0.0378)	(0.0395)	(0.0582)	(0.0674)	(0.1214)
Lobby in T=2003	0.181***	0.016	0.097**	0.197***	0.257***	1.566***
	(0.0479)	(0.0427)	(0.0477)	(0.0507)	(0.0606)	(0.1044)
Lobby in T=2004	0.228***	0.035	0.150***	0.240***	0.261***	1.539***
	(0.0510)	(0.0422)	(0.0511)	(0.0540)	(0.0621)	(0.1045)
Lobby in T=2005	0.204***	0.064*	0.135***	0.176***	0.242***	1.475***
	(0.0487)	(0.0381)	(0.0442)	(0.0489)	(0.0567)	(0.0985)
Lobby in T=2006	0.214***	0.039	0.102***	0.131***	0.219***	1.440***
	(0.0421)	(0.0348)	(0.0379)	(0.0458)	(0.0526)	(0.1004)
Lobby in T=2007	0.225***	0.059	0.157***	0.167***	0.232***	1.424***
	(0.0471)	(0.0365)	(0.0431)	(0.0496)	(0.0567)	(0.0956)
Lobby in T=2008	0.182***	0.061*	0.128***	0.067	0.184***	1.439***
	(0.0455)	(0.0334)	(0.0360)	(0.0461)	(0.0514)	(0.0995)
Lobby in T=2009	0.125***	0.078***	0.119***	0.037	0.151***	1.613***
	(0.0426)	(0.0295)	(0.0341)	(0.0434)	(0.0500)	(0.0916)
Lobby in T=2010	0.127***	0.070**	0.132***	0.071	0.189***	1.629***
	(0.0488)	(0.0345)	(0.0378)	(0.0434)	(0.0512)	(0.0963)

Notes: The dependent variable in all regressions is the respective log firm characteristic in 1999. The dummy *Lobby in T* equals one if a firm lobbied in year T. Number of observations between 6847 and 8162. Adjusted R-squared between 0.24 and 0.87. All regression include 4-digit NAICS fixed effects. Robust standard errors are denoted in parentheses. Monetary variables are in constant 1999 US$ (millions), deflated by the industry PPI. TFP is firm-level total factor productivity obtained from an Olley and Pakes (1996) estimation of an industry production function at the 2-digit NAICS level. Value-added is *Operating Income Before Depreciation plus Labor Cost.* Capital is *Property, Plant and Equipment.* Investment is *Capital Expenditures.* * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 3.26: Ex-ante lobby premium in 2002, varying horizon T

	Pre-entry premium in 2002					
	Sales	TFP	Value-added	Capital	Investment	Employees
Lobby in T=2003	-0.033	0.068	0.124**	0.199***	0.314***	1.562***
	(0.0715)	(0.0419)	(0.0497)	(0.0763)	(0.0856)	(0.1455)
Lobby in T=2004	0.043	0.104***	0.203***	0.211***	0.314***	1.500***
	(0.0699)	(0.0371)	(0.0532)	(0.0701)	(0.0792)	(0.1289)
Lobby in T=2005	0.130**	0.024	0.079*	0.124**	0.207***	1.564***
	(0.0517)	(0.0427)	(0.0444)	(0.0538)	(0.0613)	(0.1072)
Lobby in T=2006	0.157***	-0.004	0.054	0.137***	0.193***	1.467***
	(0.0487)	(0.0403)	(0.0434)	(0.0518)	(0.0609)	(0.1064)
Lobby in T=2007	0.146***	0.062*	0.130***	0.174***	0.233***	1.465***
	(0.0487)	(0.0358)	(0.0404)	(0.0554)	(0.0653)	(0.1039)
Lobby in T=2008	0.110**	0.044	0.113***	0.126**	0.203***	1.531***
	(0.0473)	(0.0312)	(0.0391)	(0.0544)	(0.0636)	(0.1060)
Lobby in T=2009	0.101**	0.068**	0.109***	0.132**	0.255***	1.702***
	(0.0422)	(0.0281)	(0.0331)	(0.0531)	(0.0618)	(0.0974)
Lobby in T=2010	0.120***	0.041	0.106***	0.147***	0.266***	1.756***
	(0.0437)	(0.0328)	(0.0369)	(0.0521)	(0.0620)	(0.0995)

Notes: The dependent variable in all regressions is the respective log firm characteristic in 2002. The dummy *Lobby in T* equals one if a firm lobbied in year T. Number of observations between 5839 and 6993. Adjusted R-squared between 0.25 and 0.89. All regression include 4-digit NAICS fixed effects. Robust standard errors are denoted in parentheses. Monetary variables are in constant 1999 US$ (millions), deflated by the industry PPI. TFP is firm-level total factor productivity obtained from an Olley and Pakes (1996) estimation of an industry production function at the 2-digit NAICS level. Value-added is *Operating Income Before Depreciation plus Labor Cost*. Capital is *Property, Plant and Equipment*. Investment is *Capital Expenditures*. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 3.27: Ex-ante lobby premium in 2005, varying horizon T

	Pre-entry premium in 2005					
	Sales	TFP	Value-added	Capital	Investment	Employees
Lobby in T=2006	0.188**	0.056	0.093	0.153	0.264***	1.168***
	(0.0783)	(0.0608)	(0.0678)	(0.1085)	(0.1000)	(0.1703)
Lobby in T=2007	0.221***	0.103**	0.165***	0.156**	0.274***	1.220***
	(0.0683)	(0.0448)	(0.0497)	(0.0785)	(0.0783)	(0.1271)
Lobby in T=2008	0.168***	0.086**	0.133***	0.069	0.242***	1.276***
	(0.0601)	(0.0384)	(0.0436)	(0.0787)	(0.0766)	(0.1217)
Lobby in T=2009	0.167***	0.080**	0.123***	0.092	0.183***	1.468***
	(0.0525)	(0.0319)	(0.0375)	(0.0688)	(0.0705)	(0.1097)
Lobby in T=2010	0.203***	0.067**	0.152***	0.207***	0.318***	1.579***
	(0.0519)	(0.0312)	(0.0357)	(0.0618)	(0.0628)	(0.1081)

Notes: The dependent variable in all regressions is the respective log firm characteristic in 2005. The dummy *Lobby in T* equals one if a firm lobbied in year T. Number of observations between 5445 and 6423. Adjusted R-squared between 0.27 and 0.87. All regression include 4-digit NAICS fixed effects. Robust standard errors are denoted in parentheses. Monetary variables are in constant 1999 US$ (millions), deflated by the industry PPI. TFP is firm-level total factor productivity obtained from an Olley and Pakes (1996) estimation of an industry production function at the 2-digit NAICS level. Value-added is *Operating Income Before Depreciation plus Labor Cost*. Capital is *Property, Plant and Equipment*. Investment is *Capital Expenditures*. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 3.28: Ex-ante lobby premium in 2008, varying horizon T

	Pre-entry premium in 2008					
	Sales	TFP	Value-added	Capital	Investment	Employees
Lobby in T=2009	0.277***	0.044	0.103*	0.255***	0.337***	1.353***
	(0.0715)	(0.0522)	(0.0557)	(0.0800)	(0.0875)	(0.1474)
Lobby in T=2010	0.257***	0.039	0.116**	0.277***	0.367***	1.386***
	(0.0639)	(0.0467)	(0.0504)	(0.0712)	(0.0782)	(0.1284)

Notes: The dependent variable in all regressions is the respective log firm characteristic in 2008. The dummy *Lobby in T* equals one if a firm lobbied in year *T*. Number of observations between 4631 and 5527. Adjusted R-squared between 0.28 and 0.85. All regression include 4-digit NAICS fixed effects. Robust standard errors are denoted in parentheses. Monetary variables are in constant 1999 US$ (millions), deflated by the industry PPI. TFP is firm-level total factor productivity obtained from an Olley and Pakes (1996) estimation of an industry production function at the 2-digit NAICS level. Value-added is *Operating Income Before Depreciation plus Labor Cost*. Capital is *Property, Plant and Equipment*. Investment is *Capital Expenditures*. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 3.29: Ex-ante lobby growth premium from 1999 to $T-1$

	Pre-entry growth premium 1999-(T-1)					
	Sales	TFP	Value-added	Capital	Investment	Employees
Lobby in T=2001	0.056	0.007	0.159***	0.205***	0.307***	0.127***
	(0.0466)	(0.0251)	(0.0329)	(0.0371)	(0.0585)	(0.0247)
Lobby in T=2002	0.103***	-0.012	0.088***	0.148***	0.192***	0.091***
	(0.0206)	(0.0151)	(0.0210)	(0.0207)	(0.0331)	(0.0150)
Lobby in T=2003	0.073***	0.011	0.087***	0.113***	0.106***	0.068***
	(0.0152)	(0.0142)	(0.0175)	(0.0142)	(0.0238)	(0.0112)
Lobby in T=2004	0.050***	0.005	0.053***	0.069***	0.087***	0.038***
	(0.0134)	(0.0098)	(0.0134)	(0.0124)	(0.0175)	(0.0096)
Lobby in T=2005	0.067***	0.003	0.060***	0.081***	0.087***	0.050***
	(0.0114)	(0.0083)	(0.0109)	(0.0115)	(0.0145)	(0.0089)
Lobby in T=2006	0.061***	0.002	0.052***	0.064***	0.068***	0.038***
	(0.0096)	(0.0065)	(0.0100)	(0.0105)	(0.0121)	(0.0079)
Lobby in T=2007	0.064***	0.008	0.054***	0.066***	0.071***	0.038***
	(0.0089)	(0.0052)	(0.0079)	(0.0095)	(0.0109)	(0.0073)
Lobby in T=2008	0.055***	0.001	0.044***	0.067***	0.065***	0.033***
	(0.0084)	(0.0048)	(0.0077)	(0.0085)	(0.0101)	(0.0066)
Lobby in T=2009	0.056***	0.001	0.041***	0.063***	0.061***	0.026***
	(0.0078)	(0.0044)	(0.0073)	(0.0079)	(0.0092)	(0.0062)
Lobby in T=2010	0.067***	0.007*	0.047***	0.066***	0.066***	0.033***
	(0.0075)	(0.0038)	(0.0067)	(0.0077)	(0.0092)	(0.0058)

Notes: The dependent variable in all regressions is the average growth rate of the respective firm characteristic in the period 1999 – (T-1). The dummy *Lobby in T* equals one if a firm lobbied in year *T*. Number of observations between 2541 and 7254. Adjusted R-squared between 0.03 and 0.19. All regression include 4-digit NAICS fixed effects. All regressions include log firm employment to control for firm size, except for the employee regression. Robust standard errors are denoted in parentheses. Monetary variables are in constant 1999 US$ (millions), deflated by the industry PPI. TFP is firm-level total factor productivity obtained from an Olley and Pakes (1996) estimation of an industry production function at the 2-digit NAICS level. Value-added is *Operating Income Before Depreciation plus Labor Cost*. Capital is *Property, Plant and Equipment*. Investment is *Capital Expenditures*. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 3.30: Ex-ante lobby growth premium from 2002 to $T-1$

	Pre-entry growth premium 2002-(T-1)					
	Sales	TFP	Value-added	Capital	Investment	Employees
Lobby in T=2004	0.043	-0.022	-0.010	0.002	-0.053	-0.020
	(0.0347)	(0.0249)	(0.0280)	(0.0472)	(0.0590)	(0.0306)
Lobby in T=2005	0.060***	0.004	0.057**	0.057***	0.062**	0.030**
	(0.0208)	(0.0194)	(0.0229)	(0.0203)	(0.0295)	(0.0138)
Lobby in T=2006	0.069***	0.012	0.053***	0.035**	0.062***	0.035***
	(0.0152)	(0.0127)	(0.0152)	(0.0155)	(0.0206)	(0.0107)
Lobby in T=2007	0.074***	0.006	0.045***	0.054***	0.070***	0.034***
	(0.0133)	(0.0090)	(0.0118)	(0.0138)	(0.0168)	(0.0096)
Lobby in T=2008	0.071***	0.009	0.047***	0.060***	0.083***	0.041***
	(0.0113)	(0.0067)	(0.0095)	(0.0117)	(0.0146)	(0.0077)
Lobby in T=2009	0.064***	0.009	0.039***	0.061***	0.061***	0.028***
	(0.0106)	(0.0059)	(0.0085)	(0.0094)	(0.0119)	(0.0071)
Lobby in T=2010	0.064***	0.015**	0.044***	0.052***	0.060***	0.026***
	(0.0092)	(0.0062)	(0.0084)	(0.0088)	(0.0119)	(0.0064)

Notes: The dependent variable in all regressions is the average growth rate of the respective firm characteristic in the period 1999 – (T-1). The dummy *Lobby in T* equals one if a firm lobbied in year *T*. Number of observations between 2925 and 6306. Adjusted R-squared between 0.00 and 0.16. All regression include 4-digit NAICS fixed effects. All regressions include log firm employment to control for firm size, except for the employee regression. Robust standard errors are denoted in parentheses. Monetary variables are in constant 1999 US$ (millions), deflated by the industry PPI. TFP is firm-level total factor productivity obtained from an Olley and Pakes (1996) estimation of an industry production function at the 2-digit NAICS level. Value-added is *Operating Income Before Depreciation plus Labor Cost*. Capital is *Property, Plant and Equipment*. Investment is *Capital Expenditures*. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 3.31: Ex-ante lobby growth premium from 2005 to $T-1$

	Pre-entry growth premium 2005-(T-1)					
	Sales	TFP	Value-added	Capital	Investment	Employees
Lobby in T=2007	0.069**	0.012	0.049*	0.101**	0.055	0.044**
	(0.0295)	(0.0257)	(0.0295)	(0.0406)	(0.0457)	(0.0180)
Lobby in T=2008	0.061***	-0.009	0.018	0.087***	0.064*	0.033***
	(0.0226)	(0.0160)	(0.0180)	(0.0265)	(0.0324)	(0.0127)
Lobby in T=2009	0.064***	0.006	0.034**	0.083***	0.088***	0.032***
	(0.0198)	(0.0119)	(0.0148)	(0.0204)	(0.0242)	(0.0104)
Lobby in T=2010	0.064***	0.007	0.029**	0.044***	0.054***	0.030***
	(0.0145)	(0.0102)	(0.0124)	(0.0150)	(0.0176)	(0.0085)

Notes: The dependent variable in all regressions is the average growth rate of the respective firm characteristic in the period 1999 – (T-1). The dummy *Lobby in T* equals one if a firm lobbied in year *T*. Number of observations between 3504 and 5837. Adjusted R-squared between -0.00 and 0.11. All regression include 4-digit NAICS fixed effects. All regressions include log firm employment to control for firm size, except for the employee regression. Robust standard errors are denoted in parentheses. Monetary variables are in constant 1999 US$ (millions), deflated by the industry PPI. TFP is firm-level total factor productivity obtained from an Olley and Pakes (1996) estimation of an industry production function at the 2-digit NAICS level. Value-added is *Operating Income Before Depreciation plus Labor Cost*. Capital is *Property, Plant and Equipment*. Investment is *Capital Expenditures*. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 3.32: Ex-ante lobby growth premium from 2008 to 2009

	Pre-entry growth premium 2008-2009					
	Sales	TFP	Value-added	Capital	Investment	Employees
Lobby in T=2010	0.047*	0.080***	0.096***	0.037	0.085	0.033*
	(0.0267)	(0.0285)	(0.0328)	(0.0236)	(0.0567)	(0.0178)

Notes: The dependent variable in all regressions is the average growth rate of the respective firm characteristic in the period 1999 – (T-1). The dummy *Lobby in T* equals one if a firm lobbied in year *T*. Number of observations between 4084 and 5093. Adjusted R-squared between 0.02 and 0.13. All regression include 4-digit NAICS fixed effects. All regressions include log firm employment to control for firm size, except for the employee regression. Robust standard errors are denoted in parentheses. Monetary variables are in constant 1999 US$ (millions), deflated by the industry PPI. TFP is firm-level total factor productivity obtained from an Olley and Pakes (1996) estimation of an industry production function at the 2-digit NAICS level. Value-added is *Operating Income Before Depreciation plus Labor Cost*. Capital is *Property, Plant and Equipment*. Investment is *Capital Expenditures*. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 3.33: Linear probability model with firm size interaction effect

Dependent Variable: Dummy for	Subsidy-Tracker	Federal Grants	ITC	Any subsidy
Lobby	0.035***	0.032***	0.030***	0.078***
	(0.0046)	(0.0049)	(0.0067)	(0.0079)
Log employees	0.010***	0.001**	0.009***	0.018***
	(0.0006)	(0.0005)	(0.0008)	(0.0010)
Lobby*Log employees	0.032***	0.006**	-0.004	0.022***
	(0.0026)	(0.0024)	(0.0026)	(0.0034)
Constant	-0.025	-0.015***	-0.011	-0.042
	(0.0160)	(0.0017)	(0.0148)	(0.0273)
R-squared	0.12	0.06	0.10	0.14
Observations	91383	91383	91383	91383
Clusters	14392	14392	14392	14392
Year FE	Yes	Yes	Yes	Yes
4-digit NAICS FE	Yes	Yes	Yes	Yes

Notes: The dependent variable is a dummy that indicates either a subsidy from Subsidy-Tracker, ITC, Federal Grants or the combination of those (any subsidy) in year t. The dummy *Lobby* equals one if a firm lobbied in year t. All regressions include 4-digit NAICS fixed effects and year fixed effects. Robust standard errors are denoted in parentheses and are clustered at the firm level. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

3.A.2 Lobbying and the likelihood to receive subsidies

3.A.2.1 Interaction effects and Probit model

In Table 3.33, I show results from a linear probability model including interaction effects between firm size (log employees) and the lobby dummy. In particular, I estimate the following equation:

$$D_{ijt} = \beta_0 + \beta_1 \cdot Lobby_{it} + \beta_2 \cdot \ln Emp_{it} + \beta_3 \cdot (Lobby_{it} \cdot \ln Emp_{it}) + \alpha_j + \lambda_t + \epsilon_{ijt}. \quad (3.13)$$

The main effects are all highly significant across all subsidy types. For Subsidy-Tracker, Federal Grants and for all subsidy measures combined, the interaction effect is also positive and statistically significant at the one and five percent level, respectively. Thus, lobbying increases the likelihood of receiving subsidies, and this positive effect of lobbying is even stronger for larger firms. In Table 3.34 I show results from estimating a linear probability model with an interaction term of the lobby dummy and the industry lobby share. As further robustness checks, Tables 3.35 and 3.36 report results from a Probit model without and with an interaction term of firm size and a lobby dummy, respectively. In particular, I estimate

$$Pr(D_{ijt} = 1|X) = \phi\left(\beta_0 + \beta_1 \cdot Lobby_{it} + \beta_2 \cdot \ln Emp_{it} + \alpha_j + \lambda_t + \epsilon_{ijt}\right), \quad (3.14)$$

where $Pr(D_{ijt} = 1|X)$ is the conditional probability that the subsidy dummy D_{ijt} equals one and $\phi(.)$ is the cumulative distribution function of the standard normal distribution. While the estimated marginal effects of the Probit model are smaller, the sign and the significance level is the same as in the linear probability model (see Tables 3.35 and 3.36). Thus, my results are robust to using a Probit model.

3.A.2.2 Linear probability model – agency level

I summarize the information about the agency that was lobbied and that funded grants at the firm-year level, and estimate the following equation by OLS:

$$GrantAgency_{ijt} = \beta_0 + \beta_1 \cdot LobbyAgency_{it} + \beta_2 \cdot \ln Emp_{it} + \alpha_j + \lambda_t + \epsilon_{ijt}, \quad (3.15)$$

where the dummy variable $GrantAgency_{ijt}$ equals one if in year t, firm i receives a grant from any funding agency. The dummy variable $LobbyAgency_{it}$ equals one if a firm

Table 3.34: Linear probability model with industry lobby share interaction effect

Dependent Variable: Dummy for	Subsidy-Tracker	Federal Grants	ITC	Any subsidy
Lobby	0.058***	0.013*	0.033***	0.085***
	(0.0089)	(0.0068)	(0.0108)	(0.0127)
Industry lobby share	-0.038*	-0.095***	0.153***	0.043
	(0.0223)	(0.0176)	(0.0229)	(0.0325)
Lobby*Industry lobby share	0.096**	0.143***	-0.057	0.107**
	(0.0400)	(0.0335)	(0.0402)	(0.0524)
Log employees	0.014***	0.002***	0.009***	0.021***
	(0.0007)	(0.0006)	(0.0009)	(0.0010)
Constant	-0.017	-0.017***	-0.003	-0.031
	(0.0206)	(0.0029)	(0.0137)	(0.0303)
R-squared	0.10	0.06	0.10	0.14
Observations	91383	91383	91383	91383
Clusters	14392	14392	14392	14392
Year FE	Yes	Yes	Yes	Yes
4-digit NAICS FE	Yes	Yes	Yes	Yes

Notes: The dependent variable is a dummy that indicates either a subsidy from Subsidy-Tracker, ITC, Federal Grants or the combination of those (any subsidy) in year t. The dummy *Lobby* equals one if a firm lobbied in year t. *Industry lobby share* is the share of lobbying firms within a NAICS 4-digit industry in year t. All regressions include 4-digit NAICS fixed effects and year fixed effects. Robust standard errors are denoted in parentheses and are clustered at the firm level. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 3.35: Probit model: marginal effects – lobbying and receiving subsidy

Dependent Variable: Dummy for	Subsidy-Tracker	Federal Grants	ITC	Any subsidy
Lobby	0.028***	0.031***	0.017***	0.083***
	(0.0026)	(0.0036)	(0.0041)	(0.0064)
Log employees	0.008***	0.000	0.003***	0.014***
	(0.0004)	(0.0003)	(0.0006)	(0.0009)
Pseudo R-squared	0.23	0.15	0.12	0.14
Observations	92560	81251	92087	92560
Clusters	14604	13273	14524	14604
Year FE	Yes	Yes	Yes	Yes
2-digit NAICS FE	Yes	Yes	Yes	Yes

Notes: The dependent variable is a dummy that indicates either a subsidy from Subsidy-Tracker, ITC, Federal Grants or the combination of those (any subsidy) in year t. The dummy *Lobby* equals one if a firm lobbied in year t. Reported coefficients are marginal effects evaluated either at the mean for continuous variables or as the discrete change from the base level for factor variables. All regressions include 2-digit NAICS fixed effects and year fixed effects. Robust standard errors are denoted in parentheses and are clustered at the firm level. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 3.36: Probit model with interaction effects: marginal effects

Dependent Variable: Dummy for	Subsidy-Tracker	Federal Grants	ITC	Any subsidy
Lobby	0.019***	0.026***	0.020***	0.067***
	(0.0031)	(0.0038)	(0.0044)	(0.0070)
Log employees	0.008***	-0.000	0.004***	0.013***
	(0.0004)	(0.0004)	(0.0006)	(0.0009)
Lobby*Log employees	0.003***	0.002***	-0.002	0.008***
	(0.0007)	(0.0006)	(0.0014)	(0.0020)
Pseudo R-squared	0.23	0.15	0.13	0.15
Observations	92560	81251	92087	92560
Clusters	14604	13273	14524	14604
Year FE	Yes	Yes	Yes	Yes
2-digit NAICS FE	Yes	Yes	Yes	Yes

Notes: The dependent variable is a dummy that indicates either a subsidy from Subsidy-Tracker, ITC, Federal Grants or the combination of those (any subsidy) in year t. The dummy *Lobby* equals one if a firm lobbied in year t. Reported coefficients are marginal effects evaluated either at the mean for continuous variables or as the discrete change from the base level for factor variables. All regressions include 2-digit NAICS fixed effects and year fixed effects. Robust standard errors are denoted in parentheses and are clustered at the firm level. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 3.37: Likelihood to receive federal grant and lobbying any funding agency

Dependent Variable: *Grant Agency* Dummy	(1)	(2)	(3)
Lobby Agency	0.076***	0.063***	0.051***
	(0.0070)	(0.0064)	(0.0069)
Log employees		0.002***	0.002***
		(0.0006)	(0.0006)
Lobby			0.014***
			(0.0039)
Constant	0.014***	-0.015***	-0.015***
	(0.0007)	(0.0025)	(0.0022)
R-squared	0.02	0.07	0.07
Observations	107887	91383	91383
Clusters	16315	14392	14392
Year FE	NO	Yes	Yes
4-digit NAICS FE	NO	Yes	Yes

Notes: The dependent variable in all specifications is a dummy that equals one if a firm received a federal grant from any funding agency in year t. The dummy *Lobby Agency* equals one if a firm lobbied at least one funding agency in year t. The dummy *Lobby* equals one if a firm lobbied in year t. Robust standard errors are denoted in parentheses and are clustered at the firm level. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 3.38: Returns to lobbying: log subsidy amount and log lobbying expenditures

Dependent Variable: Subsidy amount (in logs)	Subsidy-Tracker	Federal Grants	ITC	Any subsidy
Log lobby expenditures	0.284***	0.231***	0.247***	0.396***
	(0.0629)	(0.0753)	(0.0553)	(0.0522)
Log employees	0.164**	-0.053	0.607***	0.094**
	(0.0654)	(0.0550)	(0.0449)	(0.0417)
R-squared	0.17	0.24	0.52	0.19
Observations	1405	789	1334	2947
Clusters	566	288	420	942
Year FE	Yes	Yes	Yes	Yes
2-digit NAICS FE	Yes	Yes	Yes	Yes

Notes: The dependent variable is the log amount of subsidies in US\$ (millions) received by a firm from Subsidy-Tracker, ITC, Federal Grants or the sum of those (any subsidy) in year t. *Lobby expenditures* is the log amount a firms spent on lobbying in year t. All regressions include 2-digit NAICS fixed effects and year fixed effects. Monetary variables are in constant 1999 US\$ (millions), deflated by the industry PPI. Robust standard errors are denoted in parentheses and are clustered at the firm level. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

lobbied at least one of the funding agencies in year t. Industry and year fixed effects are denoted by α_j and λ_t, respectively. Standard errors are clustered at the firm level. The results of estimating equation (3.15) are shown in Table 3.37. Firms that lobby *any* funding agency are significantly more likely to receive federal grants. Results are robust to including year and industry fixed effects, firm size and a dummy for lobbying in general. This (general) lobby dummy accounts for the fact that some lobbying firms do not lobby a funding agency. Lobbying any federal agency increases the likelihood of receiving a federal grant by 5.1-7.6 percentage points.

3.A.3 Subsidies and the returns to lobbying

To get the elasticity of received subsidies with respect to lobby expenditures, I estimate the following equation by OLS:

$$\ln SubsidyAmount_{ijt} = \beta_0 + \beta_1 \cdot \ln LobbyExp_{it} + \beta_2 \cdot \ln Emp_{it} + \alpha_j + \lambda_t + \epsilon_{ijt}, \quad (3.16)$$

where $\ln SubsidyAmount_{ijt}$ is the amount of received subsidies (in logs) and $\ln LobbyExp_{it}$ are lobby expenditures (in logs) of firm i in year t. Industry and year fixed effects are denoted by α_j and λ_t, respectively. Results are shown in Table 3.38. To quantify the effect of lobbying on the amount of received subsidies in US-dollar, I estimate the following equation by OLS:

$$SubsidyAmount_{ijt} = \beta_0 + \beta_1 \cdot Lobby_{it} + \beta_2 \cdot Emp_{it} + \alpha_j + \lambda_t + \epsilon_{ijt}, \quad (3.17)$$

where $SubsidyAmount_{ijt}$ is the amount of subsidies received and the dummy variable $Lobby_{it}$ equals one if firm i lobbied in year t. Industry and year fixed effects are denoted by α_j and λ_t, respectively. Results are shown in Table 3.39. In Table 3.40, I show the results of a further robustness check, estimating equation (3.17) considering the full sample. In Table 3.42, I show the results of a further robustness check, estimating equation (3.12) considering the full sample. In Table 3.43, I show the results of a further robustness check, estimating a Tobit model to account for the left-censored dependent variable in the full sample.

Table 3.39: Returns to lobbying: subsidy amount and lobby dummy

Dependent Variable: Subsidy amount	Subsidy-Tracker	Federal Grants	ITC	Any subsidy
Lobby	2.221***	2.926***	0.369	6.611**
	(0.6918)	(1.0010)	(4.7434)	(3.0597)
Employees	0.010	0.022**	0.903***	0.094
	(0.0088)	(0.0097)	(0.3151)	(0.0678)
R-squared	0.01	0.14	0.09	0.02
Observations	3156	1816	6552	10499
Clusters	1367	650	1824	3139
Year FE	Yes	Yes	Yes	Yes
2-digit NAICS FE	Yes	Yes	Yes	Yes

Notes: The dependent variable is the amount of subsidies in US$ (millions) received by a firm from Subsidy-Tracker, ITC, Federal Grants or the sum of those (any subsidy) in year t. *Lobby* is a dummy that equals one if a firms lobbied in year t. All regressions include 2-digit NAICS fixed effects and year fixed effects. Monetary variables are in constant 1999 US$ (millions), deflated by the industry PPI. Robust standard errors are denoted in parentheses and are clustered at the firm level. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 3.40: Returns to lobbying: subsidy amount and lobby dummy, all observations

Dependent Variable: Subsidy amount	Subsidy-Tracker	Federal Grants	ITC	Any subsidy
Lobby	0.304***	0.313***	1.542***	2.158***
	(0.0701)	(0.0575)	(0.5288)	(0.5782)
Employees	0.005**	0.002*	0.033**	0.040**
	(0.0024)	(0.0009)	(0.0164)	(0.0193)
R-squared	0.00	0.01	0.01	0.01
Observations	94171	94171	94171	94171
Clusters	14848	14848	14848	14848
Year FE	Yes	Yes	Yes	Yes
2-digit NAICS FE	Yes	Yes	Yes	Yes

Notes: The dependent variable is the amount of subsidies in US$ (millions) received by a firm from Subsidy-Tracker, ITC, Federal Grants or the sum of those (any subsidy) in year t. *Lobby* is a dummy that equals one if a firms lobbied in year t. All regressions include 2-digit NAICS fixed effects and year fixed effects. Monetary variables are in constant 1999 US$ (millions), deflated by the industry PPI. Robust standard errors are denoted in parentheses and are clustered at the firm level. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 3.41: Returns to lobbying: subsidy amount and lobby dummy, controlling for industry share of lobbying firms

Dependent Variable: Subsidy amount (in logs)	Subsidy-Tracker	Federal Grants	ITC	Any subsidy
Lobby	0.503***	0.240	0.225**	0.297***
	(0.1173)	(0.1500)	(0.0958)	(0.0890)
Industry lobby share	0.057**	0.023	0.127***	0.079***
	(0.0242)	(0.0173)	(0.0210)	(0.0139)
Log employees	0.320***	0.108***	0.635***	0.336***
	(0.0323)	(0.0279)	(0.0234)	(0.0214)
R-squared	0.18	0.19	0.42	0.18
Observations	3145	1806	6537	10463
Clusters	1359	644	1817	3118
Year FE	Yes	Yes	Yes	Yes
2-digit NAICS FE	Yes	Yes	Yes	Yes

Notes: The dependent variable is the log amount of subsidies in US$ (millions) received by a firm from Subsidy-Tracker, ITC, Federal Grants or the sum of those (any subsidy) in year t. *Lobby* is a dummy that equals one if a firms lobbied in year t. *Industry lobby share* is the fraction of lobbying firms within a 2-digit NAICS industry in year t. All regressions include 2-digit NAICS fixed effects and year fixed effects. Monetary variables are in constant 1999 US$ (millions), deflated by the industry PPI. Robust standard errors are denoted in parentheses and are clustered at the firm level. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 3.42: Returns to lobbying: subsidies and lobby expenses, all observations

Dependent Variable: Subsidy amount	Subsidy-Tracker	Federal Grants	ITC	Any subsidy
Lobby expenditures	0.608**	0.362***	4.024**	4.994**
	(0.2375)	(0.1012)	(1.8895)	(2.1421)
Employees	0.002**	0.001	0.012	0.014
	(0.0008)	(0.0006)	(0.0087)	(0.0094)
R-squared	0.02	0.02	0.03	0.03
Observations	92929	92929	92929	92929
Clusters	14622	14622	14622	14622
Year FE	Yes	Yes	Yes	Yes
4-digit NAICS FE	Yes	Yes	Yes	Yes

Notes: The dependent variable is the amount of subsidies in US$ (millions) received by a firm from Subsidy-Tracker, ITC, Federal Grants or the sum of those (any subsidy) in year t. *Lobby expenditures* is the amount a firms spent on lobbying in year t. All regressions include 4-digit NAICS fixed effects and year fixed effects. Monetary variables are in constant 1999 US$ (millions), deflated by the industry PPI. Employees in 1000s. Robust standard errors are denoted in parentheses and are clustered at the firm level. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 3.43: Returns to lobbying: Tobit model – subsidy amount and lobby expenditures

Dependent Variable: Subsidy amount	Subsidy-Tracker	Federal Grants	ITC	Any subsidy
Lobby expenditures	0.027**	0.189***	2.145**	2.686**
	(0.0110)	(0.0539)	(1.0446)	(1.1992)
Log employees	0.049***	0.006**	0.151***	0.168***
	(0.0176)	(0.0030)	(0.0561)	(0.0573)
R-squared	0.11	0.00	0.00	0.00
Observations	92560	92560	92560	92560
Clusters	14604	14604	14604	14604
Year FE	Yes	Yes	Yes	Yes
2-digit NAICS FE	Yes	Yes	Yes	Yes

Notes: Marginal effects at the mean for left-censored dependent variable. The dependent variable is the amount of subsidies in US$ (millions) received by a firm from Subsidy-Tracker, ITC, Federal Grants or the sum of those (any subsidy) in year t. *Lobby expenditures* is the amount a firms spent on lobbying in year t. All regressions include 2-digit NAICS fixed effects and year fixed effects. Monetary variables are in constant 1999 US$ (millions), deflated by the industry PPI. Employees in 1000s. Robust standard errors are denoted in parentheses and are clustered at the firm level. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 3.44: Returns to lobbying: amount of subsidies and lobbying expenditures, controlling for industry share of lobbying firms

Dependent Variable: Subsidy amount	Subsidy-Tracker	Federal Grants	ITC	Any subsidy
Lobby expenditures	1.637**	0.836*	5.401	9.652**
	(0.7711)	(0.4915)	(6.6807)	(4.5631)
Industry lobby share	0.643**	0.168	0.549*	0.384
	(0.2557)	(0.2270)	(0.2836)	(0.2496)
Employees	0.004	0.011	0.754***	0.037
	(0.0047)	(0.0123)	(0.2457)	(0.0369)
R-squared	0.03	0.14	0.10	0.04
Observations	3156	1816	6552	10499
Clusters	1367	650	1824	3139
Year FE	Yes	Yes	Yes	Yes
2-digit NAICS FE	Yes	Yes	Yes	Yes

Notes: The dependent variable is the amount of subsidies in US$ (millions) received by a firm from Subsidy-Tracker, ITC, Federal Grants or the sum of those (any subsidy) in year t. *Lobby expenditures* is the amount a firms spent on lobbying in year t. *Industry lobby share* is the fraction of lobbying firms within a 2-digit NAICS industry in year t. All regressions include 2-digit NAICS fixed effects and year fixed effects. Monetary variables are in constant 1999 US$ (millions), deflated by the industry PPI. Employees in 1000s. Robust standard errors are denoted in parentheses and are clustered at the firm level. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 3.45: Returns to lobbying: amount of subsidies and lobbying expenditures, controlling for industry average lobby expenditures

Dependent Variable: Subsidy amount	Subsidy-Tracker	Federal Grants	ITC	Any subsidy
Lobby expenditures	1.608**	0.851*	5.410	9.653**
	(0.7782)	(0.4926)	(6.6758)	(4.5628)
Industry average lobby expenditures	8.673***	6.008***	12.443	14.747***
	(2.0953)	(1.2576)	(28.7509)	(5.6342)
Employees	0.004	0.010	0.753***	0.037
	(0.0047)	(0.0122)	(0.2455)	(0.0368)
R-squared	0.03	0.14	0.10	0.04
Observations	3156	1816	6552	10499
Clusters	1367	650	1824	3139
Year FE	Yes	Yes	Yes	Yes
2-digit NAICS FE	Yes	Yes	Yes	Yes

Notes: The dependent variable is the amount of subsidies in US$ (millions) received by a firm from Subsidy-Tracker, ITC, Federal Grants or the sum of those (any subsidy) in year t. *Lobby expenditures* is the amount a firms spent on lobbying in year t. *Average lobby expenditures* are the average lobbying expenses within a 2-digit NAICS industry in year t. All regressions include 2-digit NAICS fixed effects and year fixed effects. Monetary variables are in constant 1999 US$ (millions), deflated by the industry PPI. Employees in 1000s. Robust standard errors are denoted in parentheses and are clustered at the firm level. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

3.B TFP estimation

3.B.1 Olley and Pakes (1996) approach

For a given industry, let the Cobb-Douglas production function of firm i at time t be

$$y_{it} = \beta_0 + \beta_l l_{it} + \beta_k k_{it} + \omega_{it} + \eta_{it}, \tag{3.18}$$

where y_{it} is log value-added, l_{it} is log labor input, and k_{it} is log capital input. The error term η_{it} is neither observed by the firm nor by the econometrician. However, at the beginning of a period firm productivity ω_{it}, which is assumed to follow an exogenous Markov process, is only observed by the firm and not known by the econometrician.

Estimating equation (3.18) by OLS can yield biased results for two reasons. First, a simultaneity bias can arise, because labor input at time t, l_{it}, may depend on firm productivity in the same period, ω_{it}. Second, a selection bias could arise as follows. Suppose after observing its productivity at the beginning of a period, a firm faces three decisions. First, whether to stay in the market or to exit. Second, how much of the variable input (labor) it should use. Third, how much it should invest in capital. If ω_{it} is above a threshold level $\underline{\omega}_t$, the value from staying in the market is higher than the value from exiting. Given any ω_{it}, firms with low capital stock generate lower expected future profits. Even with relatively high levels of ω_{it}, small firms will exit. Therefore, a small surviving firm must have had a relatively high productivity shock. Thus, ω_{it} and k_{it} are negatively correlated in the observed data, leading to a downward bias of an OLS estimate of β_k. To account for this self-selection bias, Olley and Pakes (1996) model an exit rule. The probability to survive until period t depends on last periods productivity shock ω_{it-1} and the productivity threshold $\underline{\omega}_{t-1}$. In practice, the estimated survival probability $\hat{P}_t$ is derived from a Probit regression including a third-order polynomial in lagged capital and lagged investment.

The implementation of the Olley and Pakes (1996) procedure consists of several stages. Let firm $i's$ investment function be given by $i_{it}(\omega_{it}, k_{it})$. By inverting the investment function, one can substitute $\omega_{it} = h_{it}(i_{it}, k_{it})$ into equation (3.18) to estimate the labor coefficient β_l in a first-stage:

$$y_{it} = \beta_l l_{it} + \phi_{it}(i_{it}k_{it}) + \eta_{it}, \tag{3.19}$$

where $\phi_{it}(i_{it}k_{it}) = \beta_0 + \beta_k k_{it} + h_{it}(i_{it}k_{it})$ is captured by a third-order polynomial in investment and capital. If ω_{it} follows a random-walk, its innovation is $\xi_{it} = \omega_{it} - \omega_{it-1}$. Note that $\hat{\phi}_{t-1} - \beta_k k_{t-1}$ is an estimate of ω_{t-1}. Substituting these terms and the estimated labor coefficient $\hat{\beta}_l$ into equation (3.18) gives

$$y_{it} - \hat{\beta}_l l_{it} = \beta_k k_{it} + \hat{\phi}_{it-1} - \beta_k k_{it-1} + \xi_{it} + \eta_{it}. \tag{3.20}$$

Using the estimated survival probability $\hat{P}_{it}$, the capital coefficient β_k is estimated using the following equation:

$$y_{it} - \hat{\beta}_l l_{it} = \beta_k k_{it} + g(\hat{\phi}_{it-1} - \beta_k k_{it-1}, \hat{P}_{it}) + \xi_{it} + \eta_{it}, \tag{3.21}$$

where a third-order polynomial in $\hat{\phi}_{it-1} - \beta_k k_{it-1}$ and $\hat{P}_{it}$ is used to approximate the unknown function $g(.)$. Consequently, with the estimate of the capital coefficient $\hat{\beta}_k$, TFP (in log values) is

$$\text{TFP}_{it} = y_{it} - \hat{\beta}_l l_{it} - \hat{\beta}_k k_{it}. \tag{3.22}$$

3.B.2 TFP estimation in STATA

The user-written programs `opreg` from Yasar et al. (2008) and `levpet` from Petrin et al. (2004), implement the Olley and Pakes (1996) and Levinsohn and Petrin (2003) approaches in STATA, respectively. In Table 3.47 and 3.48, I report results from estimating a value-added industry production function at the 2-digit NAICS level for both estimation approaches. Figure 3.6 shows a scatter plot of Olley and Pakes (1996) and Levinsohn and Petrin (2003) firm TFP estimates, recovered from 2-digit NAICS production function estimations. Both variables are highly correlated ($\rho = 0.93$) and a simple linear fit (even without controlling for year of industry fixed effects) leads a highly significant and positive regression coefficient of 0.788. Consequently, using 2-digit Levinsohn and Petrin (2003) TFP estimates leads to similar results.

As robustness checks, I did also estimate industry production functions at the 3-digits and 4-digits NAICS level, which lead to similar results (available on request). However, with higher levels of industry disaggregation, for some industries there is an insufficient number of observations to estimate the coefficients of the production function using Olley and Pakes (1996) or Levinsohn and Petrin (2003) methods. Table 3.46 reports the number of missing observations and industries for the different NAICS industry disaggregation levels and estimation methods.[39] For instance, at the 3-digit NAICS level there are 29,665 observations with missing Olley and Pakes (1996) firm TFP estimates. In 478 cases, this is due to insufficient observations within the corresponding 3-digit NAICS industry, making the Olley and Pakes (1996) approach infeasible. However, Table 3.46 also shows that most missing TFP values are due to missing values of variables used in the estimation. To minimize the number of missing TFP values, I decided to use TFP estimates from a 2-digit NAICS industry production function. See Appendix 3.C for variable definitions.

[39] At the 2-digit NAICS level, the number of TFP missings is the same for both methods. Calculating firm TFP according to equation (3.22), I get TFP estimates even for observations with missing investment (or missing materials). Observing value-added, capital and employment for these observations, allows me to impute TFP.

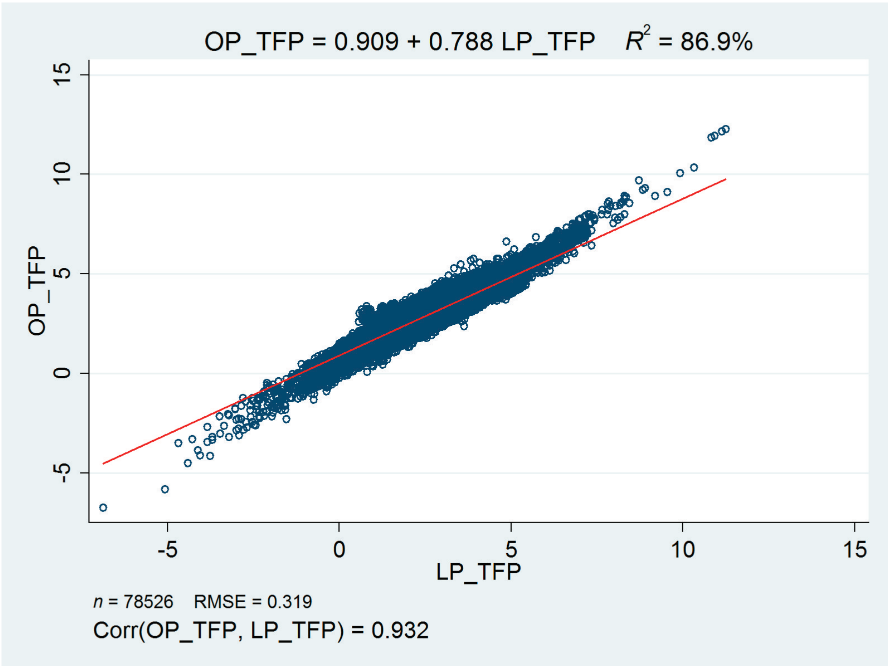


Figure 3.6: TFP estimates: Olley and Pakes (1996) vs. Levinsohn and Petrin (2003)

Table 3.46: Missings for TFP estimation

	Missings		
TFP estimation	total	insuff. obs.	variables missing
OP, 2-digits NAICS	29361	0	29361
LP, 2-digits NAICS	29361	0	29361
OP, 3-digits NAICS	29665	478	29187
LP, 3-digits NAICS	29474	105	29369
OP, 4-digits NAICS	31602	1774	29828
LP, 4-digits NAICS	31100	1054	30046

Notes: OP and LP denote Olley and Pakes (1996) and Levinsohn and Petrin (2003) estimation methods, respectively.

Table 3.47: Olley-Pakes production function estimates, 2-digits NAICS level

Dep. Variable:	2-digit NAICS industry																		
Value-added	11	21	22	23	31-33	42	44-45	48-49	51	52	53	54	55	56	61	62	71	72	81
Capital	0.402**	0.342***	0.336***	0.194***	0.306***	0.231***	0.285***	0.303***	0.162***	0.182***	0.180	0.101***	0.386	0.202***	0.019	0.193***	0.162	0.234***	0.191
	(0.1800)	(0.0441)	(0.0883)	(0.0673)	(0.0354)	(0.0491)	(0.0688)	(0.0723)	(0.0292)	(0.0537)	(0.1298)	(0.0346)	(0.2547)	(0.0531)	(0.1498)	(0.0504)	(0.1201)	(0.0907)	(0.1608)
Employment	0.523***	0.450***	0.440***	0.842***	0.683***	0.837***	0.706***	0.421***	0.876***	0.730***	0.548***	0.946***	0.675***	0.775***	0.863***	0.691***	0.605***	0.602***	0.729***
	(0.0672)	(0.0169)	(0.0358)	(0.0325)	(0.0109)	(0.0334)	(0.0293)	(0.0316)	(0.0246)	(0.0338)	(0.0302)	(0.0252)	(0.2233)	(0.0183)	(0.0736)	(0.0555)	(0.0830)	(0.0516)	(0.0428)
Trend	-0.003	-0.040***	-0.019***	-0.007	0.034***	0.032***	0.020***	0.009**	0.059***	-0.004	0.037***	0.035***	0.006	0.027***	0.004	0.028***	0.011	0.007	0.002
	(0.0184)	(0.0045)	(0.0026)	(0.0081)	(0.0016)	(0.0045)	(0.0034)	(0.0036)	(0.0028)	(0.0051)	(0.0104)	(0.0036)	(0.0083)	(0.0049)	(0.0082)	(0.0057)	(0.0105)	(0.0052)	(0.0087)
N	266	4103	3262	951	27834	2604	3538	2310	9135	8888	1536	3760	80	1750	355	1316	560	1608	317

Notes: Monetary variables are in constant 1999 US$ (millions), deflated by the industry PPI. All variables in log values (except time trend). Standard errors are denoted in parentheses and bootstrapped using 250 replications. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 3.48: Levinsohn-Petrin production function estimates, 2-digits NAICS level

Dep. Variable:	2-digit NAICS industry																		
Value-added	11	21	22	23	31-33	42	44-45	48-49	51	52	53	54	55	56	61	62	71	72	81
Capital	0.578***	0.476***	0.335***	0.248***	0.468***	0.208***	0.343***	0.394***	0.217***	0.201**	0.232*	0.188***	0.616***	0.253***	-0.120	0.236***	0.252***	0.343***	0.544*
	(0.0090)	(0.0493)	(0.0034)	(0.0532)	(0.0148)	(0.0082)	(0.0124)	(0.0404)	(0.0602)	(0.1019)	(0.1209)	(0.0230)	(0.2145)	(0.0041)	(0.1932)	(0.0471)	(0.0150)	(0.0763)	(0.3161)
Employment	0.428***	0.319***	0.378***	0.638***	0.598***	0.788***	0.653***	0.331***	0.862***	0.611***	0.434***	0.951***	0.388	0.736***	0.844***	0.618***	0.553***	0.448***	0.711***
	(0.0904)	(0.0059)	(0.0489)	(0.0123)	(0.0172)	(0.0010)	(0.0449)	(0.0032)	(0.0157)	(0.0759)	(0.0365)	(0.0269)	(0.3533)	(0.0317)	(0.0639)	(0.0252)	(0.0443)	(0.0551)	(0.0543)
N	269	3707	3188	933	27136	2574	3541	2126	8382	12644	1358	3475	73	1560	310	1288	518	1563	312

Notes: Monetary variables are in constant 1999 US$ (millions), deflated by the industry PPI. All variables in log values. Standard errors are denoted in parentheses and bootstrapped using 250 replications. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

3.C Compustat, BEA and BLS data

I obtained Compustat data from Wharton Research Data Services (WRDS) and use of the following variables:[40]

- Sales (denoted S): Net sales (Compustat Mnemonic: `sales`).
- Labor (L): Number of employees (`emp`).
- Labor costs: Number of employees times average industry wage (from BLS).
- Capital (K): Property, plant, and equipment net of depreciation (`ppent`).
- Investment (I): Capital expenditures (`capx`).
- Materials (M): Operating expenses (`xopr`) minus labor costs.
- Value-added (Y): Operating Income After Depreciation (`OIADP`) plus labor costs.
- Investment Tax Credits (Income Account) (ITC)[41]: Portion of tax savings that reduced the current year's tax liability (`itci`). See Table 3.49 for further details.

Table 3.49: Content Compustat's variable Investment Tax Credits (Income Account)

Included in ITC	Excluded from ITC
1. WIN credits	1. Alternative minimum tax credits
2. Energy tax credits	2. Any investment tax credit which increases taxes
3. Incentive tax credits	3. Deferred investment tax credits, net
4. Job development credits	4. Foreign tax credits
5. New job credits	5. Investment tax credit carry backs
6. Research and development tax credits	6. Investment tax credit recapture
7. Section 29 Oil and Gas Tax Credit	7. Net investment tax credits
8. State Investment Tax Credits	8. Restaurant industries' tip credits
9. Target Job Tax Credits	9. Tax credits not specified by type
10. TRASOP (Tax Reduction Act Stock Ownership Plan)	
11. ESOP (Employee Stock Ownership Plan) credits	
12. Current year's portion of utilized investment tax credit	
13. Amortization of deferred or prior years' investment tax credit	
14. Investment tax credit carry forwards from prior years utilized in the current year	

Source: Standard and Poor's, 2003, p. 159

Table 3.50 displays the number of missing observations for the main variables. All nominal variables are deflated by the respective industry producer price index (PPI), obtained from the US Bureau of Economic Analysis (BEA). Unfortunately, BEA does not provide a PPI for all 6-digits NAICS industries. Therefore, I construct the industry

[40] Compustat North America contains more than 300 annual items, taken from firms' Income Statement, Balance Sheet, Statement of Cash Flows, and supplemental data.

[41] Standard & Poor's defines Investment Tax Credits (Income Account) as: *"... the amortized portion of tax savings (brought about by the purchase of machinery and equipment, and/or the creation of new jobs) that reduces the current year's tax liability. If investment credit is not deferred, then the amount flowed-through is included. This item is not available for banks."* (Standard and Poor's, 2004, p. 256).

Table 3.50: Main variables missings

Variable	Missings
Sales	48
Value-added	25380
Capital	5548
Investment	12326
Employees in 1000s	15302
Labor costs	15330
Materials	17441

Notes: Monetary variables are in constant 1999 US$ (millions), deflated by the industry PPI.

Table 3.51: PPI missings

Price Index	Missings
PPI, 2-digits NAICS	48
PPI, 3-digits NAICS	1111
PPI, 4-digits NAICS	2732
PPI, 5-digits NAICS	6743
PPI, 6-digits NAICS	10067

Notes: Producer price index (PPI) from BEA's US Industry Economic Accounts, www.bea.gov.

Table 3.52: Average wage missings

Wage data	Missings
BLS annual wage, 2-digits NAICS	35
BLS annual wage, 3-digits NAICS	1102
BLS annual wage, 4-digits NAICS	2726
BLS annual wage, 5-digits NAICS	6298
BLS annual wage, 6-digits NAICS	9383

Notes: Annual average wages from the Quarterly Census of Employment and Wages Program, BLS database ftp://ftp.bls.gov.

PPI as follows. For the observations with missing 6-digit PPI data, I use the PPI of the associated 5-digit industry. If the 5-digit industry PPI is also missing, I use the 4-digit industry PPI, and so on. Table 3.51 shows the missing values of the PPI for different NAICS levels.

Annual average wage data at the industry level are obtained from the Quarterly Census of Employment and Wages Program (QCEW), which is available through the BLS database, ftp.bls.gov. Unfortunately, QCEW does not provide wage data for all 6-digits NAICS industries. Therefore, I construct the industry wage as follows. For the observations with missing 6-digits NAICS wage data, I use wage data of the associated 5-digit industry. If the 5-digit industry data are also missing, I use the 4-digit industry data, and so on. Table 3.52 shows the missing values of the wage data for different NAICS levels.

Table 3.53: Example file A

Name	Year	idA
firmaA	2002	1
firmaB	2002	2
firmaC	2002	3
firmaABC	2002	4
UnternehmenX	2002	5
UnternehmenZ	2002	6
EntrepriseY	2002	7
FirmaA	2002	8
Herr MÃŒller	2002	9
Uni Mannheim	2002	10
Laden W consolidated	2002	11

Table 3.54: Example file B

Name	Year	idB
firmaA	2002	1
firmaB	2002	2
firmaC	2002	3
EntrepriseY	2002	4
FirmaR	2002	5
firmaac	2002	6
Firma X	2002	7
Uni Marburg	2002	8
Herr Meier	2002	9
Laden V consolidated	2002	10
Laden W cons	2002	11

3.D Fuzzy string matching methods

To evaluate how similar two words are, bigram algorithms developed in computational linguistics can be used (Blasnik, 2010). A bigram is a contiguous sequence of two letters of a word. For instance, ‘train’ is split up into the bigrams ‘tr’-‘ra’-‘ai’-‘in’. More formally, if $a = (a_1, a_2, \ldots, a_n)$ is a string which has n letters, the set of all bigrams is $T_a = \{(a_i, a_{i+1}) : i \in \{1, \ldots, n-1\}\}$. Note that the maximum number of bigrams of this string is $|T_a| = length(a) - 1$. The bigram matching algorithm has been implemented by Blasnik (2010) in STATA's reclink command. The reclink command computes a so called dice-quality index (Dice, 1945), modified by the so called Winkler adjustment:

$$Q = \frac{2|T_a \cap T_b|}{|T_a| + |T_b|} + \frac{w}{10}\left(1 - \frac{2|T_a \cap T_b|}{|T_a| + |T_b|}\right), \tag{3.23}$$

where w is the number of matching bigrams within the first four bigrams. The Winkler adjustment takes into account that two strings are more likely to match if their first characters are identical. This is quite useful for our purpose of matching strings of firm names, because firm names often differ only with respect to their legal form, e.g., ‘Super Brands’ and ‘Super Brands Incorporated’.

To illustrate how the reclink command works, two sample files (Afile and Bfile) are matched using the following STATA command:

```
reclink name year using Bfile idmaster(idA) idusing(idB) wmatch(5 5) required(year) gen(quality)
```

where `wmatch(5 5)` specifies the weights given to matches for variables `name` and `year`.

The input files are shown in Tables 3.53 and 3.54 and the output file is shown in Table 3.55. Note that reclink performs a one-to-one match: ‘firma A’ is matched only once although file A contains a duplicate written with a capital, ‘Firma A’. Also, the two records that refer to ‘Uni Mannheim’ and ‘Uni Marburg’ get relatively high matching scores. This is probably due to the Winkler adjustment mentioned above and shows that manual verification is absolutely necessary.

In general, it is important to check output files generated by the reclink command carefully. Many proposed matches had to be discarded, even though the dice-quality

Table 3.55: Matching file A to file B

Name	UName	Year	Uyear	idA	quality	idB	_merge
firmaA	firmaA	2002	2002	1	1	1	3
firmaB	firmaB	2002	2002	2	1	2	3
firmaC	firmaC	2002	2002	3	1	3	3
EntrepriseY	EntrepriseY	2002	2002	7	1	4	3
FirmaA	FirmaR	2002	2002	8	0.9922	5	3
firmaABC	firmaac	2002	2002	4	0.9691	6	3
Uni Mannheim	Uni Marburg	2002	2002	10	0.9395	8	3
Herr MÃŒller	Herr Meier	2002	2002	9	0.9718	9	3
Laden W consolidated	Laden V consolidated	2002	2002	11	0.9979	10	3
UnternehmenZ		2002		6			1
UnternehmenX		2002		5			1

Table 3.56: Examples of manually rejected *reclink* matches

Client	conml	match
`Intellius Inc`	`Intelius Inc`	0
`Garden State Paper`	`General Media Inc.`	0
`Henry Inc`	`Henry Co`	0
`Progress Energy Service Co`	`Progress Energy Trust`	0
`Quantum 3D`	`Quantum Corp`	0
`United First Partners`	`First United Corp`	0
`Universal Insurance`	`Universal Insurance Holdings`	0
`Continental Airlines`	`Continental AG`	0
`Apollo Investment Management`	`Apollo Investment Corp`	0

index was quite high. When in doubt about a certain match, I acquired additional information on the Internet by using Google's search engine and websites like "Bloomberg" or "Yahoo! finance". To document how carefully and conservative the manual verification was conducted, Table 3.56 shows closely related strings that were manually identified as non-matching pairs.

3.E Merge lobbying data with Compustat

3.E.1 Lobbying data: overview

Table 3.57: General lobby issue codes

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

Source: Senate's Office of Public Records, http://lobbyingdisclosure.house.gov.

Table 3.58: Variables definitions for CRP's lobbying data

Field	Definition	Type	Length	Source
OpenSecrets Data Definitions – Lobbying data set				
Uniqid	Corresponds to a particular report from SOPR	Varchar	36	SOPR
Registrant_raw	Raw registrant	Varchar	100	SOPR
Registrant	Standardized registrant	Varchar	40	CRP
Isfirm	Notes whether or not the firm is a lobbying firm.	Char	1	CRP
Client_raw	Raw client	Varchar	100	SOPR
Client	Standardized client	Varchar	40	CRP
Ultorg	Parent company to the client	Varchar	40	CRP
Amount	Lobbying income/expenses	Float		SOPR
Catcode	The standard five character code identifying the donor's industry or ideology.	Char	5	CRP
Source	Souce of catcode	char	5	CRP
Self	Indicate type of filing: *n* means a non self filer parent. *m* means a non self filer subsidiary for a non self filer parent. *x* means self filer subsidiary for a non self filer parent *p* means a self filer parent *i* means a non self filer for a self filer parent that has same catorder as the parent *s* means a self filer subsidiary for a self filer parent *e* means a non self filer subsidiary for a self file subsidiary. Don't count this unless the e is bigger than the s *c* means a non self filer subsidiary for a self filer parent with same catorder. Count it in both total and industry when IncludeNSFS is null. Don't count it in total or industry when IncludeNSFS=y *b* means a non self filer subsidiary for a self filer parent that has different catorder. Count it in both total and industry when IncludeNSFS is null. Exclude from total and include in indus but mines it from the total of the parent when IncludeNSFS=y	Char		
IncludeNSFS	To indicate if the filer included its non self filers affiliates activities	Char	1	CRP
Use	To indicate if this report should be used or ignored. The general method is to use the latest report.	Char	1	CRP
Ind	To indicate if the amount on this report should be included to calculate industry totals.	Char	1	CRP
Year	The year.	Char	4	CRP
Type	A CRP short version of reports' types. Look at the reference table "ReportTypes" for possible values	Char	4	CRP
Typelong	The long version of reports' types. Look at the reference table "ReportTypes" for possible values	Varchar	80	SOPR
OrgID	If the client has a major political contributor profile on opensecrets or one of its affiliates then this field will hold the organization/affiliates ID	Char	10	CRP
Affiliate	To indicate if the major political contributor is an affiliate or not	Char	1	CRP
OpenSecrets Data Definition – Lobbyists data set				
UniqID	Corresponds to a particular report from SOPR	Varchar	36	SOPR
Lobbyist_raw	Raw value of lobbyist's name.	Varchar	50	SOPR
Lobbyist	Standardized lobbyist.	Varchar	50	CRP
Lobbyist_id	An ID assigned to each unique lobbyist.	Varchar	12	CRP
Year	The year.	Char	4	SOPR

Field	Definition	Type	Length	Source
OfficialPosition	Any previous government official position the individual lobbyist had	Varchar	100	SOPR
CID	An ID assigned to members of congress and federal candidates. It will have a value if the lobbyist is a former member of congress	Varchar	15	CRP
Formercongmem	Notes whether the lobbyist is a former member.			CRP
OpenSecrets Data Definitions – Lobby Issues data set				
SI_ID	Unique identifier for this table	int		
Uniqid	Corresponds to a particular report from SOPR	Varchar	36	SOPR
IssueID	A three-letter code corresponding to the general issue area.	Char	3	CRP
Issue	The long version of the three letter general issue.	Varchar	50	SOPR
SpecificIssue	The specific issue.	Varchar	Max	SOPR
Year	The Year.	Char	4	SOPR
OpenSecrets Data Definitions – Lobbying Industries data set				
Ultorg	Standardized parent company.	Varchar	40	CRP
Client	Standardized client.	Varchar	40	CRP
Total	Total amount by catcode	Float		CRP
Year	The year.	Char	4	SOPR
Catcode	The standard five character code identifying the donor's industry or ideology.	Char	5	CRP
OpenSecrets Data Definitions – Lobbying Agency data set				
Uniqid	Corresponds to a particular report from SOPR	Varchar	36	SOPR
AgencyID	An agency unique identifier	Char	3	CRP
Agency	The government agency lobbied	Varchar	80	SOPR
OpenSecrets Data Definition – Lobbying Bills data set				
B_ID	A bill unique identifier	int		CRP
SI_ID	It is the specific issue unique identifier. It is a foreign key on this table	int		CRP
CongNo	Congress number	char	3	CRP
Bill_Name	The bill name	Char	15	CRP
OpenSecrets Data Definition – Report Types data set				
Type Long		Text	50	SOPR
Type code		Text	4	CRP

Source: CRP, OpenData User's Guide, www.opensecrets.org.

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

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

LOBBYING REGISTRATION

Lobbying Disclosure Act of 1995 (Section 4)

Check One: ☐ New Registrant ☐ New Client for Existing Registrant ☐ Amendment

1. Effective Date of Registration 03/31/2008

2. House Identification ______ **Senate Identification** 40048370

REGISTRANT

☑ Organization/Lobbying Firm ☐ Self Employed Individual

3. Registrant Coca-Cola Enterprises, Inc.

Address P.O. Box 723040 Address2

City Atlanta State GA Zip 31139 - Country USA

4. Principal place of business (if different than line 3)

City State Zip - Country

5. Contact name and telephone number ☐ **International Number**

Contact Eugene Rackley Telephone (770) 989-3408 E-mail grackley@cokecce.com

6. General description of registrant's business or activities

Beverage manufacturing, sales, and distribution

CLIENT

A Lobbying Firm is required to file a separate registration for each client. Organizations employing in-house lobbyists should check the box labeled "Self" and proceed to line 10. ☒ ***Self***

7. Client name Coca-Cola Enterprises, Inc.

Address

City State Zip - Country

8. Principal place of business (if different than line 7)

City State Zip - Country

9. General description of client's business or activities

LOBBYISTS

10. Name of each individual who has acted or is expected to act as a lobbyist for the client identified on line 7. If any person listed in this section has served as a "covered executive branch official" or "covered legislative branch official" within twenty years of first acting as a lobbyist for the client, *state the executive and/or legislative position(s) in which the person served.*

Name: First	Last	Suffix	Covered Official Position (if applicable)
Eugene	Rackley	IV	
Jennifer	Thomas		

v6.0.0d

Registrant Coca-Cola Enterprises, Inc. Client Name Coca-Cola Enterprises, Inc.

LOBBYING ISSUES

11. General lobbying issue areas (Select all applicable codes).

BEV AGR CSP LBR MAN ENV FOO TRD TAX

12. Specific lobbying issues (current and anticipated)
HR 5512, Coin Modernization and Taxpayer Savings Act of 2008
S. 2745/HR 2419, Farm Bill - Nutrition Title
HR 4238, Bottle Recycling Climate Protection Act of 2007
Clean Water Trust Fund - currently in proposal form; Child Nutrition Act

AFFILIATED ORGANIZATIONS

13. Is there an entity other than the client that contributes more than $5,000 to the lobbying activities of the registrant in a quarterly period and either actively participates in and/or in whole or in major part plans, supervises or controls the registrant's lobbying activities?

☒ No --> Go to line 14. ☐ Yes --> Complete the rest of this section for each entity matching the criteria above, then proceed to line 14.

Internet Address:

Name	Address (Street, City, State/Province, Zip Code, Country)	Principal Place of Business
		City / State / Country
		City / State / Country
		City / State / Country

FOREIGN ENTITIES

14. Is there any foreign entity

a) holds at least 20% equitable ownership in the client or any organization identified on line 13: or
b) directly or indirectly, in whole or in major part, plans, supervises, controls, directs, finances or subsidizes activities of the client or any organization identified on line 13; or
c) is an affiliate of the client or any organization identified on line 13 and has a direct interest in the outcome of the lobbying activity?

☒ No --> Sign and date the registration. ☐ Yes --> Complete the rest of this section for each entity matching the criteria above, then sign the registration.

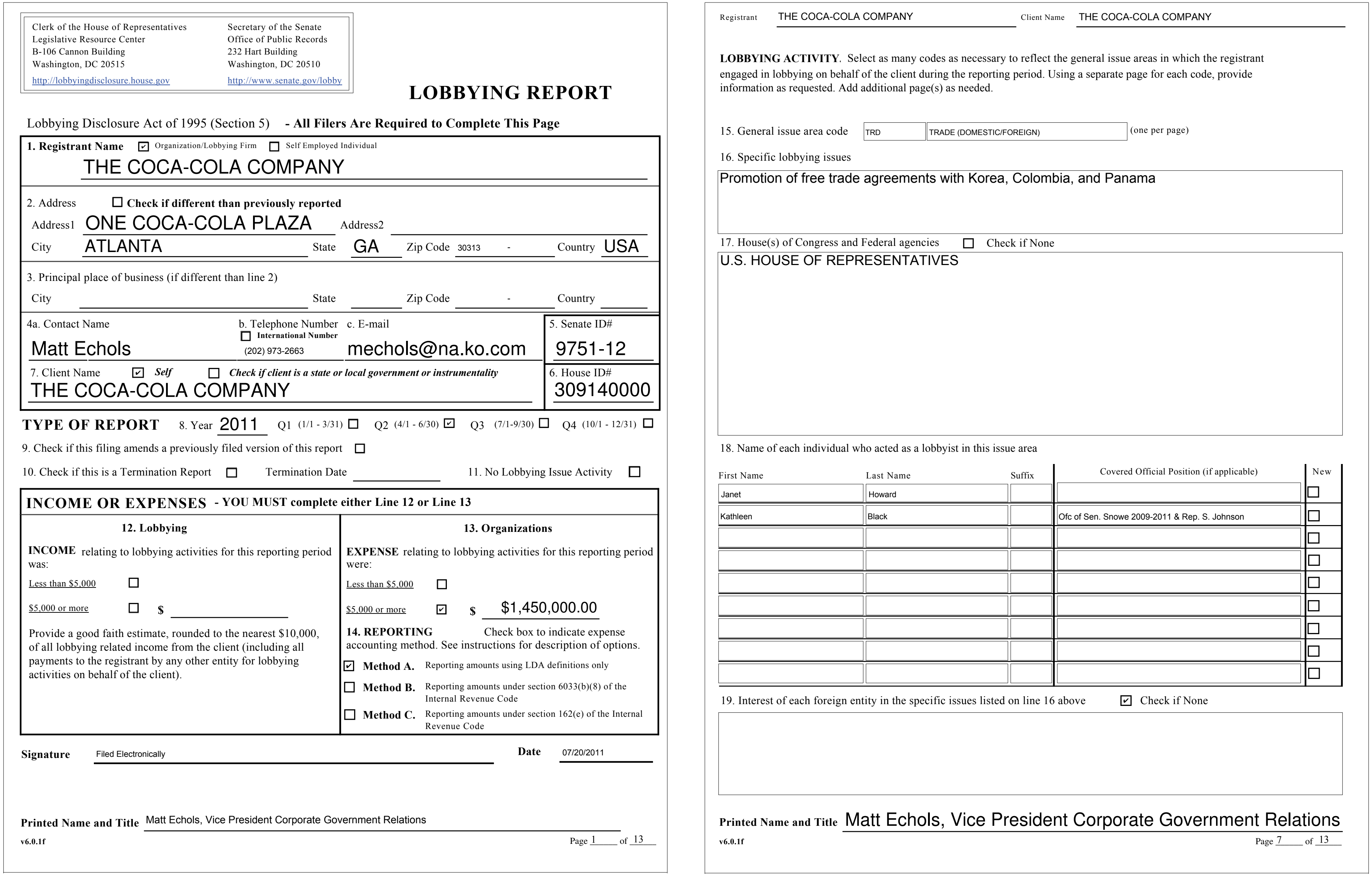
Name	Address (Street, City, State/Province, Country)	Principal place of business (city and state or country)	Amount of contribution for lobbying activities	Ownership
		City / State / Country		%
		City / State / Country		%

Signature Filed Electronically **Date** 03/31/2008

Printed Name and Title Eugene Rackley Director, Public Affairs and Government Relations

v6.0.0d

Figure 3.7: Sample registration report for Coca-Cola Enterprises



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

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

LOBBYING REPORT

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

1. Registrant Name ☑ Organization/Lobbying Firm ☐ Self Employed Individual
THE COCA-COLA COMPANY

2. Address ☐ **Check if different than previously reported**
Address1 ONE COCA-COLA PLAZA Address2
City ATLANTA State GA Zip Code 30313 - Country USA

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

4a. Contact Name: Matt Echols
b. Telephone Number ☐ International Number: (202) 973-2663
c. E-mail: mechols@na.ko.com
5. Senate ID#: 9751-12

7. Client Name ☑ *Self* ☐ *Check if client is a state or local government or instrumentality*
THE COCA-COLA COMPANY
6. House ID#: 309140000

TYPE OF REPORT 8. Year 2011 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

INCOME relating to lobbying activities for this reporting period was:

Less than $5,000 ☐

$5,000 or more ☐ $ ________

Provide a good faith estimate, rounded to the nearest $10,000, of all lobbying related income from the client (including all payments to the registrant by any other entity for lobbying activities on behalf of the client).

13. Organizations

EXPENSE relating to lobbying activities for this reporting period were:

Less than $5,000 ☐

$5,000 or more ☑ $ $1,450,000.00

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 Filed Electronically **Date** 07/20/2011

Printed Name and Title Matt Echols, Vice President Corporate Government Relations

v6.0.1f Page 1 of 13

Registrant THE COCA-COLA COMPANY Client Name THE COCA-COLA COMPANY

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

15. General issue area code TRD TRADE (DOMESTIC/FOREIGN) (one per page)

16. Specific lobbying issues

Promotion of free trade agreements with Korea, Colombia, and Panama

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

U.S. HOUSE OF REPRESENTATIVES

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

First Name	Last Name	Suffix	Covered Official Position (if applicable)	New
Janet	Howard			☐
Kathleen	Black		Ofc of Sen. Snowe 2009-2011 & Rep. S. Johnson	☐
				☐
				☐
				☐
				☐
				☐
				☐
				☐

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

Printed Name and Title Matt Echols, Vice President Corporate Government Relations

v6.0.1f Page 7 of 13

Figure 3.8: Sample lobbying report for Coca-Cola Enterprises

3.E.2 Lobbying data: matching rounds and results

Due to the lack of unique identifiers, it is difficult and tedious to link the lobbying data from CRP to Compustat data. In the lobbying data, the two string variables describing the name of the subsidiary and the parent firm are `CLIENT` and `ULTORG`, respectively. Compustat provides the company name, `conm`, and the legal name of the company, `conml`. In some cases, the variables in the two data sets are exactly identical. In most cases, however, entries differ (e.g., the string variable client "Coca-Cola Enterprises, Inc." is different from conm "COCA-COLA CO" and conm "Volvo AB" is different from ultorg "AB Volvo"). Therefore, so called *fuzzy string matching methods*, which provide the "closest match" of an entry in another data set, were employed. The proposed matches had to be verified manually. A newly created `match` variable got the following values: 0 if no match; 1 if match; 2 if unclear. If a record was not obviously a correct match, a web search was conducted to acquire further information. After verifying results manually, the *residuals*, which are the non-matched observations of both data sets, where saved in two separate files. These files were the starting point for further matching rounds.

The linkage procedure was conducted in two big steps and results are summarized in Table 3.59. First, by using the *merge* command, which is integrated in the STATA software package. The *merge* command is convenient if strings match exactly or differ only slightly. After exact matches of company names were linked, non-merged company names were further modified (i.e., excluding special characters and abbreviations). Merging all possible combinations of `CLIENT, ULTORG, conm,` and `conml,` the merge command lead to 12,532 matched firm-year observations.

In a second step, the STATA command *reclink* was used (see Appendix 3.D for a detailed discussion of the reclink command). This command uses the so called *bigram-distance-based* matching algorithm.[42] *Reclink* matches records of one string variable to the "best" record of another string variable and produces a list containing the approximately closest matches. A *quality* variable, which can take values between 0 and 1, measured the precision of the matches based on the number of matching bigrams. After verifying the output file manually, records that were indicated as being a match are re-imported in STATA, saved in the *linkage* file and excluded from further matching rounds. Non-matched observations were saved in two separate files. Overall 13,693 matched firm-year observations were the result of several matching rounds with different specifications (see Table 3.59).

[42] Other algorithms such as *Soundex*, are more suited to match one-word string variables, like family names. They fail to accurately match company names that consist of multiple strings.

Table 3.59: Identified matches – Lobbying and Compustat data

Linkage procedure	Number of matches
Total	13693
STATA merge-command	
conm to Client	6507
conm to Client modified	3754
conm to Ultorg	558
conm to Ultorg modified	372
conml to Client	357
conml to Client modified	845
conml to Ultorg	36
conml to Ultorg modified	103
STATA reclink-command	
conm to Client	1089
conml to Client	46
conm to Ultorg	26
conml to Ultorg	0

Notes: Compustat variables conm and conml denote *company name* and *company legal name*, respectively. Client and Ultorg denote the company and the parent company engaged in lobbying, respectively. See Blasnik (2010) for details on the reclink command for STATA.

Table 3.60: Subsidy-Tracker: subsidy types and summary information

Variable	N
Subsidy type	
Cash grant	16
Cost reimbursement	49
Enterprise zone	382
Grant/low-cost loan	715
Property tax abatement	822
Tax credit/rebate	1626
Tax credit/rebate and grant	24
Tax credit/rebate; property tax abateme	612
Tax increment financing	29
Summary information	
# Subsidies, per receiving firm	1.44
# Subsidy programs, per receiving firm	1.56

Notes: Types of Subsidy-Tracker subsidies in alphabetic order. See Subsidy-Tracker variable definitions for details.

3.F Merge Subsidy-Tracker data with Compustat

3.F.1 Subsidy-Tracker data: overview

For the period 1999-2010, firm-level data on US subsidy programs were obtained from the Subsidy-Tracker database, available online at goodjobsfirst.org. The Subsidy-Tracker database contains information on subsidies on the federal level as well as on the state level. Therefore, it complements the federal grants data. Table 3.60 shows the prevalence of different Subsidy-Tracker subsidy types in my data. Table 3.61 gives an overview of the available variables in the Subsidy-Tracker data.

Table 3.61: Variables definitions Subsidy-Tracker data

Field	Definition
state	Recipient state
program	Subsidy Program
subsidy_type	*tax credit/rebate* — these include corporate income tax credits, sales tax exemptions and other programs in which a company's tax obligation is reduced or the firm is rebated taxes previously paid. *property tax abatement* — most taxes on real property and business personal property are paid at the local level, but we include some programs in which the state allows companies to reduce their payments for the state and/or local portions of their property tax obligations, usually by reducing the valuation of property subject to the tax. *grant/low-cost loan* — these include a variety of programs in which corporations are awarded a specific amount of money outright or in connection with meeting job performance or other goals. Also included are a limited number of programs that are technically loans but in many cases are "forgivable", meaning that the company may not have to pay back the money if certain goals are met. *enterprise zone* — programs tied to investment in specific geographic areas that often bundle a variety of state and/or local tax breaks. *training reimbursement* — programs that pay for or reimburse companies for the cost of training new or existing workers. *cost reimbursement programs* — usually involving film production, that reimburse companies for specific expenditures (other than worker training) in the state. *infrastructure assistance programs* — that cover costs such as installation of utilities or building of private roads at a company facility. *tax credit/rebate and grant programs* — that combine tax credits/rebates with grants *tax credit/rebate; property tax abatement programs* — combine income or sales-tax credits or rebates with property tax abatements.
agency	Name of the state agency involved in awarding or overseeing the program, and often the entity responsible for reporting the recipient data.
year	The year in which a specific subsidy (or portion of a multi-year subsidy) was awarded or disbursed. When the data relate to a fiscal year, this is indicated in the Notes field below.
company_asis	The name of the company as it appears in the original source. We did not standardize company names or correct errors.
subsidy_value	The dollar amount specific in the source document. We indicate in the Notes whether the amount is an actual or a projected amount (the latter being common in projects in which payouts are based on company performance with regard to job creation or investment). We converted amounts showing cents to full-dollar figures. In programs with many recipients we sometimes eliminated listings involving minimal amounts. Entries with negative amounts were also deleted. Quite a few entries display zero as the subsidy value, reflecting what was in the original sources. In some cases the zero seems to indicate that the information is not available; in other cases it seems to indicate that in the given year the company received no subsidy but is listed because received an award from that program in another year. Check the original source for clarification.
city_town	City of the subsidized facility
county	County of the subsidized facility
street_address	Street address of the subsidized facility
zip	Zip of the subsidized facility
proj_descr	Activity of the subsidized facility. For film subsidy programs this is the name of the film or other production.
NAICS	The North American Industry Classification System is the federal government's standard system for classifying companies according to the nature of their business activity.

Field	Definition
jobs_data	The number of jobs to be created or retained at a subsidized facility as a result of the financial assistance. In the case of training subsidies, this is the number of training slots. The Notes indicate whether the job number is projected (i.e., what the company promises) or actual.
wage_data	Hourly wage rate, an annual salary figure or an aggregate payroll figure (which can be divided by the number of jobs to get a rough salary estimate). The Wage Data field shows the dollar figure;
wage_data _type	Wage Data Type field indicates the category of wage_data
invest_data	Amount that the company is investing in the subsidized project. The Notes indicate whether the amount is projected or actual.
info_source	Where the information came from. In cases where the source is online, the web address is given.
notes	This field clarifies issues relating to the other categories.

Source: Good Jobs First, http://www.goodjobsfirst.org/subsidy-tracker-user-guide.

Table 3.62: Identified matches – Subsidy-Tracker and Compustat data

Linkage procedure	Number of matches
Total	4245
STATA merge-command	2652
STATA reclink-command	
conm to companyasis	300
conml to companyasis	1041
conm, conml to companyasis	8
conml to companyasis, w/o exclude option	244

Notes: Compustat variables conm and conml denote *company name* and *company legal name*, respectively. Subsidy-Tracker variable companyasis denotes *The name of the company as it appears in the original source.* See Blasnik (2010) for details on the reclink command for STATA.

3.F.2 Subsidy-Tracker data: matching rounds and results

Similar to matching the lobbying data, for Subsidy-Tracker data I also ran several linkage rounds using STATA's built-in commands *merge* and *reclink*. Subsidy-Tracker's company name variable `companyasis` was used to match the Subsidy-Tracker data to Compustat (using `conm` and `conml`). To improve the linkage procedure, string variables were modified in several ways for the different linkage rounds. Special characters, blanks, abbreviations and keywords were removed from the string variables. As Table 3.62 shows, overall 4,245 firm-year observations could be matched. The merge command lead to 2,652 matches. The reclink command lead to 1593 matches.

3.G Merge federal grants data with Compustat

3.G.1 Federal grants data: overview

Firm-level data on federal grants in the US are publicly available on usaspending.gov, a website collecting data from a variety of different sources (see Figure 3.9). Until fiscal year 2007, the Federal Assistance Award Data System (FAADS) was operated by the US Census Bureau and collected quarterly data from 33 departments and agencies of the Executive branch of the Federal Government. Since fiscal year 2007, 31 departments and agencies of the Executive branch submit data to the Federal Assistance Award Data System PLUS (FAADS PLUS), which is directly linked to usaspending.gov. Table 3.63 gives an overview of the available variables in the federal grants data. Figure 3.10 gives an overview of the federal spending process in the US.

Figure 3.9: Sources of US federal spending data (Source: usaspending.gov)

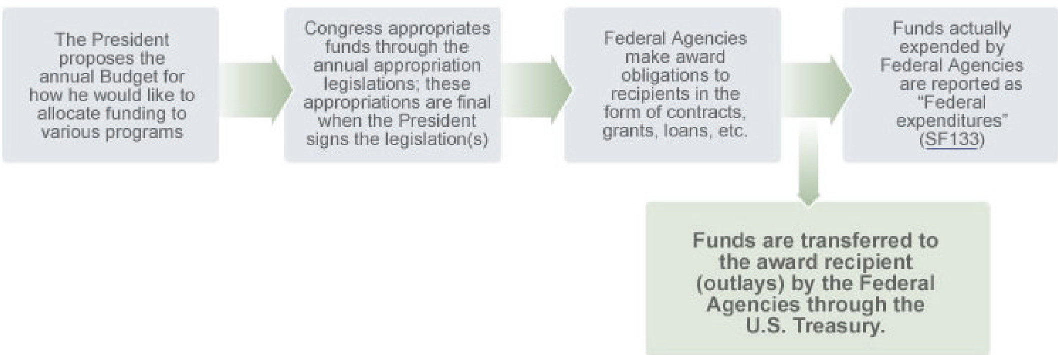


Figure 3.10: The process of US federal spending (Source: usaspending.gov)

Table 3.63: Variables definitions Federal Grants data

Data Feed field name	Description
recipient_name	The name of the recipient of the award.
recipient_city_code	The five-digit FIPS city code for the city in the address of the recipient of the award.
recipient_city_name	The city in which the address of the recipient of the award is located.
recipient_county_code	The three-digit FIPS county code or ANSI INCITS county code for the county in which the address for the recipient of the award is located.
recipient_county_name	The county in which the address for the recipient of the award is located.
First two characters of (recipient_state_code)	The two-digit FIPS or INCITS state code for the state or territory in which the address for the recipient of the award is located.
Fourth character onwards of (recipient_state_code)	The name of the state or territory in which the address for the recipient of the award is located.
recipient_zip	The Zip code in the address of the recipient of the award.
recipient_cd	The Congressional district in which the address of the recipient of the award is located. 90 indicates district not known, 00 at-large or statewide, 98 nonvoting, 99 no representative.
recip_cat_type	The original Federal Assistance Awards Data System recipient type code, modified by USAspending.gov into a set of broader categories (government, individual, nonprofit, for profit, higher ed, other).
recipient_type	The type of recipient (i.e., state government, local government, Indian tribe, individual, small business, for-profit, nonprofit, etc.)
receip_addr1	Recipient 's Full address Line 1
receip_addr2	Recipient 's Full address Line 2
receip_addr3	Recipient 's Full address Line 3
duns_no	Unique nine-digit number issued by Dun & Bradstreet to the Agency. Followed by optional DUNS Plus 4 which allows an agency to submit different bank account data for a single DUNS (Assigned by Dun & Bradstreet).
duns_conf_code	Optional data field to enter the D&B Confidence Code received for validated DUNS data (As provided to agencies by Dun & Bradstreet when obtaining DUNS). OMB encourages Agencies to submit this code with their file submissions to affirm the accuracy of data validated through the D&B process.
recipient_country_code	The ISO or FIPS code for the country in which the recipient of the award is located.
maj_agency_cat	The combination of two leftmost characters of the contracting agency code representing major federal organizations and departments and its description.
agency_code	A code indicating which governmental agency or bureau provided the award.
agency_name	The name of the governmental agency or bureau that provided the award.
federal_award_id	An agency-specific unique ID number for each individual assistance award. There may be more than one action record per assistance award, because of continuations, revisions, funding adjustments, corrections, etc.
federal_award_mod	A modification number used to indicate action records that modify a previous action record with the same federal award ID.
sai_number	A number assigned by state (as opposed to federal) review agencies to the award during the grant application process.

Data Feed field name	Description
cfda_program_num	The numeric code that indicates the program under which this award was funded within the Catalog of Federal Domestic Assistance (CFDA). Numbers that contain AAA, AAB etc. are pseudo-codes and are not in CFDA.
cfda_program_title	The title of the program under which the award was funded, taken from the Catalog of Federal Domestic Assistance (CFDA).
assistance_type	The original Federal Assistance Awards Data System assistance type code, modified by USAspending.gov into a set of broader categories (direct grants, loans, insurance, etc.)
asst_cat_type	The type of assistance provided by the award: whether it is a grant, cooperative agreement, direct payment, loan, insurance, etc.
project_description	The description of the project grants, loans, direct payments, insurance or other categories of grants.
progsrc_agen_code	Agency Code part (First 2 characters) of Treasury Account Symbol (9 characters) assigned by U.S. Department of Treasury.
progsrc_acnt_code	Account Code part (3rd to 6th characters) of Treasury Account Symbol (9 characters) assigned by U.S. Department of Treasury.
progsrc_subacnt_code	Sub-Account Code part (7th to 9th characters) of Treasury Account Symbol (9 characters) assigned by U.S. Department of Treasury.
account_title	The description of the Program Source.
rec_flag	Identifies whether the Treasury Account Symbol is for Recovery
uri	An agency defined identifier that is unique for every reported action.
unique_transaction_id	The unique identifying record id.
transaction_status	The status of the particular record, either active or inactive.
fiscal_year	The fiscal year in which the award occurred. It may be different from the fiscal year of the award record if the record is a late filing or correction of an amount for a prior fiscal year. Data field added by USAspending.gov.
fyq	The fiscal year and fiscal year quarter for this record, with the first four digits being the year, the fifth the quarter.
action_type	The type of action for the record: whether it is a new assistance action, a continuation, a revision, or a funding adjustment.
fed_funding_amount	Amount of federal government's obligation or contingent liability, in dollars. A negative number represents a decrease in funding.
non_fed_funding_amount	Amount of non-federal funding, in dollars. A negative number represents a decrease in funding.
total_funding_amount	The total federal plus non-federal funding amount in dollars. A negative number represents a decrease in funding.
face_loan_guran	The face value of the direct loan or loan guarantee.
orig_sub_guran	The original subsidy cost of the direct loan or loan guarantee.
obligation_action_date	Obligation or action date for the award.
starting_date	The starting date for the award.
ending_date	The ending date for the award.
record_type	Federal Assistance Awards Data System record type: 1 = county aggregate record, 2 = individual action record.
correction_late_ind	Indicates that the action record is either a correction of a record from a previous quarter or a late reported record from a previous quarter. The previous quarter is indicated in the Corrected Fiscal Year / Quarter data field.
fyq_correction	The fiscal year (first four digits) and quarter (fifth digit) of the previous fiscal year and quarter that this record corrects, or which it is a late report for.

Source: www.usaspending.gov.

Table 3.64: Major funding agencies, grant types and summary information

Variable	N
Federal agency	
Agency for International Development	3
Department of Agriculture	44
Department of Commerce	142
Department of Defense	211
Department of Educatoion	19
Department of Energy	747
Department of Health and Human Services	711
Department of Homeland Security	33
Department of Housing and Development	2
Department of Interior	40
Department of Justice	31
Department of Labor	10
Department of State	3
Department of Transportation	65
Department of Treasury	51
Environmental Protection Agency	1
Federal Mediation and Conciliation	3
National Aeronautics and Space Administration	86
National Science Foundation	86
Grant type	
Block Grant	42
Copoperative Agreement	902
Formula Grant	18
Project Grant	1299
Summary information	
Different grant programs	191
Recovery grants	161
Grants, per receiving firm	1.59
Funding agencies, per receiving firm	1.21
Grant types, per receiving firm	1.21
Grant programs, per receiving firm	1.54

Notes: Major funding agencies and types of federal grants in alphabetic order. Recovery grants (since 2009) are due to the *American Recovery and Reinvestment Act of 2009 (ARRA)*.

Table 3.64 shows the major funding agencies, types of grants covered in my sample and additional summary information.

3.G.2 Federal grants data: matching rounds and results

For federal grants data, I also ran seven linkage rounds using STATA's built-in commands *merge* and *reclink*. The federal grants data contains the company name variable `recipient_name`, as well as the zip code and the city of the company. Overall, 2,040 firm-year observations could be matched. To improve the linkage procedure, string variables were modified in several ways for the different linkage rounds. For the merge command and reclink commands special characters, blanks, long strings and abbreviations were removed from the respective string variables. The merge command lead to 891 matches. The reclink rounds lead to 1,149 matches. Table 3.65 gives an overview of the record linkage results.

Table 3.65: Identified matches – Federal grants and Compustat data

Linkage procedure	Number of matches
Total	2040
STATA merge-command	891
STATA reclink-command	
conml to recipient	994
conml to recipient, town	46
conml to recipient, zip	4
conml to recipient modified, zip	49
conm, conml to recipient modified, zip	56
conm to recipient	0

Notes: Compustat variables conm and conml denote *company name* and *company legal name*, respectively. The variable recipient denotes *the name of the recipient of the award.* See Blasnik (2010) for details on the reclink command for STATA.

Chapter 4

Export Subsidies, Lobbying and Heterogeneous Firms

4.1 Introduction

> "So tonight, we set a new goal: We will double our exports over the next five years (...). We have to seek new markets aggressively, just as our competitors are.", *Barack Obama, January 27, 2010.*[1]

In his 2010 State of the Union address, President Obama sets the starting point for the National Export Initiative by announcing its ambitious goal of nothing less than doubling US exports by 2015.[2] More than ever, promoting exports is of highest priority to the US federal government, opening doors for lobbyists advocating export subsidies. One prominent example is the 2012 Export-Import Bank Reauthorization Act, which was heavily lobbied, in particular by the few major Ex-Im Bank subsidy recipients.[3]

While the recent international trade literature highlights the importance of firm heterogeneity and resource reallocation within an industry (Melitz, 2003), so far, it has been overlooked that trade promoting policies may also affect firms within the group of exporters differently.[4] This paper fills this gap in the literature by studying lobbying for export subsidies in a heterogeneous firms model of international trade (Melitz, 2003; Chaney, 2008). In a Melitz-type model with two countries, I analyze the welfare implications of a unilateral export subsidy, its distributional impact across firms within an industry, and its effect on firms' export behavior and aggregate exports.

A key ingredient of my model are administrative fixed costs to join a special interest group that lobbies for an export subsidy for its members. Similar to the wide within-industry variation in exporting, participation in lobbying is heavily biased towards large

[1] Remarks by the President in State of the Union Address, January 27, 2010. Whitehouse.gov, retrieved December 2, 2013.

[2] Executive Order 13534 - National Export Initiative, March 11, 2010. Whitehouse.gov, retrieved December 2, 2013.

[3] In May 2012, Congress chartered for another three years the Ex-Im Bank (Bill H.R. 2072), the major federal agency promoting exports. In particular, Boeing, the largest aircraft manufacturer in the US, was lobbying in favor of the Reauthorization Act and filed most lobbying reports on this bill (Opensecrets.org, retrieved December 2, 2013). Interestingly, in 2012, remarkable 82.7 percent of Ex-Im Bank's long-term loan guarantees ($12.2 billion out of $14.7 billion) subsidized sales of a single company: Boeing (Ex-Im Bank, 2012).

[4] See Bernard et al. (2012) and Redding (2011) for recent surveys on the heterogeneous firms trade literature.

corporations (Kerr et al., forthcoming). Due to the administrative fixed costs, my model captures this pattern of the data. In a model without lobbying, these administrative fixed costs should be considered as reflecting the administrative burden of applying for an existing export subsidy. This is in line with empirical evidence showing that even within narrowly defined industries, few and large firm benefit from subsidies (Wagner, 2010; Kammerer, 2013a).[5]

Specific export subsidies (i.e., subsidies contingent on export sales) are legally banned by WTO agreements. However, in the real world governments still subsidize exporting firms through various forms of export promoting policies that are not banned by the WTO.[6] In the US, for instance, the federal Ex-Im Bank continues to expand its export guarantees and loans that support US exporters.[7] Such export promotion policies are subtle ways how governments – in the face of WTO rules – still intervene to increase home firms' competitiveness in foreign markets. Therefore, studying lobbying for export subsidies is still of high importance.

In my model, there are two profit shifting motives that drive lobbying. First, if all exporters receive the export subsidy – in the *low administrative fixed costs case* – there is only cross-country profit shifting. All exporters gain from the export subsidy at the expense of foreign firms, which lose profits in their domestic market. Second, if only some exporters receive the export subsidy – in the *high administrative fixed costs case* – there is an additional within-exporter profit shifting effect. The export subsidy does not only shift profits from foreign firms to home firms, it also shifts profits from smaller home exporters to larger home exporters. Large subsidized exporters harm smaller exporters by dumping their goods into the foreign market, leading to within-exporter resource reallocation.

Overall, an export subsidy has a positive effect on trade flows. However, both the intensive margin and the extensive margin of trade matter and may react in opposite directions. In the low costs case, there are more exported varieties (positive extensive margin) and also higher sales of all exporters (positive intensive margin). In the high costs case, however, subsidized exporters sell more (positive intensive margin), but there are less exported varieties (negative extensive margin). Profits from the foreign market are shifted *only* towards the subsidized exporters. These firms increase their sales in the foreign market, resulting in worse market conditions for non-subsidized exporters. Although aggregate exports still increase, small non-subsidized exporters sell less or

[5]Instead of modeling the export subsidy as a public good, I assume that it is a club good only available to lobby members. Therefore, I focus explicitly on the case with negligible positive spillovers for non-lobbying firms. This assumption can be relaxed by allowing for small positive spillovers and introducing two distinct fixed costs for lobbying and receiving the export subsidy. For sufficiently small spillovers the model with two distinct fixed costs delivers same sorting patterns.

[6]The WTO "Agreement on Subsidies and Countervailing Measures" (ASCM) defines international rules regarding export subsidies. Article 8 of the ASCM specifies actionable and non-actionable subsidies. See Lederman et al. (2010) for a survey on the presence and effectiveness of export promotion agencies.

[7]Remarks by the President at the Export-Import Bank's Annual Conference, March 11, 2010. Whitehouse.gov, retrieved December 2, 2013.

even exit the foreign market. Thus, due to the presence of administrative fixed costs, an export subsidy may reduce export participation. This negative effect on the extensive margin considerably dampens the overall positive trade effect of an export subsidy.[8]

In my model, if the government is only interested in maximizing home welfare, it should never introduce an export subsidy. The costs of financing the export subsidy are always greater than the additional export profits.[9] However, an export subsidy reduces the mark-up distortion from monopolistic competition in the foreign country, increasing foreign welfare. Overall, in the low costs case, a small export subsidy improves global welfare. Thus, in contrast to conventional wisdom, lobbying for export subsidies can be global welfare improving.

Comparative statics of the lobbying game deliver novel insights into lobbying for export subsidies. Within the lobbying game, a trade liberalization through a decline in variable trade costs leads to a decline of the export subsidy. Therefore, the positive effect of a trade liberalization on trade flows can be considerably reduced. Put it differently, an increase in variable export costs induces higher export subsidies, partially reversing the effect of higher trade barriers. One key component of the model is firm heterogeneity in productivity. Increasing firm heterogeneity leads to relatively more lobbying firms and to a decline in the export subsidy. Similarly, increasing the barriers to lobby through higher administrative fixed costs leads to less lobbying firms and to an increase in the export subsidy rate. Thus, a smaller interest group receives higher export subsidies, because the profit shifting motive for lobbying is amplified if the mass of recipients declines.

There is a growing theoretical literature considering lobbying and trade policy in heterogeneous firms models. Optimal trade policy and export subsidies in a heterogeneous firms framework have been studied by Demidova and Rodríguez-Clare (2009).[10] While in their paper all exporters necessarily benefit from an export subsidy, I explicitly study selection into subsidized exporting by introducing administrative fixed costs to receive an export subsidy. Lobbying has been introduced into heterogeneous firms models by Abel-Koch (2010) and Rebeyrol and Vauday (2008). In contrast to these papers, I make use of firm heterogeneity to endogenize lobby formation within an industry. Endogenous lobby formation across industry can be found in Mitra (1999). In contrast, I focus on endogenous lobby formation within an industry at the firm level. Bombardini (2008) also studies lobby participation and firm heterogeneity. In contrast to her paper, I make use of profit shifting effects to introduce costly lobbying for export subsidies in a Melitz-type model with monopolistic competition and heterogeneous firms. The key

[8] This result gives an explanation for recent empirical firm-level evidence showing that there is no positive effect of subsidies on export participation (e.g., Bernard and Jensen (2004b), Görg et al. (2008), Girma et al. (2009a), Girma et al. (2009b)).

[9] In the high costs case, in addition to the costs of financing the subsidy, there is also an additional negative impact due to less export profits of non-subsidized firms.

[10] Subsidies on fixed costs in Melitz-type models have been studied by Jung (2012) and Pflüger and Suedekum (2013). Chor (2009) studies FDI subsidies for heterogeneous firms.

mechanism in my model is also related to papers with technology upgrading (i.e firms pay fixed costs to invest in superior technology, (Bustos, 2011)). In my model, however, the optimal export subsidy rate (i.e., the optimal rate of technology upgrading) is an endogenous outcome of a lobbying game.

The model's underlying mechanism that leads to self-selection of firms into lobbying relies on the supermodularity of a firm's profit function in productivity and in the export subsidy. Due to the export subsidy, additional variable export profits increase with firm productivity, while administrative fixed costs are identical across firms. Consequently, the sorting pattern of firms into subsidized exporting and lobbying does not hinge on the assumption of a subsidy on variable export costs. Alternative subsidy instruments that do not violate supermodularity (e.g., ad-valorem or unit subsidies) lead to similar selection patterns.[11] The selection effect is well known in the heterogeneous firms literature of international trade (Melitz, 2003; Helpman et al., 2004; Chaney, 2008; Mrázová and Neary, 2012). This is the first paper that applies this selection effect to lobbying for export subsidies.

There are only few very recent empirical papers that study lobbying at the firm-level. Due to the 1995 Lobbying Disclosure Act, the US provide the most comprehensive firm-level lobbying data in the world. By now, several studies make use of this data (e.g., Ansolabehere et al. (2002), Bombardini and Trebbi (2012), Chen et al. (2013), Ludema et al. (2010), Igan et al. (2011) and Kerr et al. (forthcoming)). Most related to my paper, by showing that there are considerable fixed costs to lobbying, Kerr et al. (forthcoming) provide empirical evidence for the assumption of administrative fixed costs.

Using a panel data set for German manufactures in the period 1999-2006, Wagner (2010) shows that while the fraction of subsidized firms is low, receiving firms are larger and are already more profitable before receiving subsidies.[12] Girma et al. (2009b) using additional information on German manufacturers exports, find a positive relationship between exports and production subsidies. However, the probability of starting to export is not affected by subsidies. Girma et al. (2009a) investigate the relationship between production subsidies and exports in China. These authors find that production subsidies increase exports at the intensive margin, but do not help firms to start exporting. Similar results can be found in Görg et al. (2008) for the case of the Republic of Ireland, where subsidies lead to more exports of existing exporters but not to entry of new exporters. Bernard and Jensen (2004b, p. 561) find that "State export promotion expenditures have no significant effect on the probability of exporting". Overall, the empirical literature does not find evidence for a positive effect of export subsidies on export participation. My model gives a theoretical explanation for this lack of empirical evidence. In the case

[11] See the Appendix in Kammerer (2013c) for a closed economy model with an ad-valorem output subsidy as alternative policy instrument.

[12] The particular historical and economic situation in Germany may explain that the results of Wagner (2010) differ for Western and Eastern Germany. Of the manufacturing firms in his dataset, in 2006 only 3.35 percent in Western Germany and 17.27 percent in Eastern Germany received subsidies. Subsidized manufacturers in Eastern Germany are also less productive and less human capital intensive firms.

of sufficiently high administrative fixed costs, high productive subsidized firms export more, leading to a positive intensive margin of trade. However, the marginal firm at the export cutoff – which does not receive the export subsidy – stops exporting, leading to a negative extensive margin of trade and even to less exporting firms.[13]

This paper is closely related to my previous work (Kammerer, 2013c). Similar to Kammerer (2013c), in this paper I make use of an heterogeneous firms model with monopolistic competition (Melitz, 2003; Chaney, 2008). However, I extend the model setup in Kammerer (2013c) substantially. First, I consider an open economy framework with two countries and international trade. Second, instead of a production subsidy as policy instrument of interest, I consider an export subsidy. Therefore, I am able to answer research questions that could not even be ask in the closed economy model of Kammerer (2013c). For instance, I explore the impact of a costly export subsidy on global welfare and trade flows. Most importantly, in contrast to a production subsidy in a closed economy, the channels through which the policy instrument affects the economy differ. The positive welfare effect through rising consumer surplus is no longer present in the home country, because consumer surplus increases only in the foreign country. However, there is a novel positive welfare effect for the home country through cross-country profit shifting. Profit shifting across countries is also the driving force behind lobbying, amplified by a within-exporter profit shifting effect, which only appears if administrative fixed costs are sufficiently large. Global welfare may increase through lobbying, because the mark-up distortion in the foreign market is reduced. Hence, studying lobbying for export subsidies in an open economy framework delivers novel insights.

In the main body of the paper, I follow Chaney (2008) by assuming an exogenous mass of entrants. In Appendix 4.B, I relax this assumption by allowing for free entry as in Melitz (2003). Under free entry and symmetry, the mass of entrants in the baseline model is proportional to expenditures on differentiated goods. More importantly, the mass of active firms is the same as in a model with an exogenous mass of entrants. However, due to free entry, the profit shifting effect of an export subsidy turns into a production relocation effect (i.e., aggregate profits are competed away by entry).[14] Both export flows and export participation unambiguously increase. For the purpose of this paper, aggregate profits and profit shifting are essential for lobbying. Therefore, taking potential shortcomings into account, I abstract from free entry. Model results may therefore be best seen as predictions in the short-run, when entry is restricted.

The rest of the paper is organized as follows. In Section 4.2, after presenting a baseline model with heterogeneous firms and two countries, I introduce an export subsidy and lobbying in the model. In Section 4.3 and Section 4.4, I distinguish between two cases

[13]With free entry, export participation may increase.

[14]See Venables (1987) for an early study on the relocation effect in a Krugman model. Recently, Ossa (2011a) makes use of relocation effects to study trade negotiations in a new trade model.

with low and high administrative fixed costs. For both cases, I first study the equilibrium with a given subsidy or with an ex-ante welfare maximizing government, before analyzing the equilibrium of the lobbying game. Section 4.5 concludes.

4.2 The model

In this section, I follow the Melitz (2003) and Chaney (2008) framework and present a baseline model with two countries, monopolistic competition and a continuum of heterogeneous firms. Subsequently, I introduce a unilateral export subsidy into the model, and study the case where firms can join a special interest group that lobbies for the export subsidy. Essentially, the model presented below is an open economy version of the closed economy model in Kammerer (2013c). Therefore, parts of the description of the model are highly similar and can also be found in Kammerer (2013c).

4.2.1 Baseline two country model with heterogeneous firms

Preferences. There are two countries, $i = Home$ and $j = Foreign$. In both countries, there is a differentiated goods sector and a sector where a homogeneous good, X, is produced under constant returns to scale. One unit of this outside good is produced by one unit of labor input such that the wage rate is fixed to one. For simplicity the mass of labor in each country is normalized to one, such that a country's total labor income is also fixed to unity.[15] The outside good is freely traded between countries and serves as numéraire. For the sake of brevity, I lay out the model from the perspective of country $i = Home$. The quasilinear utility function of the representative consumer in country i is given by

$$U(X_i, Q_i) = y_i \ln(Q_i) + X_i, \tag{4.1}$$

where $y_i > 0$.[16] Note that by utility maximization, the constant y_i equals aggregate expenditure of the representative consumer of country i on all available differentiated varieties, $y_i = P_i Q_i$. Following Dixit and Stiglitz (1977), varieties sold domestically by home firms, $\omega_{ii} \in \Omega_{ii}$, and imported varieties of foreign firms, $\omega_{ji} \in \Omega_{ji}$, form a constant elasticity of substitution (CES) composite good:

$$Q_i = [\int_{\omega_{ii}\in\Omega_{ii}} q(\omega_{ii})^{\frac{\sigma-1}{\sigma}} d\omega_{ii} + \int_{\omega_{ji}\in\Omega_{ji}} q(\omega_{ji})^{\frac{\sigma-1}{\sigma}} d\omega_{ji}]^{\frac{\sigma}{\sigma-1}}, \tag{4.2}$$

where $\sigma > 1$ denotes the elasticity of substitution between varieties, and $q(\omega)$ is the consumed quantity of variety ω. The sum of aggregate profits of firms located in country i, Π_i, and labor income gives total income in country i, $Y_i = \Pi_i + 1$. Total income is spend on differentiated goods and on the outside good, such that $Y_i = y_i + X_i$. Due to quasilinear preferences, welfare is given by $W_i = Y_i + CS_i$, where $CS_i = y_i \ln(Q_i) - P_i Q_i = y_i \ln(\frac{y_i}{P_i}) - y_i$ denotes consumer surplus. Utility maximization yields the standard CES

[15] I implicitly assume that aggregate labor demand in the differentiated goods sector is less than one, such that both countries also produce the outside good. All results hold if the mass of labor in the economy is greater than one.

[16] Quasilinear preferences with an outside good and log utility can be found in various recent papers (e.g., Abel-Koch (2010), Breinlich and Cuñat (2010), Pflüger and Russek (2014), Pflüger and Suedekum (2013)).

demand function for variety ω:

$$q(\omega) = A_i p(\omega)^{-\sigma}, \quad A_i = y_i P_i^{\sigma-1}, \tag{4.3}$$

where $p(\omega)$ denotes the price of variety ω, and P_i is the dual price index in country i, defined as

$$P_i = [\int_{\omega_{ii}\in\Omega_{ii}} p(\omega_{ii})^{1-\sigma} d\omega_{ii} + \int_{\omega_{ji}\in\Omega_{ji}} p(\omega_{ji})^{1-\sigma} d\omega_{ji}]^{\frac{1}{1-\sigma}}. \tag{4.4}$$

Technology and firm behavior. Firms use labor as only input to produce a unique variety in a market with monopolistic competition. A firm draws its productivity φ (i.e., the inverse of its variable per-unit labor requirement) from a Pareto distribution with shape parameter $\theta > \sigma$ and scale parameter $b > 0$.[17] The cumulative distribution function is given by $V(\varphi) = 1 - \left(\frac{b}{\varphi}\right)^{\theta}$, such that the probability density function is $v(\varphi) = \frac{\theta b^{\theta}}{\varphi^{\theta+1}}$ for $\varphi \geq b$.[18] Low values of θ correspond to "fat tails" of the productivity distribution and therefore to greater firm heterogeneity. Following Chaney (2008), the set of *possible* entrants (i.e., the set of possibly active firms) in each country is a fixed measure, J_i.[19]

After a firm in country i knows its productivity draw, it has to pay fixed costs f_{ii} to serve its domestic market. To serve the foreign market in country j, a firm located in country i has to pay export fixed costs f_{ij}. There are iceberg trade costs $\tau_{ij} \geq 1$ for selling from country i to country j. A firm's total firm profits are $\pi(\varphi) = \pi_{ii}(\varphi) + \pi_{ij}(\varphi)$, where $\pi_{ii}(\varphi) = p_{ii}(\varphi)q_{ii}(\varphi) - \tau_{ii}\frac{q_{ii}(\varphi)}{\varphi} - f_{ii}$ are domestic profits and $\pi_{ij}(\varphi) = p_{ij}(\varphi)q_{ij}(\varphi) - \tau_{ij}\frac{q_{ij}(\varphi)}{\varphi} - f_{ij}$ are export profits. Total profit maximization is achieved by setting the profit maximizing price for each market separately. As optimal pricing in both markets is conceptually the same, I only describe optimal firm behavior in the export market. The respective domestic variables follow directly by setting $j = i$.

Equilibrium. With a continuum of firms, each firm is of measure zero and takes the price index in a market as given when setting the price of its variety to maximize profits. By using the demand function from above, first order conditions of maximizing $\pi_{ij}(\varphi)$ deliver the standard constant markup pricing rule in the Dixit and Stiglitz (1977) framework:

$$p_{ij}(\varphi) = \frac{\sigma}{\sigma - 1}\frac{\tau_{ij}}{\varphi}. \tag{4.5}$$

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[17] Luttmer (2007) and Axtell (2001) provide empirical evidence for a Pareto distribution of firm size.

[18] For the n-th moment of the Pareto distribution to exist, it must hold that $\theta > n$. With $\theta > \sigma$ aggregate quantity is well defined in the model. Given its productivity draw, each firm produces a single variety. However, several firms can have identical productivity draws. Taking this into account, henceforth I denote a firm's variety and its productivity draw interchangeably.

[19] Note that by assuming an exogenous mass of potential entrants, I abstract from free entry as in Melitz (2003). In Appendix 4.B, I relax this assumption and allow for free entry. With symmetric countries, the mass of active firms is identical to the baseline model. Under free entry, positive profits are competed away and a production relocation effect replaces the profit shifting effect (see Ossa (2012)). I rule out free entry, because conflicting producer interests and positive profits are essential for lobbying. Model results may best be considered as implications in the short-run, when firm entry is not possible.

In equilibrium, revenues of a firm located in country i selling to country j are

$$r_{ij}(\varphi) = A_j \left[p_{ij}(\varphi)\right]^{1-\sigma} = A_j \left(\frac{\sigma - 1}{\sigma}\frac{\varphi}{\tau_{ij}}\right)^{\sigma-1}. \tag{4.6}$$

Variable profits are proportional to revenues, $\pi_{ij}^{var}(\varphi) = \frac{r_{ij}(\varphi)}{\sigma}$, such that equilibrium profits from selling from country i to country j are

$$\pi_{ij}(\varphi) = \frac{r_{ij}(\varphi)}{\sigma} - f_{ij} = B_j \left(\frac{\varphi}{\tau_{ij}}\right)^{\sigma-1} - f_{ij}, \quad B_j = \frac{(\sigma-1)^{\sigma-1}}{\sigma^\sigma} A_j. \tag{4.7}$$

The productivity level of a firm located in country i making zero profits by selling to country j is implicitly defined by $\pi_{ij}(\varphi_{ij,base}^*) = 0$. Therefore, in country i there is an *export cutoff*

$$\varphi_{ij,base}^* = \tau_{ij}\left(\frac{f_{ij}}{B_j}\right)^{\frac{1}{\sigma-1}}, \tag{4.8}$$

and also also a *domestic cutoff*

$$\varphi_{ii,base}^* = \tau_{ii}\left(\frac{f_{ii}}{B_i}\right)^{\frac{1}{\sigma-1}}, \tag{4.9}$$

where henceforth the subscript "*base*" refers to values of the baseline model. All firms with productivity greater or equal to the corresponding cutoff serve the domestic or the foreign market, respectively. If trade costs are sufficiently high, only some high productive firms sell domestically and also engage in exporting: $\varphi_{ij,base}^* > \varphi_{ii,base}^*$ if $f_{ij} > f_{ii}\frac{y_j}{y_i}\left(\frac{\tau_{ii}}{\tau_{ij}}\frac{P_j}{P_i}\right)^{\sigma-1}$.[20] To be consistent with this finding of the empirical trade literature, henceforth I assume parameter values that assure this sorting pattern. In Appendix 4.A.1, I solve for the price index and the cutoffs in terms of exogenous model parameters.

Due to constant aggregate expenditures on the differentiated goods, one can easily show that total aggregate profits in market i (i.e., the sum of aggregate profits of foreign firms' imports and aggregate profits of home firms' domestic sales) depend only on σ, θ and y_i:

$$\Pi_{ii} + \Pi_{ji} = \frac{\sigma - 1}{\sigma}\frac{y_i}{\theta}. \tag{4.10}$$

While more firm heterogeneity (i.e., lower θ) or a smaller markup (i.e., higher elasticity of substitution) lead to higher total profits in market i, trade costs do not influence total aggregate profits in market i. In contrast, aggregate profits of firms located in country i (i.e., the sum of aggregate profits of home firms' domestic sales and aggregate profits of home firms' exports) depend on other model parameters, such as trade barriers. Consequently, trade costs affect the share of aggregate profits made by home firms and foreign firms in a market, leading to a cross-country profit shifting motive.[21]

4.2.2 Introducing a *costly* export subsidy unilaterally in country i

Next, I consider the case where the home country (i.e., country i) introduces a *costly* export subsidy unilaterally. The export subsidy is costly because in order to receive it, firms have to pay *administrative* fixed costs f_s. These fixed costs can be interpreted in

[20] Under symmetry (i.e., $P_{i,base} = P_{j,base}$ and $y_j = y_i$) this condition simplifies to $f_{ij} > f_{ii}\left(\frac{\tau_{ii}}{\tau_{ij}}\right)^{\sigma-1}$.

[21] Aggregate profits in terms of exogenous model parameters are derived in the Appendix.

two ways. First, one could see them as pure bureaucratic costs to apply and to receive an export subsidy. For instance, searching and applying for a specific export promotion program is time consuming and costly for firms. The increasing effort that is made by the Export-Import Bank of the US to provide export promotion also to small and medium size enterprises shows that policy makers are aware of these barriers and that they play an important role prohibiting small firms to receive subsidies (Ex-Im Bank, 2013). Second, the administrative fixed costs could be seen as fixed costs to enter a lobby and to benefit from an export subsidy that is specific to the lobby group. This latter interpretation fits nicely to a recent empirical study on firm-level lobbying by Kerr et al. (forthcoming), providing evidence for the existence of considerable lobby entry costs. For simplicity, in this paper I assume that the administrative fixed costs contain both pure bureaucratic costs and lobby entry costs. Hence, only firms that pay these fixed costs can benefit from the export subsidy that the interest group is lobbying for. Before analyzing the lobbying game in detail, I first derive the equilibrium of the model for a given export subsidy.[22]

In particular, I assume that an export subsidy $s \in (1, \bar{s})$ reduces a firm's variable export costs by a factor $\frac{1}{s}$.[23] The highest feasible export subsidy $\bar{s}$ depends on the government budget constraint (discussed below in detail). Modeling an export subsidy that reduces variable trade costs corresponds nicely to the notion of iceberg trade costs, which are commonly assumed in international trade theory. Similarly to iceberg trade costs, a variable export costs subsidy is convenient, because the model remains highly tractable. However, to get selection into export subsidies with respect to productivity, it is sufficient to have supermodularity of the profit function in the export subsidy and in firm productivity. Therefore, an ad-valorem subsidy or a unit subsidy could be used as alternative instruments leading to similar selection patterns of firms into subsidized exporting. With an export subsidy on variable export costs, total costs of a subsidized firm located in country i to serve country j are

$$TC_{ij,s} = \frac{\tau_{ij}}{s}\frac{q_{ij}(\varphi)}{\varphi} + f_{ij} + f_s. \tag{4.11}$$

Due to the administrative fixed costs there is self-selection into subsidized exporting with respect to firm productivity (i.e., only larger and high productive firms receive the export subsidy). The key mechanism is that subsidy payments per firm increase with firm productivity, while administrative fixed costs are the same across firms. Consequently, there exists an eligibility cutoff with respect to firm productivity above which all firms

[22] At first glance, it seems to be a strong assumption that there are no spillovers from lobbying to non-lobbying firms. It is straightforward to extend the model with positive spillovers from lobbying (non-lobbying firms receive a discounted export subsidy) by introducing two distinct fixed costs for entering the lobby and for applying for export subsidies. However, if lobby spillovers are not too high, in equilibrium all receiving firms also join the lobby. Therefore, the assumption of a single fixed costs for both receiving and lobbying for an export subsidy keeps the model highly tractable and is robust. In the Appendix of Kammerer (2013c), present a closed economy model with two distinct fixed costs for receiving subsidy and for lobbying.

[23] Defining the export subsidy as $s \in (1, \bar{s})$ simplifies notation. The model can easily be rewritten in terms of an export subsidy rate $\mathfrak{s} = \frac{1}{s} \in (\underline{\mathfrak{s}}, 1)$, which is multiplied with variable export costs.

are subsidized. For low administrative fixed costs there is a unique eligibility and export cutoff. For sufficiently high administrative fixed costs, however, there are two distinct cutoffs for exporting and for receiving the export subsidy. In Section 4.3 and Section 4.4 I distinguish these two cases when analyzing the model.

Given that a firm pays the administrative fixed cost, it maximizes export profits by setting the price of its variety in country j to $p_{ij,s}(\varphi) = \frac{\sigma}{\sigma-1}\frac{\tau_{ij}}{s\varphi}$. Export revenues of a subsidized firm located in country i are

$$r_{ij,s}(\varphi) = A_{j,s}\left[p_{ij,s}(\varphi)\right]^{1-\sigma} = A_{j,s}\left(\frac{\sigma-1}{\sigma}\frac{s\varphi}{\tau_{ij}}\right)^{\sigma-1}, \quad A_{j,s} = y_j P_{j,s}^{\sigma-1}. \tag{4.12}$$

Variable export profits are proportional to revenues, $\pi_{ij,s}^{var}(\varphi) = \frac{r_{ij,s}(\varphi)}{\sigma}$, such that equilibrium export profits of a subsidized firm are

$$\pi_{ij,s}(\varphi) = \frac{r_{ij,s}(\varphi)}{\sigma} - f_{ij} - f_s = B_{j,s}\left(\frac{s\varphi}{\tau_{ij}}\right)^{\sigma-1} - f_{ij} - f_s, \quad B_{j,s} = \frac{(\sigma-1)^{\sigma-1}}{\sigma^{\sigma}}A_{j,s}. \tag{4.13}$$

While the price index in country i is not affected by a unilateral export subsidy, the price index in country j changes, because some imported varieties are subsidized. Dividing imported varieties in country j into sets of subsidized and non-subsidized varieties, $\Omega_{ij,s} = \Omega_{ij,E} \cup \Omega_{ij,NE}$, the price index in country j is now defined by

$$P_{j,s}^{\sigma-1} = \int\limits_{\omega_{jj}\in\Omega_{jj}} \left(\frac{\sigma}{\sigma-1}\frac{\tau_{jj}}{\varphi}\right)^{1-\sigma} d\omega_{jj} + \int\limits_{\omega_{ij}\in\Omega_{ij,NE}} \left(\frac{\sigma}{\sigma-1}\frac{\tau_{ij}}{\varphi}\right)^{1-\sigma} d\omega_{ij} + \int\limits_{\omega_{ij}\in\Omega_{ij,E}} \left(\frac{\sigma}{\sigma-1}\frac{\tau_{ij}}{\varphi s}\right)^{1-\sigma} d\omega_{ij}. \tag{4.14}$$

Subsidy payments per firm are the difference between the actual variable costs for output $q_{ij,s}(\varphi)$ and subsidized variable costs: $\left(1-\frac{1}{s}\right)\frac{\tau_{ij}}{\varphi}q_{ij,s}(\varphi)$. By $\frac{\tau_{ij}}{s\varphi}q_{ij,s}(\varphi) = \frac{\sigma-1}{\sigma}r_{ij,s}(\varphi)$, aggregating over all subsidized firms gives total subsidy payments:

$$S = (s-1)\frac{\sigma-1}{\sigma}R_E, \tag{4.15}$$

where R_E denote aggregate export revenues of **E**ligible firms, which together with aggregate export revenues of **N**on-**E**ligible firms define total aggregate export revenues of country i: $R_{ij,s} = R_E + R_{NE}$ ($\Pi_{ij,s} = \Pi_E + \Pi_{NE}$ for profits). Explicit expression for aggregate variables can be found in the Appendix. For simplicity, I assume that the export subsidy is financed by a lump-sum tax on labor income, such that the government budget constraint is given by $S \leq 1$. Therefore, the upper bound on the set of feasible subsidy rates $\bar{s}$ is implicitly defined by $S = 1$. Consequently, with a unilateral export subsidy in country i, welfare in country i is

$$W_{i,s} = \underbrace{\Pi_{ii} + \Pi_{ij,s}}_{\text{agg. profits}} + \underbrace{(1-S)}_{\text{net labor income}} + \underbrace{(y_i \ln(\frac{y_i}{P_i}) - y_i)}_{\text{consumer surplus}}, \tag{4.16}$$

and welfare in country j is

$$W_{j,s} = \underbrace{\Pi_{jj,s} + \Pi_{ji}}_{\text{agg. profits}} + \underbrace{1}_{\text{labor income}} + \underbrace{(y_j \ln(\frac{y_j}{P_{j,s}}) - y_j)}_{\text{consumer surplus}}. \tag{4.17}$$

Recall that consumer surplus in country i is not affected by the export subsidy (i.e., the price index in country i does not change) and aggregate profits in a market are constant.

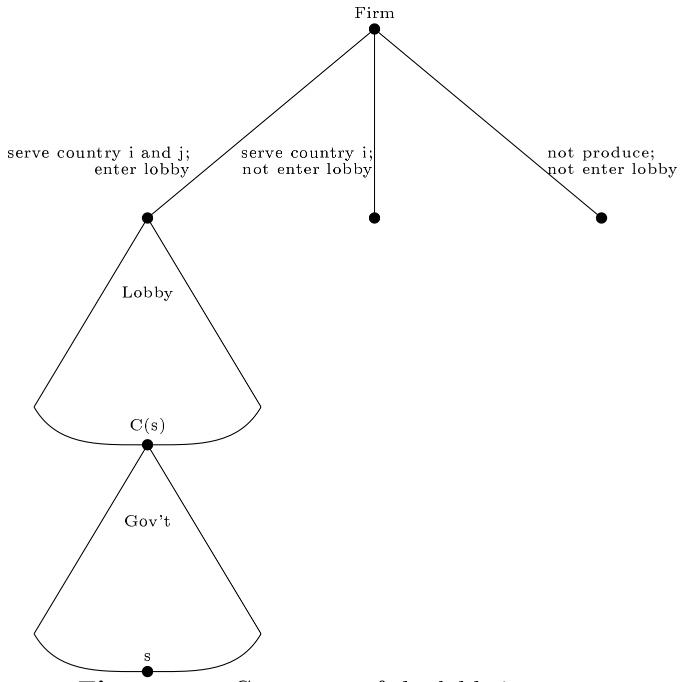

Figure 4.1: Game tree of the lobbying game

Therefore, the export subsidy affects welfare by shifting profits across countries (i.e., $\Pi_{ij,s}$ increases and $\Pi_{jj,s}$ decreases), by shifting profits potentially also among home exporters (i.e., if only some exporters receive the subsidy, $\Pi_{ij,s} = \Pi_E + \Pi_{NE}$), and by increasing foreign consumer surplus at the cost of financing subsidy payments in the home country.

4.2.3 Introducing lobbying for a unilateral export subsidy in country i

Timing and structure of the lobbying game. I model the lobbying game in three stages. In the first stage, firms decide to serve country i and/or country j, and to join the lobby group. In the second stage, maximizing aggregate member profits, the lobby determines the contribution schedule $C(s)$ that it offers to the government. In the third stage, facing $C(s)$, the government sets the export subsidy, firms produce and set the profit maximizing price with or without being subsidized. Figure 4.1 illustrates the timing of the lobbying game graphically.

The second and third stage of the lobbying game are familiar from the Grossman and Helpman (1994) "Protection for Sale" model (i.e., the menu auction approach by Bernheim and Whinston (1986)), in which the formation of special interest groups is exogenous. However, due to the first stage of my lobbying game, the size and composition of the special interest group becomes an endogenous object of the model. Similar to endogenous lobby formation across industries in Mitra (1999), my paper captures endogenous lobby formation *within* an industry. Due to this endogenous within-industry lobby formation, parameter changes cause indirect equilibrium effects (i.e. changes in the size and composition of the lobby) leading to novel insights into lobbying.

Following the Protection for Sale literature, the government objective function is

$$G = \alpha W_{i,s}(s) + C(s), \tag{4.18}$$

where $C(s)$ is the contribution schedule offered by the lobby group and $\alpha \in (0, \infty)$ is the relative weight that the government puts on welfare in country i. Given the timing of the game, when the government decides about the export subsidy rate, firms already joined the lobby group and the lobby group determined its contribution schedule. Therefore, the government takes the number of lobbying firms and the contribution schedule as given. Similarly, when the lobby determines its contribution schedule, it maximize the profits of its current members, taking the number of lobby members as given. Anticipating the optimal behavior of the lobby and the government, only firms with productivity above the respective productivity cutoff serve a market and only firms with productivity above the lobby/eligibility cutoff, φ_L^*, decide to join the lobby.[24]

The joint contribution schedule offered by the lobby, $C(s)$, has to be financed by variable individual member contributions $c(\varphi, s)$ such that $C(s) = \int_{\varphi_L^*} c(\varphi, s) dV(\varphi)$. I assume that these individual contribution are such that each lobby member still gains from joining the lobby:

Assumption 4.1. *If* $\varphi \geq \varphi_L^*$ *then* $c(\varphi, s) \leq \pi_{ij,s}(\varphi) - \pi_{ij}(\varphi)$.

If this assumption holds, a firm with net-benefits from receiving the export subsidy (after paying lobby entry costs f_s) does not exit the lobby because of additional individual contributions. In other words, even with additional individual lobby contributions, the functional form of the productivity cutoffs is the same as with an exogenous export subsidy. Henceforth, I call the eligibility cutoff also lobby cutoff. It is important to note that Assumption 4.1 does not impose any specific functional form on how the lobby collects the individual contributions from its member firms.[25]

Equilibrium of the lobbying game in the general case. Before analyzing the lobbying game with explicit functional forms, I derive the equilibrium of the lobbying game for the general case. With only one lobby group, a modified version of the second lemma in Bernheim and Whinston (1986) defines the equilibrium of the lobbying game:

Definition 4.1. *A set* $\{C^o, s^o, \varphi_{ii}^o, \varphi_{jj}^o, \varphi_{ji}^o, \varphi_{ij}^o, \varphi_L^o\}$ *is a subgame-perfect Nash equilibrium of the lobbying game if and only if:*

1. *firms with* $\varphi \geq \varphi_{ii}^o$, ($\varphi \geq \varphi_{jj}^o$) *serve their domestic market, firms with* $\varphi \geq \varphi_{ij}^o$, ($\varphi \geq \varphi_{ji}^o$) *export, and firms with* $\varphi \geq \varphi_L^o$ *enter the lobby;*
2. $C^o \geq 0$ *is feasible for the lobby;*
3. $s^o \in \arg\max_{s \in [1,\bar{s}]} G = \{\alpha W_i(s) + C^o(s)\}$;
4. $\{\alpha W_i(s^o) + C^o(s^o)\} + \{\Pi_E(s^o) - C^o(s^o)\} \geq \{\alpha W_i(s) + C^o(s)\} + \{\Pi_E(s) - C^o(s)\} \forall s \in [1, \bar{s}]$;
5. $\exists s^* \in [1, \bar{s}]$, *such that* $s^* \in \arg\max_{s \in [1,\bar{s}]} \{\alpha W_i(s) + C^o(s)\}$ *and* $C^o(s^*) = 0$.

[24]For low levels of f_s the export cutoff is identical to the eligibility/lobby cutoff.

[25]Under Assumption 4.1, the size of the lobby is maximized, in the sense that all firms that bear the administrative fixed costs find it profitable to stay in the lobby. There is an infinite number of potential individual contribution schedules that fulfill Assumption 4.1. One straightforward functional form would be a linear increasing schedule that starts with zero contributions at the cutoff φ_L^*.

Condition 1 reflects the first stage of the lobbying game, in which firms decide which market to serve and whether to join the lobby. The joint contribution schedule has to be non-negative and feasible (condition 2). The equilibrium export subsidy has to maximize the government's objective (condition 3), and the joint welfare of the government and the lobby on the set of feasible export subsidy rates (condition 4). For condition 5 to be fulfilled, there has to be a feasible export subsidy that maximizes the government's objective, given that the contributions of the lobby are zero.

As a refinement of the set of all Nash Equilibria, I follow Grossman and Helpman (1994) by assuming that the contribution schedule is truthful in the sense that it represent the true preferences of the lobby:

Assumption 4.2. *Aggregate contribution schedules are truthful:*

$$C^T = \max\left[\Pi_E - B_L, 0\right],$$

where Π_E are aggregate export profits of the lobby members and B_L denotes the additional aggregate surplus of all lobbying firms, determined in equilibrium.

Bernheim and Whinston (1986) argue that truthful strategies may be focal within the Nash set, and they show that every best-response set contains a truthful strategy. With truthful contribution schedules the following corollary can be stated:

Corollary 4.1. *Under truthful contribution schedules, the equilibrium subsidy satisfies*

$$s^o = \arg\max_{s\in[1,\bar{s}]} \left\{\alpha W_i(s) + \Pi_E(s)\right\}.$$

Proof. See Appendix 4.A.2. □

Thus, with truthful contributions, the government behaves *as if* it maximizes a weighted sum of general welfare and joint lobby profits. The equilibrium contributions compensate the government for the weighted welfare loss induced from deviating from the export subsidy rate that would maximize general welfare in country i, s^*. It must therefore hold that $C^T(s^o) = \alpha\left[W_i(s^*) - W_i(s^o)\right]$. With truthful contributions (Assumption 4.2), the equilibrium lobby surplus is $B_L = \Pi_E(s^o) - \alpha\left[W_i(s^*) - W_i(s^o)\right]$. With welfare defined by equation (4.16), the first order condition of the government maximization problem is given by[26]

$$\frac{\partial G}{\partial s} = \alpha\left(\frac{\partial \Pi_{ij}}{\partial s} - \frac{\partial S}{\partial s}\right) + \frac{\partial \Pi_E}{\partial s} = 0. \tag{4.19}$$

Above a certain level of administrative fixed costs (parameter condition derived below) only a subset of exporters find it profitable to join the lobby. Therefore, to analyze the equilibrium of the lobbying game in detail, in the following I distinguish a *low administrative fixed costs case,* in which all exporters lobby, and a *high administrative fixed costs case*, in which only a subset of exporters lobbies. In both cases, I first state the equilibrium expressions for a given export subsidy, before deriving the optimal export

[26]When solving equation (4.19) the government takes the mass of active, exporting and lobbying firms as given. The respective derivatives are calculated holding the boundaries of the integrals (i.e., the cutoffs) fixed.

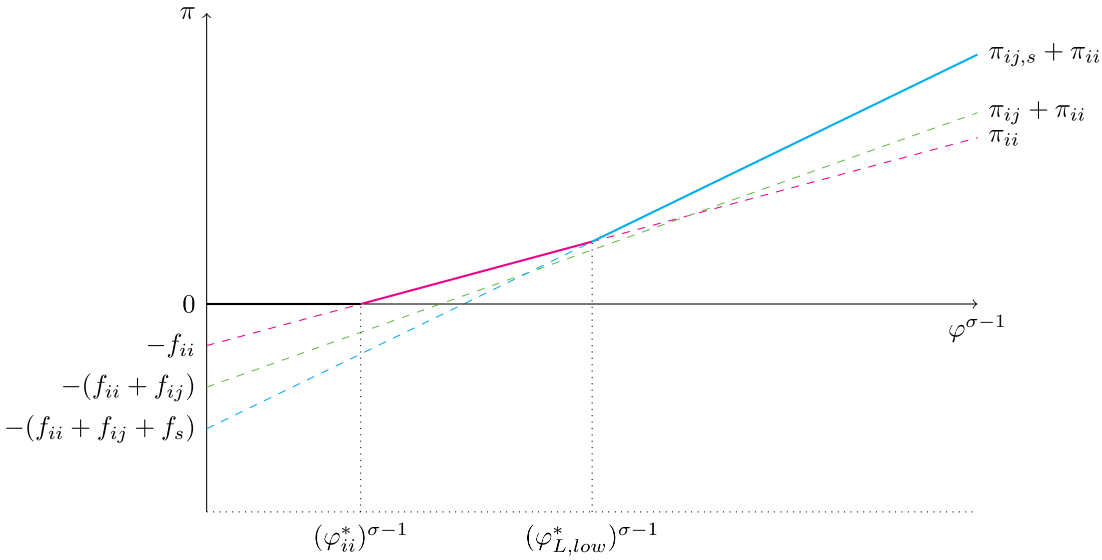

Figure 4.2: Firm profits in the low costs case

subsidy rate for an *ex-ante* welfare maximizing government.[27] Subsequently, I derive the equilibrium of the lobbying game, where the government takes the mass of firms as given, when setting the export subsidy.

4.3 The low administrative fixed costs case

In this section, I consider the case where the administrative fixed costs are sufficiently low, such that all exporting firms are subsidized.

4.3.1 Equilibrium in the low costs case for a given export subsidy

Note that both the domestic product market cutoff and the home price index are identical to the the baseline model, $\varphi^*_{ii} = \varphi^*_{ii,base} = \tau_{ii}\left(\frac{f_{ii}}{B_i}\right)^{\frac{1}{\sigma-1}}$ and $P_{i,s} = P_{i,base}$. For sufficiently low administrative fixed costs all exporting firms are subsidized. The marginal firm that pays the administrative fixed costs to receive the export subsidy makes zero profits from exporting, $\pi_{ij,s}(\varphi^*_{L,low}) = 0$. Therefore, the corresponding *eligibility and export cutoff* is

$$\varphi^*_{L,low} = \frac{\tau_{ij}}{s}\left(\frac{f_{ij} + f_s}{B_{j,s}}\right)^{\frac{1}{\sigma-1}}, \tag{4.20}$$

where $B_{j,s} = \frac{(\sigma-1)^{\sigma-1}}{\sigma^\sigma} y_j P_{j,s}^{\sigma-1}$. In Appendix 4.A.3, I derive the explicit expressions for the price index in country j and for the eligibility and export cutoff.

In the low costs case, Figure 4.2 depicts firm profits as a function of firm productivity. Firms below φ^*_{ii} do not produce at all. Firms at an intermediate range between φ^*_{ii} and $\varphi^*_{L,low}$ serve only the domestic market in country i. All firms above $\varphi^*_{L,low}$ find it profitable to receive the export subsidy *and* to export. The equilibrium in the low costs case with a given unilateral export subsidy can be summarized in the following lemma:

[27]The government maximized ex-ante welfare in the sense that it takes firm entry and exit into account.

Lemma 4.1. *In the low costs case with a given unilateral export subsidy in country i, there is a unique eligibility and export cutoff $\varphi^*_{L,low}$, and*

1. *the price index in country j lies below the baseline value, $P_{j,s} < P_{j,base}$;*
2. *$\varphi^*_{L,low}$ lies below the baseline export cutoff, $\varphi^*_{L,low} < \varphi^*_{ij,base}$;*
3. *$\varphi^*_{L,low}$ is decreasing in s, but increasing in f_s and f_{ij}.*

Proof. See Appendix 4.A.4. □

Due to the export subsidy, all exporters sell at a lower price and the foreign price index declines (1. statement of Lemma 4.1). However, even though the decline in the foreign price index affects a firm's export profits negatively, the direct positive effect through the export subsidy leads to a net increase in export profits of all exporting firms. Therefore, the eligibility and export cutoff lies below the baseline export cutoff, such that new and less productive firms start to export (2. statement). Consequently, a further increase in the export subsidy leads to more exported varieties, while an increase in the administrative and export fixed costs forces the marginal firm to exit the export market (3. statement). The unilateral introduction of an export subsidy is beneficial for all home exporters because foreign firms' profits are shifted to home firms.

Total export revenues and export profits increase when an export subsidy is introduced. This effect is stronger the lower the administrative fixed costs are. Thus, the following corollary follows directly from Lemma 4.1.

Corollary 4.2. *In the low costs case, a rise in the unilateral export subsidy of country i increases both aggregate exports and export participation.*

4.3.2 Ex-ante welfare maximizing export subsidy

As a benchmark, I look for ex-ante optimal export subsidy rates that maximize home welfare, foreign welfare and global welfare. Therefore, I assume that the government moves first by setting the export subsidy. For a given export subsidy, a firm decides whether to be subsidized or not. In the low costs case, denote $\epsilon_{R_{E,low}}$ the elasticity of aggregate export revenues with respect to the export subsidy.[28] The following proposition summarizes the welfare results in the low costs case:

Proposition 4.1. *In the low costs case, from an ex-ante point of view,*

1. *$s = 1$ maximizes home welfare;*
2. *$s = \bar{s}$ maximizes foreign welfare;*
3. *$\tilde{s} = \frac{\frac{\sigma}{\sigma-1}+\epsilon_{R_{E,low}}}{1+\epsilon_{R_{E,low}}} \in (1, \frac{\sigma}{\sigma-1})$ is the unique interior solution maximizing global welfare.*

Proof. See Appendix 4.A.5. □

A government that maximizes only home welfare should not introduce an export subsidy (1. statement of Proposition 4.1). The induced cross-country profit shifting effect is not sufficient to compensate for the loss due to financing subsidy payments.[29]

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[28] In Appendix 4.A.3 I show that $\epsilon_{R_{E,low}} = \theta[\frac{J_i}{J_j}\left(\frac{s\tau_{jj}}{\tau_{ij}}\right)^{\theta}\left(\frac{f_{jj}}{f_{ij}+f_s}\right)^{\frac{\theta-\sigma+1}{\sigma-1}} + 1]^{-1}$.

[29] The first order condition for maximizing home welfare is $\frac{\partial W_i}{\partial s} = \frac{\partial \Pi_{ij}}{\partial s} - \frac{\partial S}{\partial s} = 0$.

In the foreign country, welfare effects are different. On the one hand, foreign welfare is negatively affected through cross-country profit shifting. On the other hand, there is also a positive effect on foreign welfare through increasing consumer surplus.[30] However, as the second statement of Proposition 4.1 shows, in the low costs case the positive consumer surplus effect always dominates, and the foreign government would prefer that the home government subsidized home exporters as much as possible.

For global welfare, an export subsidy can be beneficial. The profit shifting effect does not matter from a global point of view, because total profits in a market are constant, $\frac{\partial \Pi_{ij}}{\partial s} + \frac{\partial \Pi_{jj}}{\partial s} = 0$. All that matters is that an export subsidy improves consumer surplus in the foreign country at the cost of financing the subsidy in the home country. Due to monopolistic competition and the associated mark-up distortion, an export subsidy reduces the mark-up of exported varieties sold in the foreign market.[31] Thus, from a global welfare perspective, export subsidies are beneficial because the mark-up distortion can be mitigated. As the third statement of Proposition 4.1 shows, a small export subsidy improves global welfare.

One can show that the globally optimal export subsidy $\tilde{s}$ is a decreasing function in in the elasticity $\epsilon_{R_{E,low}}$. Therefore, comparative static results for fixed and variable costs follow directly from statement 3 of Proposition 4.1, and are summarized by the following corollary:

Corollary 4.3. *Increasing f_{jj} or decreasing τ_{ij}, f_{ij} or f_s leads to an increase in $\tilde{s}$.*

Thus, from a global welfare point of view, it is optimal to increase the export subsidy if a trade liberalization occurs (if τ_{ij} or f_{ij} decline). In this case, imports become more important for the foreign country and an increase in the export subsidy leads to large improvements in consumer surplus.

4.3.3 Lobbying in the low costs case

Equilibrium of the lobbying game. In the low costs case, the first order condition of the government within the lobbying game (equation (4.19)) can be simplified to

$$\frac{\partial G}{\partial s} = (1 + \frac{1}{\alpha})\frac{\partial \Pi_{ij}}{\partial s} - \frac{\partial S}{\partial s} = 0. \tag{4.21}$$

For $\alpha \to \infty$ there is no additional weight on export profits and the government maximizes only general welfare of country i. For $\alpha \to 0$ only export profits matter for the government. In the latter case, the government sets the export subsidy to the upper bound that is feasible by its budget constraint. For finite positive values of the welfare weight α, the first order condition delivers an interior solution, s^o.

Given the government's optimal choice of the export subsidy, and given the implied lobby contributions, the respective productivity cutoffs are determined. Given these cutoffs, the relative mass of lobbying firms to foreign firms as a function of the export

[30] The first order condition for maximizing foreign welfare is $\frac{\partial W_j}{\partial s} = \frac{\partial \Pi_{jj}}{\partial s} + \frac{\partial CS_j}{\partial s} = 0$.

[31] The first order condition for maximizing global welfare is $\frac{\partial W_i}{\partial s} + \frac{\partial W_j}{\partial s} = \frac{\partial CS_j}{\partial s} - \frac{\partial S}{\partial s} = 0$.

subsidy, $m(s) := \frac{J_L}{J_{jj}}$, is also pinned down.[32] The following proposition summarizes the lobbying equilibrium in the low costs case:

Proposition 4.2. *In the low costs case, there exists a unique equilibrium of the lobbying game, such that*

1. *all firms with $\varphi \geq \varphi^o_{L,low}$ both export and enter the lobby, and the relative mass of lobbying firms is $m(s) := \frac{J_L}{J_{jj}} = \frac{J_i}{J_j}\left(\frac{s\tau_{jj}}{\tau_{ij}}\right)^{\theta}\left(\frac{f_{jj}}{f_{ij}+f_s}\right)^{\frac{\theta}{\sigma-1}}$;*
2. *lobby contributions are $C^T(s^o) = \alpha(\Pi_{ij}(s^*) - \Pi_{ij}(s^o) + S(s^o) - S(s^*))$;*
3. *the government implements $z(\frac{J_L}{J_{jj}}) := s^o = \frac{1+\frac{(1+\frac{1}{\alpha})}{\sigma-1}}{\frac{\sigma}{\sigma-1}+\frac{1}{\sigma-1}\frac{J_L}{J_{jj}}\frac{f_{ij}+f_s}{f_{jj}}}$.*

Proof. See Appendix 4.A.6. □

In contrast to maximizing only home welfare, if the government is also influenced by lobbying it is willing to introduce an export subsidy s^o. As shown in Proposition 4.1, a small export subsidy may lead to global welfare gains. Therefore, lobbying for an export subsidy can be beneficial for global welfare. However, it is not the case that this outcome is achieved because of global welfare considerations taking the positive externality for the other country into account. To the contrary, it is the selfish lobbying behavior of exporters that leads to this result. Thus, even though conventional wisdom suggests that lobbying as well as export subsidies are both undesirable, at least from a global welfare point of view, in my model lobbying for export subsidies can be beneficial.

Comparative statics of the lobbying equilibrium. Given the entry stage in the lobbying game, comparative statics of the equilibrium are characterized by both a direct effect and an indirect effect. For instance, considering the equilibrium export subsidy, the direct effect is the direct (partial) impact of a parameter change on the export subsidy, holding the lobby size fixed. The indirect effect is the effect on s due to a change in lobby size, which itself is induced by the respective parameter change. The following lemma summarizes the analytically derived comparative statics of the lobbying game in the low costs case.

Lemma 4.2. *In the low costs case, comparative statics of the lobbying equilibrium show that*

1. *a trade liberalization through a decline in τ_{ij} leads to an increase in $\frac{J_L}{J_{jj}}$ and to a decline in the export subsidy;*
2. *a decline in f_s, f_{ij} or an increase in f_{jj} lead to an increase in $\frac{J_L}{J_{jj}}$ and to a decline in the export subsidy.*
3. *a decline in the welfare weight α leads to an increase in $\frac{J_L}{J_{jj}}$ and to an increase in the export subsidy;*
4. *an increase in firm heterogeneity (lower θ) leads to an increase in $\frac{J_L}{J_{jj}}$ and to a decline in the export subsidy.*

Proof. See Appendix 4.A.7. □

[32] The relative mass of lobbying firms is a function of the subsidy rate and the subsidy rate is a function of the relative mass of lobbying firms. The lobbying equilibrium is the locus where both functions intersect.

For any given export subsidy rate, a decline in iceberg trade costs leads to more exporting/lobbying firms $\frac{J_L}{J_{jj}}$. An increase in $\frac{J_L}{J_{jj}}$, however, leads to a decline of the export subsidy (1. statement of Lemma 4.2).

For any given $\frac{J_L}{J_{jj}}$, a decline in f_s, f_{ij} or a rise in f_{jj} initially increases the export subsidy $z(\frac{J_L}{J_{jj}})$. However, for any given s, a decline in f_s, f_{ij} or a rise in f_{jj} also increases $\frac{J_L}{J_{jj}}$. The latter effect has a dominating negative effect on s, such that the export subsidy decreases and the relative mass of lobbying firms increases (2. statement).

An increase in the welfare weight α leads to a lower export subsidy. This induces less firms to enter the lobby, because $m(s)$ is upward sloping (3. statement).

An increase in θ leads to a decline of $\frac{J_L}{J_{jj}}$, and therefore to an increase in the export subsidy, because $z(\frac{J_L}{J_{jj}})$ is downwards sloping (4. statement).

Besides deriving comparative statics of the model analytically, I also illustrate them graphically by simulating the model in MATLAB. To solve the model numerically, I choose parameter values that have been widely used in the international trade literature (Axtell, 2001; Bernard et al., 2003). In particular, I set $\theta = 3.12$, $\sigma = 4$, $f_s = 0.1$.[33]

The effect of a trade liberalization in the low costs case with lobbying can be seen in Figure 4.3. There I plot the optimal export subsidy, aggregate exports R_{ij}, the mass of exporting/lobbying firms J_{ij} and the mass of exporting/lobbying firms relative to foreign firms $\frac{J_{ij}}{J_{jj}}$ for different welfare weights α and as function of τ_{ij}. A decline in iceberg trade costs leads to more exporting/subsidized firms. Within the lobbying game this leads to a decline in the export subsidy. Thus, while due to the trade liberalization trade flows still increase, this positive trade effect is reduced by the endogenous adjustment of the export subsidy rate. Additional figures for comparative statics of other model parameters can be found in Appendix 4.C.

In summary, with sufficiently low administrative fixed costs, all exporting firms decide to receive an export subsidy. Firms already exporting increase their export sales to country j (positive intensive margin) and new firms start exporting (positive extensive margin). An export subsidy decreases welfare in the granting country. However, a small export subsidy, which could be the outcome of lobbying, increases global welfare. Hence, in contrast to conventional wisdom, lobbying for export subsidies may result in global welfare gains.[34] Moreover, due to the endogenous size and composition of the lobby, comparative statics of the lobbying game deliver novel insights. For instance, a trade liberalization through a drop in iceberg trade costs leads to a decline in the endogenously determined export subsidy, reducing the positive trade effect.

[33] I set the elasticity of substitution to $\sigma = 4$, which corresponds to a markup of 33 percent, and is in line with estimates in the literature (Bernard et al., 2003). Axtell (2001) shows that the sales distribution of US firms can be approximated by a Pareto distribution with a shape parameter of 1.04. Sales in my model are distributed with Pareto shape parameter $\frac{\theta}{\sigma-1}$. Therefore, I set $\theta = 1.04\,(\sigma-1) = 3.12$. I set $\tau_{ij} = \tau_{ji} = 1.5$. I normalize $\tau_{ii}, \tau_{jj}, f_{ii}, f_{jj}, f_{ji}, f_{ij}, J_i, J_j, y_i, y_j$ and b to 1. Normalization of the these parameters do not change the results qualitatively.

[34] There does always exist a welfare weight α such that the export subsidy rate of the lobbying equilibrium equals the subsidy rate that maximized global welfare. In particular, $\tilde{s} = s^o$ if $\alpha = \frac{\left(1+\epsilon_{R_{E,low}}\right)}{\theta\left(\frac{\sigma}{\sigma-1}+\epsilon_{R_{E,low}}\right)-1}$.

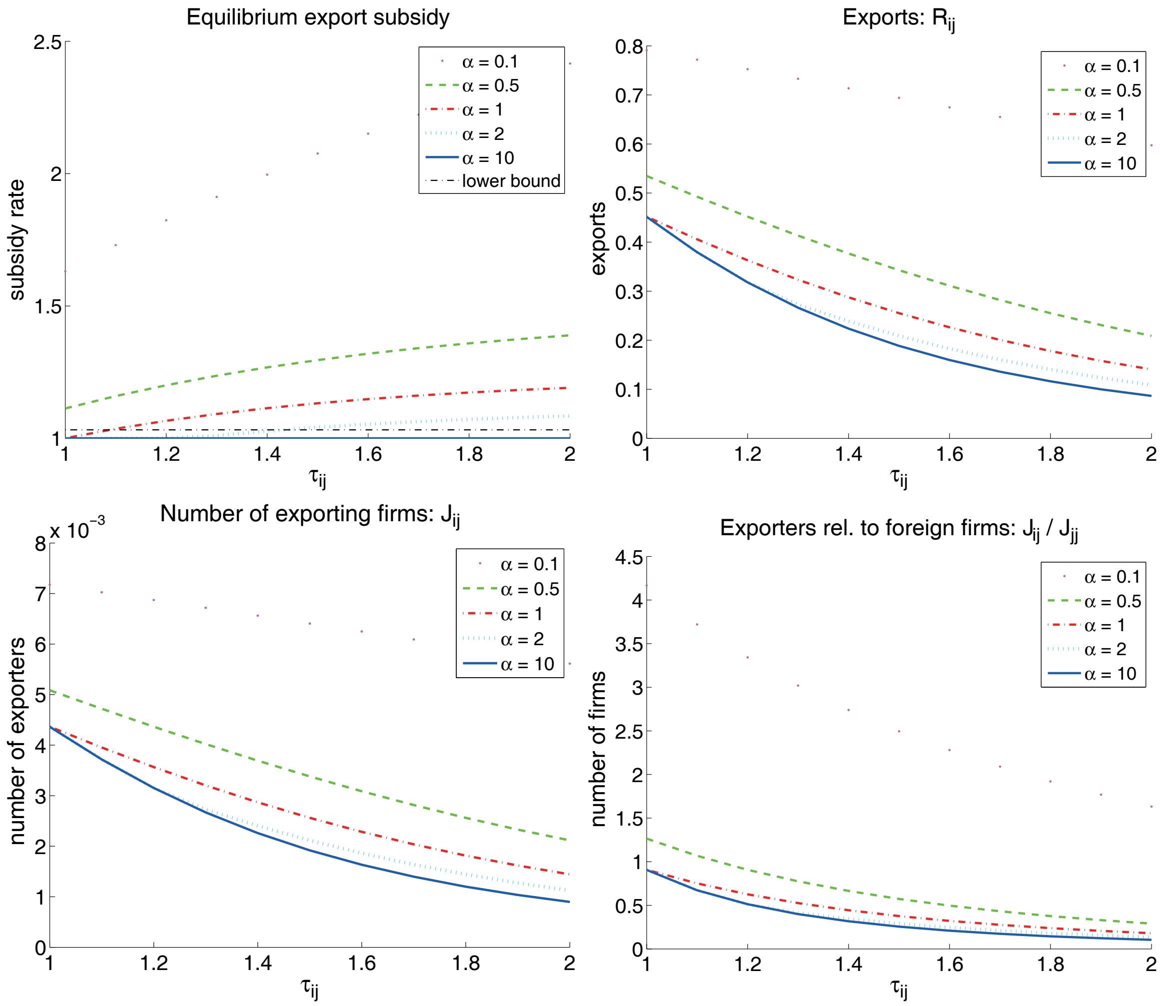

Figure 4.3: Simulated comparative statics: increasing τ_{ij} in the low costs case

4.4 The high administrative fixed costs case

In this section, I consider the case where the administrative fixed costs are sufficiently high, such that there are some exporting firms that do not receive the export subsidy.

4.4.1 Equilibrium in the high costs case for a given export subsidy

Again, both the domestic product market cutoff and the home price index are identical to the the baseline model, $\varphi_{ii}^* = \varphi_{ii,base}^* = \tau_{ii}\left(\frac{f_{ii}}{B_i}\right)^{\frac{1}{\sigma-1}}$ and $P_{i,s} = P_{i,base}$. The *export cutoff* for firms selling from i to j, implicitly defined by $\pi_{ij}(\varphi_{ij}^*) = 0$, is

$$\varphi_{ij}^* = \tau_{ij}\left(\frac{f_{ij}}{B_{j,s}}\right)^{\frac{1}{\sigma-1}}, \tag{4.22}$$

where $B_{j,s} = \frac{(\sigma-1)^{\sigma-1}}{\sigma^\sigma} y_j P_{j,s}^{\sigma-1}$. The marginal firm that still decides to receive the export subsidy makes zero additional profits from subsidized exporting, $\pi_{ij,s}(\varphi_L^*) - \pi_{ij}(\varphi_L^*) = 0$. Therefore, the *eligibility cutoff* is given by

$$\varphi_L^* = \tau_{ij}\left(\frac{f_s}{B_{j,s}(s^{\sigma-1}-1)}\right)^{\frac{1}{\sigma-1}}. \tag{4.23}$$

In Appendix 4.A.8, I derive the explicit expressions for the price index in country j, for the export cutoff and for the eligibility cutoff. For sufficiently high administrative fixed costs (relative to the export subsidy rate and the export fixed costs), there are some exporting firms that are not subsidized. From equations (4.22) and (4.23) it follows that the export cutoff lies below the eligibility cutoff if[35]

$$f_s > f_{ij}(s^{\sigma-1}-1). \tag{4.24}$$

For the high costs case, Figure 4.4 depicts firm profits as a function of firm productivity. Firms below φ_{ii}^* do not produce at all. Firms at an intermediate range between φ_{ii}^* and φ_{ij}^* serve only the domestic market in country i. All firms above φ_{ij}^* export, but only firms above φ_L^* find it profitable to receive the export subsidy. The following lemma characterizes the equilibrium with a given unilateral export subsidy and sufficiently high administrative fixed costs.

Lemma 4.3. *In the high costs case with a given unilateral export subsidy in country i, there is both an export cutoff φ_{ij}^* and an eligibility cutoff φ_L^*, and*

1. *the price index in country j lies below the baseline value, $P_{j,s} < P_{j,base}$;*
2. *the export cutoff φ_{ij}^* lies above the baseline value, $\varphi_{ij}^* > \varphi_{ij,base}^*$;*
3. *a rise in s or f_{ij}, or a decline in f_s increases φ_{ij}^* and decreases φ_L^*.*

Proof. See Appendix 4.A.8. □

Due to the unilateral export subsidy, high productive eligible exporters sell their varieties at a lower price in country j. This drives down the price index in country j (1. statement of Lemma 4.3). Consequently, profits of all exporters decline. While receiving

[35] Note that the restriction $f_s > (s^{\sigma-1}-1)f_{ij}$ does not necessarily imply high administrative fixed costs. For instance, with $s = 1.10$ and $\sigma = 3$ we have $\frac{f_s}{f_{ij}} > (s^{\sigma-1}-1) = 0.21$. Thus, if the administrative fixed costs are just 21 percent of the export fixed costs, only a subset of exporters receives a 10 percent reduction in variable export costs.

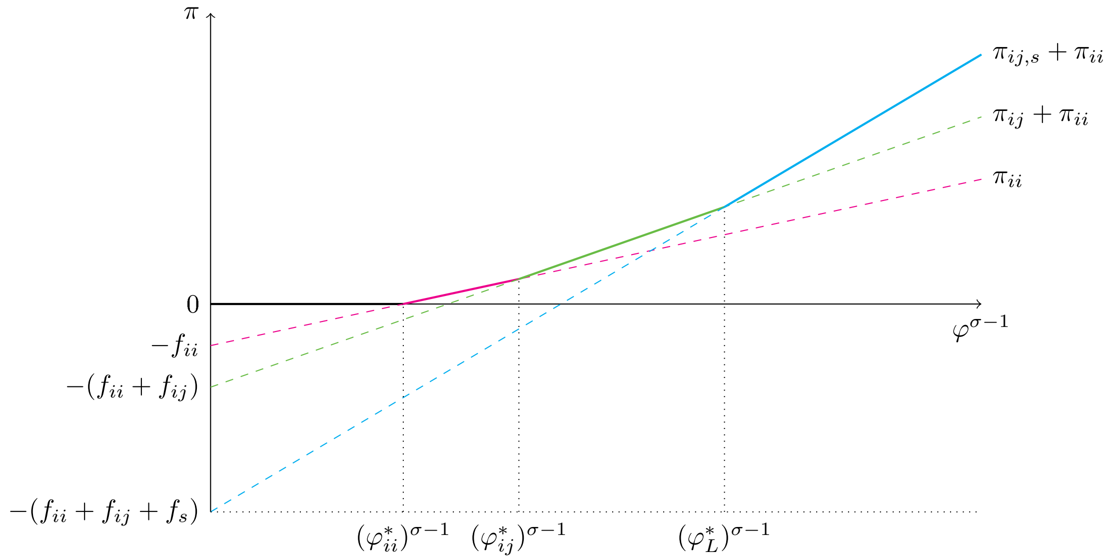

Figure 4.4: Firm profits in the high costs case

exporters due to the export subsidy still gain, less productive non-receiving exporters experience a net loss in export profits. Therefore, the least productive exporters are forced to exit the export market (2. statement), firms at an intermediate productivity level remain in the market but export less, and high productive firms expand their market share in the foreign market. The export cutoff increases in the export subsidy, while the eligibility cutoff is decreasing in the export subsidy (3. statement). Hence, more of the exported varieties are subsidized but less varieties are exported over all. The export subsidy does not only harm foreign firms, it also harms small home exporters. This leads to a distributional conflict among exporters: the export subsidy shifts profits not only from foreign firms to home firms, but also from less productive to more productive home exporters.[36]

Introducing or increasing an export subsidy has two opposing effects on trade flows. First, there is a positive effect because more exporters are subsidized and therefore increase their export sales. Second, there is a negative effect because some non-receiving exporters sell less or stop exporting. The following proposition summarizes these two results and shows that the first effect always dominates.

Proposition 4.3. *In the high costs case, a rise in the unilateral export subsidy of country i increases its aggregate exports but leads to less exporting firms.*

Proof. See Appendix 4.A.9. □

With sufficiently high administrative fixed costs, an increase in the export subsidy reduces the mass of exporters. This result of the model is in line with empirical evidence that export subsidies do not have a positive effect on the probability of exporting (Bernard and Jensen, 2004b; Görg et al., 2008; Girma et al., 2009a; Girma et al., 2009b). In my model, the negative effect on the extensive margin of trade is due to cheap sub-

[36]The distributional conflict within country i occurs only among exporting firms. Pure domestic firms are not affected by the export subsidy, because these firms are not harmed by a decline in the foreign price index.

sidized varieties that are dumped into the foreign market. This worsens export market conditions, in particular for the smallest exporters. As a policy implication, my results show that if policy makers intend to increase export participation, precise targeting and reducing barriers to receive export subsidies is crucial. By simply increasing public spending on export subsidies for an industry without careful considerations which firms will benefit, policy makers may obtain results directly opposing their intention.

4.4.2 Ex-ante welfare maximizing export subsidy

As a benchmark, I look for ex-ante optimal export subsidy rates that maximize home welfare, foreign welfare and global welfare. Therefore, I assume that the government moves first by setting the export subsidy. For a given export subsidy, a firm decides whether to be subsidized or not. The following proposition summarizes the welfare results in the high costs case:

Proposition 4.4. *In the high costs case, from an ex-ante point of view,*

1. $s = 1$ *maximizes home welfare;*
2. *if an interior solution in* $(1, \bar{s})$ *exists that maximizes foreign welfare, it is unique; otherwise* $s = \bar{s}$ *maximizes foreign welfare;*
3. *for sufficiently large values of* θ *(i.e., low firm heterogeneity),* $s = 1$ *maximizes global welfare.*

Proof. See Appendix 4.A.10. □

As the first statement of Proposition 4.4 shows, despite cross-country profit shifting, an export subsidy always reduces welfare in country i.[37] In contrast to the low costs case, profit shifting occurs also among home exporters, amplifying the negative welfare impact of the export subsidy.

The result for foreign welfare is more nuanced. On the one hand, foreign welfare is negatively affected due to lower aggregate profits of foreign firms in their home market. On the other hand, foreign welfare is positively affected due to higher consumer surplus.[38] As the second statement of Proposition 4.4 shows, in the high costs case there exists either a unique interior solution or the highest feasible export subsidy is preferred by the foreign government.

From a global point of view, the profit shifting effect is irrelevant, because total profits in a market are unaffected by the export subsidy, $\frac{\partial \Pi_{ij}}{\partial s} + \frac{\partial \Pi_{jj}}{\partial s} = 0$.[39] The export subsidy still leads to higher consumer surplus, because the price index in country j declines. However, due to the CES love-of-variety preferences and an export subsidy that results in less exported varieties, the decline in P_j may not be sufficient to make up for the costs of financing the subsidy. With lower firm heterogeneity, this effect is even more pronounced. As a consequence, and in contrast to the low costs case, for sufficiently low

[37]The first order condition for maximizing welfare in country i is $\frac{\partial W_i}{\partial s} = \frac{\partial \Pi_{ij}}{\partial s} - \frac{\partial S}{\partial s} = 0$.
[38]The first order condition for maximizing welfare in country j is $\frac{\partial W_j}{\partial s} = \frac{\partial \Pi_{jj}}{\partial s} + \frac{\partial CS_j}{\partial s} = 0$.
[39]The first order condition for maximizing global welfare is $\frac{\partial W_i}{\partial s} + \frac{\partial W_j}{\partial s} = \frac{\partial CS_j}{\partial s} - \frac{\partial S}{\partial s} = 0$.

firm heterogeneity there is no longer an interior solution to the first order condition of a global welfare maximizing government (3. statement).

4.4.3 Lobbying in the high costs case

Equilibrium of the lobbying game. Solving the first order condition of the government within the lobbying game (equation (4.19)), yields the optimal export subsidy s^o. Given this subsidy rate and the contribution schedule $C^T(s^o)$, the mass of firms selling domestically (J_{ii},J_{jj}), the mass of exporters (J_{ij},J_{ji}) and the mass of lobbying firms (J_L) is determined. Note that J_{ii} and J_{ji} do not depend on s, because the price index at home is not affected by the export subsidy. However, the export subsidy set by the government affects the export cutoff, the lobby cutoff and the product market cutoff in the foreign country. Thus, the relative mass of lobbying to exporting firms, $h(s) := \frac{J_L}{J_{ij}}$, the relative mass of lobbying firms to foreign firms, $m(s) := \frac{J_L}{J_{jj}}$, and the relative mass of exporting firms to foreign firms $n(s) := \frac{J_{ij}}{J_{jj}}$ are pinned down by the productivity cutoffs. Moreover, for a given mass of firms that receive the export subsidy, one can show that the elasticity of their aggregate export revenues with respect to the export subsidy rate is $\tilde{\epsilon}_{R_E,s}(\frac{J_L}{J_{ij}}, \frac{J_L}{J_{jj}}) = (\sigma - 1)\left[1 - \frac{R_E(\frac{J_L}{J_{ij}}, \frac{J_L}{J_{jj}})}{y_j}\right]$.[40] The following proposition summarizes the lobbying equilibrium in the high costs case:

Proposition 4.5. *In the high costs case, there exists a unique equilibrium of the lobbying game, such that*

1. *all firms with $\varphi \geq \varphi^o_{ij}$ export and all firms with $\varphi \geq \varphi^o_L$ enter the lobby, such that* $h(s) := \frac{J_L}{J_{ij}} = \left(\frac{f_s}{f_{ij}(s^{\sigma-1}-1)}\right)^{-\frac{\theta}{\sigma-1}}$, $m(s) := \frac{J_L}{J_{jj}} = \frac{J_i}{J_j}(\frac{\tau_{ij}}{\tau_{jj}})^{-\theta}\left(\frac{f_s}{f_{jj}(s^{\sigma-1}-1)}\right)^{-\frac{\theta}{\sigma-1}}$ *and* $n(s) := \frac{J_{ij}}{J_{jj}} = \frac{J_i}{J_j}(\frac{\tau_{ij}}{\tau_{jj}})^{-\theta}\left(\frac{f_{ij}}{f_{jj}}\right)^{-\frac{\theta}{\sigma-1}}$;
2. *lobby contributions are* $C^T(s^o) = \alpha(\Pi_{ij}(s^*) - \Pi_{ij}(s^o) + S(s^o) - S(s^*))$;
3. *the government implements* $z(\frac{J_L}{J_{ij}}, \frac{J_L}{J_{jj}}, \frac{J_{ij}}{J_{jj}}) := s^o = \frac{\frac{R_{jj}}{y_j} + (\frac{1}{\alpha}\frac{1}{\sigma-1}+1)\tilde{\epsilon}_{R_E,s}}{1+\tilde{\epsilon}_{R_E,s}}$.

Proof. See Appendix 4.A.11. □

Comparative statics of the lobbying equilibrium. Due to the rich structure of the lobbying game, comparative statics in the high costs case are more complex but still deliver clear predictions for most model parameters. The following lemma summarizes the analytically derived comparative statics of the lobbying game in the high costs case.

Lemma 4.4. *In the high costs case, comparative statics of the lobbying equilibrium show that*

1. *a trade liberalization through a decline in τ_{ij} leads to an increase in $\frac{J_L}{J_{jj}}$ and $\frac{J_{ij}}{J_{jj}}$, leaves $\frac{J_L}{J_{ij}}$ unaffected, and leads to a decline in the export subsidy;*
2. *a trade liberalization through a decline in f_{ij} leads to a decline in $\frac{J_{ij}}{J_{jj}}$ and has an ambiguous effect on $\frac{J_L}{J_{ij}}$, $\frac{J_L}{J_{jj}}$ and on the export subsidy;*

[40] In Appendix 4.A.11, I derive the elasticity and show that $R_E = \frac{s^{\sigma-1}}{s^{\sigma-1}-1}y_j[\frac{J_{jj}}{J_L}\left(\frac{f_{jj}}{f_s}\right) + \left(\frac{f_{ij}}{f_s}\right)\frac{J_{ij}}{J_L} + 1]^{-1}$ and $R_{jj} = y_j[\frac{J_{ij}}{J_{jj}}\frac{f_{ij}}{f_{jj}} + \frac{J_L}{J_{jj}}\frac{f_s}{f_{jj}} + 1]^{-1}$.

3. *a decline in the welfare weight α leads to an increase in $\frac{J_L}{J_{ij}}$ and $\frac{J_L}{J_{jj}}$, leaves $\frac{J_{ij}}{J_{jj}}$ unaffected, and leads to an increase in the export subsidy;*
4. *an increase in firm heterogeneity (lower θ) leads to an increase in $\frac{J_L}{J_{ij}}$, $\frac{J_L}{J_{jj}}$ and $\frac{J_{ij}}{J_{jj}}$, and to a decline in the export subsidy;*
5. *an increase in f_s leads to a decline in $\frac{J_L}{J_{ij}}$ and $\frac{J_L}{J_{jj}}$, leaves $\frac{J_{ij}}{J_{jj}}$ unaffected, and leads to an increase in the export subsidy;*
6. *an increase in f_{jj} leads to an increase in $\frac{J_L}{J_{jj}}$, $\frac{J_{ij}}{J_{jj}}$ and $\frac{J_L}{J_{ij}}$, and leads to a decline in the export subsidy.*

Proof. See Appendix 4.A.12. □

Trade liberalization through a reduction in iceberg trade costs increases $\frac{J_L}{J_{jj}}$ and $\frac{J_{ij}}{J_{jj}}$. The rise in $\frac{J_L}{J_{jj}}$ leads to an increase in R_E and therefore to a decline in $\tilde{\epsilon}_{R_E,s}$. The rise in $\frac{J_L}{J_{jj}}$ and $\frac{J_{ij}}{J_{jj}}$ leads to a decline in R_{jj}. Therefore, in equilibrium the export subsidy unambiguously declines (1. statement of Lemma 4.4).

On the one hand, a decline in f_{ij} leads to a decline in R_E and therefore to an increase in $\tilde{\epsilon}_{R_E,s}$. On the other hand, a decline in f_{ij} also induces a decline in R_{jj}. Therefore, the direct effect on the export subsidy is ambiguous.[41] Consequently, the effect on $\frac{J_L}{J_{ij}}$ and $\frac{J_L}{J_{jj}}$ is also not clear (2. statement).

An increase in the welfare weight α leads to a decline in the export subsidy rate. This in turn decreases $\frac{J_L}{J_{ij}}$ and $\frac{J_L}{J_{jj}}$ but leaves $\frac{J_{ij}}{J_{jj}}$ unaffected (3. statement).

An increase in θ leads to a decline in $\frac{J_L}{J_{ij}}$, $\frac{J_L}{J_{jj}}$ and $\frac{J_{ij}}{J_{jj}}$. Therefore, R_{jj} and $\tilde{\epsilon}_{R_{E,high}}$ increase, leading to an increase in the export subsidy (4. statement).

An increase in f_s leads to a decline in $\frac{J_L}{J_{ij}}$ and $\frac{J_L}{J_{jj}}$. Therefore, R_{jj} and $\tilde{\epsilon}_{R_{E,high}}$ increase, leading to an increase in the export subsidy. Thus, increasing the barriers to receive the benefit from lobby leads to a higher equilibrium export subsidy (5. statement).

An increase in f_{jj} leads to an increase in $\frac{J_L}{J_{jj}}$, $\frac{J_{ij}}{J_{jj}}$ and $\frac{J_L}{J_{ij}}$. Therefore, R_{jj} and $\tilde{\epsilon}_{R_{E,high}}$ decrease, leading to a decline in the export subsidy (6. statement).

Besides deriving comparative statics of the model analytically, I also illustrate them graphically by simulating the model in MATLAB. I solve the first order condition of the government numerically for varying values of the parameter of interest. In particular, following the literature I choose the following parameter values $\theta = 3.12$, $\sigma = 4$, $f_s = 2$ (Axtell, 2001; Bernard et al., 2003).[42] The effect of a trade liberalization in the high costs case can be seen in Figure 4.5. There I plot the optimal export subsidy rate, aggregate exports R_{ij}, the number of exporting firms J_{ij} and the size of the lobby J_L for various values of the welfare weight α and as a function of τ_{ij}. Additional figures for comparative statics of other model parameters can be found in Appendix 4.C.

[41] The effect on the export subsidy is negative, if the decline in R_{jj} is sufficiently strong $\frac{\partial R_{jj}}{\partial f_{ij}} < \frac{\left(\frac{1}{\alpha}\frac{1}{\sigma-1}+1-\frac{R_{jj}}{y_j}\right)}{(1+\tilde{\epsilon}_{R_E,s})}\frac{\partial R_E}{\partial f_{ij}}$.

[42] I set $\tau_{ij} = \tau_{ji} = 1.5$ and normalize $\tau_{ii}, \tau_{jj}, f_{ii}, f_{jj}, f_{ji}, f_{ij}, J_i, J_j, y_i, y_j$ and b to 1. Normalizations of the these parameters do not change the results qualitatively.

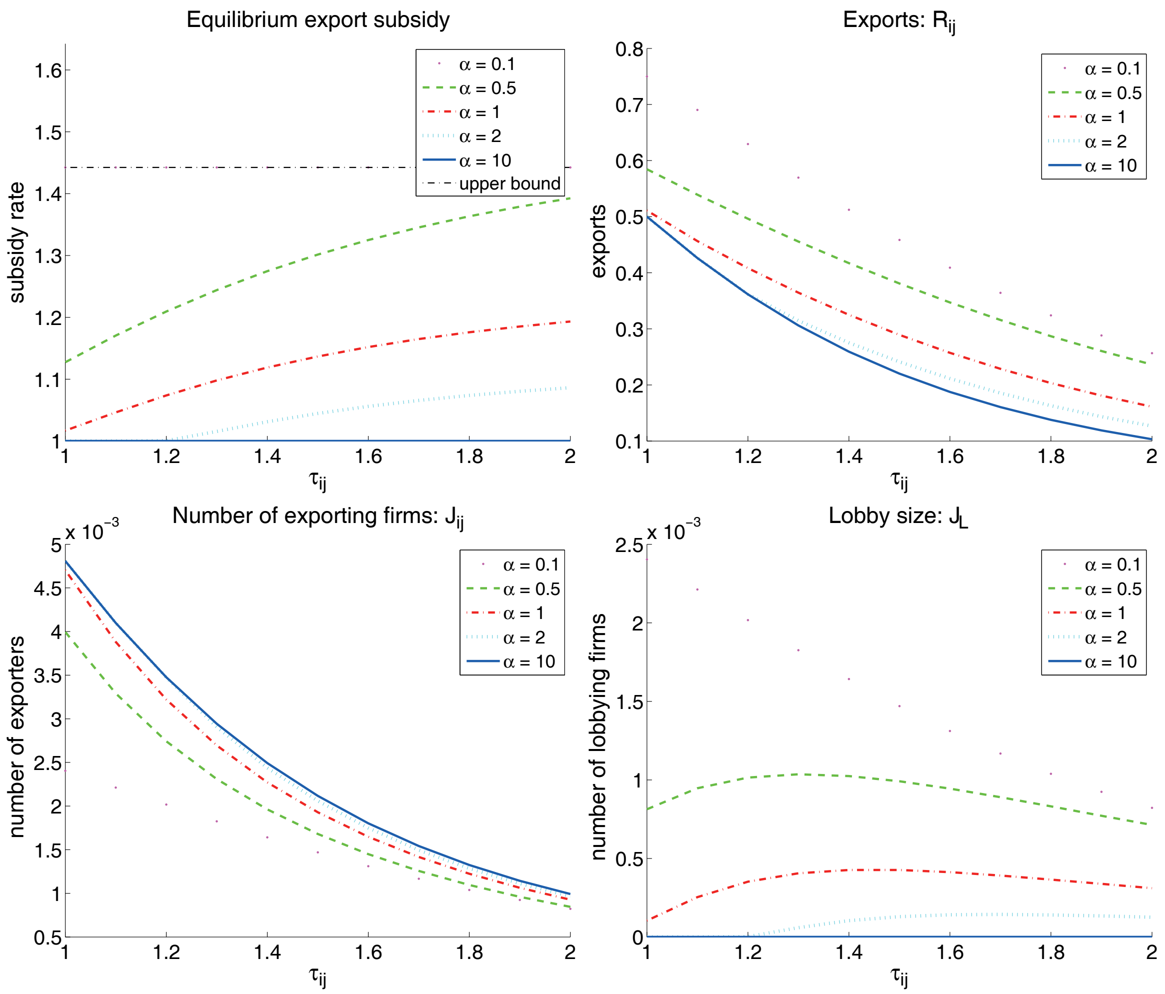

Figure 4.5: Simulated comparative statics: increasing τ_{ij} in the high costs case

As an endogenous outcome of the lobbying game, a trade liberalization leads to a lower export subsidy. This endogenous adjustment has an interesting distributional effect among exporters. In comparison to non-subsidized exporters, subsidized exporters benefit less from a trade liberalization because they suffer from a declining export subsidy. Put it differently, the endogenous decline in the export subsidy, induced by a trade liberalization, is relatively more beneficial for non-subsidized exporters because for those firms a decline in the export subsidy makes it easier to compete in the export market (i.e., market conditions are less tough, the foreign price index declines in s). This argument can be seen by comparing export revenues of subsidized and non-subsidized exporters. The ratio of export revenues of a subsidized exporter with productivity φ_1 and a non-subsidized exporter with productivity φ_2, $\frac{r_{ij,s}(\varphi_1)}{r_{ij}(\varphi_2)} = s^{\sigma-1}\left(\frac{\varphi_1}{\varphi_2}\right)^{\sigma-1}$, is increasing in the export subsidy. Consequently, a trade liberalization that induces an endogenous decline in the export subsidy benefits non-subsidized firms relatively more.

In summary, the high costs case gives important insights into the within-exporters profit-shifting motive for lobbying. Less efficient home firms, which cannot afford to receive and lobby for the export subsidy, suffer from cheap subsidized exports of their competitors. Therefore, lobbying is not only driven by a cross-country profit shifting effect, but also by a profit shifting motive among exporters. Comparative statics of the lobbying game show that due to the endogenous adjustment of the export subsidy a trade liberalization has a differential impact among exporters, being relatively more beneficial for non-subsidized exporters.

4.5 Conclusion

In this paper, I present a heterogeneous firms model of international trade in which firms have to pay administrative fixed costs to join an interest group that lobbies for an export subsidy. Due to firm heterogeneity the size and composition of the lobby is endogenous. Therefore, my model captures the empirical finding that within industries larger and more productive firms self-select into lobbying (Kammerer, 2013a). In a homogenous firms model à la Krugman (1980) the selection effect that I apply to lobby formation would not be present.

With respect to the level of administrative fixed costs, two interesting cases emerge in my model. In the low costs case, in which all firms find it profitable to join the lobby, a government that wants to maximize home welfare should not introduce an export subsidy. However, if firms can influence the government by lobbying, an export subsidy that increases global welfare can be sustained. Moreover, I show that under lobbying a trade liberalization leads to a decline in the endogenously determined export subsidy, reducing the positive trade effect.

In the high costs case, in which only the most productive exporters find in profitable to join the lobby, additionally to the cross-country profit shifting effect, there is also profit shifting among exporters. Large subsidized exporters decrease the price of their variety in the foreign market. Therefore, less efficient exporters, which are not able to receive the export subsidy, face tougher export conditions. As a result, while total exports still increase, small exporters stop selling abroad and export participation decreases. This result gives a theoretical explanation for recent empirical evidence, showing that several export promotion programs fail to have a positive effect on the probability of exporting (Bernard and Jensen, 2004b; Görg et al., 2008; Girma et al., 2009a and Girma et al., 2009b). Moreover, I show that under lobbying the endogenous adjustment of the export subsidy, induced by a trade liberalization, has a differential impact among exporters, being relatively more beneficial for non-subsidized exporters.

There is some empirical evidence that larger firms are more likely to participate in export subsidy programs. Recently, however, some export promotion programs are especially tailored to small and medium size enterprises (SME). The existence of these programs does not contradict my model. To the contrary, they could be seen as evidence that governments are aware of the administrative burden and adapt eligibility rules to favor SME's. Thus, in the real world, politics may not entirely be driven by the interests of large firms, and governments may also take the interests of smaller enterprises into account.

Appendix

4.A Proofs and explicit expressions

4.A.1 Explicit expressions in the baseline case

The price index in country i (equation (4.4)), the domestic cutoff (equation (4.9)), and the export cutoff (equation (4.8)) can be rewritten in terms of model parameters:

$$P_{i,base} = \tilde{\kappa}_i[(f_{ii})^{\frac{\sigma-1-\theta}{\sigma-1}} + \frac{J_j}{J_i}(\frac{\tau_{ji}}{\tau_{ii}})^{-\theta}(f_{ji})^{\frac{\sigma-1-\theta}{\sigma-1}}]^{-\frac{1}{\theta}}, \tag{4.25}$$

where $\tilde{\kappa}_i = \left[J_i\frac{\theta b^\theta}{\theta-\sigma+1}(\frac{\sigma}{\sigma-1}\tau_{ii})^{-\theta}\left(\frac{\sigma}{y_i}\right)^{\frac{\sigma-1-\theta}{\sigma-1}}\right]^{-\frac{1}{\theta}}$ and

$$\varphi^*_{ii,base} = \kappa_{ii}f_{ii}^{\frac{1}{\theta}}[1 + \frac{J_j}{J_i}(\frac{\tau_{ii}}{\tau_{ji}})^{\theta}\left(\frac{f_{ii}}{f_{ji}}\right)^{\frac{\theta-\sigma+1}{\sigma-1}}]^{\frac{1}{\theta}}, \tag{4.26}$$

where $\kappa_{ii} = \left(J_i\frac{\theta b^\theta}{\theta-\sigma+1}\frac{\sigma}{y_i}\right)^{\frac{1}{\theta}}$ and

$$\varphi^*_{ij,base} = \kappa_{ij}f_{ij}^{\frac{1}{\theta}}[1 + \frac{J_j}{J_i}\left(\frac{\tau_{ij}}{\tau_{jj}}\right)^{\theta}\left(\frac{f_{ij}}{f_{jj}}\right)^{\frac{\theta-\sigma+1}{\sigma-1}}]^{\frac{1}{\theta}}, \tag{4.27}$$

where $\kappa_{ij} = \left(J_i\frac{\theta b^\theta}{\theta-\sigma+1}\frac{\sigma}{y_j}\right)^{\frac{1}{\theta}}$.

4.A.2 Proof of Corollary 4.1

Corollary. *Under truthful contribution schedules, the equilibrium subsidy satisfies*

$$s^o = \arg\max_{s\in[1,\bar{s}]}\left\{\alpha W(s) + \Pi_E(s)\right\}.$$

Proof. The proof is similar to the one in Grossman and Helpman (1994)(p. 840, footnote 7). By condition 3 of Definition 4.1 we have

$$G^o = \alpha W(s^o) + C(s^o) \geq G = \alpha W(s) + C(s)\,\forall s \in [1,\bar{s}].$$

By truthfulness, we have

$$C^T(s^o) = \Pi_E(s^o) - B_L^o$$

and

$$C^T(s) \geq \Pi_E(s) - B_L^o\,\forall s \in [1,\bar{s}].$$

Therefore,

$$\alpha W(s^o) + \Pi_E(s^o) - B_L^o \geq \alpha W(s) + C^T(s) \geq \alpha W(s) + \Pi_E(s) - B_L^o.$$

Hence,

$$\alpha W(s^o) + \Pi_E(s^o) \geq \alpha W(s) + \Pi_E(s)\,\forall s \in [1,\bar{s}].$$

□

4.A.3 Explicit expressions in the low costs case

In terms of model parameters, the price index in country j and the eligibility and export cutoff in country i are, respectively,

$$P_{j,s} = \tilde{\kappa}_j[(f_{jj})^{\frac{\sigma-1-\theta}{\sigma-1}} + s^\theta\frac{J_i}{J_j}(\frac{\tau_{ij}}{\tau_{jj}})^{-\theta}(f_{ij}+f_s)^{\frac{\sigma-1-\theta}{\sigma-1}}]^{-\frac{1}{\theta}},$$

where $\tilde{\kappa}_j = \left[J_j\frac{\theta b^\theta}{\theta-\sigma+1}(\frac{\sigma}{\sigma-1}\tau_{jj})^{-\theta}\left(\frac{\sigma}{y_j}\right)^{\frac{\sigma-1-\theta}{\sigma-1}}\right]^{-\frac{1}{\theta}}$ and

$$\varphi^*_{L,low} = \kappa_{ij}\,(f_{ij}+f_s)^{\frac{1}{\theta}}\,[1 + \frac{J_j}{J_i}(\frac{\tau_{ij}}{\tau_{jj}})^{\theta}s^{-\theta}\left(\frac{f_{ij}+f_s}{f_{jj}}\right)^{\frac{\theta-\sigma+1}{\sigma-1}}]^{\frac{1}{\theta}},$$

where $\kappa_{ij} = \left(J_i \frac{\theta b^\theta}{\theta-\sigma+1}\frac{\sigma}{y_j}\right)^{\frac{1}{\theta}}$. The first derivative of $P_{j,s}$ with respect to s

$$\frac{\partial P_{j,s}}{\partial s} = -\frac{P_{j,s}}{s}[1 + \frac{J_j}{J_i}(\frac{\tau_{ij}}{\tau_{jj}})^\theta s^{-\theta}\left(\frac{f_{ij}+f_s}{f_{jj}}\right)^{-\frac{\sigma-1-\theta}{\sigma-1}}]^{-1}.$$

Aggregate subsidy payments are $S_{low} = (s-1)\frac{\sigma-1}{\sigma}R_{E,low}$. The first derivative of S_{low} with respect to s is

$$\frac{\partial S_{low}}{\partial s} = \frac{\sigma-1}{\sigma}R_{E,low} + (s-1)\frac{\sigma-1}{\sigma}\frac{\partial R_{E,low}}{\partial s}.$$

Aggregate export revenues are defined as $R_{ij,low} = R_{E,low} = J_i\int_{\varphi_{L,low}} r_{ij,s}(\varphi)v(\varphi)d\varphi$. With $\frac{J_L}{J_{jj}} = \frac{J_i}{J_j}(\frac{\tau_{ij}}{s\tau_{jj}})^{-\theta}\left(\frac{f_{ij}+f_s}{f_{jj}}\right)^{-\frac{\theta}{\sigma-1}}$, $R_{E,low}$ can be expressed in terms of model parameters:

$$R_{E,low} = y_j[\frac{J_{jj}}{J_L}\left(\frac{f_{jj}}{f_{ij}+f_s}\right) + 1]^{-1}.$$

The first derivative of $R_{E,low}$ with respect to s is

$$\frac{\partial R_{E,low}}{\partial s} = \theta\frac{R_{E,low}}{s}[\frac{J_i}{J_j}\left(\frac{\tau_{jj}}{\tau_{ij}}\right)^\theta s^\theta\left(\frac{f_{jj}}{f_{ij}+f_s}\right)^{\frac{\theta-\sigma+1}{\sigma-1}} + 1]^{-1}.$$

The elasticity of eligible firms aggregate export revenues, defined by $\epsilon_{R_{E,low}} = \frac{\partial R_{E,low}}{\partial s}\frac{s}{R_{E,low}}$, is

$$\epsilon_{R_{E,low}} = \theta[\frac{J_i}{J_j}\left(\frac{\tau_{jj}}{\tau_{ij}}\right)^\theta s^\theta\left(\frac{f_{jj}}{f_{ij}+f_s}\right)^{\frac{\theta-\sigma+1}{\sigma-1}} + 1]^{-1}$$

$$\iff \epsilon_{R_{E,low}} = \theta\frac{R_{E,low}}{y_j}\frac{J_{jj}}{J_L}\left(\frac{f_{jj}}{f_{ij}+f_s}\right).$$

Aggregate export profits are defined by $\Pi_{ij,low} = \Pi_{E,low} = J_i\int_{\varphi_{L,low}} \pi_{ij,s}(\varphi)v(\varphi)d\varphi$. Rewritten in terms of model parameters we get

$$\Pi_{E,low} = \frac{\sigma-1}{\sigma}\frac{y_j}{\theta}[\frac{J_j}{J_i}\left(\frac{\tau_{jj}}{\tau_{ij}}\right)^{-\theta}\left(\frac{f_{ij}}{f_{jj}}\right)^{\frac{\theta-\sigma+1}{\sigma-1}} s^{-\theta}\left(1+\frac{f_s}{f_{ij}}\right)^{\frac{\theta-\sigma+1}{\sigma-1}} + 1]^{-1}.$$

The first derivative of $\Pi_{E,low}$ with respect to s is

$$\frac{\partial \Pi_{E,low}}{\partial s} = \frac{\sigma-1}{\sigma}\frac{R_{E,low}}{s}[1 + \frac{J_i}{J_j}\left(\frac{\tau_{jj}}{\tau_{ij}}\right)^\theta\left(\frac{f_{ij}}{f_{jj}}\right)^{-\frac{\theta-\sigma+1}{\sigma-1}} s^\theta\left(1+\frac{f_s}{f_{ij}}\right)^{-\frac{\theta-\sigma+1}{\sigma-1}}]^{-1}.$$

4.A.4 Proof of Lemma 4.1

Lemma. *In the low costs case with a given unilateral export subsidy in country i, there is a unique eligibility and export cutoff $\varphi^*_{L,low}$, and*

1. *the price index in country j lies below the baseline value, $P_{j,s} < P_{j,base}$;*
2. *$\varphi^*_{L,low}$ lies below the baseline export cutoff, $\varphi^*_{L,low} < \varphi^*_{ij,base}$;*
3. *$\varphi^*_{L,low}$ is decreasing in s, but increasing in f_s and f_{ij}.*

Proof. First, I show that $P_{j,s} < P_{j,base}$:

$$P_{j,s} = \tilde{\kappa}_j[(f_{jj})^{\frac{\sigma-1-\theta}{\sigma-1}} + \frac{J_i}{J_j}(\frac{\tau_{ij}}{s\tau_{jj}})^{-\theta}(f_{ij}+f_s)^{\frac{\sigma-1-\theta}{\sigma-1}}]^{-\frac{1}{\theta}} \quad <$$

$$P_{j,base} = \tilde{\kappa}_j[(f_{jj})^{\frac{\sigma-1-\theta}{\sigma-1}} + \frac{J_i}{J_j}(\frac{\tau_{ij}}{\tau_{jj}})^{-\theta}(f_{ij})^{\frac{\sigma-1-\theta}{\sigma-1}}]^{-\frac{1}{\theta}}$$

$$\iff s > \left(1+\frac{f_s}{f_{ij}}\right)^{\frac{1}{\theta}\frac{\theta-\sigma+1}{\sigma-1}}.$$

By definition of the low costs case, it must hold that $\left(\frac{f_s}{f_{ij}}+1\right)^{\frac{1}{\sigma-1}} < s$. Therefore it holds that $s > \left(\frac{f_s}{f_{ij}}+1\right) > \left(1+\frac{f_s}{f_{ij}}\right)^{1-\frac{\sigma-1}{\theta}}$.

Second, I show that $\varphi^*_{L,low} < \varphi^*_{ij,base}$:

$$\varphi_{L,low} = (\frac{\sigma}{\sigma-1}\frac{\tau_{ij}}{s})\left((f_{ij}+f_s)\frac{\sigma P_{j,s}^{1-\sigma}}{y_j}\right)^{\frac{1}{\sigma-1}} < \varphi^*_{ij,base} = (\frac{\sigma}{\sigma-1}\tau_{ij})\left((f_{ij}+f_s)\frac{\sigma P_j^{1-\sigma}}{y_j}\right)^{\frac{1}{\sigma-1}}$$

$$\iff \frac{P_{j,base}^{\sigma-1}}{P_{j,s}^{\sigma-1}} < s^{\sigma-1}$$

By $P_{j,s} < P_{j,base}$, we know that $\frac{P_{j,s}}{P_{j,base}} < 1$. Therefore, $\frac{P_{j,base}^{\sigma-1}}{P_{j,s}^{\sigma-1}} < 1 < s^{\sigma-1}$.

The third statement follows directly from the functional form of $\varphi^*_{L,low} = \kappa_{ij}\left(f_{ij}+f_s\right)^{\frac{1}{\theta}}[1+\frac{J_j}{J_i}(\frac{\tau_{ij}}{\tau_{jj}})^{\theta}s^{-\theta}\left(\frac{f_{ij}+f_s}{f_{jj}}\right)^{\frac{\theta-\sigma+1}{\sigma-1}}]^{\frac{1}{\theta}}$. □

4.A.5 Proof of Proposition 4.1

Proposition. *In the low costs case, from an ex-ante point of view,*

1. $s = 1$ *maximizes home welfare;*
2. $s = \bar{s}$ *maximizes foreign welfare;*
3. $\tilde{s} = \frac{\frac{\sigma}{\sigma-1}+\epsilon_{R_{E,low}}}{1+\epsilon_{R_{E,low}}} \in (1, \frac{\sigma}{\sigma-1})$ *is the unique interior solution maximizing global welfare.*

Proof. **For the first statement**, consider the rewritten first order condition of a welfare maximizing home government: $s = \frac{\frac{\theta+1}{\theta}}{1+(\epsilon_{R_{E,low}})^{-1}}$. For $s > 1$ it must be that $1+\frac{1}{\theta} > 1 + (\epsilon_{R_{E,low}})^{-1}$ or equivalently $\epsilon_{R_{E,low}} > \theta$. With $\epsilon_{R_{E,low}} = \theta[\frac{J_i}{J_j}\left(\frac{\tau_{jj}}{\tau_{ij}}\right)^{\theta}s^{\theta}\left(\frac{f_{jj}}{f_{ij}+f_s}\right)^{\frac{\theta-\sigma+1}{\sigma-1}}+1]^{-1}$, a contradiction.

For the second statement, note that the derivative of consumer surplus in country j is given by

$$\frac{\partial CS_j}{\partial s} = \frac{\partial[y_i \ln(\frac{y}{P_i}) - y_i]}{\partial s} = y_j\frac{\partial \ln(\frac{y_j}{P_{j,s}})}{\partial s} = -y_j\frac{\partial \ln(\frac{P_{j,s}}{y_j})}{\partial s} = -\frac{\partial P_{j,s}}{\partial s}\frac{y_j}{P_{j,s}}.$$

With $\frac{\partial P_{j,s}}{\partial s} = -\frac{P_{j,s}}{s}[1+\frac{J_j}{J_i}(\frac{\tau_{ij}}{\tau_{jj}})^{\theta}s^{-\theta}\left(\frac{f_{ij}+f_s}{f_{jj}}\right)^{-\frac{\sigma-1-\theta}{\sigma-1}}]^{-1}$ we get

$$\frac{\partial CS_j}{\partial s} = -\frac{\partial P_{j,s}}{\partial s}\frac{y_j}{P_{j,s}} = \frac{y_j}{s}[1+\frac{J_j}{J_i}(\frac{\tau_{ij}}{\tau_{jj}})^{\theta}s^{-\theta}\left(\frac{f_{ij}+f_s}{f_{jj}}\right)^{-\frac{\sigma-1-\theta}{\sigma-1}}]^{-1}.$$

With $R_{E,low} = y_j[\frac{J_j}{J_i}\left(\frac{s\tau_{jj}}{\tau_{ij}}\right)^{-\theta}\left(\frac{f_{ij}+f_s}{f_{jj}}\right)^{\frac{\theta-\sigma+1}{\sigma-1}}+1]^{-1}$we get

$$\frac{\partial CS_j}{\partial s} = -\frac{\partial P_{j,s}}{\partial s}\frac{y_j}{P_{j,s}} = \frac{R_{E,low}}{s}.$$

Note that $\Pi_{jj}+\Pi_{ji} = \frac{\sigma-1}{\sigma}\frac{y_j}{\theta}$ and $\frac{\partial \Pi_{ij}}{\partial s}+\frac{\partial \Pi_{jj}}{\partial s} = 0$. With

$$\Pi_{ij,low} = \frac{\sigma-1}{\sigma}\frac{y_j}{\theta}[\frac{J_j}{J_i}\left(\frac{\tau_{jj}}{\tau_{ij}}\right)^{-\theta}\left(\frac{f_{ij}}{f_{jj}}\right)^{\frac{\theta-\sigma+1}{\sigma-1}}s^{-\theta}\left(1+\frac{f_s}{f_{ij}}\right)^{\frac{\theta-\sigma+1}{\sigma-1}}+1]^{-1}$$

and

$$\frac{\partial \Pi_{ij,low}}{\partial s} = \frac{\sigma-1}{\sigma}\frac{R_{E,low}}{s}[1+\frac{J_i}{J_j}\left(\frac{\tau_{jj}}{\tau_{ij}}\right)^{\theta}\left(\frac{f_{ij}}{f_{jj}}\right)^{-\frac{\theta-\sigma+1}{\sigma-1}}s^{\theta}\left(1+\frac{f_s}{f_{ij}}\right)^{-\frac{\theta-\sigma+1}{\sigma-1}}]^{-1}$$

it follows that

$$\Pi_{jj} = \frac{\sigma-1}{\sigma}\frac{y_j}{\theta}\left(1 - [\frac{J_j}{J_i}\left(\frac{\tau_{jj}}{\tau_{ij}}\right)^{-\theta}\left(\frac{f_{ij}}{f_{jj}}\right)^{\frac{\theta-\sigma+1}{\sigma-1}} s^{-\theta}\left(1+\frac{f_s}{f_{ij}}\right)^{\frac{\theta-\sigma+1}{\sigma-1}} + 1]^{-1}\right)$$

$$\iff \Pi_{jj} = \frac{\sigma-1}{\sigma}\frac{1}{\theta}\left(y_j - R_{E,low}\right).$$

Also,

$$\frac{\partial \Pi_{jj}}{\partial s} = -\frac{\sigma-1}{\sigma}\frac{1}{\theta}\frac{\partial R_{E,low}}{\partial s}.$$

Therefore,

$$\frac{\partial W_j}{\partial s} = \frac{\partial \Pi_{jj}}{\partial s} - \frac{\partial P_{j,s}}{\partial s}\frac{y_j}{P_{j,s}} = -\frac{\sigma-1}{\sigma}\frac{1}{\theta}\frac{\partial R_{E,low}}{\partial s} + \frac{R_{E,low}}{s} = 0.$$

It is left to show that $-\frac{\sigma-1}{\sigma}\frac{1}{\theta}\frac{\partial R_{E,low}}{\partial s} + \frac{R_{E,low}}{s} > 0$.

With $\frac{\partial R_{E,low}}{\partial s} = \theta\frac{R_{E,low}}{s}[\frac{J_i}{J_j}\left(\frac{\tau_{jj}}{\tau_{ij}}\right)^{\theta} s^{\theta}\left(\frac{f_{jj}}{f_{ij}+f_s}\right)^{\frac{\theta-\sigma+1}{\sigma-1}} + 1]^{-1}$ we get

$$-\frac{\sigma-1}{\sigma}\frac{1}{\theta}\theta\frac{R_{E,low}}{s}[\frac{J_i}{J_j}\left(\frac{\tau_{jj}}{\tau_{ij}}\right)^{\theta} s^{\theta}\left(\frac{f_{jj}}{f_{ij}+f_s}\right)^{\frac{\theta-\sigma+1}{\sigma-1}} + 1]^{-1} + \frac{R_{E,low}}{s} > 0$$

$$\iff -\frac{\sigma-1}{\sigma}[\frac{J_i}{J_j}\left(\frac{\tau_{jj}}{\tau_{ij}}\right)^{\theta} s^{\theta}\left(\frac{f_{jj}}{f_{ij}+f_s}\right)^{\frac{\theta-\sigma+1}{\sigma-1}} + 1]^{-1} + 1 > 0$$

$$\iff 1 > \frac{\sigma-1}{\sigma}[\frac{J_i}{J_j}\left(\frac{\tau_{jj}}{\tau_{ij}}\right)^{\theta} s^{\theta}\left(\frac{f_{jj}}{f_{ij}+f_s}\right)^{\frac{\theta-\sigma+1}{\sigma-1}} + 1]^{-1}.$$

This holds always, because $\frac{\sigma-1}{\sigma} < 1$ and $[\frac{J_i}{J_j}\left(\frac{\tau_{jj}}{\tau_{ij}}\right)^{\theta} s^{\theta}\left(\frac{f_{jj}}{f_{ij}+f_s}\right)^{\frac{\theta-\sigma+1}{\sigma-1}} + 1]^{-1} < 1$.

For the third statement, note that with $\frac{\partial S_{low}}{\partial s} = \frac{\sigma-1}{\sigma}R_{E,low} + (s-1)\frac{\sigma-1}{\sigma}\frac{\partial R_{E,low}}{\partial s}$ and $\frac{\partial CS_j}{\partial s} = -\frac{\partial P_{j,s}}{\partial s}\frac{y_j}{P_{j,s}} = \frac{R_{E,low}}{s}$ we get

$$\frac{\partial W_{i+j}}{\partial s} = \frac{R_{E,low}}{s} - \frac{\sigma-1}{\sigma}R_{E,low} - (s-1)\frac{\sigma-1}{\sigma}\frac{\partial R_{E,low}}{\partial s} = 0.$$

With $\epsilon_{R_{E,low}} = \frac{\partial R_{E,low}}{\partial s}\frac{s}{R_{E,low}}$ we get

$$1 - \frac{\sigma-1}{\sigma}s - (s-1)\frac{\sigma-1}{\sigma}\epsilon_{R_{E,low}} = 0$$

and therefore:

$$s = \frac{\frac{\sigma}{\sigma-1} + \epsilon_{R_{E,low}}}{1+\epsilon_{R_{E,low}}}.$$

The left hand side of this equation is strictly increasing in s with lower limit $\lim_{s\to 1} s = 1$. Because $\epsilon_{R_{E,low}} = \theta[\frac{J_i}{J_j}\left(\frac{\tau_{jj}}{\tau_{ij}}\right)^{\theta} s^{\theta}\left(\frac{f_{jj}}{f_{ij}+f_s}\right)^{\frac{\theta-\sigma+1}{\sigma-1}} + 1]^{-1}$ is strictly concave and decreasing in s with $\lim_{s\to\infty}\epsilon_{R_{E,low}} = 0$, the right hand side of this equation is concave and increasing in s with an upper limit of $\frac{\sigma}{\sigma-1}$ and a lower limit strictly above 1. Therefore, there exists a unique fixed point $\tilde{s} \in (1, \frac{\sigma}{\sigma-1})$ that solves this equation and maximizes global welfare. □

4.A.6 Proof of Proposition 4.2

Proposition. *In the low costs case, there exists a unique equilibrium of the lobbying game, such that*

1. *all firms with $\varphi \geq \varphi^o_{L,low}$ both export and enter the lobby, such that the relative mass of lobbying firms is $m(s) := \frac{J_L}{J_{jj}} = \frac{J_i}{J_j}\left(\frac{s\tau_{jj}}{\tau_{ij}}\right)^{\theta}\left(\frac{f_{jj}}{f_{ij}+f_s}\right)^{\frac{\theta}{\sigma-1}}$;*
2. *lobby contributions are $C^T(s^o) = \alpha(\Pi_{ij}(s^*) - \Pi_{ij}(s^o) + S(s^o) - S(s^*))$;*

3. *the government implements* $z(\frac{J_L}{J_{jj}}) := s^o = \frac{1+\frac{(1+\frac{1}{\alpha})}{\sigma-1}}{\frac{\sigma}{\sigma-1}+\frac{1}{\sigma-1}\frac{J_L}{J_{jj}}\frac{f_{ij}+f_s}{f_{jj}}}$.

Proof. Denote $\tilde{\epsilon}_{R_E,s}$ the elasticity of export revenues, holding the number of lobbying firms / exporting firms fixed:

$$\begin{aligned}\tilde{\epsilon}_{R_E,s} = \frac{\partial R_E}{\partial s}\frac{s}{R_E} &= \frac{s}{R_E}J_L\frac{\partial r_s(\tilde{\varphi}_L)}{\partial s} \\ &= \frac{s}{R_E}J_L(\frac{\sigma}{\sigma-1}\frac{1}{\tilde{\varphi}_L})^{1-\sigma}y_j\frac{\partial(\frac{s^{\sigma-1}}{P_j^{1-\sigma}})}{\partial s}.\end{aligned}$$

With

$$P_{j,s} = \kappa_p[\varphi_{jj}^{\sigma-1-\theta} + (s^{\sigma-1})\frac{J_i}{J_j}(\frac{\tau_{ij}}{\tau_{jj}})^{1-\sigma}\varphi_{L,low}^{\sigma-1-\theta}]^{\frac{1}{1-\sigma}}$$

we get

$$\frac{s^{\sigma-1}}{P_j^{1-\sigma}} = \kappa_p^{\sigma-1}[\varphi_{jj}^{\sigma-1-\theta} + (s^{\sigma-1})\frac{J_i}{J_j}(\frac{\tau_{ij}}{\tau_{jj}})^{1-\sigma}\varphi_{L,low}^{\sigma-1-\theta}]^{-1}s^{\sigma-1}$$

such that

$$\frac{\partial(\frac{s^{\sigma-1}}{P_j^{1-\sigma}})}{\partial s} = \frac{s^{\sigma-1}}{P_j^{1-\sigma}}[\varphi_{jj}^{\sigma-1-\theta} + s^{\sigma-1}\frac{J_i}{J_j}(\frac{\tau_{ij}}{\tau_{jj}})^{1-\sigma}\varphi_{L,low}^{\sigma-1-\theta}]^{-1}s^{-1}(\sigma-1)\varphi_{jj}^{\sigma-1-\theta}$$

Therefore,

$$\tilde{\epsilon}_{R_E,s} = [1 + s^{\sigma-1}\frac{J_i}{J_j}(\frac{\tau_{ij}}{\tau_{jj}})^{1-\sigma}\frac{\varphi_{L,low}^{\sigma-1-\theta}}{\varphi_{jj}^{\sigma-1-\theta}}]^{-1}(\sigma-1).$$

With $\frac{\varphi_{jj}^*}{\varphi_{ij}} = \frac{s\tau_{jj}}{\tau_{ij}}\left(\frac{f_{jj}}{f_{ij}+f_s}\right)^{\frac{1}{\sigma-1}}$ and $\epsilon_{R_{E,low}} = \theta[\frac{J_i}{J_j}\left(\frac{\tau_{jj}}{\tau_{ij}}\right)^{\theta}s^{\theta}\left(\frac{f_{jj}}{f_{ij}+f_s}\right)^{\frac{\theta-\sigma+1}{\sigma-1}} + 1]^{-1}$ we get

$$\tilde{\epsilon}_{R_E,s} = [1 + \frac{J_i}{J_j}\left(\frac{s\tau_{jj}}{\tau_{ij}}\right)^{\theta}\left(\frac{f_{jj}}{f_{ij}+f_s}\right)^{\frac{\theta-\sigma+1}{\sigma-1}}]^{-1}(\sigma-1) = \frac{\sigma-1}{\theta}\epsilon_{R_{E,low}}.$$

Therefore,

$$s^\circ = \frac{\frac{(1+\frac{1}{\alpha})}{\sigma-1}+1}{1+(\tilde{\epsilon}_{R_E,s})^{-1}}.$$

Given that $\epsilon_{R_{E,low}}$ is a concave, strictly decreasing function in s, the right hand side if this equation is decreasing in s with limit 0 for $s \to \infty$, and for $s = 1$ the right hand side converges to a constant that is strictly greater than 1. Therefore, there exists a unique fixed point s°. □

4.A.7 Proof of Lemma 4.2

Lemma. *In the low costs case, comparative statics of the lobbying equilibrium show that*

1. *a trade liberalization through a decline in* τ_{ij} *leads to an increase in* $\frac{J_L}{J_{jj}}$ *and to a decline in the export subsidy;*
2. *a decline in* f_s*,* f_{ij} *or an increase in* f_{jj} *lead to an increase in* $\frac{J_L}{J_{jj}}$ *and to a decline in the export subsidy.*
3. *a decline in the welfare weight* α *leads to an increase in* $\frac{J_L}{J_{jj}}$ *and to an increase in the export subsidy;*
4. *an increase in firm heterogeneity (lower* θ*) leads to an increase in* $\frac{J_L}{J_{jj}}$ *and to a decline in the export subsidy.*

Proof. I prove each statement by totally differentiating with respect to the parameter of interest.

1. By totally differentiating with respect to τ_{ij} we get:
$$\frac{ds}{d\tau_{ij}} = \underbrace{\frac{\partial z(\frac{J_L}{J_{jj}};\tau_{ij})}{\partial \tau_{ij}}}_{=0} + \underbrace{\frac{\partial z(\frac{J_L}{J_{jj}};\tau_{ij})}{\partial \frac{J_L}{J_{jj}}}}_{<0} \underbrace{\frac{\partial m(s;\tau_{ij})}{\partial \tau_{ij}}}_{<0} > 0$$
and
$$\frac{d\left(\frac{J_L}{J_{jj}}\right)}{d\tau_{ij}} = \underbrace{\frac{\partial m(s;\tau_{ij})}{\partial \tau_{ij}}}_{<0} + \underbrace{\frac{\partial m(s;\tau_{ij})}{\partial s}}_{>0} \underbrace{\frac{\partial z(\frac{J_L}{J_{jj}};\tau_{ij})}{\partial \tau_{ij}}}_{=0} < 0.$$
2. By totally differentiating with respect to f_{ij} we get:
$$\frac{ds}{df_{ij}} = \underbrace{\frac{\partial z(\frac{J_L}{J_{jj}};f_{ij})}{\partial f_{ij}}}_{<0} + \underbrace{\frac{\partial z(\frac{J_L}{J_{jj}};f_{ij})}{\partial \frac{J_L}{J_{jj}}}}_{<0} \underbrace{\frac{\partial m(s;f_{ij})}{\partial f_{ij}}}_{<0} > 0.$$
The indirect positive effect $\underbrace{\frac{\partial z(\frac{J_L}{J_{jj}};f_{ij})}{\partial \frac{J_L}{J_{jj}}}}_{<0} \underbrace{\frac{\partial m(s;f_{ij})}{\partial f_{ij}}}_{<0}$ dominates, thus $\frac{ds}{df_{ij}} > 0$. Also,
$$\frac{d\left(\frac{J_L}{J_{jj}}\right)}{df_{ij}} = \underbrace{\frac{\partial m(s;f_{ij})}{\partial f_{ij}}}_{<0} + \underbrace{\frac{\partial m(s;f_{ij})}{\partial s}}_{>0} \underbrace{\frac{\partial z(\frac{J_L}{J_{jj}};f_{ij})}{\partial f_{ij}}}_{<0} < 0.$$
By totally differentiating with respect to f_s we get:
$$\frac{ds}{df_s} = \underbrace{\frac{\partial z(\frac{J_L}{J_{jj}};f_s)}{\partial f_s}}_{<0} + \underbrace{\frac{\partial z(\frac{J_L}{J_{jj}};f_s)}{\partial \frac{J_L}{J_{jj}}}}_{<0} \underbrace{\frac{\partial m(s;f_s)}{\partial f_s}}_{<0} > 0.$$
The indirect positive effect $\underbrace{\frac{\partial z(\frac{J_L}{J_{jj}};f_s)}{\partial \frac{J_L}{J_{jj}}}}_{<0} \underbrace{\frac{\partial m(s;f_s)}{\partial f_s}}_{<0}$ dominates, thus $\frac{ds}{df_s} > 0$. Also,
$$\frac{d\left(\frac{J_L}{J_{jj}}\right)}{df_s} = \underbrace{\frac{\partial m(s;f_s)}{\partial f_s}}_{<0} + \underbrace{\frac{\partial m(s;f_s)}{\partial s}}_{>0} \underbrace{\frac{\partial z(\frac{J_L}{J_{jj}};f_s)}{\partial f_s}}_{<0} < 0.$$
3. By totally differentiating with respect to α we get:
$$\frac{ds}{d\alpha} = \underbrace{\frac{\partial z(\frac{J_L}{J_{jj}};\alpha)}{\partial \alpha}}_{<0} + \underbrace{\frac{\partial z(\frac{J_L}{J_{jj}};\alpha)}{\partial \frac{J_L}{J_{jj}}}}_{<0} \underbrace{\frac{\partial m(s;\alpha)}{\partial \alpha}}_{=0} < 0$$
and
$$\frac{d\left(\frac{J_L}{J_{jj}}\right)}{d\alpha} = \underbrace{\frac{\partial m(s;\alpha)}{\partial \alpha}}_{=0} + \underbrace{\frac{\partial m(s;\alpha)}{\partial s}}_{>0} \underbrace{\frac{\partial z(\frac{J_L}{J_{jj}};\alpha)}{\partial \alpha}}_{<0} < 0.$$
4. By totally differentiating with respect with respect to θ we get:
$$\frac{ds}{d\theta} = \underbrace{\frac{\partial z(\frac{J_L}{J_{jj}};\theta)}{\partial \theta}}_{=0} + \underbrace{\frac{\partial z(\frac{J_L}{J_{jj}};\theta)}{\partial \frac{J_L}{J_{jj}}}}_{<0} \underbrace{\frac{\partial m(s;\theta)}{\partial \theta}}_{<0} > 0$$

and

$$\frac{d\left(\frac{J_L}{J_{jj}}\right)}{d\theta} = \underbrace{\frac{\partial m(s;\theta)}{\partial\theta}}_{<0} + \underbrace{\frac{\partial m(s;\theta)}{\partial s}}_{>0}\underbrace{\frac{\partial z(\frac{J_L}{J_{jj}};\theta)}{\partial\theta}}_{=0} < 0.$$

□

4.A.8 Proof of Lemma 4.3

Lemma. *In the high costs case with a given unilateral export subsidy in country i, there is both an export cutoff φ^*_{ij} and an eligibility cutoff φ^*_L, and*

1. *the price index in country j lies below the baseline value, $P_{j,s} < P_{j,base}$;*
2. *the export cutoff φ^*_{ij} lies above the baseline value, $\varphi^*_{ij} > \varphi^*_{ij,base}$;*
3. *a rise in s or f_{ij}, or a decline in f_s increases φ^*_{ij} and decreases φ^*_L.*

Proof. The price index in country j can be written in terms of model parameters:

$$P_{j,s} = \tilde{\kappa}_j[(f_{jj})^{\frac{\sigma-1-\theta}{\sigma-1}} + \frac{J_i}{J_j}\left(\frac{\tau_{ij}}{\tau_{jj}}\right)^{-\theta}\left[(f_{ij})^{\frac{\sigma-1-\theta}{\sigma-1}} + (s^{\sigma-1}-1)^{\frac{\theta}{\sigma-1}}(f_s)^{\frac{\sigma-1-\theta}{\sigma-1}}\right]]^{-\frac{1}{\theta}},$$

where $\tilde{\kappa}_j = \left[J_j\frac{\theta b^\theta}{\theta-\sigma+1}(\frac{\sigma}{\sigma-1}\tau_{jj})^{-\theta}\left(\frac{\sigma}{y_j}\right)^{\frac{\sigma-1-\theta}{\sigma-1}}\right]^{-\frac{1}{\theta}}$. To prove the first statement, just take the limit for $s \to 1$ of the price index in country j:

$$\lim_{s\to 1} P_{j,s} = \tilde{\kappa}_j\,(f_{jj})^{-\frac{1}{\theta}\frac{\sigma-1-\theta}{\sigma-1}}\,[1 + \frac{J_i}{J_j}\left(\frac{\tau_{ij}}{\tau_{jj}}\right)^{-\theta}\left(\frac{f_{ij}}{f_{jj}}\right)^{\frac{\sigma-1-\theta}{\sigma-1}}]^{-\frac{1}{\theta}} > P_{j,s},$$

where $\tilde{\kappa}_j = \left[J_j\frac{\theta b^\theta}{\theta-\sigma+1}(\frac{\sigma}{\sigma-1}\tau_{jj})^{-\theta}\left(\frac{\sigma}{y_j}\right)^{\frac{\sigma-1-\theta}{\sigma-1}}\right]^{-\frac{1}{\theta}}$. For the second and third statement, first note that the cutoffs can be rewritten in terms of model parameters. For the export cutoff we get

$$\varphi^*_{ij} = \kappa_{ij}\,(f_{ij})^{\frac{1}{\theta}}\,[1 + \frac{J_j}{J_i}\left(\frac{\tau_{ij}}{\tau_{jj}}\right)^{\theta}\left(\frac{f_{ij}}{f_{jj}}\right)^{\frac{\theta-\sigma+1}{\sigma-1}} + \left(s^{\sigma-1}-1\right)^{\frac{\theta}{\sigma-1}}\left(\frac{f_{ij}}{f_s}\right)^{\frac{\theta-\sigma+1}{\sigma-1}}]^{\frac{1}{\theta}},$$

where $\kappa_{ij} = \left(J_i\frac{\theta b^\theta}{\theta-\sigma+1}\frac{\sigma}{y_j}\right)^{\frac{1}{\theta}}$. For the lobby cutoff we get

$$\varphi^*_L = \kappa_{ij}\,(f_{ij})^{\frac{1}{\theta}}\left(\frac{f_s}{f_{ij}(s^{\sigma-1}-1)}\right)^{\frac{1}{\sigma-1}}[1+\frac{J_j}{J_i}\left(\frac{\tau_{ij}}{\tau_{jj}}\right)^{\theta}\left(\frac{f_{jj}}{f_{ij}}\right)^{\frac{\sigma-1-\theta}{\sigma-1}} + \left(s^{\sigma-1}-1\right)^{\frac{\theta}{\sigma-1}}\left(\frac{f_{ij}}{f_s}\right)^{\frac{\theta-\sigma+1}{\sigma-1}}]^{\frac{1}{\theta}}.$$

For the second statement take the limit for $s \to 1$ from the export cutoff:

$$\lim_{s\to 1}\varphi^*_{ij} = \kappa_{ij}\,(f_{ij})^{\frac{1}{\theta}}\,[1 + \frac{J_j}{J_i}\left(\frac{\tau_{ij}}{\tau_{jj}}\right)^{\theta}\left(\frac{f_{ij}}{f_{jj}}\right)^{\frac{\theta-\sigma+1}{\sigma-1}}]^{\frac{1}{\theta}} < \varphi^*_{ij,base},$$

where $\kappa_{ij} = \left(J_i\frac{\theta b^\theta}{\theta-\sigma+1}\frac{\sigma}{y_j}\right)^{\frac{1}{\theta}}$.The third statement follows directly from the explicit expressions of φ^*_{ij} and φ^*_L. □

4.A.9 Proof of Proposition 4.3

Proposition. *In the high costs case, a rise in the unilateral export subsidy of country i increases its aggregate exports but leads to less exporting firms.*

Proof. By Lemma 4.3 we know that $\frac{\partial\varphi^*_{ij}}{\partial s} > 0$. Therefore, $\frac{\partial J_{ij}}{\partial s} < 0$. The mass of eligible firms is given by $J_L = J_i\left(\frac{b}{\varphi^*_L}\right)^\theta$ and the mass of all exporters is given by $J_{ij} = J_i\left(\frac{b}{\varphi^*_{ij}}\right)^\theta$. Aggregate export revenues of eligible firms and non-eligible firms are respectively,

$$R_{ij,E} = \frac{\theta\sigma}{\theta-\sigma+1}J_L f_s\left(\frac{s^{\sigma-1}}{s^{\sigma-1}-1}\right)$$

and
$$R_{ij,NE} = \frac{\theta\sigma}{\theta-\sigma+1}\left[J_{ij}f_{ij} - J_L f_s\left(\frac{1}{s^{\sigma-1}-1}\right)\right].$$
Therefore, total aggregate export revenues are
$$R_{ij} = R_{ij,E} + R_{ij,NE} = \frac{\theta\sigma}{\theta-\sigma+1}\left(J_L f_s + J_{ij}f_{ij}\right).$$
Total profits in market j are given by $\Pi_{j,s} = \frac{\sigma-1}{\sigma}\frac{y_j}{\theta}$. Aggregate export profits of eligible firms and non-eligible firms are respectively,
$$\Pi_{ij,E} = J_L\left[\frac{\theta}{\theta-\sigma+1}\left(\frac{s^{\sigma-1}}{s^{\sigma-1}-1}\right)f_s - f_s - f_{ij}\right]$$
and
$$\Pi_{ij,NE} = \frac{\sigma-1}{\theta-\sigma+1}J_{ij}f_{ij} - J_L\left[\frac{\theta}{\theta-\sigma+1}f_s\left(\frac{1}{s^{\sigma-1}-1}\right) - f_{ij}\right].$$
Therefore, aggregate export profits are given by
$$\Pi_{ij} = \Pi_{ij,E} + \Pi_{ij,NE} = \frac{\sigma-1}{\theta-\sigma+1}\left(J_L f_s + J_{ij}f_{ij}\right) = \frac{\sigma-1}{\sigma}\frac{R_{ij}}{\theta}.$$
Note that in the limits, where administrative fixed costs converge to infinity or the subsidy converges to one, export revenues of subsidized firms converge to zero because the set of subsidized firms converges to zero as well. Aggregate export revenues are can be rewritten as
$$R_{ij} = y_j[\frac{J_j}{J_i}\left(\frac{\tau_{jj}}{\tau_{ij}}\right)^{-\theta}\left(\frac{f_{ij}}{f_{jj}}\right)^{\frac{\theta-\sigma+1}{\sigma-1}}\left[1 + (s^{\sigma-1}-1)^{\frac{\theta}{\sigma-1}}\left(\frac{f_s}{f_{ij}}\right)^{\frac{\sigma-1-\theta}{\sigma-1}}\right]^{-1} + 1]^{-1}.$$
Thus, $\frac{\partial R_{ij}}{\partial s} > 0$. Therefore $\frac{\partial \Pi_{ij}}{\partial s} = \frac{\sigma-1}{\sigma}\frac{1}{\theta}\frac{\partial R_{ij}}{\partial s} > 0$. □

4.A.10 Proof of Proposition 4.4

Proposition. *In the high costs case, from an ex-ante point of view,*

1. *$s = 1$ maximizes home welfare;*
2. *if an interior solution in $(1, \bar{s})$ exists that maximizes foreign welfare, it is unique; otherwise $s = \bar{s}$ maximizes foreign welfare;*
3. *for sufficiently large values of θ (i.e., low firm heterogeneity), $s = 1$ maximizes global welfare.*

Proof. **For the first statement,** consider the rewritten first order condition:
$$s = 1 + \frac{1}{\theta}\left(\frac{\frac{\partial R_{ij}}{\partial s}}{\frac{\partial R_{E,high}}{\partial s}}\right) - \frac{R_{E,high}}{\frac{\partial R_{E,high}}{\partial s}}. \tag{4.28}$$
The first order condition cannot hold if the right hand side of equation (4.28) is always smaller than one. Therefore, it is to show that it can never be the case that $\frac{1}{\theta}\frac{\frac{\partial R_{ij}}{\partial s}}{\frac{\partial R_{ij,E}}{\partial s}} - \frac{R_{ij,E}}{\frac{\partial R_{ij,E}}{\partial s}} > 0$ or equivalently, that $\frac{1}{\theta}\frac{\partial R_{ij}}{\partial s} > R_{ij,E}$. With
$$R_{ij} = y_j[\frac{J_j}{J_i}\left(\frac{\tau_{jj}}{\tau_{ij}}\right)^{-\theta}\left(\frac{f_{ij}}{f_{jj}}\right)^{\frac{\theta-\sigma+1}{\sigma-1}}\left[1 + (s^{\sigma-1}-1)^{\frac{\theta}{\sigma-1}}\left(\frac{f_s}{f_{ij}}\right)^{\frac{\sigma-1-\theta}{\sigma-1}}\right]^{-1} + 1]^{-1}$$
and
$$R_{ij,E} = \frac{s^{\sigma-1}}{s^{\sigma-1}-1}y_j[\frac{J_j}{J_i}\left(\frac{\tau_{jj}}{\tau_{ij}}\right)^{-\theta}\left(\frac{f_{jj}}{f_s}\right)^{\frac{\sigma-1-\theta}{\sigma-1}}(s^{\sigma-1}-1)^{-\frac{\theta}{\sigma-1}} + \left(\frac{f_{ij}}{f_s}\right)^{\frac{\sigma-1-\theta}{\sigma-1}}(s^{\sigma-1}-1)^{-\frac{\theta}{\sigma-1}} + 1]^{-1}$$

and

$$\begin{aligned}\frac{\partial R_{ij}}{\partial s} &= \frac{R_{ij}}{s}\theta\frac{s^{\sigma-1}}{s^{\sigma-1}-1}[1+\frac{J_i}{J_j}\left(\frac{\tau_{jj}}{\tau_{ij}}\right)^{\theta}\left(\frac{f_{ij}}{f_{jj}}\right)^{-\frac{\theta-\sigma+1}{\sigma-1}} \\ &\left[1+(s^{\sigma-1}-1)^{\frac{\theta}{\sigma-1}}\left(\frac{f_s}{f_{ij}}\right)^{\frac{\sigma-1-\theta}{\sigma-1}}\right]]^{-1}\left[1+\left(\frac{f_s}{f_{ij}}\right)^{-\frac{\sigma-1-\theta}{\sigma-1}}(s^{\sigma-1}-1)^{-\frac{\theta}{\sigma-1}}\right]^{-1}\end{aligned}$$

we can rewrite $\frac{1}{\theta}\frac{\partial R_{ij}}{\partial s} > R_{ij,E}$ to

$$\begin{aligned}R_{ij,E} &< \frac{R_{ij}}{s}\frac{s^{\sigma-1}}{s^{\sigma-1}-1}[1+\frac{J_i}{J_j}\left(\frac{\tau_{jj}}{\tau_{ij}}\right)^{\theta}\left(\frac{f_{ij}}{f_{jj}}\right)^{-\frac{\theta-\sigma+1}{\sigma-1}} \\ &\left[1+(s^{\sigma-1}-1)^{\frac{\theta}{\sigma-1}}\left(\frac{f_s}{f_{ij}}\right)^{\frac{\sigma-1-\theta}{\sigma-1}}\right]]^{-1}\left[1+\left(\frac{f_s}{f_{ij}}\right)^{-\frac{\sigma-1-\theta}{\sigma-1}}(s^{\sigma-1}-1)^{-\frac{\theta}{\sigma-1}}\right]^{-1} \\ \Longleftrightarrow y_j\frac{J_i}{J_j}\left(\frac{\tau_{jj}}{\tau_{ij}}\right)^{\theta}\left(\frac{f_{jj}}{f_s}\right)^{-\frac{\sigma-1-\theta}{\sigma-1}}&(s^{\sigma-1}-1)^{\frac{\theta}{\sigma-1}} > \frac{R_{ij}}{s}\left[1+\left(\frac{f_s}{f_{ij}}\right)^{-\frac{\sigma-1-\theta}{\sigma-1}}(s^{\sigma-1}-1)^{-\frac{\theta}{\sigma-1}}\right]^{-1} \\ \Longleftrightarrow s &< [\left[1+(s^{\sigma-1}-1)^{-\frac{\theta}{\sigma-1}}\left(\frac{f_s}{f_{ij}}\right)^{-\frac{\sigma-1-\theta}{\sigma-1}}\right]^{-1}+\frac{J_i}{J_j}\left(\frac{\tau_{jj}}{\tau_{ij}}\right)^{\theta}\left(\frac{f_{jj}}{f_s}\right)^{-\frac{\sigma-1-\theta}{\sigma-1}}(s^{\sigma-1}-1)^{\frac{\theta}{\sigma-1}}]^{-1} \\ &\left[1+\left(\frac{f_s}{f_{ij}}\right)^{-\frac{\sigma-1-\theta}{\sigma-1}}(s^{\sigma-1}-1)^{-\frac{\theta}{\sigma-1}}\right]^{-1} \\ &\Longleftrightarrow s < [1+\frac{J_i}{J_j}\left(\frac{\tau_{jj}}{\tau_{ij}}\right)^{\theta}\left(\frac{f_{jj}}{f_s}\right)^{-\frac{\sigma-1-\theta}{\sigma-1}}(s^{\sigma-1}-1)^{\frac{\theta}{\sigma-1}}]^{-1},\end{aligned}$$

a contradiction, because $s > 1$. Therefore, $-\frac{R_{ij,E}}{\frac{\partial R_{ij,E}}{\partial s}} + \frac{1}{\theta}\frac{\frac{\partial R_{ij}}{\partial s}}{\frac{\partial R_{ij,E}}{\partial s}} < 0$ and $s = 1 - \frac{R_{ij,E}}{\frac{\partial R_{ij,E}}{\partial s}} + \frac{1}{\theta}\frac{\frac{\partial R_{ij}}{\partial s}}{\frac{\partial R_{ij,E}}{\partial s}}$ does never hold. Therefore, there does not exist an export subsidy that solves the first order condition of a welfare maximizing government in the home country.

For the second statement, note that the first order condition of maximizing foreign welfare is given by $\frac{\partial W_j}{\partial s} = \frac{\partial \Pi_{jj}}{\partial s} + \frac{\partial CS_j}{\partial s} = 0$. The derivative of consumer welfare in country j is

$$\frac{\partial CS_j}{\partial s} = \frac{\partial[y_i \ln(\frac{y}{P_j}) - y_i]}{\partial s} = y_j\frac{\partial \ln(\frac{y_j}{P_{j,s}})}{\partial s} = -y_j\frac{\partial \ln(\frac{P_{j,s}}{y_j})}{\partial s} = -\frac{\partial P_{j,s}}{\partial s}\frac{y_j}{P_{j,s}}.$$

Taking the derivative of $\frac{\partial P_{j,s}}{\partial s}$ it is straightforward to show that $\frac{\partial CS_j}{\partial s} = -\frac{\partial P_{j,s}}{\partial s}\frac{y_j}{P_{j,s}} = \frac{R_{ij,E}}{s}$. Note that

$$\Pi_{jj} = \frac{\sigma-1}{\sigma}\frac{y_j}{\theta} - \Pi_{ji} = \frac{\sigma-1}{\sigma}\frac{y_j}{\theta} - \frac{\sigma-1}{\sigma}\frac{R_{ij}}{\theta} == \frac{\sigma-1}{\sigma}\frac{(y_j - R_{ij})}{\theta},$$

such that $\frac{\partial \Pi_{jj}}{\partial s} = -\frac{\sigma-1}{\sigma}\frac{1}{\theta}\frac{\partial R_{ij}}{\partial s}$.

With $R_{ij} = y_j[\frac{J_j}{J_i}\left(\frac{\tau_{jj}}{\tau_{ij}}\right)^{-\theta}\left(\frac{f_{ij}}{f_{jj}}\right)^{\frac{\theta-\sigma+1}{\sigma-1}}\left[1+(s^{\sigma-1}-1)^{\frac{\theta}{\sigma-1}}\left(\frac{f_s}{f_{ij}}\right)^{\frac{\sigma-1-\theta}{\sigma-1}}\right]^{-1}+1]^{-1}$ we get

$$\frac{\partial R_{ij}}{\partial s} = \frac{R_{ij,E}}{s}\theta\frac{s^{\sigma-1}}{s^{\sigma-1}-1}[1+\frac{J_i}{J_j}\left(\frac{\tau_{jj}}{\tau_{ij}}\right)^{\theta}\left(\frac{f_{ij}}{f_{jj}}\right)^{-\frac{\theta-\sigma+1}{\sigma-1}}\left[1+(s^{\sigma-1}-1)^{\frac{\theta}{\sigma-1}}\left(\frac{f_s}{f_{ij}}\right)^{\frac{\sigma-1-\theta}{\sigma-1}}\right]]^{-1}.$$

Plugging $\frac{\partial CS_j}{\partial s}$ and $\frac{\partial \Pi_{jj}}{\partial s}$ into the first order condition we get $\frac{\partial W_j}{\partial s} = -\frac{\sigma-1}{\sigma}\frac{1}{\theta}\frac{\partial R_{ij}}{\partial s} + \frac{R_{ij,E}}{s} = 0$. Rewritten we get:

$$\frac{\sigma-1}{\sigma}[1+\frac{J_i}{J_j}\left(\frac{\tau_{jj}}{\tau_{ij}}\right)^{\theta}\left(\frac{f_{ij}}{f_{jj}}\right)^{-\frac{\theta-\sigma+1}{\sigma-1}}\left[1+(s^{\sigma-1}-1)^{\frac{\theta}{\sigma-1}}\left(\frac{f_s}{f_{ij}}\right)^{\frac{\sigma-1-\theta}{\sigma-1}}\right]]^{-1}=1-\frac{1}{s^{\sigma-1}}.$$

Note that the left hand side (lhs) of this equation is a strictly decreasing function of s with limits

$$\lim_{s\to 1} lhs=\frac{\sigma-1}{\sigma}[1+\frac{J_i}{J_j}\left(\frac{\tau_{jj}}{\tau_{ij}}\right)^{\theta}\left(\frac{f_{ij}}{f_{jj}}\right)^{-\frac{\theta-\sigma+1}{\sigma-1}}]^{-1}\in(0,1)$$

and

$$\lim_{s\to\left(\frac{f_s}{f_{ij}}+1\right)^{\frac{1}{\sigma-1}}} lhs=\frac{\sigma-1}{\sigma}[1+\frac{J_i}{J_j}\left(\frac{\tau_{jj}}{\tau_{ij}}\right)^{\theta}\left(\frac{f_{ij}}{f_{jj}}\right)^{-\frac{\theta-\sigma+1}{\sigma-1}}\left[1+\left(\frac{f_s}{f_{ij}}\right)\right]]^{-1}\in(0,1).$$

Similarly, the right hand side (rhs) of this equation is a strictly increasing function of s, with limits

$$\lim_{s\to 1} rhs=0$$

and

$$\lim_{s\to\left(\frac{f_s}{f_{ij}}+1\right)^{\frac{1}{\sigma-1}}} rhs=\frac{\frac{f_s}{f_{ij}}}{\frac{f_s}{f_{ij}}+1}\in(0,1).$$

For sufficiently high f_s there does always exist a unique interior optimum, because

$$\lim_{f_s\to\infty}\frac{\frac{f_s}{f_{ij}}}{\frac{f_s}{f_{ij}}+1}=1$$

and

$$\lim_{f_s\to\infty}\frac{\sigma-1}{\sigma}[1+\frac{J_i}{J_j}\left(\frac{\tau_{jj}}{\tau_{ij}}\right)^{\theta}\left(\frac{f_{ij}}{f_{jj}}\right)^{-\frac{\theta-\sigma+1}{\sigma-1}}\left[1+\left(\frac{f_s}{f_{ij}}\right)\right]]^{-1}<1.$$

Hence, for sufficiently high f_s it holds that

$$\frac{\frac{f_s}{f_{ij}}}{\frac{f_s}{f_{ij}}+1}>\frac{\sigma-1}{\sigma}[1+\frac{J_i}{J_j}\left(\frac{\tau_{jj}}{\tau_{ij}}\right)^{\theta}\left(\frac{f_{ij}}{f_{jj}}\right)^{-\frac{\theta-\sigma+1}{\sigma-1}}\left[1+\left(\frac{f_s}{f_{ij}}\right)\right]]^{-1}$$

and there is a unique interior solution that maximizes welfare in the foreign country. If f_s is sufficiently small, the interior solution may not exist. However, then $\frac{\partial W_j}{\partial s}>0$ for all feasible s and it is optimal to set the highest feasible export subsidy rate.

For the third statement, note that $\frac{\partial CS_j}{\partial s}=-\frac{\partial P_{j,s}}{\partial s}\frac{y_j}{P_{j,s}}=\frac{R_{ij,E}}{s}$ and $\frac{\partial S_{high}}{\partial s}=\frac{\sigma-1}{\sigma}R_{E,high}+(s-1)\frac{\sigma-1}{\sigma}\frac{\partial R_{E,high}}{\partial s}$. Therefore, we get

$$\frac{\partial W_i}{\partial s}+\frac{\partial W_j}{\partial s}=\frac{R_{ij,E}}{s}-\frac{\sigma-1}{\sigma}R_{E,high}-(s-1)\frac{\sigma-1}{\sigma}\frac{\partial R_{E,high}}{\partial s}=0.$$

With $\epsilon_{R_{E,high}}=\frac{\partial R_{E,high}}{\partial s}\frac{s}{R_{E,high}}$ this expression simplifies to

$$1-\frac{\sigma-1}{\sigma}s-(s-1)\frac{\sigma-1}{\sigma}\epsilon_{R_{E,high}}=0$$

or equivalently

$$s=\frac{\frac{\sigma}{\sigma-1}+\epsilon_{R_{E,high}}}{1+\epsilon_{R_{E,high}}}.$$

Thus, any $s>\frac{\sigma}{\sigma-1}$ cannot be an equilibrium export subsidy rate. Note that

$$\epsilon_{R_{E,high}}=\frac{\partial R_{ij,E}}{\partial s}\frac{s}{R_{ij,E}}=(\sigma-1)\left[1-\frac{R_{ij,E}}{y_j}\right]+(\theta-\sigma+1)\frac{R_{ij,E}}{y_j}\left(\frac{J_{jj}}{J_L}\frac{f_{jj}}{f_s}+\frac{J_{ij}}{J_L}\frac{f_{ij}}{f_s}\right).$$

Therefore,

$$\lim_{s\to 1}\epsilon_{R_{E,high}} = \lim_{s\to 1}(\sigma-1) + \lim_{s\to 1}(\theta-\sigma+1)\frac{r(\tilde{\varphi}_L)}{y_j}\left(J_{jj}\frac{f_{jj}}{f_s} + J_{ij}\frac{f_{ij}}{f_s}\right) = \infty,$$

(because average productivity of eligible firms, converges to infinity for $s \to 1$) and

$$\lim_{s\to\left(\frac{f_s}{f_{ij}}+1\right)^{\frac{1}{\sigma-1}}}\epsilon_{R_{E,high}} = (\sigma-1) + \left[(\theta-\sigma+1)\left(\frac{J_{jj}f_{jj}+J_{ij}f_{ij}}{J_{ij}f_s}\right) - (\sigma-1)\right]\frac{R_{ij}}{y_j} > 0.$$

The right hand side of the first order condition has limits of

$$\lim_{s\to\left(\frac{f_s}{f_{ij}}+1\right)^{\frac{1}{\sigma-1}}}\frac{\frac{\sigma}{\sigma-1}+\epsilon_{R_{E,high}}}{1+\epsilon_{R_{E,high}}} > 0$$

and

$$\lim_{s\to 1}\frac{\frac{\sigma}{\sigma-1}+\epsilon_{R_{E,high}}}{1+\epsilon_{R_{E,high}}} = 1.$$

Therefore, there does not necessarily exist a $s \in (1, \frac{\sigma}{\sigma-1})$ such that $s = \frac{\frac{\sigma}{\sigma-1}+\epsilon_{R_{E,high}}}{1+\epsilon_{R_{E,high}}}$. If the derivative of the right hand side is sufficiently small, then there may not be any interior fixed point.

Next, I show that for θ is sufficiently large, the right hand side of $s = \frac{\frac{\sigma}{\sigma-1}+\epsilon_{R_{E,high}}}{1+\epsilon_{R_{E,high}}}$ is smaller than the left hand side for any $s \in (1, \frac{\sigma}{\sigma-1})$.With

$$\begin{aligned}\epsilon_{R_{E,high}} &= (\sigma-1)\left[1-\frac{R_{ij,E}}{y_j}\right]\\ &+\frac{(\theta-\sigma+1)s^{\sigma-1}}{(s^{\sigma-1}-1)}[\frac{J_i}{J_j}\left(\frac{\tau_{jj}}{\tau_{ij}}\right)^{\theta}\left(\frac{f_{jj}(s^{\sigma-1}-1)}{f_s}\right)^{\frac{\theta}{\sigma-1}}\frac{f_s}{f_{jj}} + \left(\frac{f_{ij}(s^{\sigma-1}-1)}{f_s}\right)^{\frac{\theta}{\sigma-1}}\frac{f_s}{f_{ij}}+1]^{-1}\end{aligned}$$

we get $\frac{\partial\epsilon_{R_{E,high}}}{\partial\theta} > 0$, such that for sufficiently high θ, for all $s \in (1, \frac{\sigma}{\sigma-1})$ $\epsilon_{R_{E,high}}$ is sufficiently high to guarantee that $s > \frac{\frac{\sigma}{\sigma-1}+\epsilon_{R_{E,high}}}{1+\epsilon_{R_{E,high}}}$. □

4.A.11 Proof of Proposition 4.5

Proposition. *In the high costs case, there exists a unique equilibrium of the lobbying game, such that*

1. *all firms with $\varphi \geq \varphi^o_{ij}$ export and all firms with $\varphi \geq \varphi^o_L$ enter the lobby, such that $h(s) := \frac{J_L}{J_{ij}} = \left(\frac{f_s}{f_{ij}(s^{\sigma-1}-1)}\right)^{-\frac{\theta}{\sigma-1}}$, $m(s) := \frac{J_L}{J_{jj}} = \frac{J_i}{J_j}(\frac{\tau_{ij}}{\tau_{jj}})^{-\theta}\left(\frac{f_s}{f_{jj}(s^{\sigma-1}-1)}\right)^{-\frac{\theta}{\sigma-1}}$ and $n(s) := \frac{J_{ij}}{J_{jj}} = \frac{J_i}{J_j}(\frac{\tau_{ij}}{\tau_{jj}})^{-\theta}\left(\frac{f_{ij}}{f_{jj}}\right)^{-\frac{\theta}{\sigma-1}}$;*
2. *lobby contributions are $C^T(s^o) = \alpha(\Pi_{ij}(s^*) - \Pi_{ij}(s^o) + S(s^o) - S(s^*))$;*
3. *the government implements $z(\frac{J_L}{J_{ij}}, \frac{J_L}{J_{jj}}) := s^o = \frac{\frac{R_{jj}}{y_j}+\left(\frac{1}{\alpha}\frac{1}{\sigma-1}+1\right)\tilde{\epsilon}_{R_E,s}}{1+\tilde{\epsilon}_{R_E,s}}$.*

Proof. The first order condition of a government that takes lobby contributions into account is given by

$$\frac{\partial G}{\partial s} = \alpha\frac{\partial W_i}{\partial s} + \frac{\partial\Pi_{ij,E}}{\partial s} = 0.$$

Rewriting the first order condition gives an implicit definition of the subsidy rate:

$$z(\frac{J_L}{J_{ij}}, \frac{J_L}{J_{jj}}) = s^\circ = \frac{\frac{R_{jj}}{y_j} + \left(\frac{1}{\alpha}\frac{1}{\sigma-1}+1\right)\tilde{\epsilon}_{R_E,s}}{1+\tilde{\epsilon}_{R_E,s}},$$

where $\tilde{\epsilon}_{R_E,s} = (\sigma-1)\left[1-\frac{R_E}{y_j}\right]$, $R_{ij,E} = \frac{s^{\sigma-1}}{s^{\sigma-1}-1}y_j[\frac{J_{jj}}{J_L}\frac{f_{jj}}{f_s}+\frac{J_{ij}}{J_L}\frac{f_{ij}}{f_s}+1]^{-1}$ and $R_{jj} = y_j[\frac{J_{ij}}{J_{jj}}\frac{f_{ij}}{f_{jj}}+$

$\frac{J_L}{J_{jj}}\frac{f_s}{f_{jj}}+1]^{-1}$. Rewrite the first order condition as

$$s = 1+\frac{1}{\theta}\frac{1}{\alpha}+\frac{1}{\theta}\frac{\frac{\partial R_{ij}}{\partial s}}{\frac{\partial R_{E,high}}{\partial s}}-\frac{R_{E,high}}{\frac{\partial R_{E,high}}{\partial s}}.$$

Then, for α sufficiently low, there exists an interior solution to the government's maximization problem.

For the comparative statics, note that taking the derivative of $z(\frac{J_L}{J_{ij}},\frac{J_L}{J_{jj}})$ with respect to any parameter x we get

$$\frac{\partial s}{\partial x}=\frac{\left(\frac{1}{\alpha}\frac{1}{\sigma-1}+1-\frac{R_{jj}}{y_j}\right)\frac{\partial\tilde{\epsilon}_{R_E,s}}{\partial x}+(1+\tilde{\epsilon}_{R_E,s})\frac{1}{y_j}\frac{\partial R_{jj}}{\partial x}}{[1+\tilde{\epsilon}_{R_E,s}]^2}$$

If the sign of $\frac{\partial\tilde{\epsilon}_{R_E,s}}{\partial x}$ and $\frac{\partial R_{jj}}{\partial x}$ are identical, the sign of $\frac{\partial s}{\partial x}$ is also the same. Thus, s is strictly decreasing in $\frac{J_L}{J_{ij}}$, $\frac{J_L}{J_{jj}}$ and $\frac{J_{ij}}{J_{jj}}$. Note that $\frac{J_L}{J_{ij}}=\left(\frac{f_s}{f_{ij}(s^{\sigma-1}-1)}\right)^{-\frac{\theta}{\sigma-1}}$ and $\frac{J_L}{J_{jj}}=\frac{J_i}{J_j}(\frac{\tau_{ij}}{\tau_{jj}})^{-\theta}\left(\frac{f_s}{f_{jj}(s^{\sigma-1}-1)}\right)^{-\frac{\theta}{\sigma-1}}$ are strictly increasing in s, while $\frac{J_{ij}}{J_{jj}}=\frac{J_i}{J_j}(\frac{\tau_{jj}}{\tau_{ij}})^{\theta}\left(\frac{f_{jj}}{f_{ij}}\right)^{\frac{\theta}{\sigma-1}}$ is independent of s. □

4.A.12 Proof of Lemma 4.4

Lemma. *In the high costs case, comparative statics of the lobbying equilibrium show that*

1. *a trade liberalization through a decline in τ_{ij} leads to an increase in $\frac{J_L}{J_{jj}}$ and $\frac{J_{ij}}{J_{jj}}$, leaves $\frac{J_L}{J_{ij}}$ unaffected, and leads to a decline in the export subsidy;*
2. *a trade liberalization through a decline in f_{ij} leads to a decline in $\frac{J_{ij}}{J_{jj}}$ and has an ambiguous effect on $\frac{J_L}{J_{ij}}$, $\frac{J_L}{J_{jj}}$ and on the export subsidy;*
3. *a decline in the welfare weight α leads to an increase in $\frac{J_L}{J_{ij}}$ and $\frac{J_L}{J_{jj}}$, leaves $\frac{J_{ij}}{J_{jj}}$ unaffected, and leads to an increase in the export subsidy;*
4. *an increase in firm heterogeneity (lower θ) leads to an increase in $\frac{J_L}{J_{ij}}$, $\frac{J_L}{J_{jj}}$ and $\frac{J_{ij}}{J_{jj}}$, and to a decline in the export subsidy;*
5. *an increase in f_s leads to a decline in $\frac{J_L}{J_{ij}}$ and $\frac{J_L}{J_{jj}}$, leaves $\frac{J_{ij}}{J_{jj}}$ unaffected, and leads to an increase in the export subsidy;*
6. *an increase in f_{jj} leads to an increase in $\frac{J_L}{J_{jj}}$, $\frac{J_{ij}}{J_{jj}}$ and $\frac{J_L}{J_{ij}}$, and leads to a decline in the export subsidy.*

Proof. First, recall that $h(s):=\frac{J_L}{J_{ij}}=\left(\frac{f_s}{f_{ij}(s^{\sigma-1}-1)}\right)^{-\frac{\theta}{\sigma-1}}$, $m(s):=\frac{J_L}{J_{jj}}=\frac{J_i}{J_j}(\frac{\tau_{ij}}{\tau_{jj}})^{-\theta}\left(\frac{f_s}{f_{jj}(s^{\sigma-1}-1)}\right)^{-\frac{\theta}{\sigma-1}}$, $n(s):=\frac{J_{ij}}{J_{jj}}=\frac{J_i}{J_j}(\frac{\tau_{ij}}{\tau_{jj}})^{-\theta}\left(\frac{f_{ij}}{f_{jj}}\right)^{-\frac{\theta}{\sigma-1}}$ and $s^o=\frac{\frac{R_{jj}}{y_j}+\left(\frac{1}{\alpha}\frac{1}{\sigma-1}+1\right)\tilde{\epsilon}_{R_E,s}}{1+\tilde{\epsilon}_{R_E,s}}$, where $\tilde{\epsilon}_{R_E,s}(\frac{J_L}{J_{ij}},\frac{J_L}{J_{jj}})=(\sigma-1)\left[1-\frac{R_E}{y}\right]$, $R_{ij,E}=\frac{s^{\sigma-1}}{s^{\sigma-1}-1}y_j[\frac{J_{jj}}{J_L}\left(\frac{f_{jj}}{f_s}\right)+\left(\frac{f_{ij}}{f_s}\right)\frac{J_{ij}}{J_L}+1]^{-1}$ and $R_{jj}=y_j[\frac{J_{ij}}{J_{jj}}\frac{f_{ij}}{f_{jj}}+\frac{J_L}{J_{jj}}\frac{f_s}{f_{jj}}+1]^{-1}$.

1. By totally differentiating with respect to τ_{ij} we get:

$$\frac{ds}{d\tau_{ij}} = \underbrace{\frac{\partial z(\frac{J_L}{J_{ij}},\frac{J_L}{J_{jj}},\frac{J_{ij}}{J_{jj}};\tau_{ij})}{\partial \tau_{ij}}}_{=0} + \underbrace{\frac{\partial z(\frac{J_L}{J_{ij}},\frac{J_L}{J_{jj}},\frac{J_{ij}}{J_{jj}};\tau_{ij})}{\partial \frac{J_L}{J_{ij}}}}_{<0} \underbrace{\frac{\partial h(s;\tau_{ij})}{\partial \tau_{ij}}}_{=0}$$
$$+ \underbrace{\frac{\partial z(\frac{J_L}{J_{ij}},\frac{J_L}{J_{jj}},\frac{J_{ij}}{J_{jj}};\tau_{ij})}{\partial \frac{J_L}{J_{jj}}}}_{<0} \underbrace{\frac{\partial m(s;\tau_{ij})}{\partial \tau_{ij}}}_{<0} + \underbrace{\frac{\partial z(\frac{J_L}{J_{ij}},\frac{J_L}{J_{jj}},\frac{J_{ij}}{J_{jj}};\tau_{ij})}{\partial \frac{J_{ij}}{J_{jj}}}}_{<0} \underbrace{\frac{\partial n(s;\tau_{ij})}{\partial \tau_{ij}}}_{<0} > 0$$

and

$$\frac{d\left(\frac{J_L}{J_{ij}}\right)}{d\tau_{ij}} = \underbrace{\frac{\partial h(s;\tau_{ij})}{\partial \tau_{ij}}}_{=0} + \underbrace{\frac{\partial h(s;\tau_{ij})}{\partial s}}_{>0} \underbrace{\frac{\partial z(\frac{J_L}{J_{ij}},\frac{J_L}{J_{jj}},\frac{J_{ij}}{J_{jj}};\tau_{ij})}{\partial \tau_{ij}}}_{=0} = 0,$$

$$\frac{d\left(\frac{J_L}{J_{jj}}\right)}{d\tau_{ij}} = \underbrace{\frac{\partial m(s;\tau_{ij})}{\partial \tau_{ij}}}_{<0} + \underbrace{\frac{\partial m(s;\tau_{ij})}{\partial s}}_{>0} \underbrace{\frac{\partial z(\frac{J_L}{J_{ij}},\frac{J_L}{J_{jj}},\frac{J_{ij}}{J_{jj}};\tau_{ij})}{\partial \tau_{ij}}}_{=0} < 0,$$

$$\frac{d\left(\frac{J_{ij}}{J_{jj}}\right)}{d\tau_{ij}} = \underbrace{\frac{\partial n(s;\tau_{ij})}{\partial \tau_{ij}}}_{<0} + \underbrace{\frac{\partial n(s;\tau_{ij})}{\partial s}}_{=0} \underbrace{\frac{\partial z(\frac{J_L}{J_{ij}},\frac{J_L}{J_{jj}},\frac{J_{ij}}{J_{jj}};\tau_{ij})}{\partial \tau_{ij}}}_{=0} < 0.$$

2. By totally differentiating with respect to f_{ij} we get:

$$\frac{ds}{df_{ij}} = \underbrace{\frac{\partial z(\frac{J_L}{J_{ij}},\frac{J_L}{J_{jj}},\frac{J_{ij}}{J_{jj}};f_{ij})}{\partial f_{ij}}}_{=?} + \underbrace{\frac{\partial z(\frac{J_L}{J_{ij}},\frac{J_L}{J_{jj}},\frac{J_{ij}}{J_{jj}};f_{ij})}{\partial \frac{J_L}{J_{ij}}}}_{<0} \underbrace{\frac{\partial h(s;f_{ij})}{\partial f_{ij}}}_{>0}$$
$$+ \underbrace{\frac{\partial z(\frac{J_L}{J_{ij}},\frac{J_L}{J_{jj}},\frac{J_{ij}}{J_{jj}};f_{ij})}{\partial \frac{J_L}{J_{jj}}}}_{<0} \underbrace{\frac{\partial m(s;f_{ij})}{\partial f_{ij}}}_{=0} + \underbrace{\frac{\partial z(\frac{J_L}{J_{ij}},\frac{J_L}{J_{jj}},\frac{J_{ij}}{J_{jj}};f_{ij})}{\partial \frac{J_{ij}}{J_{jj}}}}_{<0} \underbrace{\frac{\partial n(s;f_{ij})}{\partial f_{ij}}}_{<0} =?,$$

$$\frac{d\left(\frac{J_L}{J_{ij}}\right)}{df_{ij}} = \underbrace{\frac{\partial h(s;f_{ij})}{\partial f_{ij}}}_{>0} + \underbrace{\frac{\partial h(s;f_{ij})}{\partial s}}_{>0} \underbrace{\frac{\partial z(\frac{J_L}{J_{ij}},\frac{J_L}{J_{jj}},\frac{J_{ij}}{J_{jj}};f_{ij})}{\partial f_{ij}}}_{=?} =?,$$

$$\frac{d\left(\frac{J_L}{J_{jj}}\right)}{df_{ij}} = \underbrace{\frac{\partial m(s;f_{ij})}{\partial f_{ij}}}_{=0} + \underbrace{\frac{\partial m(s;f_{ij})}{\partial s}}_{>0} \underbrace{\frac{\partial z(\frac{J_L}{J_{ij}},\frac{J_L}{J_{jj}},\frac{J_{ij}}{J_{jj}};f_{ij})}{\partial f_{ij}}}_{=?} =?$$

and

$$\frac{d\left(\frac{J_{ij}}{J_{jj}}\right)}{df_{ij}} = \underbrace{\frac{\partial n(s;f_{ij})}{\partial f_{ij}}}_{<0} + \underbrace{\frac{\partial n(s;f_{ij})}{\partial s}}_{=0} \underbrace{\frac{\partial z(\frac{J_L}{J_{ij}},\frac{J_L}{J_{jj}},\frac{J_{ij}}{J_{jj}};f_{ij})}{\partial f_{ij}}}_{=?} < 0.$$

3. By totally differentiating with respect to α we get:

$$\frac{ds}{d\alpha} = \underbrace{\frac{\partial z(\frac{J_L}{J_{ij}}, \frac{J_L}{J_{jj}}, \frac{J_{ij}}{J_{jj}};\alpha)}{\partial \alpha}}_{<0} + \underbrace{\frac{\partial z(\frac{J_L}{J_{ij}}, \frac{J_L}{J_{jj}}, \frac{J_{ij}}{J_{jj}};\alpha)}{\partial \frac{J_L}{J_{ij}}}}_{<0} \underbrace{\frac{\partial h(s;\alpha)}{\partial \alpha}}_{=0}$$

$$+ \underbrace{\frac{\partial z(\frac{J_L}{J_{ij}}, \frac{J_L}{J_{jj}}, \frac{J_{ij}}{J_{jj}};\alpha)}{\partial \frac{J_L}{J_{jj}}}}_{<0} \underbrace{\frac{\partial m(s;\alpha)}{\partial \alpha}}_{=0} + \underbrace{\frac{\partial z(\frac{J_L}{J_{ij}}, \frac{J_L}{J_{jj}}, \frac{J_{ij}}{J_{jj}};\alpha)}{\partial \frac{J_{ij}}{J_{jj}}}}_{<0} \underbrace{\frac{\partial n(s;\alpha)}{\partial \alpha}}_{=0} < 0,$$

$$\frac{d\left(\frac{J_L}{J_{ij}}\right)}{d\alpha} = \underbrace{\frac{\partial h(s;\alpha)}{\partial \alpha}}_{=0} + \underbrace{\frac{\partial h(s;\alpha)}{\partial s}}_{>0} \underbrace{\frac{\partial z(\frac{J_L}{J_{ij}}, \frac{J_L}{J_{jj}}, \frac{J_{ij}}{J_{jj}};\alpha)}{\partial \alpha}}_{<0} < 0,$$

$$\frac{d\left(\frac{J_L}{J_{jj}}\right)}{d\alpha} = \underbrace{\frac{\partial m(s;\alpha)}{\partial \alpha}}_{=0} + \underbrace{\frac{\partial m(s;\alpha)}{\partial s}}_{>0} \underbrace{\frac{\partial z(\frac{J_L}{J_{ij}}, \frac{J_L}{J_{jj}}, \frac{J_{ij}}{J_{jj}};\alpha)}{\partial \alpha}}_{<0} < 0,$$

and

$$\frac{d\left(\frac{J_{ij}}{J_{jj}}\right)}{d\alpha} = \underbrace{\frac{\partial n(s;\alpha)}{\partial \alpha}}_{=0} + \underbrace{\frac{\partial n(s;\alpha)}{\partial s}}_{=0} \underbrace{\frac{\partial z(\frac{J_L}{J_{ij}}, \frac{J_L}{J_{jj}}, \frac{J_{ij}}{J_{jj}};\alpha)}{\partial \alpha}}_{<0} = 0.$$

4. By totally differentiating with respect with respect to θ we get:

$$\frac{ds}{d\theta} = \underbrace{\frac{\partial z(\frac{J_L}{J_{ij}}, \frac{J_L}{J_{jj}}, \frac{J_{ij}}{J_{jj}};\theta)}{\partial \theta}}_{=0} + \underbrace{\frac{\partial z(\frac{J_L}{J_{ij}}, \frac{J_L}{J_{jj}}, \frac{J_{ij}}{J_{jj}};\theta)}{\partial \frac{J_L}{J_{ij}}}}_{<0} \underbrace{\frac{\partial h(s;\theta)}{\partial \theta}}_{<0}$$

$$+ \underbrace{\frac{\partial z(\frac{J_L}{J_{ij}}, \frac{J_L}{J_{jj}}, \frac{J_{ij}}{J_{jj}};\theta)}{\partial \frac{J_L}{J_{jj}}}}_{<0} \underbrace{\frac{\partial m(s;\theta)}{\partial \theta}}_{<0} + \underbrace{\frac{\partial z(\frac{J_L}{J_{ij}}, \frac{J_L}{J_{jj}}, \frac{J_{ij}}{J_{jj}};\theta)}{\partial \frac{J_{ij}}{J_{jj}}}}_{<0} \underbrace{\frac{\partial n(s;\theta)}{\partial \theta}}_{<0} > 0,$$

$$\frac{d\left(\frac{J_L}{J_{ij}}\right)}{d\theta} = \underbrace{\frac{\partial h(s;\theta)}{\partial \theta}}_{<0} + \underbrace{\frac{\partial h(s;\theta)}{\partial s}}_{>0} \underbrace{\frac{\partial z(\frac{J_L}{J_{ij}}, \frac{J_L}{J_{jj}}, \frac{J_{ij}}{J_{jj}};\theta)}{\partial \theta}}_{=0} < 0,$$

$$\frac{d\left(\frac{J_L}{J_{jj}}\right)}{d\theta} = \underbrace{\frac{\partial m(s;\theta)}{\partial \theta}}_{<0} + \underbrace{\frac{\partial m(s;\theta)}{\partial s}}_{>0} \underbrace{\frac{\partial z(\frac{J_L}{J_{ij}}, \frac{J_L}{J_{jj}}, \frac{J_{ij}}{J_{jj}};\theta)}{\partial \theta}}_{=0} < 0,$$

and

$$\frac{d\left(\frac{J_{ij}}{J_{jj}}\right)}{d\theta} = \underbrace{\frac{\partial n(s;\theta)}{\partial \theta}}_{<0} + \underbrace{\frac{\partial n(s;\theta)}{\partial s}}_{=0} \underbrace{\frac{\partial z(\frac{J_L}{J_{ij}}, \frac{J_L}{J_{jj}}, \frac{J_{ij}}{J_{jj}};\theta)}{\partial \theta}}_{=0} < 0.$$

5. By totally differentiating with respect to f_s we get:

$$\frac{ds}{df_s} = \underbrace{\frac{\partial z(\frac{J_L}{J_{ij}},\frac{J_L}{J_{jj}},\frac{J_{ij}}{J_{jj}};f_s)}{\partial f_s}}_{<0} + \underbrace{\frac{\partial z(\frac{J_L}{J_{ij}},\frac{J_L}{J_{jj}},\frac{J_{ij}}{J_{jj}};f_s)}{\partial \frac{J_L}{J_{ij}}}}_{<0}\underbrace{\frac{\partial h(s;f_s)}{\partial f_s}}_{<0}$$

$$+\underbrace{\frac{\partial z(\frac{J_L}{J_{ij}},\frac{J_L}{J_{jj}},\frac{J_{ij}}{J_{jj}};f_s)}{\partial \frac{J_L}{J_{jj}}}}_{<0}\underbrace{\frac{\partial m(s;f_s)}{\partial f_s}}_{<0} + \underbrace{\frac{\partial z(\frac{J_L}{J_{ij}},\frac{J_L}{J_{jj}},\frac{J_{ij}}{J_{jj}};f_s)}{\partial \frac{J_{ij}}{J_{jj}}}}_{<0}\underbrace{\frac{\partial n(s;f_s)}{\partial f_s}}_{=0} > 0,$$

$$\frac{d\left(\frac{J_L}{J_{ij}}\right)}{df_s} = \underbrace{\frac{\partial h(s;f_s)}{\partial f_s}}_{<0} + \underbrace{\frac{\partial h(s;f_s)}{\partial s}}_{>0}\underbrace{\frac{\partial z(\frac{J_L}{J_{ij}},\frac{J_L}{J_{jj}},\frac{J_{ij}}{J_{jj}};f_s)}{\partial f_s}}_{<0} < 0,$$

$$\frac{d\left(\frac{J_L}{J_{jj}}\right)}{df_s} = \underbrace{\frac{\partial m(s;f_s)}{\partial f_s}}_{<0} + \underbrace{\frac{\partial m(s;f_s)}{\partial s}}_{>0}\underbrace{\frac{\partial z(\frac{J_L}{J_{ij}},\frac{J_L}{J_{jj}},\frac{J_{ij}}{J_{jj}};f_s)}{\partial f_s}}_{<0} < 0,$$

and

$$\frac{d\left(\frac{J_{ij}}{J_{jj}}\right)}{df_s} = \underbrace{\frac{\partial n(s;f_s)}{\partial f_s}}_{=0} + \underbrace{\frac{\partial n(s;f_s)}{\partial s}}_{=0}\underbrace{\frac{\partial z(\frac{J_L}{J_{ij}},\frac{J_L}{J_{jj}},\frac{J_{ij}}{J_{jj}};f_s)}{\partial f_s}}_{<0} = 0.$$

Note that $\left(\frac{f_{ij}}{f_s}\right)\frac{J_{ij}}{J_L}$ and $\left(\frac{f_{jj}}{f_s}\right)\frac{J_{jj}}{J_L}$ both are increasing in f_s. Therefore, R_{jj} and $\tilde{\epsilon}_{R_{E,high}}$ both increase, the indirect effect dominates, such that $\frac{ds}{df_s} > 0$.

6. By totally differentiating with respect to f_s we get:

$$\frac{ds}{df_{jj}} = \underbrace{\frac{\partial z(\frac{J_L}{J_{ij}},\frac{J_L}{J_{jj}},\frac{J_{ij}}{J_{jj}};f_{jj})}{\partial f_{jj}}}_{>0} + \underbrace{\frac{\partial z(\frac{J_L}{J_{ij}},\frac{J_L}{J_{jj}},\frac{J_{ij}}{J_{jj}};f_{jj})}{\partial \frac{J_L}{J_{ij}}}}_{<0}\underbrace{\frac{\partial h(s;f_{jj})}{\partial f_{jj}}}_{=0}$$

$$+\underbrace{\frac{\partial z(\frac{J_L}{J_{ij}},\frac{J_L}{J_{jj}},\frac{J_{ij}}{J_{jj}};f_{jj})}{\partial \frac{J_L}{J_{jj}}}}_{<0}\underbrace{\frac{\partial m(s;f_{jj})}{\partial f_{jj}}}_{>0} + \underbrace{\frac{\partial z(\frac{J_L}{J_{ij}},\frac{J_L}{J_{jj}},\frac{J_{ij}}{J_{jj}};f_{jj})}{\partial \frac{J_{ij}}{J_{jj}}}}_{<0}\underbrace{\frac{\partial n(s;f_{jj})}{\partial f_{jj}}}_{>0} < 0,$$

$$\frac{d\left(\frac{J_L}{J_{ij}}\right)}{df_{jj}} = \underbrace{\frac{\partial h(s;f_{jj})}{\partial f_{jj}}}_{=0} + \underbrace{\frac{\partial h(s;f_{jj})}{\partial s}}_{>0}\underbrace{\frac{\partial z(\frac{J_L}{J_{ij}},\frac{J_L}{J_{jj}},\frac{J_{ij}}{J_{jj}};f_{jj})}{\partial f_{jj}}}_{>0} > 0,$$

$$\frac{d\left(\frac{J_L}{J_{jj}}\right)}{df_{jj}} = \underbrace{\frac{\partial m(s;f_{jj})}{\partial f_{jj}}}_{>0} + \underbrace{\frac{\partial m(s;f_{jj})}{\partial s}}_{>0}\underbrace{\frac{\partial z(\frac{J_L}{J_{ij}},\frac{J_L}{J_{jj}},\frac{J_{ij}}{J_{jj}};f_{jj})}{\partial f_{jj}}}_{>0} > 0,$$

and

$$\frac{d\left(\frac{J_{ij}}{J_{jj}}\right)}{df_{jj}} = \underbrace{\frac{\partial n(s;f_{jj})}{\partial f_{jj}}}_{>0} + \underbrace{\frac{\partial n(s;f_{jj})}{\partial s}}_{=0}\underbrace{\frac{\partial z(\frac{J_L}{J_{ij}},\frac{J_L}{J_{jj}},\frac{J_{ij}}{J_{jj}};f_{jj})}{\partial f_{jj}}}_{>0} > 0.$$

Note that $\frac{J_{jj}}{J_L}\left(\frac{f_{jj}}{f_s}\right)$ is decreasing in f_{jj} and $\frac{J_{ij}}{J_{jj}}\frac{f_{ij}}{f_{jj}}$ is increasing in f_{jj}. Therefore, R_{jj} and $\tilde{\epsilon}_{R_{E,high}}$ both decrease, the indirect effect dominates, such that $\frac{ds}{df_{jj}} < 0$.

□

4.B Free entry

In the main body of the paper, I follow Chaney (2008) by assuming that the mass of entrants is exogenous. To relax this assumption, in this section I allow for free entry, such that the mass of entrants is endogenously determined as in Melitz (2003).[43] Out of an unbounded mass of *prospective* entrants, a mass of $J_{i,e}$ of firms decides to enter in country i. To enter and to obtain its productivity draw, a firm has to pay sunk entry costs f_e. Conditional on entry, firms that make negative profits immediately exit and do not produce, such that the mass of active firms J_{ii} is a subset of the mass of entrants $J_{i,e}$. With probability δ a producing firm has to exit. In a steady state, firm exit equals firm entry: $(1 - V(\varphi_{ii}^*))J_{i,e} = \delta J_{ii}$. As in the main body of the paper, the wage rate is fixed to one and the total mass of labor in the economy is also normalized to unity.

Before solving the model with a costly export subsidy and free entry, I derive the equilibrium in the baseline model with free entry. I show that in the baseline model with symmetric countries free entry is irrelevant: the mass of active firms is the same as in a model with an exogenous mass of entrants (Chaney, 2008). However, under country asymmetries, the mass of active firms and the mass of entrants depends on the fixed costs and on iceberg trade costs. If a costly export subsidy is unilaterally introduced, the resulting production relocation effect leads to entry of firms in the home country and to exit of firms in the foreign country. This increases export participation and exports. Note that under free entry aggregate profits are competed away, such that the profit shifting effect turns into a production relocation effect.

4.B.1 Baseline model

Define average productivity of firms above cutoff φ_{xy}^* as $\tilde{\varphi}_{xy} = \left[\int_{\varphi_{xy}^*}^{\infty} \varphi^{\sigma-1} \frac{v(\varphi)}{1-V(\varphi_{xy}^*)} d\varphi\right]^{\frac{1}{\sigma-1}}$. Under a Pareto distribution of productivity, $V(\varphi) = 1 - \left(\frac{b}{\varphi}\right)^{\theta}$, average productivity of exporters is $\tilde{\varphi}_{ij} = \left(\frac{\theta}{\theta+1-\sigma}\right)^{\frac{1}{\sigma-1}} \varphi_{ij}^*$ and average productivity of all firms located in country i is $\tilde{\varphi}_{ii} = \left(\frac{\theta}{\theta+1-\sigma}\right)^{\frac{1}{\sigma-1}} \varphi_{ii}^*$. Average revenues of firms located in country i are defined by $\bar{r}_i = r_{ii}(\tilde{\varphi}_{ii}) + \frac{1-V(\varphi_{ij}^*)}{1-V(\varphi_{ii}^*)} r_{ij}(\tilde{\varphi}_{ij})$. By the zero profit condition, domestic profits at the domestic product market cutoff φ_{ii}^* are zero, $\pi_{ii}(\varphi_{ii}^*) = 0 \Longleftrightarrow r_{ii}(\varphi_{ii}^*) = \sigma f_{ii}$, and export profits at the export cutoff φ_{ij}^* are also zero, $\pi_{ij}(\varphi_{ij}^*) = 0 \Longleftrightarrow r_{ij}(\varphi_{ij}^*) = \sigma f_{ij}$. Therefore, we get $r_{ii}(\tilde{\varphi}_{ii}) = r_{ii}(\varphi_{ii}^*)\left(\frac{\tilde{\varphi}_{ii}}{\varphi_{ii}^*}\right)^{\sigma-1}$ and $r_{ij}(\tilde{\varphi}_{ij}) = r_{ij}(\varphi_{ij}^*)\left(\frac{\tilde{\varphi}_{ij}}{\varphi_{ij}^*}\right)^{\sigma-1}$. Together with $\frac{(1-V(\varphi_{ij}^*))}{(1-V(\varphi_{ii}^*))} = \left(\frac{\varphi_{ii}^*}{\varphi_{ij}^*}\right)^{\theta}$ average revenues of firms located in country i can be written as

$$\bar{r}_i = \frac{\theta\sigma}{\theta+1-\sigma} f_{ii}\left(1 + \left(\frac{\varphi_{ii}^*}{\varphi_{ij}^*}\right)^{\theta} \frac{f_{ij}}{f_{ii}}\right).$$

Average profits are defined by $\bar{\pi}_i = \pi_{ii}(\tilde{\varphi}_{ii}) + \frac{1-V(\varphi_{ij}^*)}{1-V(\varphi_{ii}^*)}\pi_{ij}(\tilde{\varphi}_{ij})$. Under CES variable profits are proportional to revenues. Therefore, average profits of firms located in country i can

[43] Note that Arkolakis et al. (2008) show that with a Pareto distribution of productivity and CES preferences, heterogeneous firms models with a fixed measure of entrants (proportional to country size) and with free entry are isomorphic. In equilibrium, under free entry aggregate profits are no longer positive but equal to aggregate entry costs.

be written as

$$\bar{\pi}_i = \frac{\sigma - 1}{\theta + 1 - \sigma} f_{ii} \left(1 + \left(\frac{\varphi_{ii}^*}{\varphi_{ij}^*}\right)^{\theta} \frac{f_{ij}}{f_{ii}}\right).$$

4.B.1.1 Symmetric countries

Note that under country symmetry $\varphi_{ii}^* = \varphi_{jj}^*$ and $\varphi_{ij}^* = \varphi_{ji}^*$, such that by the zero profit conditions $\varphi_{ij}^* = \varphi_{ii}^* \left(\frac{\tau_{ij}}{\tau_{ii}}\right)\left(\frac{f_{ij}}{f_{ii}}\right)^{\frac{1}{\sigma-1}}$. Therefore,

$$\bar{r}_i = \frac{\theta\sigma}{\theta + 1 - \sigma} f_{ii} \left(1 + \left(\frac{\tau_{ij}}{\tau_{ii}}\right)^{-\theta} \left(\frac{f_{ii}}{f_{ij}}\right)^{\frac{\theta-\sigma+1}{\sigma-1}}\right)$$

and

$$\bar{\pi}_i = \frac{\sigma - 1}{\theta + 1 - \sigma} f_{ii} \left(1 + \left(\frac{\tau_{ij}}{\tau_{ii}}\right)^{-\theta} \left(\frac{f_{ii}}{f_{ij}}\right)^{\frac{\theta-\sigma+1}{\sigma-1}}\right).$$

Together with the free entry condition $\bar{\pi}_i = \frac{\delta f_e}{1-V(\varphi_{ii}^*)} = \frac{\delta f_e}{\left(\frac{b}{\varphi_{ii}^*}\right)^{\theta}}$, we can solve for the domestic product market cutoff:

$$\varphi_{ii}^* = \left[b^{\theta} \frac{\sigma - 1}{\theta + 1 - \sigma} \frac{f_{ii}}{\delta f_e} \left(1 + \left(\frac{\tau_{ij}}{\tau_{ii}}\right)^{-\theta} \left(\frac{f_{ii}}{f_{ij}}\right)^{\frac{\theta-\sigma+1}{\sigma-1}}\right)\right]^{\frac{1}{\theta}}.$$

By symmetry $J_{ii} = \frac{y_i}{\bar{r}_i}$, such that the mass of active firms is

$$J_{ii} = \frac{\theta + 1 - \sigma}{\theta\sigma} \frac{y_i}{f_{ii}} \left(1 + \left(\frac{\tau_{ij}}{\tau_{ii}}\right)^{-\theta} \left(\frac{f_{ii}}{f_{ij}}\right)^{\frac{\theta-\sigma+1}{\sigma-1}}\right)^{-1}.$$

By the steady state condition, the mass of entrants is

$$J_{i,e} = \frac{\delta J_{ii}}{1 - V(\varphi_{ii}^*)} = \frac{\sigma - 1}{\theta\sigma} \frac{y_i}{f_e}.$$

Hence, in comparison to autarky, the mass of entrants stays constant, while active firms are fewer and more productive. In comparison to the baseline model of the paper where the mass of entrants is exogenous, under symmetry the model with free entry yields exactly the same number of active firms.

4.B.1.2 Asymmetric countries

With asymmetric countries, there is no longer a straightforward relationship between φ_{ij}^* and φ_{ii}^*, because $\varphi_{ij}^* \neq \varphi_{ji}^*$. The mass of entrants is not necessarily identical across countries. Instead of being pinned down by the condition $J_{ii} = \frac{y_i}{\bar{r}_i}$, the mass of active firms is determined by the two market clearing conditions with two unknown variables, J_{ii} and J_{jj}.

Substituting the expression for average profits into the free entry conditions of both countries yields a system of two equations and two unknowns:

$$(\varphi_{ii}^*)^{-\theta} = \frac{\delta f_e}{b^{\theta} f_{ii}} \left(\frac{\theta + 1 - \sigma}{\sigma - 1}\right) - (\varphi_{jj}^*)^{-\theta} \frac{f_{ij}}{f_{ii}} \left(\frac{\tau_{jj}}{\tau_{ij}}\right)^{\theta} \left(\frac{f_{ij}}{f_{jj}}\right)^{-\frac{\theta}{\sigma-1}} \tag{4.29}$$

$$(\varphi_{jj}^*)^{-\theta} = \frac{\delta f_e}{b^{\theta} f_{jj}} \left(\frac{\theta + 1 - \sigma}{\sigma - 1}\right) - (\varphi_{ii}^*)^{-\theta} \frac{f_{ji}}{f_{jj}} \left(\frac{\tau_{ii}}{\tau_{ji}}\right)^{\theta} \left(\frac{f_{ji}}{f_{ii}}\right)^{-\frac{\theta}{\sigma-1}}. \tag{4.30}$$

Plugging (4.29) in (4.30) and solving for φ_{ii}^* gives

$$\varphi_{ii}^* = \left[\left(\frac{\sigma-1}{\theta+1-\sigma}\right) \frac{b^\theta f_{ii}}{\delta f_e} \frac{1 - \left(\frac{\tau_{ii}}{\tau_{ji}}\right)^\theta \left(\frac{f_{ji}}{f_{ii}}\right)^{\frac{\sigma-1-\theta}{\sigma-1}} \left(\frac{\tau_{jj}}{\tau_{ij}}\right)^\theta \left(\frac{f_{ij}}{f_{jj}}\right)^{\frac{\sigma-1-\theta}{\sigma-1}}}{\left(1 - \left(\frac{\tau_{jj}}{\tau_{ij}}\right)^\theta \left(\frac{f_{ij}}{f_{jj}}\right)^{\frac{\sigma-1-\theta}{\sigma-1}}\right)} \right]^{\frac{1}{\theta}}.$$

Therefore,

$$\varphi_{jj}^* = \left[\left(\frac{\sigma-1}{\theta+1-\sigma}\right) \frac{b^\theta f_{jj}}{\delta f_e} \frac{1 - \left(\frac{\tau_{ii}}{\tau_{ji}}\right)^\theta \left(\frac{f_{ji}}{f_{ii}}\right)^{\frac{\sigma-1-\theta}{\sigma-1}} \left(\frac{\tau_{jj}}{\tau_{ij}}\right)^\theta \left(\frac{f_{ij}}{f_{jj}}\right)^{\frac{\sigma-1-\theta}{\sigma-1}}}{\left(1 - \left(\frac{\tau_{ii}}{\tau_{ji}}\right)^\theta \left(\frac{f_{ji}}{f_{ii}}\right)^{\frac{\sigma-1-\theta}{\sigma-1}}\right)} \right]^{\frac{1}{\theta}}.$$

Note that $\frac{\varphi_{ii}^*}{\varphi_{jj}^*} = \left[\frac{f_{ii}}{f_{jj}} \frac{1-\left(\frac{\tau_{ii}}{\tau_{ji}}\right)^\theta \left(\frac{f_{ji}}{f_{ii}}\right)^{\frac{\sigma-1-\theta}{\sigma-1}}}{1-\left(\frac{\tau_{jj}}{\tau_{ij}}\right)^\theta \left(\frac{f_{ij}}{f_{jj}}\right)^{\frac{\sigma-1-\theta}{\sigma-1}}} \right]^{\frac{1}{\theta}}$ and $\varphi_{ij}^* = \varphi_{jj}^* \frac{\tau_{ij}}{\tau_{jj}} \left(\frac{f_{ij}}{f_{jj}}\right)^{\frac{1}{\sigma-1}}$ and $\varphi_{ji}^* = \varphi_{ii}^* \frac{\tau_{ji}}{\tau_{ii}} \left(\frac{f_{ji}}{f_{ii}}\right)^{\frac{1}{\sigma-1}}$.

To solve for the mass of active firms, note that aggregate revenues in the differentiated goods sector in country i have to be equal to y_i. Moreover, the mass of firms exporting from i to j, J_{ij}, is the mass of active firms in country i multiplied by the conditional probability to be an exporter $J_{ii}\frac{(1-V(\varphi_{ij}^*))}{(1-V(\varphi_{ii}^*))}$. This yields a system of two market clearing conditions with two unknowns, J_{ii} and J_{jj}. With $r_{ii}(\tilde{\varphi}_{ii}) = \sigma f_{ii}\frac{\theta}{\theta+1-\sigma}$, $r_{ij}(\tilde{\varphi}_{ij}) = \sigma f_{ij}\frac{\theta}{\theta+1-\sigma}$, $r_{jj}(\tilde{\varphi}_{jj}) = \sigma f_{jj}\frac{\theta}{\theta+1-\sigma}$ and $r_{ji}(\tilde{\varphi}_{ji}) = \sigma f_{ji}\frac{\theta}{\theta+1-\sigma}$ we get

$$J_{ii} = \frac{\theta+1-\sigma}{\theta\sigma}\frac{y_i}{f_{ii}} - J_{jj}\frac{(1-V(\varphi_{ji}^*))}{(1-V(\varphi_{jj}^*))}\frac{f_{ji}}{f_{ii}}$$
$$J_{jj} = \frac{\theta+1-\sigma}{\theta\sigma}\frac{y_j}{f_{jj}} - J_{ii}\frac{(1-V(\varphi_{ij}^*))}{(1-V(\varphi_{ii}^*))}\frac{f_{ij}}{f_{jj}}.$$

With $\frac{(1-V(\varphi_{ij}^*))}{(1-V(\varphi_{ii}^*))} = \left(\frac{\varphi_{ii}^*}{\varphi_{ij}^*}\right)^\theta$, $\varphi_{ij}^* = \varphi_{jj}^* \frac{\tau_{ij}}{\tau_{jj}} \left(\frac{f_{ij}}{f_{jj}}\right)^{\frac{1}{\sigma-1}}$ and $\varphi_{ji}^* = \varphi_{ii}^* \frac{\tau_{ji}}{\tau_{ii}} \left(\frac{f_{ji}}{f_{ii}}\right)^{\frac{1}{\sigma-1}}$ we get:

$$J_{ii} = \frac{\theta+1-\sigma}{\theta\sigma}\frac{y_i}{f_{ii}} \frac{1 - \left(\frac{\tau_{ii}}{\tau_{ji}}\right)^\theta \left(\frac{f_{ji}}{f_{ii}}\right)^{\frac{\sigma-1-\theta}{\sigma-1}} \frac{f_{ii}}{f_{jj}}\frac{y_j}{y_i}\left(\frac{\varphi_{jj}^*}{\varphi_{ii}^*}\right)^\theta}{\left(1 - \left(\frac{\tau_{ii}}{\tau_{ji}}\frac{\tau_{jj}}{\tau_{ij}}\right)^\theta \left(\frac{f_{ji}}{f_{ii}}\frac{f_{ij}}{f_{jj}}\right)^{\frac{\sigma-1-\theta}{\sigma-1}}\right)},$$

where $\frac{\varphi_{jj}^*}{\varphi_{ii}^*} = \left[\frac{f_{jj}}{f_{ii}} \frac{1-\left(\frac{\tau_{jj}}{\tau_{ij}}\right)^\theta \left(\frac{f_{ij}}{f_{jj}}\right)^{\frac{\sigma-1-\theta}{\sigma-1}}}{1-\left(\frac{\tau_{ii}}{\tau_{ji}}\right)^\theta \left(\frac{f_{ji}}{f_{ii}}\right)^{\frac{\sigma-1-\theta}{\sigma-1}}} \right]^{\frac{1}{\theta}}$. The number of entrants is pinned down by the steady state condition $J_{i,e} = \frac{\delta J_{ii}}{1-V(\varphi_{ii}^*)}$. Therefore,

$$J_{i,e} = \frac{\sigma-1}{\theta\sigma}\frac{y_i}{f_e} \frac{1 - \left(\frac{\tau_{ii}}{\tau_{ji}}\right)^\theta \left(\frac{f_{ji}}{f_{ii}}\right)^{\frac{\sigma-1-\theta}{\sigma-1}} \frac{y_j}{y_i}\frac{f_{ii}}{f_{jj}}\left(\frac{\varphi_{jj}^*}{\varphi_{ii}^*}\right)^\theta}{1 - \left(\frac{\tau_{jj}}{\tau_{ij}}\right)^\theta \left(\frac{f_{ij}}{f_{jj}}\right)^{\frac{\sigma-1-\theta}{\sigma-1}}}.$$

Note that under symmetry this expression simplifies to $J_{i,e} = \frac{\sigma-1}{\theta\sigma}\frac{y_i}{f_e}$. However, with asymmetric countries the mass of entrants depends also on the fixed costs and on iceberg trade costs.

4.B.2 Model with costly export subsidy

Country i unilaterally introduces an export subsidy $s > 1$ on variable export costs. To receive the export subsidy, firms have to pay fixed costs f_s. To keep the analysis brief, I focus on the high costs case only. There are three cutoff conditions. First, for the domestic product market cutoff:

$$\pi_{ii}(\varphi_{ii}^*) = 0 \Longleftrightarrow r_{ii}(\varphi_{ii}^*) = \sigma f;$$

second, for the export cutoff φ_{ij}^*:

$$\pi_{ij}(\varphi_{ij}^*) = 0 \Longleftrightarrow r_{ij}(\varphi_{ij}^*) = \sigma f_{ij};$$

and third, for the lobby cutoff φ_L^* :

$$\pi_{ij,s}(\varphi_L^*) = \pi_{ij}(\varphi_L^*) \Longleftrightarrow \left(s^{\sigma-1} - 1\right) r_{ij}(\varphi_L^*) = \sigma f_s.$$

Average productivity for all domestic firms, for exporters and for subsidized firms is, respectively: $\tilde{\varphi}_{ii} = \left(\frac{\theta}{\theta+1-\sigma}\right)^{\frac{1}{\sigma-1}} \varphi_{ii}^*$, $\tilde{\varphi}_{ij} = \left(\frac{\theta}{\theta+1-\sigma}\right)^{\frac{1}{\sigma-1}} \varphi_{ij}^*$ and $\tilde{\varphi}_L = \left(\frac{\theta}{\theta+1-\sigma}\right)^{\frac{1}{\sigma-1}} \varphi_L^*$. By the zero profit conditions $\frac{r_{ij}(\varphi_L^*)}{r_{ij}(\varphi_{ij}^*)} = \left(\frac{\varphi_L^*}{\varphi_{ij}^*}\right)^{\sigma-1} = \frac{f_s}{f_{ij}(s^{\sigma-1}-1)}$ and therefore, $\varphi_L^* = \left(\frac{f_s}{f_{ij}(s^{\sigma-1}-1)}\right)^{\frac{1}{\sigma-1}} \varphi_{ij}^*$, such that $\tilde{\varphi}_L = \left(\frac{f_s}{f_{ij}(s^{\sigma-1}-1)}\right)^{\frac{1}{\sigma-1}} \tilde{\varphi}_{ij}$. Average export revenues are defined by $\bar{r}_{ij} = r_{ij}(\tilde{\varphi}_{ij}) + \frac{1-V(\varphi_L^*)}{1-V(\varphi_{ij}^*)}(s^{\sigma-1}-1) r_{ij}(\tilde{\varphi}_L)$. With $r_{ii}(\varphi_{ii}^*) = \sigma f_{ii}$, $r_{ij}(\varphi_{ij}^*) = \sigma f_{ij}$, $r_{ij}(\varphi_L^*) = \frac{\sigma f_s}{(s^{\sigma-1}-1)}$, $r_{ij}(\tilde{\varphi}_L) = r_{ij}(\varphi_L^*)(\frac{\tilde{\varphi}_L}{\varphi_L^*})^{\sigma-1}$, $r_{ij}(\tilde{\varphi}_{ij}) = r_{ij}(\varphi_{ij}^*)(\frac{\tilde{\varphi_L}_{ij}}{\varphi_{ij}^*})^{\sigma-1}$, $\frac{1-V(\varphi_L^*)}{1-V(\varphi_{ij}^*)} = \left(\frac{\frac{b}{\varphi_L^*}}{\frac{b}{\varphi_{ij}^*}}\right)^{\theta} = \left(\frac{\varphi_{ij}^*}{\varphi_L^*}\right)^{\theta}$, $\tilde{\varphi}_L = \left(\frac{\theta}{\theta+1-\sigma}\right)^{\frac{1}{\sigma-1}} \varphi_L^*$ and $\left(\frac{\varphi_{ij}^*}{\varphi_L^*}\right)^{\theta} = \left(\frac{f_s}{f_{ij}(s^{\sigma-1}-1)}\right)^{-\frac{\theta}{\sigma-1}}$ we get

$$\bar{r}_{ij} = \frac{\theta\sigma}{\theta+1-\sigma} f_{ij} \left(1 + \left(\frac{f_s}{f_{ij}(s^{\sigma-1}-1)}\right)^{-\frac{\theta}{\sigma-1}} \frac{f_s}{f_{ij}}\right).$$

Average revenues of firms located in country i are $\bar{r}_i = r_{ii}(\tilde{\varphi}_{ii}) + \frac{1-V(\varphi_{ij}^*)}{1-V(\varphi_{ii}^*)} \bar{r}_{ij}$. Therefore,

$$\bar{r}_i = \frac{\theta\sigma}{\theta+1-\sigma} f_{ii} \left[1 + \frac{f_{ij}}{f_{ii}} + \left(\frac{f_s}{f_{ij}(s^{\sigma-1}-1)}\right)^{-\frac{\theta}{\sigma-1}} \frac{f_s}{f_{ii}}\right].$$

Average export profits are defined by $\bar{\pi}_{ij} = \frac{\bar{r}_i}{\sigma} - f_{ij} - \frac{1-V(\varphi_L^*)}{1-V(\varphi_{ij}^*)} f_s$. Therefore,

$$\bar{\pi}_{ij} = \frac{\sigma-1}{\theta+1-\sigma} f_{ij} \left(1 + \left(\frac{f_s}{f_{ij}(s^{\sigma-1}-1)}\right)^{-\frac{\theta}{\sigma-1}} \frac{f_s}{f_{ij}}\right).$$

Average profits in country i are defined by $\bar{\pi}_i = \pi_{ii}(\tilde{\varphi}_{ii}) + \frac{1-V(\varphi_{ij}^*)}{1-V(\varphi_{ii}^*)} \bar{\pi}_{ij}$. Using $\varphi_{ij}^* = \varphi_{jj}^* \frac{\tau_{ij}}{\tau_{jj}} \left(\frac{f_{ij}}{f_{jj}}\right)^{\frac{1}{\sigma-1}}$ we get

$$\bar{\pi}_i = f_{ii}(\frac{\sigma-1}{\theta+1-\sigma}) \left[1 + \left(\frac{\varphi_{ii}^*}{\varphi_{jj}^*}\right)^{\theta} \left(\frac{\tau_{jj}}{\tau_{ij}}\right)^{\theta} \left(\frac{f_{jj}}{f_{ij}}\right)^{\frac{\theta}{\sigma-1}} \frac{f_{ij}}{f_{ii}} \left[1 + \left(\frac{f_s}{f_{ij}(s^{\sigma-1}-1)}\right)^{\frac{-\theta}{\sigma-1}} \frac{f_s}{f_{ij}}\right]\right].$$

Plugging this expression into the free entry condition, $\bar{\pi}_i = \frac{\delta f_e}{1-V(\varphi_{ii}^*)} = \frac{\delta f_e}{\left(\frac{b}{\varphi_{ii}^*}\right)^{\theta}}$, gives

$$(\varphi_{ii}^*)^{-\theta} = \frac{\delta f_e}{b^{\theta} f_{ii}} \frac{\theta+1-\sigma}{\sigma-1} - (\varphi_{jj}^*)^{-\theta} \left(\frac{\tau_{jj}}{\tau_{ij}}\right)^{\theta} \left(\frac{f_{jj}}{f_{ij}}\right)^{\frac{\theta}{\sigma-1}} \frac{f_{ij}}{f_{ii}} \left[1 + \left(\frac{f_s}{f_{ij}(s^{\sigma-1}-1)}\right)^{\frac{-\theta}{\sigma-1}} \frac{f_s}{f_{ij}}\right].$$

If the subsidy is unilaterally introduced and there is no export subsidy in country j, the free entry condition in country j is

$$\bar{\pi}_j = \frac{\sigma-1}{\theta+1-\sigma} f_{jj} \left[1 + \left(\frac{\varphi_{jj}^*}{\varphi_{ji}^*}\right)^{\theta} \frac{f_{ji}}{f_{jj}}\right] = \frac{\delta f_e}{\left(\frac{b}{\varphi_{ii}^*}\right)^{\theta}}.$$

The free entry conditions of both countries yield a system of two equations with two unknowns φ_{ii}^* and φ_{jj}^*:

$$(\varphi_{ii}^*)^{-\theta} = \frac{\delta f_e}{b^\theta f_{ii}}\frac{\theta+1-\sigma}{\sigma-1} - \left(\varphi_{jj}^*\right)^{-\theta}\left(\frac{\tau_{jj}}{\tau_{ij}}\right)^{\theta}\left(\frac{f_{jj}}{f_{ij}}\right)^{\frac{\theta}{\sigma-1}}\frac{f_{ij}}{f_{ii}}\left[1+\left(\frac{f_s}{f_{ij}(s^{\sigma-1}-1)}\right)^{\frac{-\theta}{\sigma-1}}\frac{f_s}{f_{ij}}\right] \tag{4.31}$$

$$\left(\varphi_{jj}^*\right)^{-\theta} = \frac{\delta f_e}{b^\theta f_{jj}}\left(\frac{\theta+1-\sigma}{\sigma-1}\right) - (\varphi_{ii}^*)^{-\theta}\frac{f_{ji}}{f_{jj}}\left(\frac{\tau_{ii}}{\tau_{ji}}\right)^{\theta}\left(\frac{f_{ji}}{f_{ii}}\right)^{-\frac{\theta}{\sigma-1}}. \tag{4.32}$$

Solving for φ_{ii}^* gives

$$\varphi_{ii}^* = \left[\frac{b^\theta f_{ii}}{\delta f_e}\frac{\sigma-1}{\theta+1-\sigma}\frac{1-\left(\frac{\tau_{ii}}{\tau_{ji}}\frac{\tau_{jj}}{\tau_{ij}}\right)^{\theta}\left(\frac{f_{ji}}{f_{ii}}\frac{f_{ij}}{f_{jj}}\right)^{\frac{\sigma-1-\theta}{\sigma-1}}\left(1+\left(\frac{f_s}{f_{ij}(s^{\sigma-1}-1)}\right)^{\frac{-\theta}{\sigma-1}}\frac{f_s}{f_{ij}}\right)}{1-\left(\frac{\tau_{jj}}{\tau_{ij}}\right)^{\theta}\left(\frac{f_{jj}}{f_{ij}}\right)^{\frac{\theta-\sigma+1}{\sigma-1}}\left(1+\left(\frac{f_s}{f_{ij}(s^{\sigma-1}-1)}\right)^{\frac{-\theta}{\sigma-1}}\frac{f_s}{f_{ij}}\right)}\right]^{\frac{1}{\theta}}.$$

$$\varphi_{ii}^* = \left[\frac{b^\theta f_{ii}}{\delta f_e}\frac{\sigma-1}{\theta+1-\sigma}\frac{1-\left[\left(\frac{\tau_{ii}}{\tau_{ji}}\right)^{\theta}\left(\frac{f_{ii}}{f_{ji}}\right)^{\frac{\theta-\sigma+1}{\sigma-1}}\right]\left(\frac{\tau_{jj}}{\tau_{ij}}\right)^{\theta}\left(\frac{f_{jj}}{f_{ij}}\right)^{\frac{\theta-\sigma+1}{\sigma-1}}\left(1+\left(\frac{f_s}{f_{ij}(s^{\sigma-1}-1)}\right)^{\frac{-\theta}{\sigma-1}}\frac{f_s}{f_{ij}}\right)}{1-\left(\frac{\tau_{jj}}{\tau_{ij}}\right)^{\theta}\left(\frac{f_{jj}}{f_{ij}}\right)^{\frac{\theta-\sigma+1}{\sigma-1}}\left(1+\left(\frac{f_s}{f_{ij}(s^{\sigma-1}-1)}\right)^{\frac{-\theta}{\sigma-1}}\frac{f_s}{f_{ij}}\right)}\right]^{\frac{1}{\theta}}.$$

Therefore,

$$\varphi_{jj}^* = \left[\frac{b^\theta f_{jj}}{\delta f_e}\frac{\sigma-1}{\theta+1-\sigma}\frac{1-\left(\frac{\tau_{ii}}{\tau_{ji}}\frac{\tau_{jj}}{\tau_{ij}}\right)^{\theta}\left(\frac{f_{ji}}{f_{ii}}\frac{f_{ij}}{f_{jj}}\right)^{\frac{\sigma-1-\theta}{\sigma-1}}\left(1+\left(\frac{f_s}{f_{ij}(s^{\sigma-1}-1)}\right)^{\frac{-\theta}{\sigma-1}}\frac{f_s}{f_{ij}}\right)}{1-\left(\frac{\tau_{ii}}{\tau_{ji}}\right)^{\theta}\left(\frac{f_{ii}}{f_{ji}}\right)^{\frac{\theta-\sigma+1}{\sigma-1}}}\right]^{\frac{1}{\theta}}$$

and

$$\left(\frac{\varphi_{ii}^*}{\varphi_{jj}^*}\right)^{\theta} = \left[\frac{f_{ii}}{f_{jj}}\frac{1-\left(\frac{\tau_{ii}}{\tau_{ji}}\right)^{\theta}\left(\frac{f_{ii}}{f_{ji}}\right)^{\frac{\theta-\sigma+1}{\sigma-1}}}{1-\left(\frac{\tau_{jj}}{\tau_{ij}}\right)^{\theta}\left(\frac{f_{jj}}{f_{ij}}\right)^{\frac{\theta-\sigma+1}{\sigma-1}}\left(1+\left(\frac{f_s}{f_{ij}(s^{\sigma-1}-1)}\right)^{\frac{-\theta}{\sigma-1}}\frac{f_s}{f_{ij}}\right)}\right].$$

The ratio of home and foreign product market cutoffs, is increasing in s.

The number of active firms is determined by the product market clearing conditions in the two countries:

$$\begin{aligned} J_{ii}r_{ii}(\tilde{\varphi}_{ii}) + J_{ji}r_{ji}(\tilde{\varphi}_{ji}) &= y_i \\ J_{jj}r_{jj}(\tilde{\varphi}_{jj}) + J_{ij}\bar{r}_{ij} &= y_j. \end{aligned}$$

With $r_{ij}(\tilde{\varphi}_L) = r_{ij}(\varphi_L^*)(\frac{\tilde{\varphi}_L}{\varphi_L^*})^{\sigma-1} = \frac{\sigma f_s}{(s^{\sigma-1}-1)}\frac{\theta}{\theta+1-\sigma}$, $r_{ij}(\tilde{\varphi}_{ij}) = \sigma f_{ij}\frac{\theta}{\theta+1-\sigma}$, $r_{ji}(\tilde{\varphi}_{ji}) = \sigma f_{ji}\frac{\theta}{\theta+1-\sigma}$, $r_{ii}(\tilde{\varphi}_{ii}) = \sigma f_{ii}\frac{\theta}{\theta+1-\sigma}$, $r_{jj}(\tilde{\varphi}_{jj}) = \sigma f_{jj}\frac{\theta}{\theta+1-\sigma}$ and $\bar{r}_{ij} = \frac{\theta\sigma}{\theta+1-\sigma}f_{ij}\left(1+\left(\frac{f_s}{f_{ij}(s^{\sigma-1}-1)}\right)^{-\frac{\theta}{\sigma-1}}\frac{f_s}{f_{ij}}\right)$, $J_{ji} = J_{jj}\frac{(1-V(\varphi_{ji}^*))}{(1-V(\varphi_{jj}^*))}$ and $J_{ij} = J_{ii}\frac{(1-V(\varphi_{ij}^*))}{(1-V(\varphi_{ii}^*))}J_L = J_{ii}\frac{(1-V(\varphi_L^*))}{(1-V(\varphi_{ii}^*))}$ we get a system with two equations and two unknowns J_{ii} and J_{jj}

$$\begin{aligned} J_{ii} &= \frac{\theta+1-\sigma}{\theta\sigma}\frac{y_i}{f_{ii}} - J_{jj}\frac{f_{ji}}{f_{ii}}\left(\frac{\varphi_{jj}^*}{\varphi_{ji}^*}\right)^{\theta} \\ J_{jj} &= \frac{\theta+1-\sigma}{\theta\sigma}\frac{y_j}{f_{jj}} - J_i\frac{f_{ij}}{f_{jj}}\left(\left(\frac{\varphi_{ii}^*}{\varphi_{ij}^*}\right)^{\theta} + \left(\frac{\varphi_{ii}^*}{\varphi_L^*}\right)^{\theta}\frac{f_s}{f_{ij}}\right). \end{aligned}$$

Solving for J_{ii} delivers

$$J_{ii}=\frac{\theta+1-\sigma}{\theta\sigma}\frac{y_i}{f_{ii}}\left(\frac{1-\frac{y_j}{y_i}\frac{f_{ii}}{f_{jj}}\left(\frac{\varphi_{jj}^*}{\varphi_{ii}^*}\right)^{\theta}\left(\frac{\tau_{ji}}{\tau_{ii}}\right)^{-\theta}\left(\frac{f_{ji}}{f_{ii}}\right)^{\frac{\sigma-1-\theta}{\sigma-1}}}{1-\left(\frac{f_{ij}}{f_{jj}}\frac{f_{ji}}{f_{ii}}\right)^{\frac{\sigma-1-\theta}{\sigma-1}}\left(\frac{\tau_{ji}}{\tau_{ii}}\frac{\tau_{ij}}{\tau_{jj}}\right)^{-\theta}\left(1+\left(\frac{f_s}{f_{ij}(s^{\sigma-1}-1)}\right)^{\frac{-\theta}{\sigma-1}}\frac{f_s}{f_{ij}}\right)}\right).$$

As $\left(\frac{\varphi_{ii}^*}{\varphi_{jj}^*}\right)^{\theta}$ is also increasing in s, J_{ii} is unambiguously increasing in s. Thus, an increase in the export subsidy, leads to more active firms with higher average productivity.

The mass of entering firms is pinned down by the steady state condition, $J_{i,e}=\frac{\delta J_{ii}}{1-V(\varphi_{ii}^*)}$:

$$J_{i,e}=\frac{y_i}{f_e}\frac{\sigma-1}{\theta\sigma}\frac{1-\left(\frac{\tau_{ii}}{\tau_{ji}}\right)^{\theta}\left(\frac{f_{ii}}{f_{ji}}\right)^{\frac{\theta-\sigma+1}{\sigma-1}}\frac{y_j}{y_i}\frac{f_{ii}}{f_{jj}}\left(\frac{\varphi_{jj}^*}{\varphi_{ii}^*}\right)^{\theta}}{\left[1-\left(\frac{\tau_{jj}}{\tau_{ij}}\right)^{\theta}\left(\frac{f_{jj}}{f_{ij}}\right)^{\frac{\theta-\sigma+1}{\sigma-1}}\left(1+\left(\frac{f_s}{f_{ij}(s^{\sigma-1}-1)}\right)^{\frac{-\theta}{\sigma-1}}\frac{f_s}{f_{ij}}\right)\right]},$$

where $\left(\frac{\varphi_{jj}^*}{\varphi_{ii}^*}\right)^{\theta}$ is decreasing in s. Therefore, the mass of entrants is increasing in country i. With $\varphi_{ij}^*=\varphi_{jj}^*\frac{\tau_{ij}}{\tau_{jj}}\left(\frac{f_{ij}}{f_{jj}}\right)^{\frac{1}{\sigma-1}}$ the mass of exporters is

$$J_{ij}=J_{ii}\frac{(1-V(\varphi_{ij}))}{(1-V(\varphi_{ii}))}=J_{ii}\left(\frac{\varphi_{ii}}{\varphi_{jj}^*}\right)^{\theta}\left(\frac{\tau_{jj}}{\tau_{ij}}\right)^{\theta}\left(\frac{f_{ij}}{f_{jj}}\right)^{\frac{-\theta}{\sigma-1}}.$$

Because both J_{ii} and $\frac{(1-V(\varphi_{ij}))}{(1-V(\varphi_{ii}))}$ are both increasing in s, J_{ij} is also increasing in s.

By $\varphi_{ij}^*=\varphi_{jj}^*\frac{\tau_{ij}}{\tau_{jj}}\left(\frac{f_{ij}}{f_{jj}}\right)^{\frac{1}{\sigma-1}}$ and $\varphi_{ji}^*=\varphi_{ii}^*\frac{\tau_{ji}}{\tau_{ii}}\left(\frac{f_{ji}}{f_{ii}}\right)^{\frac{1}{\sigma-1}}$ and $\varphi_L^*=\left(\frac{f_s}{f_{ij}(s^{\sigma-1}-1)}\right)^{\frac{1}{\sigma-1}}\varphi_{ij}^*=\left(\frac{f_s}{f_{ij}(s^{\sigma-1}-1)}\right)^{\frac{1}{\sigma-1}}\frac{\tau_{ij}}{\tau_{jj}}\left(\frac{f_{ij}}{f_{jj}}\right)^{\frac{1}{\sigma-1}}\varphi_{jj}^*$ the mass of active foreign firms is

$$J_{jj}=\frac{\theta+1-\sigma}{\theta\sigma}\frac{y_j}{f_{jj}}\left[\frac{1-\frac{y_i}{y_j}\left(\frac{\tau_{ij}}{\tau_{jj}}\right)^{-\theta}\left(\frac{\varphi_{ii}^*}{\varphi_{jj}^*}\right)^{\theta}\left(\frac{f_{ij}}{f_{jj}}\right)^{\frac{\sigma-1-\theta}{\sigma-1}}\left(1+\frac{f_{jj}}{f_{ii}}\frac{f_s}{f_{ij}}\left(\frac{f_s}{f_{ij}(s^{\sigma-1}-1)}\right)^{-\frac{\theta}{\sigma-1}}\right)}{1-\left(\frac{f_{ij}}{f_{jj}}\frac{f_{ji}}{f_{ii}}\right)^{\frac{\sigma-1-\theta}{\sigma-1}}\left(\frac{\tau_{ji}}{\tau_{ii}}\frac{\tau_{ij}}{\tau_{jj}}\right)^{-\theta}\left(1+\left(\frac{f_s}{f_{ij}(s^{\sigma-1}-1)}\right)^{\frac{-\theta}{\sigma-1}}\frac{f_s}{f_{ij}}\right)}\right].$$

It is straightforward to show that the mass off foreign active firms is declining in s. Together with the decline in the product market cutoff in the foreign country (higher probability to be an active producer), it must be that there are less entering firms in foreign: $J_{j,e}=\frac{\delta J_{jj}}{1-V(\varphi_{jj}^*)}$.

With free entry, the cross-country profit shifting effect turns into a production relocation effect.[44] Due to cheaper imported varieties, an export subsidy leads *initially* to a lower price index in the foreign country (import price effect). However, because home exporters start to make positive profits, there is entry in the home country, and because firms located in the foreign country start to make losses, there is exit in the foreign country. This production relocation effect leads to a decline in the home price index and to a net increase in the foreign price index. While the home price index is only affected by the production relocation effect, the foreign price index is also affected by the (dominated) import price effect. If the foreign price index would just rise to its level before the export subsidy was introduced, domestic exporters would sell more than

[44] For recent contributions on profit shifting effects and delocation effects in a trade policy and trade agreement context see Ossa (2011b), Ossa (2012), Mrazova (2011), Bagwell and Staiger (2009) Bagwell and Staiger (2012).

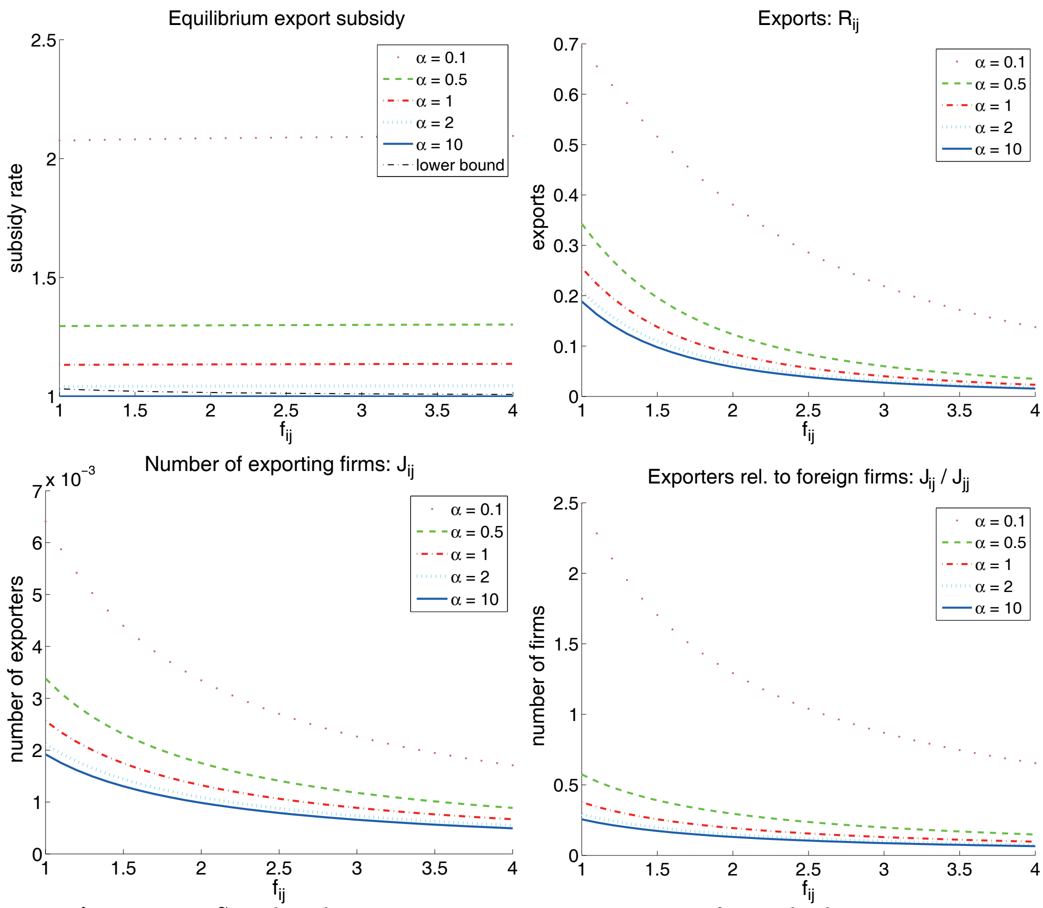

Figure 4.6: Simulated comparative statics: increasing f_{ij} in the low costs case

before and make positive profits.[45]

4.C MATLAB simulation results

4.C.1 Additional figures: low administrative fixed costs

[45]See Ossa (2011a) for a similar argument in the case of a unilateral increase of an import tariff in a (homogenous firm) Krugman model.

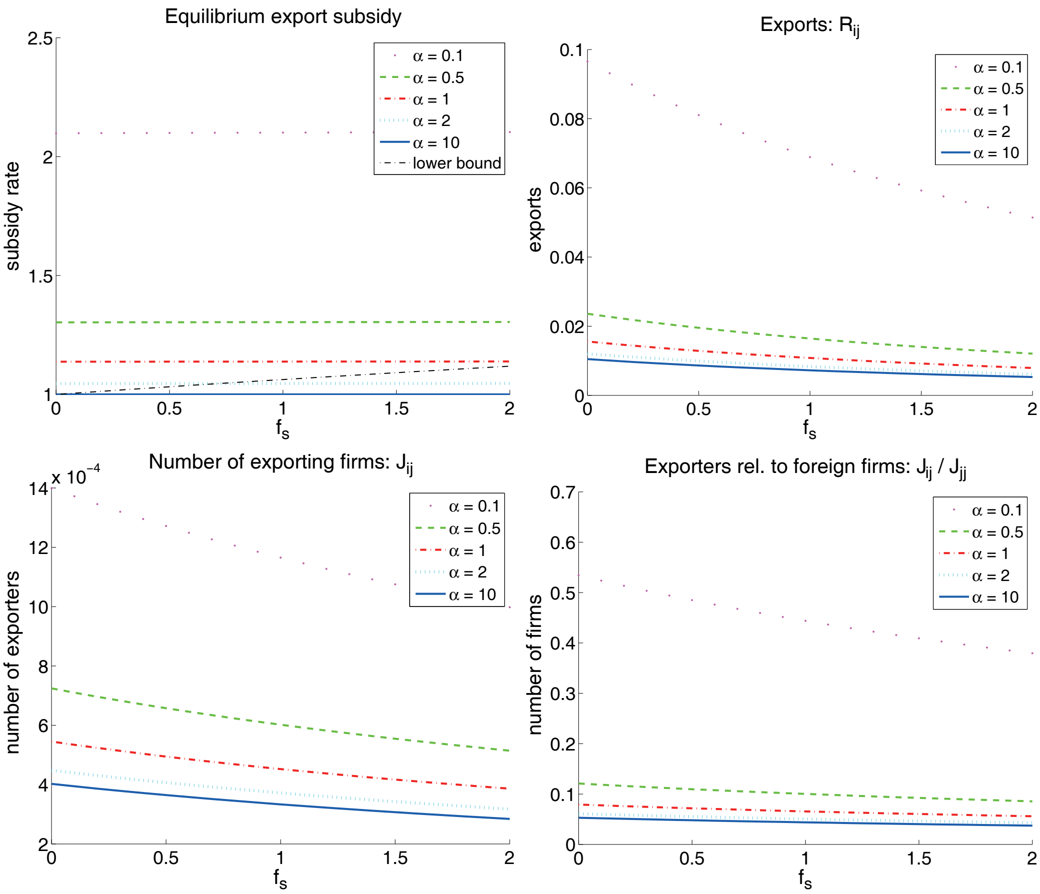

Figure 4.7: Simulated comparative statics: increasing f_s in the low costs case

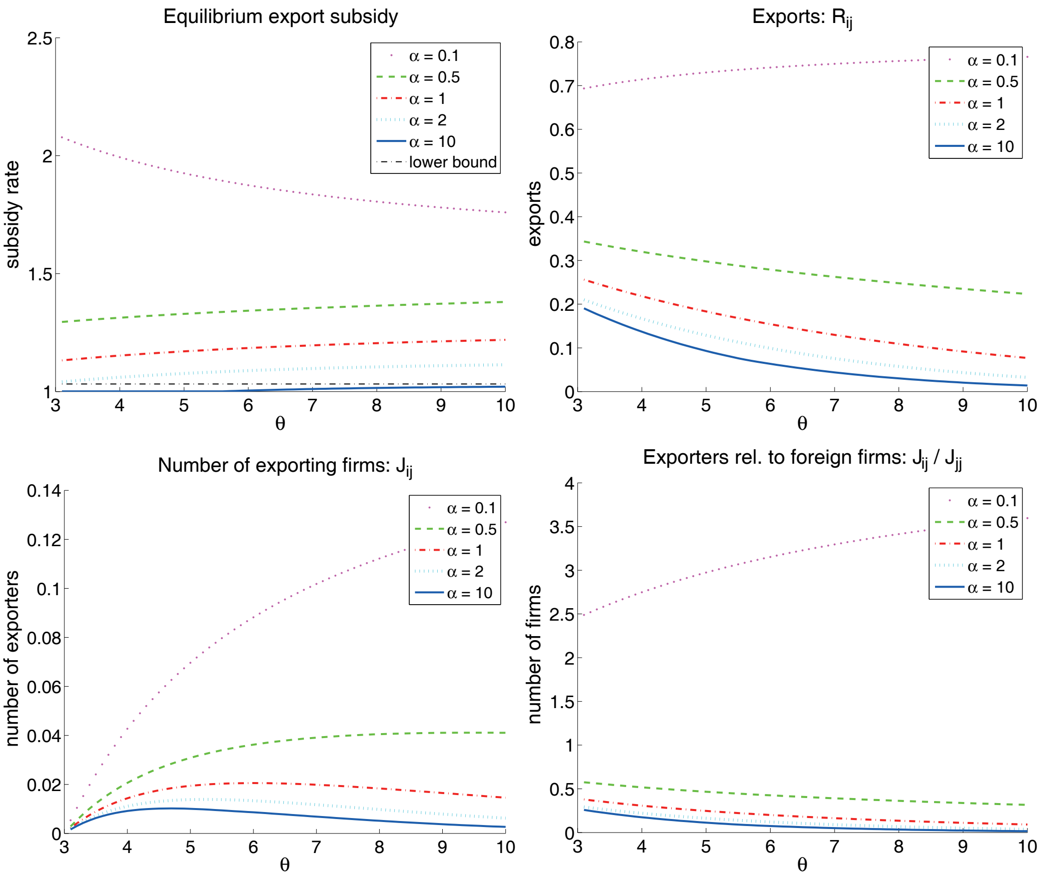

Figure 4.8: Simulated comparative statics: increasing θ in the low costs case

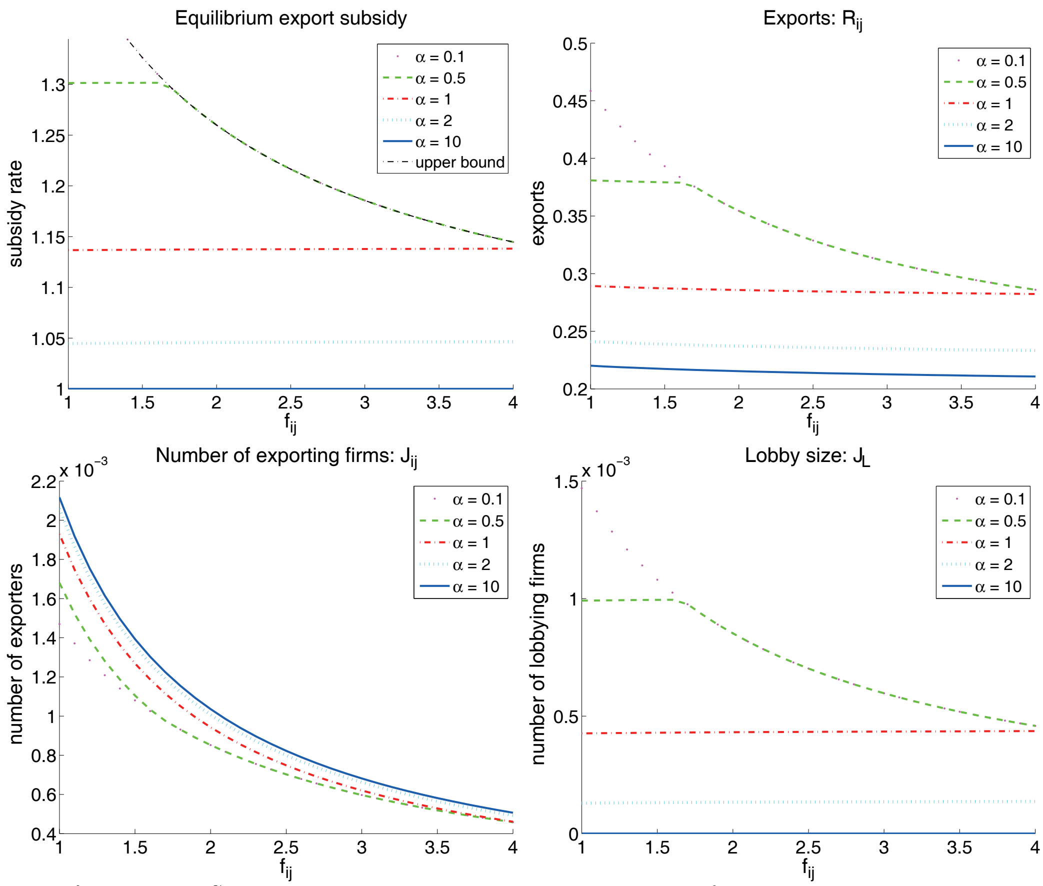

Figure 4.9: Simulated comparative statics: increasing f_{ij} in the high costs case

4.C.2 Additional figures: high administrative fixed costs

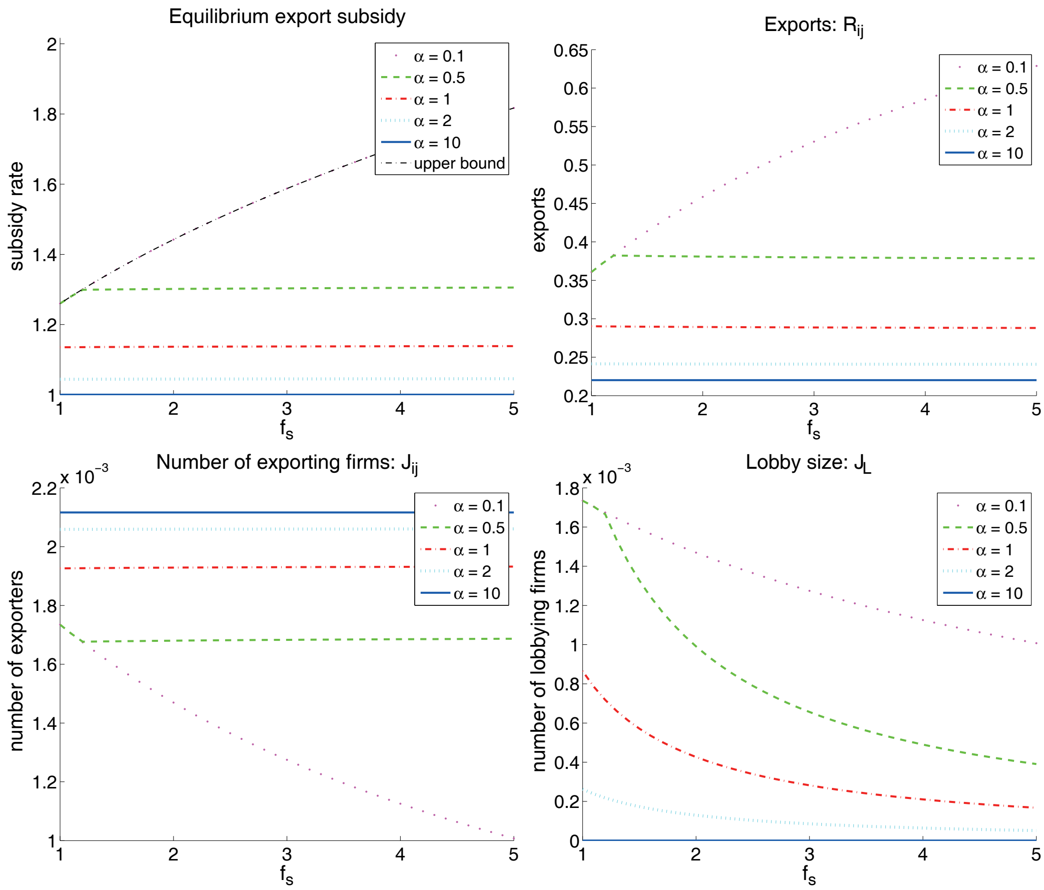

Figure 4.10: Simulated comparative statics: increasing f_s in the high costs case

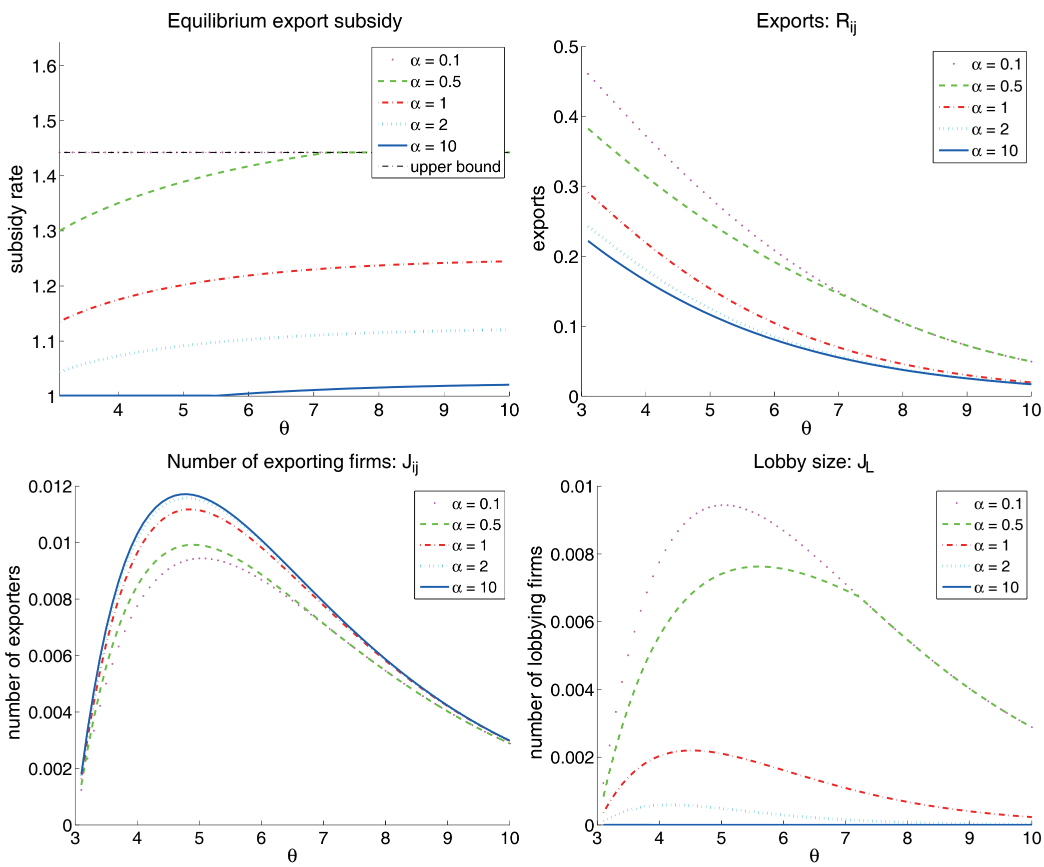

Figure 4.11: Simulated comparative statics: increasing θ in the high costs case

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