Endogenous Trade Policy with Heterogeneous Firms

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Abstract

The present paper modifies the "Protection for Sale" model of Grossman and Helpman (1994) to account for intra-industry trade and heterogeneous firms lobbying for non-tariff barriers to trade. Some non-tariff barriers to trade, such as technical standards, raise the fixed costs of market access for both domestic producers and foreign exporters, force the least efficient firms to exit, and increase the profits of the most efficient firms. Technical barriers to trade also shift profits across countries, but not necessarily to the country in which firms are more productive on average. They are inefficient from a social welfare perspective, but may nevertheless be implemented in the political equilibrium if only the largest domestic firms lobby the government. The implementation of technical barriers to trade is the more likely, the less efficient the foreign competitors. Other non-tariff barriers to trade, such as customs procedures, raise the fixed costs of foreign exporters only, and thus benefit all domestic firms. Yet, as they reduce variety and raise consumer prices, they are inefficient from a social welfare perspective, and may not even be implemented if the largest domestic firms impose political pressure. In case they are implemented, however, the government chooses the most deterring level of customs procedures to prevent foreign firms from market entry. The paper also analyzes the case of bilateral trade negotiations, and it addresses the issue of endogenous lobby formation.

Keywords: Endogenous trade policy, non-tariff barriers to trade, intra-industry trade, heterogeneous firms

JEL Classification: F12, F13, D70

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1 Introduction

There is by now a broad consensus among trade economists as well as political scientists that trade policies are set by politicians who are subject to pressures applied by special interest groups. In fact, lobbying for trade policy is a widely spread phenomenon. Between 1998 and 2008, 84 % of all U. S. sectors at the 4-digit SIC level were engaged in lobbying for trade policy, according to a recent dataset about lobbying expenditures in the U. S. (Bombardini and Trebbi (2009)). The theoretical benchmark in this line of literature is the "Protection for Sale" model of Grossman and Helpman (1994), in which some organized sectors make political contributions to sway the government's trade policy choice in their favor. The incumbent government trades off social welfare against these political contributions, and thus makes a trade policy choice that is biased towards the interest of the lobbying sectors.

Even though the "Protection for Sale" model has found general empirical support,[1] it remains silent on a couple of interesting issues. Firstly, it focuses on a small open economy in which all sectors behave perfectly competitive and thus engage in inter-industry trade only. By construction, it has nothing to say about the trade policy that would emerge in an environment with imperfect competition and intra-industry trade. This is however an important issue, given the prevalence of intra-industry trade in developed economies.[2] Secondly, the model abstracts from the role of individual firms in the political process. Yet, firms within a sector differ in their political activity, a fact that has been discussed predominantly by political scientists. Larger firms, as measured by sales, make higher contributions to political action committees in the U.S. (Bombardini (2008), Drope and Hansen (2006), Sadrieh and Annavarjula (2005), and others). In the European Union context, they are more likely to have an office in Brussels and to be accredited to lobby the European Parliament (Bernhagen and Mitchell (2006)). Smaller enterprises, in contrast, are more reluctant to engage in the process of trade policy formation due to financial constraints and lack of expertise (Fliess and Busquets (2006)). To the extent that large and small firms differ in their preferences regarding trade policy, a purely sectoral analysis may miss important determinants of the strength and the objective of lobbying activities. Thirdly, like most of the theoretical contributions on the political economy of trade policy, the analysis concentrates on import tariffs and export subsidies as the relevant trade policy instruments. However, during decades of multilateral trade negotiations, tariffs on manufacturing goods have fallen substantially. In 2007, the unweighted average applied

[1] For a critical survey of the empirical evidence on the "Protection for Sale" model, see Imai et al. (2009).

[2] According to Brülhart (2009), the share of intra-industry trade in total trade as measured by the Grubel-Lloyd index has been 0.32 in 2006 for high income countries, with industries being classified at the 5-digit SITC level.

tariff rate in high income OECD countries was below 3% (World Bank (2009)). At the same time, non-tariff barriers to trade such as technical barriers or customs procedures and administrative practices have gained importance. The use of technical barriers, for instance, has almost doubled from 1994 to 2004. In this period, the percentage of tariff lines affected by technical barriers has risen from 32% to 59% (UNCTAD (2005)). Recent empirical work by Chen and Novy (2008) suggests that technical barriers to trade have a significantly negative impact on trade integration within the European Union. Explaining around 5% of the variation in bilateral, industry-specific trade frictions, technical barriers are the most important policy-related trade barrier. Together with undue administrative complications, technical barriers are perceived by exporters around the world to be relevant obstacles to foreign market access (OECD (2005)). After all, it has been argued that non-tariff barriers to trade are easier to manipulate unilaterally and therefore more appropriate for a political economy setup (Bombardini (2008)).

The present paper accounts for these facts and modifies the theoretical framework of Grossman and Helpman (1994) to study the endogenous determination of non-tariff barriers in a lobbying model with heterogeneous firms and intra-industry trade between two asymmetric countries. The model is based on Chaney (2008) and similar to the one used for a closed economy in Rebeyrol and Vauday (2009). In each country, there is a given mass of firms producing varieties of a differentiated good with heterogeneous marginal costs. In order to access the market and sell their products, both domestic producers and foreign exporters have to incur some fixed costs. These costs are potentially different for domestic producers and foreign exporters and may be interpreted as the costs of adapting the product to local standards, of testing and certifying the product, of complying with legal requirements or of passing customs and administrative procedures.

Non-tariff barriers to trade are interpreted as additional regulations which raise these fixed costs of gaining market access. Some regulations affect both foreign exporters and domestic producers. Technical standards or labeling requirements, for example, cannot be imposed on foreign exporters only, since the national treatment principle of the WTO requires that once the imported goods have crossed the border, they must be treated like locally produced goods. Such regulations will be referred to as "behind-the-border measures". They are assumed to leave the ratio of market access costs for foreign exporters to market access costs for domestic producers unaffected. Other regulations, such as customs and administrative procedures, affect foreign exporters only, and thus raise the ratio of market access costs for foreign exporters to market access costs for domestic producers. Such regulations will be referred to as "border measures", since they accrue when the imported goods pass the border.

When a country introduces behind-the-border measures, domestic firms and foreign exporters with high marginal costs cannot generate enough revenues to cover the increased fixed costs of accessing the country's market anymore and exit. This reduces competition, and increases the market shares and profits of those domestic and foreign firms with low marginal costs. In addition to this profit shifting effect within countries, there is also a profit shifting effect across countries. In particular, profits will be shifted away from the country that introduces behind-the-border measures whenever this country has a smaller ratio of very efficient to very inefficient firms than its trading partner. However, even if profits are shifted in the opposite direction, the introduction of behind-the-border measures never increases social welfare in the country, since it raises average prices and reduces the variety available to consumers. Yet, if only the largest and thus the most efficient firms in the country engage in lobbying their government, as the empirical evidence suggests, and if the government is sufficiently susceptible to political influence of domestic special interest groups, it will nevertheless implement behind-the-border measures. The equilibrium level of technical standards or labeling requirements will be the larger, the stronger the profit shifting effect between domestic firms, and the lower the government's concern about the social welfare in its country.

When a country introduces border measures, it drives the least efficient foreign firms out of its market. Domestic firms are shielded from foreign competition, and this induces some domestic firms that have formerly been inactive to start producing and selling their goods. No domestic firm loses, and the aggregate profits of all domestic firms increase. Nevertheless, like behind-the-border measures, border measures reduce consumer surplus, and a government would never introduce such measures if it solely cared about the social welfare in its country. If the largest domestic firms lobby, however, this may be different. If the most efficient domestic firms gain enough from protection, and are willing to exert a strong political influence, the government will implement the highest possible level of border measures. On the contrary, if the lobbying firms gain only little, and the government cares a lot about social welfare, it will never implement any border measures at all. In contrast to behind-the-border measures, border measures do not provoke any conflict of interest between domestic firms, and intermediate levels border measures will never obtain.

Although the literature on firm heterogeneity in international trade is growing fast, it has so far paid little attention to the issue of endogenous trade policy. Four recent contributions stand out. Bombardini (2008) extends the traditional Grossman and Helpman (1994) setup by assuming that each sector is composed of several firms which differ in their endowments with a sector specific factor of production. Firms with a larger endowment produce more, sell more and thus have a stronger incentive to lobby for ei-

ther import tariffs or export subsidies. Yet, trade is still inter-industry, and there are no conflicts of interest within sectors. This is different in Chang and Willmann (2006), who introduce lobbying into a Melitz (2003) type model of intra-industry trade in which firms are heterogeneous in their productivities. The most productive firms operate on the export market and oppose a reciprocal import tariff since it would reduce their profits made abroad, while the least productive ones sell on the domestic market only and favor an import tariff since it would shield their market from foreign competition. Neither Bombardini (2008) nor Chang and Willmann (2006) consider non-tariff barriers to trade as the relevant policy variables. Do and Levchenko (2009) analyze the determination of the fixed costs of producing for the domestic market, which they interpret as the quality of institutions, in a modified median voter model. The political mechanism is thus different from the one considered here. Also, the fixed costs of producing for the export market are exogenous in their model. The work most closely related to the present paper deals with the endogenous determination of an entry tax in a model with heterogeneous firms and product differentiation. Rebeyrol and Vauday (2009) however focus on a closed economy. They argue informally that in a small open economy a tax on the fixed costs for both foreign exporters and domestic firms, which is equivalent to the behind-the-border measures considered here, would shift profits towards foreign firms if these were more productive on average. Further, they argue that if foreign firms were less productive on average, it would be optimal to introduce a positive entry tax even in the absence of lobbying. The formal analysis provided in the present paper qualifies their intuition, for a large as well as for a small open economy. In addition, by analyzing border measures, the present paper in principle allows for differential "entry taxes" for foreign and domestic producers, and it also addresses the question of endogenous lobby formation.

The rest of the paper is organized as follows. Section 2 lays out the basic model. Section 3 introduces behind-the-border and border barriers as the relevant trade policy instruments and analyzes their effects on individual and aggregate profits and social welfare. Section 4 presents the lobbying game and analyzes the equilibrium trade policies. Section 5 deals with possible extensions of the model, including endogenous lobby formation, and section 6 concludes.

2 The model

There are two countries, Home and Foreign. Whenever necessary, variables are indexed by H or F. In both countries there is a continuum of consumers with mass L_H and L_F, respectively, who share identical preferences over a composite numéraire good C_A and

a continuum of varieties of a manufacturing good C_M described by a quasilinear utility function of the form

$$U = C_A + \mu \ln C_M \qquad\qquad C_M = \left(\int c_i^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \tag{1}$$

where $\sigma > 1$ is the elasticity of substitution between any two varieties of the differentiated good. The model can easily be extended to more than one manufacturing sector by using an additively separable utility function like Grossman and Helpman (1994). Since this rules out cross-price effects, and since the quasilinear structure of preferences rules out income effects, it would still be an almost partial equilibrium model that could be analyzed sector by sector.

Assuming that the income of each consumer is larger than the expenditures for the manufacturing good, which are constant and equal to μ, the individual demand for any imported or locally produced variety i is

$$c_i = \frac{\mu\, p_i^{-\sigma}}{P^{1-\sigma}} \tag{2}$$

where p_i is the consumer price and $P = \left(\int p_i^{1-\sigma} \right)^{\frac{1}{1-\sigma}}$ is the ideal price index over all consumed varieties.

Each consumer inelastically supplies one unit of labor, which is the only factor of production. The numéraire good is produced under perfectly competitive conditions with constant returns to scale in both countries and is freely traded. One unit of output requires one unit of input, which fixes the wage rate at one. The differentiated good is produced with increasing returns to scale under monopolistically competitive conditions, implying that each variety is produced at most by one firm and no firm produces more than one variety. Firms differ in their marginal costs. A firm i producing variety i for its domestic market incurs marginal costs a_i. Trade in the differentiated good is subject to Iceberg trade costs. In order for one unit to arrive in Foreign, a firm i in Home has to ship $\tau_F > 1$ units of its variety, implying that its marginal costs of producing for the Foreign market are $\tau_F a_i$. The analogous holds for a firm i in Foreign, with $\tau_H - 1 > 0$ denoting the Iceberg trade costs from Foreign to Home. Profit maximization implies that a firm charges a constant markup $\frac{\sigma}{\sigma-1}$ over its marginal costs. Accordingly, the consumer price for a locally produced variety is $p_i = \frac{\sigma}{\sigma-1}\, a_i$, while it is $p_i = \frac{\sigma}{\sigma-1}\, \tau_H a_i$ for an imported variety in Home and $p_i = \frac{\sigma}{\sigma-1}\, \tau_F a_i$ for an imported variety in Foreign.

If a firm wants to sell its variety in its country of origin, it has to comply with domestic product market regulations such as technical standards, testing and certification procedures, or legal requirements. This creates fixed costs, which are denoted by f_{HD} for

a Home firm and by f_{FD} for a Foreign firm. If a firm wants to export its product, it has to comply with the product market regulations in the target country. In addition, it has to pass certain customs and administrative routines at the border. Altogether, exporting creates fixed costs, which are denoted by f_{HE} for a Home firm, and by f_{FE} for a Foreign firm.

Using profit maximizing consumer prices and the corresponding aggregate demands, the profits of a Home firm with marginal costs a_i from selling on its domestic market are

$$\pi_{HD}(a_i) = \frac{\mu}{\sigma}\left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} L_H P_H^{\sigma-1} a_i^{1-\sigma} - f_{HD} \tag{3}$$

while its profits from exporting are

$$\pi_{HE}(a_i) = \frac{\mu}{\sigma}\left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} L_F P_F^{\sigma-1} \left(\tau_F a_i\right)^{1-\sigma} - f_{HE} \tag{4}$$

where P_H denotes the price index in Home, and P_F denotes the price index in Foreign. Analogous expressions follow for a Foreign firm. The higher a Home firm's marginal cost, the less it sells on its domestic market. If a firm's marginal costs are too high, the net revenues from being active on the domestic market are too small to cover the associated fixed costs, and the firm will exit. Thus, there is a cutoff level of marginal costs a_{HD}, implicitly defined by $\pi_{HD}(a_{HD}) = 0$, such that only Home firms with $a_i \leq a_{HD}$ are active on their domestic market. Similarly, only Home firms with $a_i \leq a_{HE}$ export their products and make non-negative profits on the Foreign market, where a_{HE} is given by $\pi_{HE}(a_{HE}) = 0$. The corresponding cutoff values for Foreign firms are denoted by a_{FD} and a_{FE}, respectively.

To make the model suitable for a political economy setup, I assume that there is a fixed mass of potential firms M_H in Home and M_F in Foreign.[3] Potential firms in Home draw their marginal costs $a \in (0, \bar{a}_H]$ from the cumulative distribution function

$$H(a) = \left(\frac{a}{\bar{a}_H}\right)^{\kappa} \tag{5}$$

while firms in Foreign draw their marginal costs $a \in (0, \bar{a}_F]$ from the cumulative distribution function

$$F(a) = \left(\frac{a}{\bar{a}_F}\right)^{\kappa} \tag{6}$$

[3]The assumption of a fixed mass of potential entrepreneurs has also been used by Chaney (2008), Arkolakis (2008), and Do and Levchenko (2009), amongst others.

with $\kappa+1-\sigma > 0$, a standard regularity condition. The distribution of marginal costs a is equivalent to a Pareto distribution of marginal productivities $1/a$ with shape parameter κ and scale parameters $\bar{a}_H$ or $\bar{a}_F$, respectively. Using a Pareto distribution for marginal productivities is now quite common in the literature on heterogeneous firms, since it is in line with the empirical evidence on firm sales and ensures analytical tractability.[4] A possible generalization of the marginal cost distributions would be to allow not only for different scale parameters $\bar{a}_H$ and $\bar{a}_F$, but also for different shape parameters κ_H and κ_F. I will comment on this generalization whenever it generates additional insights. For the rest, I will content myself with the assumption of identical shape parameters and model differences in average productivities across countries with different scale parameters. This does not change the conclusions qualitatively, eases exposition, permits closed form solutions and fosters intuition.

With the distributions of marginal costs given in (5) and (6), I can explicitly solve for the price index in Home as a function of the mass of potential firms in both countries, M_H and M_F, the population size L_H, the size of the fixed costs f_{HD} and f_{FE}, the preference parameter σ and the distribution parameters κ, $\bar{a}_H$, and $\bar{a}_F$. The price index in Foreign follows analogously. This gives closed form solutions for the cutoff values a_{HD}, a_{HE}, a_{FD}, and a_{FE}, and for the individual profits of Home and Foreign firms from selling on their domestic and export market as a function of their marginal cost parameter a. All solutions are given in the appendix. Aggregating individual profits from selling on the Home market over all active Home firms gives

$$\pi_{HD}^{agg} = M_H \int_0^{a_{HD}} \pi_{HD}(a) dH(a) = L_H \, \frac{\mu}{\kappa} \, \frac{\sigma-1}{\sigma} \left(1 + \frac{M_F}{M_H} \left(\frac{f_{FE}}{f_{HD}} \right)^{\frac{\kappa+1-\sigma}{1-\sigma}} \left(\frac{\bar{a}_H}{\tau_H \bar{a}_F} \right)^{\kappa} \right)^{-1} \quad (7)$$

while aggregating individual profits from selling on the Foreign market over all exporting Home firms yields

$$\pi_{HE}^{agg} = M_H \int_0^{a_{HE}} \pi_{HE}(a) dH(a) = L_F \, \frac{\mu}{\kappa} \, \frac{\sigma-1}{\sigma} \left(1 + \frac{M_F}{M_H} \left(\frac{f_{FD}}{f_{HE}} \right)^{\frac{\kappa+1-\sigma}{1-\sigma}} \left(\frac{\tau_F \bar{a}_H}{\bar{a}_F} \right)^{\kappa} \right)^{-1} . \quad (8)$$

Exchanging H and F in equations (7) and (8) gives the corresponding expressions for the aggregate profits of Foreign firms. As it turns out, Pareto distributions with identical shape parameters have the convenient feature that the sum of aggregate profits of both Home and Foreign firms from selling on a specific market, e. g. the Home market, is

[4] Examples for papers that use a Pareto distribution for marginal productivities include Chaney (2008), Arkolakis (2008), Baldwin and Forslid (2009), Ghironi and Melitz (2005), and Helpman et al. (2004). For the empirical evidence, see Axtell (2001) and Corcos et al. (2007).

constant. In particular, it is independent of the fixed costs of gaining access to this market,

$$\pi_{HD}^{agg} + \pi_{FE}^{agg} = L_H \frac{\mu}{\kappa} \frac{\sigma - 1}{\sigma} \tag{9}$$

$$\pi_{FD}^{agg} + \pi_{HE}^{agg} = L_F \frac{\mu}{\kappa} \frac{\sigma - 1}{\sigma}. \tag{10}$$

I assume that firms do not have sources of income other than profits, and that they spend all of their profits on the numéraire good. This ensures that their interest in lobbying solely comes from their role as producers and not from their role as consumers. Thus, they do not care about prices in sectors other than their own. A comparable assumption to simplify the traditional Grossman and Helpman (1994) setup has been advocated by Bombardini (2008) and Baldwin and Robert-Nicoud (2007), for instance. Social welfare in the Home country is then given by the sum of the aggregate profits of Home firms from selling on their domestic market and from exporting, aggregate labor income, and total consumer surplus,

$$W = \pi_{HD}^{agg} + \pi_{HE}^{agg} + L_H + L_H \left(\mu \ln \frac{\mu}{P_H} - \mu \right). \tag{11}$$

3 Trade policy instruments

The government in Home may implement two different types of non-tariff barriers to trade, namely behind-the-border measures, such as technical barriers to trade, and border measures, such as customs procedures. In this section, I will analyze the effects of these two different measures on individual and aggregate profits of Home firms and consumer welfare to point out the heterogeneity of preferences over these two trade policy variables, and to identify the social welfare maximizing choice. How the level of protection is ultimately determined in the lobbying game will be the subject of section 4.

3.1 Behind-the-border measures

Behind-the-border measures are understood as regulations which increase the fixed costs for both Home and Foreign firms of accessing the Home market, f_{HD} and f_{FE}, by a factor $\alpha \in (1, \bar{\alpha}]$.[5] Such regulations have an anti-competitive effect in that they force the

[5]The assumption of multiplicative behind-the-border measures is mainly made for reasons of analytical tractability. If accessing the Home market is more difficult for Foreign exporters than for Home firms, $f_{FE} > f_{HD}$, which is quite plausible due to informational disadvantages, cultural differences, or language barriers, this assumption implies that the absolute cost of complying with a new technical standard is higher for Foreign exporters. Hence, in absolute terms, behind-the-border measures have a discriminatory

least efficient Home producers and Foreign exporters to withdraw from the Home market. Their marginal costs are too high and hence their sales too low to cover the increased fixed costs. The more comprehensive these additional regulations, the more firms have to exit. The benchmark case in which $\alpha = 1$ characterizes a situation in which the Home government does not implement any undue regulations at all.

Result 1 *Behind-the-border measures force the least efficient Home and Foreign firms that have been active on the Home market to exit,* $\frac{\partial a_{HD}(\alpha)}{\partial \alpha} < 0$ *and* $\frac{\partial a_{FE}(\alpha)}{\partial \alpha} < 0$ *for all* $\alpha \geq 1$.

This follows from multiplying the fixed costs f_{HD} and f_{FE} in the cutoff values a_{HD} and a_{FE} with α and taking the respective derivatives. Exit of the least efficient firms has two effects. It reduces competition on the Home market, since there are now less firms selling their varieties to Home consumers, and it decreases the average of marginal costs over all active firms. The first effect dominates, and hence the price index in Home increases, $\frac{\partial P_H(\alpha)}{\partial \alpha} > 0$. Equation (3) for Home firms and the analog of equation (4) for Foreign firms show that this increase in the price index P_H benefits the remaining firms the more the smaller their marginal costs. For the most efficient Home and Foreign firms, the gain in market share due to reduced competition more than compensates the increase in fixed costs, and their profits rise at the expense of the profits of the least efficient Home and Foreign firms. This profit shifting effect is illustrated in figure 1 for Home firms, with a similar picture applying to Foreign firms.

Thus, behind-the-border measures shift profits from the least efficient Home firms to the most efficient Home firms, and from the least efficient Foreign exporters to the most efficient Foreign exporters. From a social welfare perspective, we might also be interested in whether such measures also shift profits across borders, that is from Foreign exporters to Home firms. This is however not the case, at least if both countries are characterized by cost distributions with identical shape parameters. Inspection of equation (7) reveals that with identical shape parameters, any behind-the-border measures which increase the fixed costs f_{HD} and f_{FE} by the same factor cancel out and thus have no impact on the sum of all profits made by Home firms. The social welfare maximizing policy is simply to implement no behind-the-border measures at all, since any other policy would just raise the price index, and hence reduce consumer surplus. Thus, the assumption of identical shape parameters allows me to abstract from technical barriers to trade which

effect against Foreign firms, and in this respect may be seen as a protectionist trade policy. An alternative way would be to model behind-the-border measures as regulations which impose the same absolute cost on both Foreign exporters and Home firms. Additive behind-the-border measures would generally create the same conflict of interest between large and small firms. However, if $f_{FE} > f_{HD}$, they would unintentionally increase the relative competitiveness of Foreign exporters and thus would hurt rather than protect Home firms.

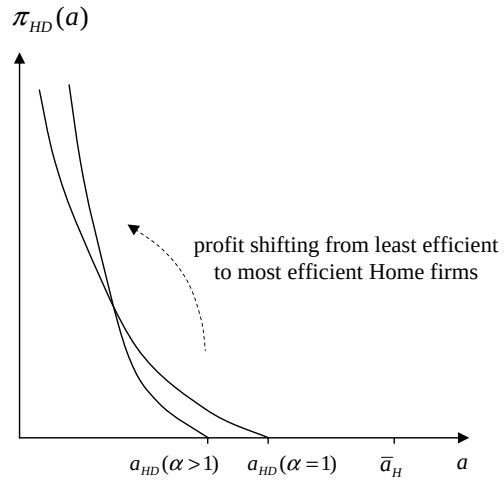

Figure 1: Effect of behind-the-border measures on the profits of Home firms

are introduced by the Home government for any reason other than giving in to the pressure of lobbying groups. Moreover, it has the interesting implication that if the differentiated good sector analyzed here was considered as an entity as in the original Grossman and Helpman (1994) model, it would have no interest whatsoever in lobbying for non-tariff barriers to trade like technical standards. The incentive to lobby arises only on the firm level, and any bias in the equilibrium trade policy will solely be driven by heterogeneous lobbying activities of large and small firms.

However, for completeness, and since it is an interesting result that relates well to the literature, I will briefly discuss how behind-the-border measures shift profits across countries characterized by cost distributions with different shape parameters κ_H and κ_F.

Result 2 *Behind-the-border measures shift aggregate profits from selling on the Home market from Foreign to Home firms if and only if the distribution of firms is more skewed in Foreign than in Home, that is* $\frac{\partial \pi_{HD}^{agg}(\alpha)}{\partial \alpha} > 0$ *and* $\frac{\partial \pi_{FE}^{agg}(\alpha)}{\partial \alpha} < 0$ *if and only if* $\kappa_H < \kappa_F$.

For a proof, see the appendix. Interestingly, whether profits from selling on the Home market are shifted from Foreign to Home firms depends only on the shape parameters κ_H and κ_F, and not on the scale parameters $\bar{a}_H$ and $\bar{a}_F$. This is because the scale parameters $\bar{a}_H$ and $\bar{a}_F$ affect the relevant cutoff values in Home and Foreign in the same way, and thus lead to the same ratio of winners to losers in Home and Foreign. However, different shape parameters κ_H and κ_F give winners and losers a different weight. If $\kappa_H < \kappa_F$, then the ratio of very efficient firms to rather inefficient firms and hence the ratio of winners to losers from behind-the-border measures is higher in Home than in Foreign, implying that in the aggregate, profits are shifted from Foreign to Home firms.

An interesting implication of this result is that the average of marginal costs of Home and Foreign firms, given by $\int_0^{\bar{a}_H} a \ dH(a) = \frac{\kappa_H}{\kappa_H+1}\bar{a}_H$ and $\int_0^{\bar{a}_H} a \ dF(a) = \frac{\kappa_F}{\kappa_F+1}\bar{a}_F$, respectively, cannot predict the direction of the profit shifting effect of behind-the-border measures. It is quite possible that potential Foreign firms have lower marginal costs and hence are more productive on average because $\bar{a}_F$ is comparably small, but profits are nevertheless shifted toward Home firms.[6] This qualifies the result of Rebeyrol and Vauday (2009) who argue by means of a rather restrictive example that behind-the-border measures would shift profits to Home firms only if these were more productive on average.[7]

Moreover, Rebeyrol and Vauday (2009) argue that if an entry tax would shift profits to Home firms, it could be optimal to introduce a positive entry tax even in the absence of lobbying. This is true because an entry tax, contrary to the behind-the-border measures considered here, generates tax revenues. In the absence of such revenues, however, the implementation of purely anti-competitive regulations like behind-the-border measures can never be social welfare maximizing.

Result 3 *For any values of κ_H and κ_F, the introduction of behind-the-border measures reduces social welfare in Home, $\frac{\partial W(\alpha)}{\partial \alpha} < 0$ for all $\alpha \geq 1$.*

See the appendix for a proof, which shows that the potentially positive effect of behind-the-border measures on the aggregate profits of Home firms is always dominated by their negative effect on consumer surplus.

3.2 Border measures

Border measures are regulations set by the Home government which increase the fixed costs f_{FE} for Foreign exporters by a factor $\beta \in (1, \bar{\beta}]$. To give an example, the government may increase the number of documents required to obtain an import license or it may extend the time needed to pass the authorization process at the border. Anecdotal evidence of such measures, which clearly discriminate against foreign exporters and which

[6] This argument also holds if the average of marginal costs is conditioned on being active on the Home market. In other words, even if active Foreign exporters are more productive on average,

$$\int_0^{a_{HD}} a \ dH(a) = \frac{\kappa_H}{\kappa_H+1} f_{HD}^{\frac{1}{1-\sigma}} > \frac{\kappa_F}{\kappa_F+1} f_{FE}^{\frac{1}{1-\sigma}} \tau_H^{-1} = \int_0^{a_{FE}} a \ dF(a),$$

because f_{HD} is small compared to f_{FE}, it is still possible that behind-the-border measures shift aggregate profits from selling to the Home market from Foreign to Home firms.

[7] Their argument is actually made for Home being a small open economy. Yet, it carries over to Home being a large open economy, since the only difference is whether Home firms have an impact on the Foreign price index or not. The Foreign price index is however irrelevant for the profit shifting effects of behind-the-border measures. For a model of a small open economy involved in intra-industry trade, see Demidova and Rodríguez-Clare (2009).

are largely unrelated to the quantity shipped, abounds.[8] And recent empirical work suggests that they may indeed have economically and statistically significant negative effects on trade flows. In a gravity equation, Wilson (2007) estimates the elasticity of exports with respect to the number of documents and signatures required by the importer, and with respect to the days the goods need to cross the border. His estimates are -0.41, -0.88 and -0.96, respectively, indicating that a 10% increase in the number of documents required would entail a 4% reduction of trade flows, for instance.

What is the effect of border measures in the present model? They shield domestic producers from Foreign competition, since small Foreign exporters are not able to cover the increased fixed costs any more and hence stop selling their varieties on the Home market. This induces Home firms that have formerly been inactive to start producing for the Home market. Again, $\beta = 1$ characterizes the benchmark situation without any undue border measures.

Result 4 *Border measures force the least efficient Foreign exporters to withdraw from the Home market and induce less efficient Home firms to start producing for the Home market,* $\frac{\partial a_{FE}(\beta)}{\partial \beta} < 0$ *and* $\frac{\partial a_{HD}(\beta)}{\partial \beta} > 0$ *for all* $\beta \geq 1$.

This follows from multiplying the fixed costs f_{FE} in the cutoff values a_{FE} and a_{HD} with β and taking the respective derivatives. The price index in Home increases, $\frac{\partial P_H(\beta)}{\partial \beta} > 0$, reflecting the anti-competitive effect of border measures. As before, this benefits the most efficient Foreign exporters. Their gain in market share overcompensates the rise in fixed costs, and their profits increase at the expense of the profits of the small Foreign exporters. In Home, all firms gain, and they gain the more the smaller their marginal costs, as illustrated in figure 2. Contrary to the case of behind-the-border measures, border measures do not provoke any conflict of interest among Home firms. However, since large firms gain more, their willingness to make campaign contributions in order to bring the government to implement a certain trade policy $\beta > 1$ is larger, and hence their political influence is stronger.

Inspection of equations (7) and (9) confirms that the aggregate profits of Home firms from selling on the domestic market rise, at the expense of the aggregate profits of Foreign exporters. However, even if border measures unambiguously raise aggregate profits of Home firms, their impact on social welfare is negative.

Result 5 *For any values of* κ_H *and* κ_F*, the introduction of border measures reduces social welfare in Home,* $\frac{\partial W(\beta)}{\partial \beta} < 0$ *for all* $\beta \geq 1$.

[8]The European Commission's Market Access Database, for instance, lists not only undue customs procedures but also technical barriers to trade which impede European exports to third countries.

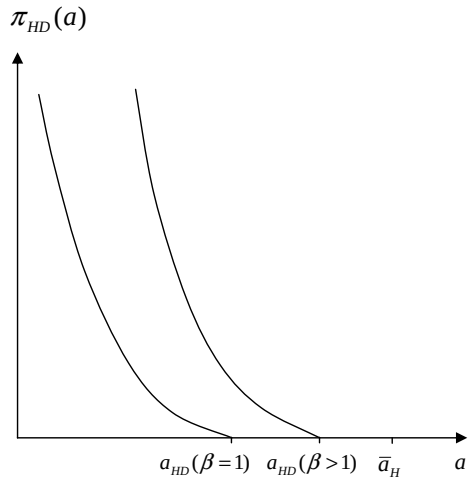

Figure 2: Effect of border measures on the profits of Home firms

See the appendix for a proof. Intuitively, the anti-competitive effect of border measures leads to less varieties available on the Home market, which is reflected in a higher ideal price index. This makes consumers worse off, and their loss in utility outweighs the gain in aggregate profits. Thus, the social welfare maximizing policy is to introduce no border measures at all. Again, any bias towards protectionist measures can only be due to the lobbying activities of some Home firms.

4 Lobbying

In principle, the theoretical framework is appropriate to model lobbying on both trade policy instruments jointly. However, allowing behind-the-border measures and border measures to be determined simultaneously does not add much insight, and blurs the main intuition. Therefore, I will consider lobbying on only one trade policy at a time, and I will start and introduce the political game with behind-the-border measures.

4.1 Theoretical framework

Like Grossman and Helpman (1994), I model the lobbying process as a menu auction based on the theoretical framework of Bernheim and Whinston (1986). I assume that Home firms are organized exogenously into $j \in K$ lobbies. At this point, I will make no specific assumption on the composition of the lobbies. Each lobby acts as a bidder and makes a menu of offers to the Home government, one for each level of behind-the-border measures that the Home government may choose. Put differently, each lobby announces political contributions $C_j(\alpha)$ contingent on the level of behind-the-border measures $\alpha \in$

$[1, \bar{\alpha}]$ that the Home government implements. The objective of each lobby is to maximize the joint welfare of its members net of contributions,

$$G_j(\alpha) = W_j(\alpha) - C_j(\alpha) = \pi^j_{HD}(\alpha) + \pi^j_{HE} - C_j(\alpha). \tag{12}$$

The Home government acts as an auctioneer. It takes the bids of the lobbies as given, and chooses behind-the-border measures $\alpha \in [1, \bar{\alpha}]$ to maximize a weighted sum of social welfare in Home and the lobbies' political contributions,

$$G(\alpha) = \phi W(\alpha) + \sum_{j \in K} C_j(\alpha) \tag{13}$$

The higher ϕ, the more the Home government cares about social welfare and the less it is susceptible to the pressure of lobbying firms.

4.2 Timing

The timing of the lobbying game is as follows. First, Home and Foreign firms draw their marginal costs a from the distributions $H(a)$ and $F(a)$, respectively. Second, Home firms organize exogenously into lobbies. Third, each lobby $j \in K$ offers a contribution for each possible level of α, $C_j(\alpha)$, to maximize its welfare net of contributions, $G_j(\alpha)$. The Home government takes the contribution schedules as given and chooses $\alpha \in [1, \bar{\alpha}]$ to maximize $G(\alpha)$. It implements the chosen trade policy and receives the corresponding contributions. Then all Home and Foreign firms produce for all markets on which they can make non-negative profits, and withdraw from markets on which they would make losses given the actual level of behind-the-border measures.

4.3 Equilibrium

Bernheim and Whinston (1986) show that the equilibrium of the lobbying game, if set up as a menu auction, can be characterized as follows:

Result 6 *(Bernheim and Whinston (1986))* $\left\{C^o_j(\alpha)_{j \in K}, \alpha^o\right\}$ *is a subgame-perfect Nash equilibrium of the lobbying game if and only if*

(a) $C^o_j(\alpha)$ *is feasible for all* $j \in L$

(b) α^o *maximizes* $\phi W(\alpha) + \sum_{j \in K} C^o_j(\alpha)$ *on* $[1, \bar{\alpha}]$

(c) α^o *maximizes* $\phi W(\alpha) + \sum_{j \in K} C^o_j(\alpha) + W_j(\alpha) - C^o_j(\alpha)$ *on* $[1, \bar{\alpha}]$ *for every* $j \in K$.

(d) for every $j \in K$ *there exists an* $\alpha^j \in [1, \bar{\alpha}]$ *that maximizes* $\phi W(\alpha) + \sum_{i \in K} C_i^o(\alpha)$ *on* $[1, \bar{\alpha}]$ *such that* $C_j^o(\alpha^j) = 0$

Condition (a) implies that each lobby's contribution schedule must not be negative, nor larger than the total income of the lobby's members. Condition (b) captures the fact that the Home government implements the trade policy $\alpha \in [1, \bar{\alpha}]$ that maximizes its own welfare, which is a weighted sum of the social welfare in Home and the political contributions. Condition (c) ensures that the equilibrium trade policy α^o maximizes the joint surplus of the government and any lobby j. If this were not the case, lobby j could modify its contribution schedule to increase the joint surplus and keep a fraction of the additional gain. And finally, condition (d) states that each lobby j contributes just enough to make the government indifferent between the equilibrium policy α^o and the policy it would choose if lobby j did not participate in the lobbying game.

A common problem of lobbying games is the multiplicity of equilibrium contribution schedules. However, Bernheim and Whinston (1986) show that the set of a lobby's best responses to any combination of contribution schedules offered by all other lobbies always includes a truthful contribution schedule. Such a schedule reflects the true preferences of the lobby in every point $\alpha \in [1, \bar{\alpha}]$ and stipulates a payment to the government which equals the excess welfare of the lobby at α relative to some basic level B_j. Formally, a truthful contribution schedule of lobby j is given by

$$C_j^T(\alpha, B_j) = \max[0, W_j(\alpha) - B_j]. \tag{14}$$

It is differentiable everywhere, except where it becomes nil, as long as the lobby's total profits are differentiable. Further, Bernheim and Whinston (1986) show that all truthful Nash equilibria, that is all equilibria which are supported by truthful contribution schedules, and only these equilibria, are coalition-proof, which makes them focal among the set of all Nash equilibria. Truthful Nash equilibria have the compelling property that the equilibrium policy α^o satisfies

$$\alpha^o = \arg\max_{\alpha \in [1, \bar{\alpha}]} \left[\phi W(\alpha) + \sum_{j \in K} W_j(\alpha) \right]. \tag{15}$$

Effectively, the Home government maximizes a social welfare function in which organized Home firms are weighted with $1 + \phi$, while non-organized firms and consumers are only weighted with ϕ. Given their useful properties, I will concentrate on truthful Nash

equilibria in the following. Note, however, that the necessary condition for an equilibrium policy in the interior of $[1, \bar{\alpha}]$,

$$\phi \frac{\partial W(\alpha^o)}{\partial \alpha} + \sum_{j \in K} \frac{\partial W_j(\alpha^o)}{\partial \alpha} = 0, \tag{16}$$

applies even if contributions schedules are not globally truthful, as long as they are differentiable around the equilibrium point α^o. This follows from combining equilibrium conditions (b) and (c).

4.3.1 Behind-the-border measures

In line with the empirical evidence, I assume that only the largest, hence the most efficient firms will engage jointly in lobbying for behind-the-border measures. This seems plausible, as they have an aligned interest in behind-the-border measures, and gain most from their introduction. In addition, even though I do not explicitly model this here, forming a lobby may involve fixed costs as in Bombardini (2008), and only firms with low marginal costs and high profits may be able to bear these costs.

Assumption 1 *In the differentiated goods sector, all Home firms with $a \in (0, a_L]$ are organized into a single lobby L, with $a_L < a_{HD}(\alpha{=}1, \beta{=}1)$. All Home firms with $a > a_L$ do not engage in lobbying.*

Thus, I assume that there is only one lobby, and that its composition is given exogenously. I will rationalize this assumption and discuss the possibility of endogenizing the lobby formation process in section 5.3. The lobby's welfare is the joint welfare of its members and given by $W_L(\alpha) = \pi^L_{HD}(\alpha) + \pi^L_{HE}$. The lobby's profits from exporting are independent of α, while the lobby's profits from selling on the domestic market are given by

$$\pi^L_{HD}(\alpha) = \begin{cases} M_H \left(\frac{a_L}{\bar{a}_H}\right)^{\kappa} \left(\frac{\mu}{\sigma} \left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} P_H(\alpha)^{\sigma-1} L_H a_L^{1-\sigma} \frac{\kappa}{\kappa+1-\sigma} - \alpha f_{HD} \right) & \text{if } \alpha < \alpha_L \\ \pi^{agg}_{HD} & \text{if } \alpha \geq \alpha_L \end{cases} \tag{17}$$

For all $\alpha < \alpha_L$, the lobby's profits from selling on the Home market are increasing and concave in α. As α increases, however, the cutoff value $a_{HD}(\alpha)$ declines. At α_L, the cutoff value coincides with the marginal costs of the least efficient lobby member, $a_{HD}(\alpha_L) = a_L$, and the lobby consist of all Home firms which are active on the domestic market. Consequently, for all $\alpha \geq \alpha_L$, the lobby's profits coincide with the aggregate profits of Home firms from selling on the domestic market. Since the gains of the largest firms in the lobby exactly offset the losses of the smallest members of the lobby, the lobby's total profits do not depend on α anymore.

With only the largest firms participating in the lobbying game, the following result regarding the equilibrium level of behind-the-border measures holds:

Result 7 *Suppose that assumption 1 is satisfied and contribution schedules are truthful. Further, suppose that* $\phi\frac{\partial W(\alpha)}{\partial \alpha} + \frac{\partial \pi^L_{HD}(\alpha)}{\partial \alpha} > 0$ *at* $\alpha = 1$ *and that* $\alpha_L < \bar{\alpha}$*. Then there exists a unique equilibrium level of behind-the-border measures* α^o *in the interior of* $[1, \bar{\alpha}]$ *which is characterized by* $\phi\frac{\partial W(\alpha^o)}{\partial \alpha} + \frac{\partial \pi^L_{HD}(\alpha^o)}{\partial \alpha} = 0$*.*

For a proof, see the appendix. If $\phi\frac{\partial W(\alpha)}{\partial \alpha} + \frac{\partial \pi^L_{HD}(\alpha)}{\partial \alpha} > 0$ at $\alpha = 1$, the lobby's marginal gain in profits and hence the Home governments marginal gain in political contributions is higher than the weighted marginal loss in social welfare from introducing behind-the-border measures, and the Home government has an incentive to deviate from the socially optimal policy. This is always the case if the price index in Home is sufficiently high, since Foreign firms are rather inefficient or variable trade costs are high, for instance, or if the weight on social welfare ϕ is sufficiently low. As α increases, however, the marginal gain in political contributions declines, and at some point becomes smaller than the weighted marginal loss in social welfare. This point characterizes the unique interior equilibrium level of behind-the-border measures.

Using the derivative of social welfare (11) and of the lobby's profits (17) with respect to α, and taking into account that the elasticity of the price index with respect to α, $\epsilon_{P_H,\alpha}$, is equal to $\frac{\kappa+1-\sigma}{(\sigma-1)\kappa}$, the first order condition $\phi\frac{\partial W(\alpha^o)}{\partial \alpha} + \frac{\partial \pi^L_{HD}(\alpha^o)}{\partial \alpha} = 0$ can be rewritten as

$$-\phi\mu\frac{L_H}{\alpha^o}\frac{\kappa+1-\sigma}{(\sigma-1)\kappa} + M_H\left(\frac{a_L}{\bar{a}_H}\right)^{\kappa}\left(\frac{\mu}{\sigma}\left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma}P_H(\alpha^o)^{\sigma-1}\frac{L_H}{\alpha^o}a_L^{1-\sigma} - f_{HD}\right) = 0. \quad (18)$$

Applying the implicit function theorem and using the first and second order condition for an interior maximum gives the following comparative static result:

Result 8 *The equilibrium level of behind-the-border measures which results from the lobbying game in Home,* α^o*, is increasing in the fixed costs of gaining access to the Home market for Foreign firms,* f_{FE}*, the variable trade costs from Foreign to Home,* τ_H*, and the scale parameter of the distribution of marginal costs in Foreign,* $\bar{a}_F$*. It is decreasing in the mass of Foreign firms,* M_L*, and in the weight the Home government puts on social welfare,* ϕ*.*

The larger the parameters f_{FE}, τ_H and $\bar{a}_F$, the fewer Foreign firms are active on the Home market, which reduces competition and increases the price index in Home. A higher price index in Home implies that the marginal gains of the most efficient Home firms from the introduction of behind-the-border measures are larger, and hence their

willingness to make political contributions that convince the government to implement such measures is higher. A larger mass of firms in Foreign, M_F, has the opposite effect, since it increases competition and reduces the price index in Home. Not surprisingly, the weight the Home government puts on social welfare has a negative impact on the equilibrium level of behind-the-border measures. All other model parameters have an ambiguous effect on the equilibrium level of behind-the-border measures, as they have an impact on both the marginal gain in political contributions and the weighted marginal loss in social welfare.

How about the equilibrium level of political contributions? With truthful contribution schedules $C_L^T(\alpha, B_L)$, the only thing that is left to be determined is the basic level of welfare B_L. In principle, B_L indicates how the surplus of the lobby's political relationship with the Home government is shared. The lobby wishes to make B_L as large as possible and hence contributions as small as possible. However, as Grossman and Helpman (1994) show, if the lobby raised B_L beyond a certain point, the Home government would neglect the lobby's interest and contributions entirely and, since there are no other lobbies participating in the lobbying game, implement the socially optimal policy. Hence, the lobby will make contributions just large enough and set B_L just small enough to make the Home government indifferent between the socially optimal policy $\alpha = 1$ and the equilibrium policy α^o. That is,

$$\phi W(\alpha^o) + C_L^T(\alpha^o, B_L) = \phi W(\alpha{=}1). \tag{19}$$

If there is only one active lobby, it captures all of the surplus, and merely compensates the Home government for the weighted loss in social welfare that arises if α^o is implemented, $C_L^T(\alpha^o, B_L) = \phi W(\alpha = 1) - \phi W(\alpha^o)$. Given that the aggregate profits of Home firms from selling on the domestic and the export market remain unaffected by changes in α, the loss in social welfare is equivalent to the loss in consumer surplus that arises from an increase in the price index, $C_L^T(\alpha^o, B_L) = \phi W(\alpha = 1) - \phi W(\alpha^o) = \phi L_H \mu \ln \frac{P_H(\alpha^o)}{P_H(\alpha=1)} = \phi \mu L_H \frac{\kappa+1-\sigma}{(\sigma-1)\kappa} \ln \alpha^o$.

4.3.2 Border measures

The same theoretical framework applies if firms lobby for border measures instead. The only difference is that the variable of interest is now $\beta \in \left[1, \bar{\beta}\right]$ instead of $\alpha \in [1, \bar{\alpha}]$. Correspondingly, the subgame-perfect Nash equilibrium of the lobbying game is denoted $\left\{C_j^o(\beta)_{j\in K}, \beta^o\right\}$. As before, the welfare of a lobby which is composed of the most efficient firms is given by $W_L(\beta) = \pi_{HD}^L(\beta) + \pi_{HE}^L$. Like in the case of behind-the-border measures,

the lobby's profits from exporting are independent of β, while its profits from selling on the domestic market, which are

$$\pi_{HD}^{L}(\beta) = M_H \left(\frac{a_L}{\bar{a}_H}\right)^{\kappa} \left(\frac{\mu}{\sigma}\left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} P_H(\beta)^{\sigma-1} L_H a_L^{1-\sigma} \frac{\kappa}{\kappa+1-\sigma} - f_{HD}\right) \tag{20}$$

for all $\beta \geq 1$, depend positively on β via the price index $P_H(\beta)$. Unlike in the case of behind-the-border measures, however, the lobby's marginal gain in profits and hence the marginal gain in political contributions does not decline as β increases. In fact, the larger β, the larger the lobby's marginal gain in profits, and the smaller the marginal loss in social welfare. Therefore, the unique equilibrium policy β^o is never in the interior of $\left[1, \bar{\beta}\right]$. The Home government either chooses the highest possible level of border measures, $\beta^o = \bar{\beta}$, or it implements no border measures at all, $\beta^o = 1$, depending on the size of the lobby and the weight on social welfare.

Result 9 *Suppose that assumption 1 is satisfied and contribution schedules are truthful. Further, suppose that either* $\phi\frac{\partial W(\beta)}{\partial \beta} + \frac{\partial \pi_{HD}^{L}(\beta)}{\partial \beta} > 0$ *at* $\beta = 1$ *or* $\phi\frac{\partial W(\beta)}{\partial \beta} + \frac{\partial \pi_{HD}^{L}(\beta)}{\partial \beta} < 0$ *at* $\beta = \bar{\beta}$*. Then there exists a unique equilibrium level of border measures* β^o*. If* $\phi\frac{\partial W(\beta)}{\partial \beta} + \frac{\partial \pi_{HD}^{L}(\beta)}{\partial \beta} > 0$ *at* $\beta = 1$*, the Home government implements the highest possible level of border measures,* $\beta^o = \bar{\beta}$*. If* $\phi\frac{\partial W(\beta)}{\partial \beta} + \frac{\partial \pi_{HD}^{L}(\beta)}{\partial \beta} < 0$ *at* $\beta = \bar{\beta}$*, the Home government implements no border measures at all,* $\beta^o = 1$*.*

For a proof, see the appendix. If neither of these conditions is satisfied, the equilibrium policy will be either $\beta^o = \bar{\beta}$ or $\beta^o = 1$, depending on which policy makes the Home government better off. The condition that $\phi\frac{\partial W(\beta)}{\partial \beta} + \frac{\partial \pi_{HD}^{L}(\beta)}{\partial \beta} > 0$ at $\beta = 1$ is satisfied if the lobby is rather large, that is if a_L is high, and if the weight on social welfare is rather small, that is if ϕ is low. In this case, the lobby's marginal gain from regulations that deter Foreign firms from entering the Home market is very high, and hence the government's marginal gain in contributions is very high, while the weighted marginal loss in social welfare is rather low. Since the marginal gain in contributions is increasing in β, while the weighted marginal loss in social welfare is decreasing in β, the Home government benefits from setting β as high as possible. On the contrary, the condition that $\phi\frac{\partial W(\beta)}{\partial \beta} + \frac{\partial \pi_{HD}^{L}(\beta)}{\partial \beta} < 0$ at $\beta = \bar{\beta}$ is likely to hold if the lobby is rather small and the weight on social welfare is comparatively high. In this case, the marginal gain in contributions never exceeds the weighted marginal loss in social welfare in the interval $[1, \bar{\beta}]$, and the Home government has no incentive at all to complicate customs or administrative procedures.[9]

[9]Result 9 obtains even if the firms represented by the lobby consume the manufacturing good, as long as it is ensured that they all make sufficient profits to cover the associated expenditures μ. Intuitively, if the firms in the lobby consume the manufacturing good, their marginal gain in profits is counteracted by their marginal loss in consumer welfare. Adding this marginal loss on part of the lobby is however

In a truthful equilibrium, the political contributions of the lobby will again reflect the loss that the government suffers from implementing any policy other than the social welfare maximizing policy. Hence, if $\beta^o = \bar{\beta}$, $C_L^T(\beta^o, B_L) = \phi W(\beta{=}1) - \phi W(\bar{\beta})$, while if $\beta^o = 1$, the lobby will make no political contributions at all.

5 Extensions

The basic model as well as the lobbying game lend themselves to several extensions, including social welfare enhancing behind-the-border measures, interactions between national governments, and endogenous lobby formation. I will discuss each of these possibilities in the following.

5.1 Welfare enhancing measures

Contrary to what I assumed so far, some behind-the-border regulations may have a beneficial effect on consumer welfare, such as food safety requirements or environmental standards. In fact, recognizing this potentially positive effect, the WTO explicitly allows for measures that serve to protect human, animal or plant life and health, but may not put foreign exporters at a disadvantage in comparison to domestic producers, in article 20 of the General Agreement of Tariffs and Trade and tries to distinguish them from hidden protectionist measures in its Agreements on Sanitary and Phytosanitary Measures and on Technical Barriers to Trade.

Allowing for such positive effects of behind-the-border measures to compensate for the loss in welfare due to higher prices does not alter the preceding analysis that much, however. The only difference is that even in the absence of lobbying, it may be beneficial to introduce behind-the-border measures, depending on whether the positive effect on consumer health, for instance, outweighs the negative effect on prices. With lobbying, a beneficial effect of technical standards and regulations simply shifts the equilibrium policy upwards, possibly pushing it to the highest feasible level of behind-the-border measures, $\bar{\alpha}$.

5.2 Interactions between national governments

The preceding analysis focuses on unilateral trade policies which are implemented by the national government of one country in response to the pressure applied by a domestic

equivalent to increasing the relative weight of consumer welfare in the Home government's objective function. The marginal loss in social welfare would then be higher, but still decreasing, while the marginal gain in profits would still be increasing in β, and the equilibrium level of border measures would again be either $\beta^o = \bar{\beta}$ or $\beta^o = 1$.

interest group. However, there is reason to believe that a national government cannot determine its trade policy in isolation. Rather, it may provoke retaliatory sanctions by the other country, possibly triggering a trade war, or it may enter into trade negotiations, eventually ending up in a multilateral agreement on non-tariff barriers to trade. The issue of interaction between national governments, either noncooperative as in the case of trade wars, or cooperative, as in the case of trade negotiations, has been addressed in the traditional Grossman and Helpman (1994) framework by Bagwell and Staiger (1999) and Grossman and Helpman (1995), for instance.

What are the implications of such interactions at the international level for the equilibrium trade policy outcomes in the present model? Formally, they add another stage to the game, which occurs after the lobbies in Home and Foreign have announced their contribution schedules to their national governments. In this stage, with the contribution schedules of their domestic lobbies in mind, the Home and the Foreign government either set their trade policies simultaneously and noncooperatively, or they bargain over the levels of border or behind-the-border measures to be implemented in Home and Foreign.

Interestingly, when the Home and the Foreign government set their levels of border measures simultaneously and noncooperatively, the equilibrium trade policy in Home will be exactly the same as the one described in the previous section. This is because the markets in Home and Foreign are separated, and the profits from selling to the domestic market and from exporting are independent of each other. No matter which trade policy is chosen by the Foreign country, the level of border measures that maximizes the Home government's objective function is the same as in a situation without international interactions. The Home government's best response is independent of the Foreign government's trade policy choice, and vice versa. Hence, the Home government cannot credibly commit to retaliatory sanctions in case the Foreign country imposes restrictive border measures. If $\beta = 1$ maximizes the Home government's welfare function if the Foreign government chooses to implement no border measures at all, it also maximizes the Home government's welfare function if the Foreign government chooses to implement the highest possible level of border measures. The same argument is true for behind-the-border measures. Thus, the analysis in the preceding section is robust to noncooperative interaction between the Home and the Foreign government.

Yet, when the levels of border measures to be implemented in Home and Foreign are determined cooperatively in a bargaining situation, they are most likely different from the levels that would obtain in a situation without international interactions. Grossman and Helpman (1995) point out that if both the Home and the Foreign government enter into trade negotiations with the aim of maximizing their respective objective function, the Nash bargaining solution implies that the equilibrium level of border measures in Home,

β^o and in Foreign, β_F^o must be efficient in the sense that they maximize the weighted sum $\bar{G} = \phi^F G + \phi G^F$, where G^F is the objective function of the Foreign government and ϕ^F is the weight the Foreign government puts on the social welfare in its country. Assuming that only the largest firms in Foreign are organized into a single lobby, substituting in the respective objective functions, and making use of (9) and (10) yields

$$\begin{aligned}\bar{G} &= \phi^F \phi \left(\pi_{HD}^{agg}(\beta) + \pi_{HE}^{agg}(\beta_F) + L_H \left(\mu \ln \frac{\mu}{P_H(\beta)} - \mu \right) \right) \phi^F + \phi^F C^L(\beta, \beta_F) \\ &\quad + \phi \, \phi^F \left(\pi_{FD}^{agg}(\beta_F) + \pi_{FE}^{agg}(\beta) + L_F \left(\mu \ln \frac{\mu}{P_F(\beta_F)} - \mu \right) \right) + \phi \, C_F^L(\beta, \beta_F) \\ &= \phi^F \phi \left((L_H + L_F) \frac{\mu}{\kappa} \frac{\sigma - 1}{\sigma} + L_H \left(\mu \ln \frac{\mu}{P_H(\beta)} - \mu \right) + L_F \left(\mu \ln \frac{\mu}{P_F(\beta_F)} - \mu \right) \right) \\ &\quad + \phi^F C^L(\beta, \beta_F) + \phi \, C_F^L(\beta, \beta_F).\end{aligned} \tag{21}$$

The structure of the problem $\max_{\beta \in [1,\bar{\beta}], \beta_F \in [1,\bar{\beta}_F]} \bar{G}$ is however equivalent to the structure of the problem considered in section 4.3, and we can apply the result of Bernheim and Whinston (1986) again. With truthful contribution schedules, this amounts to the following first order condition for the equilibrium level of border measures β^o in Home:

$$\phi^F \phi \left(-L_H \frac{\mu}{P_H(\beta^o)} \frac{\partial P_H(\beta^o)}{\partial \beta} \right) + \phi^F \frac{\partial \pi_{HD}^L(\beta^o)}{\partial \beta} + \phi \frac{\partial \pi_{FE}^L(\beta^o)}{\partial \beta} = 0 \tag{22}$$

Using the definition of social welfare in Home and taking into account that $\frac{\partial \pi_{HD}^{agg}(\beta)}{\partial \beta} = -\frac{\partial \pi_{FE}^{agg}(\beta)}{\partial \beta}$, this is equivalent to

$$\underbrace{\phi \frac{\partial W(\beta^o)}{\partial \beta}}_{<0} + \underbrace{\frac{\partial \pi_{HD}^L(\beta^o)}{\partial \beta}}_{>0} + \underbrace{\phi \frac{\partial \pi_{FE}^{agg}(\beta^o)}{\partial \beta}}_{<0} + \underbrace{\frac{\phi}{\phi^F} \frac{\partial \pi_{FE}^L(\beta^o)}{\partial \beta}}_{>0 \text{ or } <0} = 0 \tag{23}$$

The first two summands capture the effects of border measures which are already known from the noncooperative case, that is their negative effect on social welfare in Home, and their positive effect on the profits of the Home firms organized into a lobby. The third term reflects the negative effect of border measures in the Home country on the Foreign profits from exporting. In the noncooperative case, this negative externality is not taken into account by the Home government, which may result in border measures which are inefficiently high from a global social welfare perspective. And finally, the fourth summand captures the political pressure which the lobbying firms in Foreign exert on their government to make it plead for customs and administrative procedures in their favor at the negotiating table. The most efficient Foreign firms may actually prefer a positive level of protection, as it allows them to grab the market shares of the less efficient Foreign

exporters. If the Foreign government puts a relatively high weight on social welfare, it will however hardly respond to this pressure. Summing up, when both national governments are susceptible to political pressure, the effect of multilateral negotiations on the level of protection is ambiguous, since even if they can remedy inefficiencies in terms of social welfare, they add political pressure from lobbying groups abroad.

5.3 Endogenous lobby formation

Until now I have assumed that only the most efficient Home firms lobby and that the least efficient lobby member, characterized by marginal costs a_L, is exogenously given. Such an assumption may seem acceptable as it is in line with the empirical evidence and gives rather clear results. However, in reality no Home firm can be forced to be part of the lobby, and if I want a_L to reflect the equilibrium composition of the lobby, I have to ensure that indeed no Home firm with marginal costs lower than a_L wants to exit the lobby, and that no Home firm with marginal costs higher than a_L wants to joint the lobby, respectively. Therefore, in the following, I will endogenize a_L, and I will do so for the lobbying game about behind-the-border measures. The same idea and procedure is however also applicable to the lobbying game about border measures.

First note that with a continuum of lobby members, each Home firm has only a negligible impact on the level of behind-the-border measures in the political equilibrium. Thus, any Home firm in the lobby essentially has an incentive to free ride on the activities of the other lobby members. It could exit the lobby, save its share in the political contributions of the lobby, and nevertheless benefit from behind-the-border measures implemented in response to the pressure of the Home firms which are still members of the lobby. In the end, with a continuum of Home firms, if each Home firm compares its utility from being in the lobby with its utility from abstaining from it, it is hard to argue why any lobby should exist after all.

A very neat way to circumvent such a dilemma is the sincere lobbying approach suggested by Zudenkova (2008). Translated into the present modeling framework, the idea is that if a Home firm wants the lobby to exist, it also wants to be a member of the lobby and bear its share of the lobby's political contributions. The equilibrium condition for the lobby formation process then is that no Home firm which is a member of the lobby wants the lobby to stop existing. The motivation behind such an equilibrium condition is that Home firms derive a satisfaction from showing their loyalty to a lobby group which defends their interest. Also, social norms may forbid free riding on the efforts of others.

If all lobby members would have to bear an equal share of the lobby's political contributions, such an equilibrium condition would lead to a critical value a_L, such that a Home firm with a_L is just indifferent between being a member of the lobby and paying a

share of the contributions and a political equilibrium without the lobby. All Home firms with marginal costs lower than a_L strictly prefer the lobby to exist, since their gain from the implementation of behind-the-border measures is larger than their share in political contributions. All Home firms with marginal costs higher than a_L gain so little from the lobby's activities that they are not willing to bear their share in political contributions, and hence prefer to have no lobby.

Formally, a Home firm is a member of the lobby and prefers the lobby to exist if

$$\pi_{HD}(a, \alpha^o) - \frac{C_L^T(\alpha^o)}{M_H \int_0^{a_L} dH(a)} > \pi_{HD}(a, \alpha = 1) \tag{24}$$

where α^o characterizes the level of behind-the-border measures that results if the lobby exerts political pressure on the Home government. Note that a Home firm's profits from exporting to the Foreign market are independent of whether a lobby does or does not exist. The gain from the implementation of behind-the-border measures, $\pi_{HD}(a, \alpha^o) - \pi_{HD}(a, \alpha = 1)$, is strictly decreasing in marginal costs a and becomes negative if a is sufficiently large. Hence, there exists a critical level of marginal costs a_L for which a Home firm is just indifferent between being a member of the lobby and not having a lobby after all. This critical level a_L indicates the composition of the lobby and is given by

$$\pi_{HD}(a_L, \alpha^o) - \frac{C_L^T(\alpha^o)}{M_H \int_0^{a_L} dH(a)} = \pi_{HD}(a_L, \alpha = 1) \tag{25}$$

which is equivalent to

$$\begin{aligned} \frac{\mu}{\sigma}\left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} L_H P_H(\alpha^o)^{\sigma-1} a_L^{1-\sigma} - \alpha^o f_{HD} - \frac{\phi\mu L_H \frac{\kappa+1-\sigma}{(\sigma-1)\kappa} \ln \alpha^o}{M_H \left(\frac{a_L}{\bar{a}_H}\right)^{\kappa}} \\ = \frac{\mu}{\sigma}\left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} L_H P_H(\alpha = 1)^{\sigma-1} a_L^{1-\sigma} - f_{HD} \end{aligned} \tag{26}$$

Since contributions as well as profits change with the level of behind-the-border measures, the critical level a_L is an implicit function of the policy α^o that results in the equilibrium of the lobbying game. This equilibrium policy α^o in turn depends on the composition of the lobby and hence on a_L, as can be seen from the first order condition (18) for a truthful interior equilibrium. Hence, I have two equations in two unknowns, a_L and α^o. Given the non-linear structure of the underlying functions, however, solving this system of equations requires numerical methods. Yet, even if it does not lead to an explicit

analytical solution, the sincere lobbying approach seems to be a neat and tractable way to endogenize the lobby formation process.

6 Conclusion

Starting from the observation that the traditional "Protection for Sale" model of Grossman and Helpman (1994) does not address a couple of interesting issues, the present paper has proposed a different framework to model lobbying on trade policy. It allows for intra-industry trade between countries, heterogeneous lobbying activities of firms, and non-tariff barriers to trade such as technical standards or customs and administrative procedures as relevant policy instruments.

Technical standards, which are applied to both domestic firms and foreign exporters and are thus called behind-the-border measures, shift profits within countries, from the least efficient to the most efficient firms. Behind-the-border measures may also shift profits across countries, but not necessarily in the direction of the country that is more productive on average. In any case, from a pure social welfare perspective, it is never optimal to introduce such measures. With only the largest firms lobbying, they may nevertheless be an equilibrium outcome, and the model suggests that the level of such anti-competitive regulations will be the larger, the more restricted trade already is, and the less the government cares about social welfare.

Border measures, in contrast, clearly discriminate against foreign exporters. They unambiguously benefit domestic producers, and shift profits away from the foreign country. Yet, they also raise prices for consumers, and since this negative effect always dominates the positive effect on profits, border measures will never be chosen by a government that is solely interested in social welfare. Even if the government is susceptible to political pressure, it may choose not to implement any protectionists measures at all. If it implements such measures however, it will chose the maximum possible level to prevent foreign exporters from market entry.

Possible extensions of the model include positive welfare effects of behind-the-border measures, interactions between national governments, and endogenous lobby formation. The last issue requires numerical simulations for specific parameter constellations, but promises interesting results. Another avenue for further research is to allow for the possibility of foreign lobbying. And finally, the model derives a set of predictions which are, in principle, empirically testable, given appropriate data on firm productivities, lobbying expenditures and the level of non-tariff barriers to trade.

Appendix

Appendix A: Explicit solutions for price indices, cutoff values and profits

Using $a_{HD} = \left(\frac{f_{HD}}{L_H}\right)^{\frac{1}{1-\sigma}} \left(\frac{\sigma}{\mu}\right)^{\frac{1}{1-\sigma}} \left(\frac{\sigma-1}{\sigma}\right) P_H$, $a_{FE} = \left(\frac{f_{FE}}{L_H}\right)^{\frac{1}{1-\sigma}} \left(\frac{\sigma}{\mu}\right)^{\frac{1}{1-\sigma}} \left(\frac{\sigma-1}{\sigma}\right) \frac{1}{\tau_H} P_H$, and the marginal cost distributions with identical shape parameters given by (5) and (6), the price index in Home can be calculated as

$$\begin{aligned} P_H &= \left(M_H \int_0^{a_{HD}} \left(\frac{\sigma}{\sigma-1}\, a \right)^{1-\sigma} dH(a) + M_F \int_0^{a_{FE}} \left(\frac{\sigma}{\sigma-1}\, \tau_H a \right)^{1-\sigma} dF(a) \right)^{\frac{1}{1-\sigma}} \\ &= A \left(M_H \left(\frac{f_{HD}}{L_H} \right)^{\frac{\kappa+1-\sigma}{1-\sigma}} \bar{a}_H^{-\kappa} + M_F \left(\frac{f_{FE}}{L_H} \right)^{\frac{\kappa+1-\sigma}{1-\sigma}} (\tau_H \bar{a}_F)^{-\kappa} \right)^{-\frac{1}{\kappa}}. \end{aligned} \tag{27}$$

Similarly, the price index in Foreign can be calculated as

$$\begin{aligned} P_F &= \left(M_H \int_0^{a_{HE}} \left(\frac{\sigma}{\sigma-1}\, \tau_F a \right)^{1-\sigma} dH(a) + M_F \int_0^{a_{FD}} \left(\frac{\sigma}{\sigma-1}\, a \right)^{1-\sigma} dF(a) \right)^{\frac{1}{1-\sigma}} \\ &= A \left(M_F \left(\frac{f_{FD}}{L_F} \right)^{\frac{\kappa+1-\sigma}{1-\sigma}} \bar{a}_F^{-\kappa} + M_H \left(\frac{f_{HE}}{L_F} \right)^{\frac{\kappa+1-\sigma}{1-\sigma}} (\tau_F \bar{a}_H)^{-\kappa} \right)^{-\frac{1}{\kappa}} \end{aligned} \tag{28}$$

with $A = \left(\frac{\sigma}{\mu}\right)^{\frac{\kappa+1-\sigma}{\kappa(\sigma-1)}} \left(\frac{\sigma}{\sigma-1}\right) \left(\frac{\kappa}{\kappa+1-\sigma}\right)^{-\frac{1}{\kappa}}$. The corresponding cutoff values are

$$a_{HD} = B \left(\frac{M_H}{L_H} f_{HD} \bar{a}_H^{-\kappa} + \frac{M_F}{L_H} f_{FE}^{\frac{\kappa+1-\sigma}{1-\sigma}} f_{HD}^{-\frac{\kappa}{1-\sigma}} (\tau_H \bar{a}_F)^{-\kappa} \right)^{-\frac{1}{\kappa}} \tag{29}$$

$$a_{HE} = B \left(\frac{M_H}{L_F} f_{HE} \bar{a}_H^{-\kappa} + \frac{M_F}{L_F} f_{HE}^{-\frac{\kappa}{1-\sigma}} f_{FD}^{\frac{\kappa+1-\sigma}{1-\sigma}} \tau_F^{\kappa} \bar{a}_F^{-\kappa} \right)^{-\frac{1}{\kappa}} \tag{30}$$

$$a_{FD} = B \left(\frac{M_F}{L_F} f_{FD} \bar{a}_F^{-\kappa} + \frac{M_H}{L_F} f_{HE}^{\frac{\kappa+1-\sigma}{1-\sigma}} f_{FD}^{-\frac{\kappa}{1-\sigma}} (\tau_F \bar{a}_H)^{-\kappa} \right)^{-\frac{1}{\kappa}} \tag{31}$$

$$a_{FE} = B \left(\frac{M_F}{L_H} f_{FE} \bar{a}_F^{-\kappa} + \frac{M_H}{L_H} f_{FE}^{-\frac{\kappa}{1-\sigma}} f_{HD}^{\frac{\kappa+1-\sigma}{1-\sigma}} \tau_H^{\kappa} \bar{a}_H^{-\kappa} \right)^{-\frac{1}{\kappa}} \tag{32}$$

with $B = \left(\frac{\sigma}{\mu}\right)^{-\frac{1}{\kappa}} \left(\frac{\kappa}{\kappa+1-\sigma}\right)^{-\frac{1}{\kappa}}$. Given P_H and P_F, the profits of a firm with marginal costs a can be calculated as

$$\pi_{HD}(a) = C\left(\frac{M_H}{L_H} f_{HD}^{\frac{\kappa+1-\sigma}{1-\sigma}} \bar{a}_H^{-\kappa} + \frac{M_F}{L_H} f_{FE}^{\frac{\kappa+1-\sigma}{1-\sigma}} (\tau_H \bar{a}_F)^{-\kappa}\right)^{\frac{1-\sigma}{\kappa}} a^{1-\sigma} - f_{HD} \text{ if } a \leq a_{HD} \tag{33}$$

$$\pi_{HE}(a) = C\left(\frac{M_F}{L_F} f_{FD}^{\frac{\kappa+1-\sigma}{1-\sigma}} \tau_F^{\kappa} \bar{a}_F^{-\kappa} + \frac{M_H}{L_F} f_{HE}^{\frac{\kappa+1-\sigma}{1-\sigma}} \bar{a}_H^{-\kappa}\right)^{\frac{1-\sigma}{\kappa}} a^{1-\sigma} - f_{HE} \text{ if } a \leq a_{HE} \tag{34}$$

$$\pi_{FD}(a) = C\left(\frac{M_F}{L_F} f_{FD}^{\frac{\kappa+1-\sigma}{1-\sigma}} \bar{a}_F^{-\kappa} + \frac{M_H}{L_F} f_{HE}^{\frac{\kappa+1-\sigma}{1-\sigma}} (\tau_F \bar{a}_H)^{-\kappa}\right)^{\frac{1-\sigma}{\kappa}} a^{1-\sigma} - f_{FD} \text{ if } a \leq a_{FD} \tag{35}$$

$$\pi_{FE}(a) = C\left(\frac{M_H}{L_H} f_{HD}^{\frac{\kappa+1-\sigma}{1-\sigma}} \tau_H^{\kappa} \bar{a}_H^{-\kappa} + \frac{M_F}{L_H} f_{FE}^{\frac{\kappa+1-\sigma}{1-\sigma}} \bar{a}_F^{-\kappa}\right)^{\frac{1-\sigma}{\kappa}} a^{1-\sigma} - f_{FE} \text{ if } a \leq a_{FE} \tag{36}$$

and zero otherwise, with $C = \left(\frac{\sigma}{\mu}\right)^{\frac{1-\sigma}{\kappa}} \left(\frac{\kappa}{\kappa+1-\sigma}\right)^{\frac{1-\sigma}{\kappa}}$.

Appendix B: Proof of result 2

Integrating individual profits given by (3) over all Home firms active on the domestic market, with $a_{HD} = \left(\frac{\alpha f_{HD}}{L_H}\right)^{1/(1-\sigma)} \left(\frac{\sigma}{\mu}\right)^{1/(1-\sigma)} \left(\frac{\sigma-1}{\sigma}\right) P_H$ and $H(a) = \left(\frac{a}{\bar{a}_H}\right)^{\kappa_H}$, gives aggregate domestic profits of Home firms as a function of the price index P_H,

$$\pi_{HD}^{agg} = M_H \int_0^{a_{HD}} \pi_{HD}(a) dH(a) = L_H \frac{M_H}{\bar{a}_H^{\kappa_H}} \frac{\sigma-1}{\kappa_H+1-\sigma} \left(\frac{\sigma}{\mu}\right)^{\frac{\kappa_H}{1-\sigma}} \left(\frac{\sigma-1}{\sigma}\right)^{\kappa_H} \left(\frac{\alpha f_{HD}}{L_H}\right)^{\frac{\kappa_H+1-\sigma}{1-\sigma}} P_H^{\kappa_H}. \tag{37}$$

Differentiating with respect to α, taking into account that P_H itself depends on α, and rearranging yields

$$\frac{\partial \pi_{HD}^{agg}}{\partial \alpha} = L_H \frac{M_H}{\bar{a}_H^{\kappa_H}} \left(\frac{\sigma}{\mu}\right)^{\frac{\kappa_H}{1-\sigma}} \left(\frac{\sigma-1}{\sigma}\right)^{\kappa_H} \left(\frac{\alpha f_{HD}}{L_H}\right)^{\frac{\kappa_H+1-\sigma}{1-\sigma}} \frac{P_H^{\kappa_H}}{\alpha} \left(\frac{(\sigma-1)\kappa_H}{\kappa_H+1-\sigma} \epsilon_{P_H,\alpha} - 1\right) \tag{38}$$

where $\epsilon_{P_H,\alpha}$ is the elasticity of the price index P_H with respect to α. Hence,

$$\frac{\partial \pi_{HD}^{agg}}{\partial \alpha} \begin{cases} > 0 & \text{if } \frac{(\sigma-1)\kappa_H}{\kappa_H+1-\sigma} \epsilon_{P_H,\alpha} > 1 \\ = 0 & \text{if } \frac{(\sigma-1)\kappa_H}{\kappa_H+1-\sigma} \epsilon_{P_H,\alpha} = 1 \\ < 0 & \text{if } \frac{(\sigma-1)\kappa_H}{\kappa_H+1-\sigma} \epsilon_{P_H,\alpha} < 1 \end{cases} \tag{39}$$

With $a_{FE} = \left(\frac{\alpha f_{FE}}{L_H}\right)^{\frac{1}{1-\sigma}} \left(\frac{\sigma}{\mu}\right)^{\frac{1}{1-\sigma}} \left(\frac{\sigma-1}{\sigma}\right) \frac{P_H}{\tau_H}$ and $F(a) = \left(\frac{a}{\bar{a}_F}\right)^{\kappa_F}$, the equilibrium price index in Home is implicitly given by

$$0 = \frac{\sigma}{\mu} \left(D \left(\frac{\alpha f_{HD}}{L_H}\right)^{\frac{\kappa_H+1-\sigma}{1-\sigma}} P_H^{\kappa_H} + E \left(\frac{\alpha f_{FE}}{L_H}\right)^{\frac{\kappa_F+1-\sigma}{1-\sigma}} P_H^{\kappa_F}\right) - 1. \tag{40}$$

with $D = \frac{M_H}{\bar{a}_H^{\kappa_H}} \frac{\kappa_H}{\kappa_H+1-\sigma} \left(\frac{\sigma}{\mu}\right)^{\frac{\kappa_H}{1-\sigma}} \left(\frac{\sigma-1}{\sigma}\right)^{\kappa_H}$ and $E = \frac{M_F}{\bar{a}_F^{\kappa_F}} \frac{\kappa_F}{\kappa_F+1-\sigma} \left(\frac{\sigma}{\mu}\right)^{\frac{\kappa_F}{1-\sigma}} \left(\frac{\sigma-1}{\sigma}\right)^{\kappa_F} \tau_H^{-\kappa_F}$. Using the implicit function theorem and calculating the elasticity of the price index P_H with respect to α yields

$$\frac{(\sigma-1)\kappa_H}{\kappa_H+1-\sigma}\,\epsilon_{P_H,\alpha}=\frac{D\left(\frac{\alpha f_{HD}}{L_H}\right)^{\frac{\kappa_H+1-\sigma}{1-\sigma}}P_H^{\kappa_H}\kappa_H+E\left(\frac{\alpha f_{FE}}{L_H}\right)^{\frac{\kappa_F+1-\sigma}{1-\sigma}}P_H^{\kappa_F}\,\frac{\kappa_F+1-\sigma}{\kappa_H+1-\sigma}\kappa_H}{D\left(\frac{\alpha f_{HD}}{L_H}\right)^{\frac{\kappa_H+1-\sigma}{1-\sigma}}P_H^{\kappa_H}\kappa_H+E\left(\frac{\alpha f_{FE}}{L_H}\right)^{\frac{\kappa_F+1-\sigma}{1-\sigma}}P_H^{\kappa_F}\,\kappa_F}. \tag{41}$$

Thus, $\frac{(\sigma-1)\kappa_H}{\kappa_H+1-\sigma}\,\epsilon_{P_H,\alpha}>1$ and $\frac{\partial\pi_{HD}^{agg}}{\partial\alpha}>0$ if $\frac{\kappa_F+1-\sigma}{\kappa_H+1-\sigma}\kappa_H>\kappa_F$, or, equivalently, if $\kappa_H<\kappa_F$. Further, $\frac{\partial\pi_{HD}^{agg}}{\partial\alpha}<0$ if $\kappa_H>\kappa_F$ and $\frac{\partial\pi_{HD}^{agg}}{\partial\alpha}=0$ if $\kappa_H=\kappa_F$. The proof for $\frac{\partial\pi_{FE}^{agg}}{\partial\alpha}$ follows analogously. ■

Appendix C: Proof of result 3

Differentiating (11) with respect to α using (38) gives

$$\begin{aligned}\frac{\partial W}{\partial\alpha}&=\frac{\partial\pi_{HD}^{agg}}{\partial\alpha}-L_H\mu\frac{1}{P_H}\frac{\partial P_H}{\partial\alpha}\\&=\frac{L_H}{\alpha}\,\frac{M_H}{\bar{a}_H^{\kappa_H}}\left(\frac{\sigma}{\mu}\right)^{\frac{\kappa_H}{1-\sigma}}\left(\frac{\sigma-1}{\sigma}\right)^{\kappa_H}\left(\frac{\alpha f_{HD}}{L_H}\right)^{\frac{\kappa_H+1-\sigma}{1-\sigma}}P_H^{\kappa_H}\left(\frac{(\sigma-1)\kappa_H}{\kappa_H+1-\sigma}\,\epsilon_{P_H,\alpha}-1\right)\\&\quad-\frac{L_H}{\alpha}\mu\,\epsilon_{P_H,\alpha}\\&=\frac{L_H}{\alpha}\frac{\kappa_H+1-\sigma}{\kappa_H}D\left(\frac{\alpha f_{HD}}{L_H}\right)^{\frac{\kappa_H+1-\sigma}{1-\sigma}}P_H^{\kappa_H}\left(\frac{(\sigma-1)\kappa_H}{\kappa_H+1-\sigma}\,\epsilon_{P_H,\alpha}-1\right)-\frac{L_H}{\alpha}\mu\,\epsilon_{P_H,\alpha}.\end{aligned} \tag{42}$$

Substituting μ in the second summand of equation (42) using the implicit solution (40) for the price index in Home gives

$$\begin{aligned}\frac{\partial W}{\partial\alpha}&=\frac{L_H}{\alpha}\frac{\kappa_H+1-\sigma}{\kappa_H}D\left(\frac{\alpha f_{HD}}{L_H}\right)^{\frac{\kappa_H+1-\sigma}{1-\sigma}}P_H^{\kappa_H}\left(\frac{(\sigma-1)\kappa_H}{\kappa_H+1-\sigma}\,\epsilon_{P_H,\alpha}-1\right)\\&\quad-\frac{L_H}{\alpha}\sigma\left(D\left(\frac{\alpha f_{HD}}{L_H}\right)^{\frac{\kappa_H+1-\sigma}{1-\sigma}}P_H^{\kappa_H}+E\left(\frac{\alpha f_{FE}}{L_H}\right)^{\frac{\kappa_F+1-\sigma}{1-\sigma}}P_H^{\kappa_F}\right)\epsilon_{P_H,\alpha}\\&=\frac{L_H}{\alpha}(\sigma-1)D\left(\frac{\alpha f_{HD}}{L_H}\right)^{\frac{\kappa_H+1-\sigma}{1-\sigma}}P_H^{\kappa_H}\epsilon_{P_H,\alpha}-\frac{L_H}{\alpha}\sigma D\left(\frac{\alpha f_{HD}}{L_H}\right)^{\frac{\kappa_H+1-\sigma}{1-\sigma}}P_H^{\kappa_H}\epsilon_{P_H,\alpha}\\&\quad-\frac{L_H}{\alpha}\frac{\kappa_H+1-\sigma}{\kappa_H}D\left(\frac{\alpha f_{HD}}{L_H}\right)^{\frac{\kappa_H+1-\sigma}{1-\sigma}}P_H^{\kappa_H}-\frac{L_H}{\alpha}\sigma E\left(\frac{\alpha f_{FE}}{L_H}\right)^{\frac{\kappa_F+1-\sigma}{1-\sigma}}P_H^{\kappa_F}\epsilon_{P_H,\alpha}\\&<0\end{aligned} \tag{43}$$

since $\epsilon_{P_H,\alpha}>0$. ■

Appendix D: Proof of result 5

First note that with border measures, the price index in Home is implicitly given by

$$0=\frac{\sigma}{\mu}\left(D\left(\frac{f_{HD}}{L_H}\right)^{\frac{\kappa_H+1-\sigma}{1-\sigma}}P_H^{\kappa_H}+E\left(\frac{\beta f_{FE}}{L_H}\right)^{\frac{\kappa_F+1-\sigma}{1-\sigma}}P_H^{\kappa_F}\right)-1. \tag{44}$$

Differentiating with respect to β using the implicit function theorem and multiplying with $\frac{\beta}{P_H}$ gives

$$\epsilon_{P_H,\beta} = \frac{\frac{\kappa_F+1-\sigma}{\sigma-1}\ E\ \left(\frac{\beta f_{FE}}{L_H}\right)^{\frac{\kappa_F+1-\sigma}{1-\sigma}}\ P_H^{\kappa_F}}{\kappa_H D\left(\frac{f_{HD}}{L_H}\right)^{\frac{\kappa_H+1-\sigma}{1-\sigma}}\ P_H^{\kappa_H} + \kappa_F E\left(\frac{\beta f_{FE}}{L_H}\right)^{\frac{\kappa_F+1-\sigma}{1-\sigma}}\ P_H^{\kappa_F}} > 0 \tag{45}$$

Now, differentiating social welfare as given by equation (11) with respect to β yields

$$\begin{aligned}\frac{\partial W}{\partial \beta} &= \frac{\partial \pi_{HD}^{agg}}{\partial \beta} - L_H \mu \frac{1}{P_H}\frac{\partial P_H}{\partial \beta} \\ &= \frac{L_H}{\beta}\left(\frac{M_H}{\bar{a}_H^{\kappa_H}}\ \frac{\kappa_H(\sigma-1)}{\kappa_H+1-\sigma}\left(\frac{\sigma}{\mu}\right)^{\frac{\kappa_H}{1-\sigma}}\left(\frac{\sigma-1}{\sigma}\right)^{\kappa_H}\left(\frac{f_{HD}}{L_H}\right)^{\frac{\kappa_H+1-\sigma}{1-\sigma}}\ P_H^{\kappa_H} - \mu\right)\epsilon_{P_H,\beta} \\ &= \frac{L_H}{\beta}\left((\sigma-1)D\left(\frac{f_{HD}}{L_H}\right)^{\frac{\kappa_H+1-\sigma}{1-\sigma}}\ P_H^{\kappa_H} - \mu\right)\epsilon_{P_H,\beta}.\end{aligned} \tag{46}$$

Substituting μ in the second part of equation (46) using the implicit solution (44) for the price index in Home and rearranging gives

$$\frac{\partial W}{\partial \beta} = \frac{L_H}{\beta}\left(-D\left(\frac{f_{HD}}{L_H}\right)^{\frac{\kappa_H+1-\sigma}{1-\sigma}}\ P_H^{\kappa_H} - \sigma E\left(\frac{\beta f_{FE}}{L_H}\right)^{\frac{\kappa_F+1-\sigma}{1-\sigma}}\ P_H^{\kappa_F}\right)\epsilon_{P_H,\beta} < 0. \tag{47}$$

■

Appendix E: Proof of result 7

With truthful contribution schedules and differentiable profit functions, any equilibrium policy that lies in the interior of $[1,\bar{\alpha}]$ must satisfy $\phi\frac{\partial W(\alpha^o)}{\partial \alpha} + \frac{\partial W_L(\alpha^o)}{\partial \alpha} = 0$, which is equivalent to $\phi\frac{\partial W(\alpha^o)}{\partial \alpha} + \frac{\partial \pi_{HD}^L(\alpha^o)}{\partial \alpha} = 0$. Taking the first, second and third derivative of (17) with respect to α, using $\epsilon_{P_H,\alpha} = \frac{\kappa+1-\sigma}{(\sigma-1)\kappa}$, shows that the marginal gain in contributions, $\frac{\partial \pi_{HD}^L(\alpha)}{\partial \alpha}$, is positive, decreasing and convex in α until it reaches zero at $\alpha = \alpha_L$. Taking the first, second and third derivative of equation (11) with respect to α, taking into account $\frac{\pi_{HD}^{agg}}{\partial \alpha} = \frac{\pi_{HE}^{agg}}{\partial \alpha} = 0$ and $\epsilon_{P_H,\alpha} = \frac{\kappa+1-\sigma}{(\sigma-1)\kappa}$, shows that the marginal loss in social welfare, $-\phi\frac{\partial W(\alpha)}{\partial \alpha}$, is positive, decreasing, convex, and converges to zero as α goes to infinity. Restricting parameters such that $\phi\frac{\partial W(\alpha)}{\partial \alpha} + \frac{\partial \pi_{HD}^L(\alpha)}{\partial \alpha} > 0 \Leftrightarrow -\phi\frac{\partial W(\alpha)}{\partial \alpha} < \frac{\partial \pi_{HD}^L(\alpha)}{\partial \alpha}$ at $\alpha = 1$ ensures that $-\phi\frac{\partial W(\alpha)}{\partial \alpha}$ and $\frac{\partial \pi_{HD}^L(\alpha)}{\partial \alpha}$ cross exactly once in the interior of the interval $[1,\bar{\alpha}]$, provided that $\bar{\alpha} > \alpha_L$, and hence $-\phi\frac{\partial W(\alpha^o)}{\partial \alpha} = \frac{\partial \pi_{HD}^L(\alpha^o)}{\partial \alpha} \Leftrightarrow \phi\frac{\partial W(\alpha^o)}{\partial \alpha} + \frac{\partial \pi_{HD}^L(\alpha^o)}{\partial \alpha} = 0$ characterizes α^o as the unique equilibrium level of behind-the-border measures resulting from the lobbying game. ■

Appendix F: Proof of result 9

With truthful contribution schedules, the Home government acts as if it were maximizing $\phi W(\beta)+W_L(\beta)$, which is equivalent to $\phi W(\beta)+\pi^L_{HD}(\beta)+\pi^L_{HE}$. Suppose $\phi\frac{\partial W(\beta)}{\partial\beta}+\frac{\partial\pi^L_{HD}(\beta)}{\partial\beta} > 0$ at $\beta = 1$. This implies that $\frac{\beta}{L_H\epsilon_{P_H,\beta}}\phi\frac{\partial W(\beta)}{\partial\beta}+\frac{\beta}{L_H\epsilon_{P_H,\beta}}\frac{\partial\pi^L_{HD}(\beta)}{\partial\beta} > 0$ at $\beta = 1$ since $\epsilon_{P_H,\beta} > 0$. Both $\frac{\beta}{L_H\epsilon_{P_H,\beta}}\phi\frac{\partial W(\beta)}{\partial\beta}$ and $\frac{\beta}{L_H\epsilon_{P_H,\beta}}\frac{\partial\pi^L_{HD}(\beta)}{\partial\beta}$ are increasing in β, since both

$$\frac{\beta}{L_H\epsilon_{P_H,\beta}}\phi\frac{\partial W(\beta)}{\partial\beta} = \phi\left(\frac{M_H}{\bar{a}_H^{\kappa}}\left(\frac{\sigma}{\mu}\right)^{\frac{\kappa}{1-\sigma}}\left(\frac{\sigma-1}{\sigma}\right)^{\kappa}P_H(\beta)^{\kappa}\left(\frac{f_{HD}}{L_H}\right)^{\frac{\kappa+1-\sigma}{1-\sigma}}\frac{\kappa(\sigma-1)}{\kappa+1-\sigma}-\mu\right) \tag{48}$$

and

$$\frac{\beta}{L_H\epsilon_{P_H,\beta}}\frac{\partial\pi^L_{HD}(\beta)}{\partial\beta} = M_H\left(\frac{a_L}{\bar{a}_H}\right)^{\kappa}\frac{\mu}{\sigma}\left(\frac{\sigma-1}{\sigma}\right)^{\sigma-1}P_H(\beta)^{\sigma-1}a_L^{1-\sigma}\frac{\kappa(\sigma-1)}{\kappa+1-\sigma} \tag{49}$$

depend positively on $P_H(\beta)$ and $\frac{\partial P_H(\beta)}{\partial\beta} > 0$. Hence $\frac{\beta}{L_H\epsilon_{P_H,\beta}}\phi\frac{\partial W(\beta)}{\partial\beta}+\frac{\beta}{L_H\epsilon_{P_H,\beta}}\frac{\partial\pi^L_{HD}(\beta)}{\partial\beta} > 0$ must hold for all $\beta\in[1,\bar{\beta}]$, which implies that $\phi\frac{\partial W(\beta)}{\partial\beta}+\frac{\partial\pi^L_{HD}(\beta)}{\partial\beta} > 0$ must also hold for all $\beta\in[1,\bar{\beta}]$. Thus, the first derivative of the Home government's objective function is positive for all $\beta\in[1,\bar{\beta}]$ and hence the Home governments welfare has a unique maximum at $\beta^o = \bar{\beta}$.

Now suppose $\phi\frac{\partial W(\beta)}{\partial\beta}+\frac{\partial\pi^L_{HD}(\beta)}{\partial\beta} < 0$ at $\beta = \bar{\beta}$. Following the same line of arguments as above, this implies that the first derivative of the Home governments objective function is negative for all $\beta\in[1,\bar{\beta}]$ and hence the Home governments welfare has a unique maximum at $\beta^o = 1$. ■

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