

# Essays on International Trade Policy and International Outsourcing

by

Matilde Bombardini

Laurea, Universita' di Bologna

Submitted to the Department of Economics  
in partial fulfillment of the requirements for the degree of

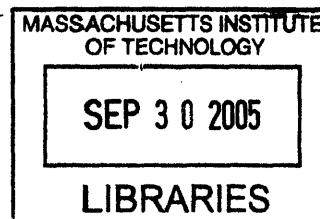
Doctor of Philosophy

at the

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

September 2005

© Matilde Bombardini. All rights reserved.



The author hereby grants to Massachusetts Institute of Technology permission to reproduce and to distribute copies of this thesis document in whole or in part.

Signature of Author .....  
Department of Economics  
15 August 2005

Certified by .....  
Pol Antràs  
Assistant Professor of Economics  
Harvard University - Department of Economics  
Thesis Supervisor

Accepted by .....  
Peter Temin  
Elisha Gray II Professor of Economics  
Chairman, Departmental Committee on Graduate Studies

ARCHIVES

# Essays on International Trade Policy and International Outsourcing

by

Matilde Bombardini

Submitted to the Department of Economics  
on 15 August 2005, in partial fulfillment of the  
requirements for the degree of  
Doctor of Philosophy

## Abstract

This thesis analyzes two issues in international trade: trade policy determination and international outsourcing.

The first three chapters introduce the firm as a novel unit of analysis in the political economy of trade policy. Chapter 1 takes a standard model of political economy of trade policy in the presence of lobbying. It shows that, in the presence of heterogeneity in the participation of firms in political activity, the level of protection is determined, among other factors, by the intensity of lobbying in a given sector. Chapter 2 analyzes the strategic interaction among firms in a given sector and shows how lobbies are formed when protection from foreign competition represents a public good. This chapter offers different criteria that lobby formation might obey and analyzes the impact of the characteristics of the distribution of firm size on the level of protection of industrial sectors. Chapter 3 presents a new dataset which allows me to test the theoretical predictions derived in Chapter 1 and Chapter 2. In particular the empirical results show how the level of protection depends positively on the intensity of lobbying as measured in Chapter 1 and how the intensity of lobbying, called here Participation Shares, depend positively on simple characteristics of the distribution of firm size, such as mean and standard deviation.

The fourth chapter offers a novel perspective on the decision of firms to outsource part of their production activities and looks at the impact of individual firms' decisions on incentive of other firms to outsource. Outsourcing firms face a potential loss of product differentiation, but achieve economies of scale at the level of the intermediate good producer. Interaction among firms in a sector can lead to waves of outsourcing.

Thesis Supervisor: Pol Antràs  
Title: Assistant Professor of Economics  
Harvard University - Department of Economics

*Dedicated to Francesco*

*and to my parents*

## ACKNOWLEDGEMENTS

I am indebted to Pol Antràs and Andrés Rodríguez-Clare for providing invaluable guidance and support. It is without hesitation that I attribute my successful completion of the program to their generous help.

I would like to thank Daron Acemoglu, David Autor, Haluk Ergin, Kishore Gawande, Marc Melitz, Jim Snyder, Francesco Trebbi and Ivan Werning for helpful discussions. I am specially thankful to Elhanan Helpman for encouraging me to pursue this project.

# Contents

<b>1</b>	<b>Firm heterogeneity and lobby participation</b>	<b>7</b>
1.1	Introduction . . . . .	7
1.2	Structure of the economy . . . . .	11
1.3	Political game . . . . .	13
1.4	Conclusions . . . . .	19
<b>2</b>	<b>Endogenous lobby formation with firm heterogeneity</b>	<b>21</b>
2.1	Introduction . . . . .	21
2.2	Structure of the economy . . . . .	25
2.3	Lobby formation with no fixed cost of contributing . . . . .	28
2.4	Lobby formation with fixed cost of contributing . . . . .	36
2.4.1	Sector-optimal equilibrium . . . . .	40
2.4.2	Lobby-optimal equilibrium . . . . .	43
2.4.3	Size distribution and the level of protection . . . . .	46
2.5	Lobby formation with a participation stage . . . . .	48
2.6	Conclusions . . . . .	50
<b>3</b>	<b>Firm heterogeneity and lobby participation: empirical evidence</b>	<b>52</b>
3.1	Introduction . . . . .	52
3.2	Empirical strategy and data description . . . . .	54
3.2.1	Reduced form evidence: the effect of firm size dispersion on protection . . . . .	55
3.2.2	The benchmark model and data description . . . . .	55
3.2.3	Introducing characteristics of the size distribution of firms . . . . .	57

3.2.4	Results . . . . .	58
3.3	Testing the model . . . . .	60
3.3.1	Firm size and the likelihood of participating in the political game . . . . .	61
3.3.2	The relationship between $\theta_i$ and size distribution parameters . . . . .	62
3.3.3	The Heterogeneity specification . . . . .	63
3.3.4	The heterogeneity specification with “true” participation shares . . . . .	64
3.3.5	The heterogeneity specification with “constructed” participation shares . . . . .	65
3.3.6	Comparing the Heterogeneity model and the "Protection for sale" model . . . . .	65
3.4	Conclusions . . . . .	66
3.5	Appendix . . . . .	67
3.5.1	Federal Election Commission contributions data and COMPUSTAT individual company information . . . . .	67
3.5.2	Construction of the characteristics of the size distribution of firms . . . . .	68
3.5.3	Determination of the participation threshold . . . . .	70
<b>4</b>	<b>Product differentiation and waves of outsourcing</b>	<b>81</b>
4.1	Introduction . . . . .	81
4.2	Structure of the economy . . . . .	86
4.3	Unique equilibrium with differentiated products . . . . .	87
4.4	Multiple equilibria case . . . . .	88
4.4.1	Equilibrium conditions . . . . .	90
4.5	Comparative statics . . . . .	94
4.6	Conclusions . . . . .	95

# Chapter 1

## Firm heterogeneity and lobby participation

*Summary 1* The structure of protection across sectors has been interpreted as the result of competition among lobbies to influence politicians, but lobbies have been treated as unitary decision makers and little attention has been devoted to the importance of individual firms in this process. This chapter builds a model where individual firms rationally determine the amount of resources to allocate to political contributions and the level of protection in a sector depends, among other factors on the degree of participation to political activity by firms in the sector. In particular, I show that the level of protection granted to a sector depends, not only on the size of the sector, but on the share of output produced by firms participating in the lobby, which I call Participation Share. The prediction is tested in Chapter 3 using data on individual firms political contributions.

### 1.1 Introduction

Why do some industries receive more protection than others? This question has been the subject of a large body of theoretical and empirical literature. The idea that the structure of trade policy is mainly the result of interest groups lobbying the government to be shielded from foreign competition has gathered large consensus among trade economists, but little attention has been devoted to the role played by individual firms in shaping the structure of protection

across sectors. In the following three chapters I uncover a strong empirical link between the level of protection of a given sector and the characteristics of the size distribution of individual firms in the industry. While traditional models of endogenous trade policy cannot account for this pattern, these chapters show that from a theoretical point of view this evidence can be reconciled with the “Protection for Sale” paradigm, first introduced by Grossman and Helpman (1994), if we shift the focus to the behavior of individual firms.

The literature on the political economy of trade policy has illustrated the importance of the interaction between governments and interest groups in the determination of the structure of trade policy in a variety of settings. The common element to these studies is the description of a specific channel through which interest groups influence the policy maker in the choice of trade policy. Most contributions can be summarized by a common scheme: pressure groups attempt to influence the government’s choice of trade policy through the promise of votes, monetary donations, and general campaign support; the government grants protection from foreign competition to a sector by comparing the benefits that it receives from the industry’s lobby and the social welfare loss brought about by protection measures.

Nevertheless, these studies have failed to investigate the behavior of the individual members (firms) that form interest groups, thus potentially disregarding important aspects of interest groups’ aggregate behavior. In particular, none of these studies can account for an important empirical feature that I uncover in these chapters. Controlling for all the variables employed in previous empirical studies of the “Protection for Sale” framework, the dispersion of the size distribution of firms within a sector is positively correlated with the level of protection granted to an industry. Why are sectors with higher firm size dispersion more protected? According to traditional models of the political economy of trade policy the distribution of firms within a sector should not matter for the determination of trade policy, so the evidence I bring forth calls for a model that incorporates the behavior of individual firms and for further empirical investigation of this new framework.

In this chapter I take the firm as the unit of analysis and adapt the menu auction set-up à la Grossman and Helpman (1994) to describe the game between firms and the government. Each firm that enters a lobby presents the government with a contribution schedule that associates a monetary contribution to each potential degree of protection. Therefore in this set-up each firm



takes individually rational decisions by maximizing its own private benefit. The government chooses the level of protection by trading off contributions and loss of aggregate welfare. The model predicts that what matters for the strength of the lobby (and therefore for the equilibrium level of protection) is not the size of the sector per se, but the share of the total industry output produced by firms that participate in the political game.

In Chapter 2 I concentrate on explaining what determines the participation of firms in the industry's lobby. There I show that the share of the industry output produced by firms participating in the lobby, is determined in equilibrium as a result of the contribution decision of individual firms and depends crucially on the size distribution of firms within the sector. I show that the individual firm's participation decision depends on the firm's size: larger firms are bound to gain more from protection, therefore in the presence of an initial fixed cost of entering the lobby, it is efficient for larger firms to participate in political activity. As a result, the model predicts that under certain conditions (that I find verified in the data), industrial sectors where the distribution of firm size is more dispersed are more likely to have a larger fraction of the sector output produced by firms large enough to gain from participating in the lobby. Therefore a larger firm dispersion will result in a larger participation share and in a higher level of protection.

Chapter 3 tests the theoretical predictions of both Chapter 1 and Chapter 2 employing data on protection measures, the size of sectors, the size distribution of firms within sectors and political contributions by individual firms.

Chapters 1 and 2 build on the important strand of literature that has explored and established a series of models formalizing the interaction between the government and interest groups in the determination of trade policy. The literature is so vast that I do not attempt at being exhaustive and simply refer to the survey by Rodrik (1995), where the various approaches are analyzed and linked to one another. Rodrik offers a clear perspective on the work in this area going from the Political Support Function introduced by Hillman (1989) to the Tariff-Formation Function approach proposed by Findlay and Wellisz (1982) to the Campaign Contribution approach explored by Magee et al. (1989) and more recently by Grossman and Helpman (1994). While previous approaches had provided a reduced form link between the characteristics of a sector and the benefit to the government of granting protection, the Grossman-Helpman model

(henceforth GH) describes a specific channel through which interest groups affect government decisions. In GH lobbies enter a game with the government and bid for protection through campaign contribution offers which the policy maker takes into account when maximizing its own utility (which is a function of aggregate welfare and total campaign funds). This last contribution by Grossman and Helpman is the most carefully micro-founded model up to date and I therefore build on this work to introduce firm heterogeneity and individual firm decisions. This chapter will adopt the same mode of interaction between the government and the lobbies, but will shift the focus on the individual firms as the counterparts to the government in the lobbying game.

This chapter is also related to a more recent but fast-growing area of international trade concerned with the importance of relaxing the assumption of identical firms within sectors. This literature has emphasized, from both a theoretical and an empirical point of view, that allowing for differences in firm productivity and size within a sector helps explain a number of facts that the representative firm approach cannot account for.

One of the first and most influential papers in this literature is Melitz (2003), where a new theoretical framework is introduced and firm heterogeneity plays an important role in the amount of factors reallocation following trade liberalization. As factors of production are reallocated to larger and more productive firms that self-select into the export market, the economy experiences an increase in productivity. The evidence on this self-selection of larger firms into the export market has been widely documented by Bernard and Jensen (1999) and Aw et al. (2000). Self-selection of larger firms is also a feature of the model presented in Chapter 2. By modelling firm heterogeneity Bernard et al. (2003) are able to explain a number of facts about the link between productivity and the exporting status of firms. In Helpman et al. (2004) firm heterogeneity plays a role in determining the prevalence of exports versus foreign direct investment as the channel for domestic firms to access foreign markets. In their model the degree of firm productivity dispersion strongly affects the choice of foreign market access. Antras and Helpman (2004) introduce firm heterogeneity as a determinant of the choice of integration versus outsourcing by multinational firms. Trade policy is an area where the firm dimension has not been carefully considered and where interest groups have generally been treated as unitary decision makers, characterized by some aggregate dimensions like total sector

output or the total number of firms.

As Chapter 2 concentrates on the individual firm's decision to participate in the lobby, the interaction among firms in the same sector and the coordination problem that firms face in forming efficient lobbies, I refer to the introduction of that chapter for a discussion of the large literature on public good provision and the possibility of free-riding.

The remainder of the paper is divided into the following sections: Section 1.2 presents the structure of the economy, Section 1.3 describes the political game and finds the equilibrium tariff identifying the main empirical prediction of this chapter. Section 1.4 concludes.

## 1.2 Structure of the economy

Consider an economy that trades with the rest of the world and faces fixed world prices. There are several goods traded. The numeraire good,  $x_0$ , is not taxable, but all the other  $m$  goods can potentially bear an import or export tax. I will focus on import tariffs and therefore on the import-competing part of the economy, but the expressions obtained describe export subsidies as well. Denote ad valorem tariff on good  $x_i$  by  $\tau_i$  such that the domestic price for good  $i$  is:

$$p_i = (1 + \tau_i) p_i^* \tag{1.1}$$

where  $p_i^*$  is the international price of good  $i$ . Normalize all international prices to one so that the expression (2.1) simplifies to  $p_i = 1 + \tau_i$ .

The population in this economy is of size one and its preferences are represented by the following quasi-linear utility function:

$$U(c_0, c_i) = c_0 + \sum_{i=1}^m u_i(c_i)$$

where  $c_0$  is consumption of good  $x_0$  and  $c_i$  is consumption of good  $x_i$ . The function  $u_i(\cdot)$  is differentiable, increasing, and strictly concave.

Quasi-linear preferences allow the demand for each good  $x_i$  to depend only on its domestic price  $p_i$  (relative to the price of the numeraire good  $x_0$ ), under the condition that income is

high enough to guarantee a positive consumption of good  $x_0$ :

$$c_i = d_i(p_i)$$

Each consumer spends the amount  $c_i(p_i)$  on good  $x_i$  and devotes the rest of his income  $I$  to the numeraire good. I assume that consumption of the numeraire good  $x_0$  is always positive.

Under quasi-linear preferences, the impact of prices on consumer welfare is easy to evaluate as one does not have to deal with distributional issues. The indirect utility function  $V(I, \mathbf{p})$  is:

$$\begin{aligned} V(I, \mathbf{p}) &= I + S(\mathbf{p}) = \\ &= I + \sum_{i=1}^m u_i(d_i(p_i)) - p_i d(p_i) \end{aligned}$$

where  $I$  is income and  $S(\mathbf{p})$  is consumer surplus.

The numeraire good is produced one-to-one with labor and does not require any other input. Each of the other goods  $x_i$  is produced using labor and a factor specific to the sector and to the firm. Free trade in the numeraire good and the production technology for  $x_0$  assures that the wage is equal to 1, assuming that the production of the numeraire good is always positive. Each sector  $i$  is populated by a set of firms that are endowed with different amounts of the specific factor. Firm  $j$  in sector  $i$  produces according to the following production function:

$$x_{ij} = f(K_{ij}, L_{ij})$$

where  $f(\cdot)$  is increasing and concave in both arguments,  $K_{ij}$  is the specific factor endowment<sup>1</sup> of firm  $j$  in sector  $i$  and  $L_{ij}$  is the labor employed by this firm.

The return to the firm's specific factor,  $\Pi_{ij}$ , depends on the domestic price for the good produced and the amount of specific factor owned. By Hotelling lemma, as the domestic price

---

<sup>1</sup>An alternative interpretation is that firms are endowed with the same amount of the specific factor, but each firm's specific factor exhibit a different productivity level. In this paper the underlying cause of firm heterogeneity is taken as given. This is a standard assumption, common to the literature on firm heterogeneity (Melitz (2003) and Bernard et al. (2003)).

$p_i$  increases, the rent increases by the amount of output produced:

$$\frac{\partial \Pi_{ij}}{\partial p_i} = x_{ij}$$

The government is not a pure welfare maximizer. In particular, the incumbent government cares about aggregate welfare as well as monetary contributions that can be used for re-election or for other purposes. The government's objective function  $G$  depends on aggregate welfare gross of contributions,  $W$ , and on the level of contributions that it receives from interest groups,  $C$

$$G = C + aW$$

The composition of  $C$  is discussed later in the model. I restrict the set of policy tools available to the government to trade taxes and subsidies and as indicated above I allow these taxes and subsidies to apply to non-numeraire goods only.

Aggregate welfare is the sum of labor income  $l = 1$ , consumer surplus  $S(\mathbf{p})$ , tariff revenues  $r(\mathbf{p})$  (that are redistributed back to consumers) and rents,  $\Pi_i$ ,<sup>2</sup> that accrue to the owners of the specific factors used in the production of non-numeraire goods, as described below.

$$W = 1 + r(\mathbf{p}) + S(\mathbf{p}) + \sum_{i=1}^m \Pi_i$$

Tariff revenues from each sector  $i$  will be the product of the ad valorem tariff and imports,  $m_i(p_i) = d_i(p_i) - X_i$ :

$$r(\mathbf{p}) = \sum_{i=1}^m \tau_i (d_i(p_i) - X_i)$$

where  $d_i(p_i)$  is demand for good  $i$  and  $X_i$  is total output in sector  $i$ .

### 1.3 Political game

The structure of the game is similar to the one described by Bernheim and Whinston (1986) and adopted by Grossman and Helpman (1994). Here firms act as a set of principals trying to induce

---

<sup>2</sup>Sector-level aggregate rents are  $\Pi_i = \sum_{j \in S_i} \Pi_{ij}$  where  $S_i$  is the set of firms in sector  $i$ .

the agent, the government, to implement a policy that might be costly for the government itself, but would benefit the firm in terms of increased specific factor rent. In this framework each firm is an individual player and therefore a lobby will result from the aggregation of contribution offers that are decided on an individual level by all firms in a given sector  $i$ . This paper follows Grossman and Helpman (1994) in adapting menu auctions to the tariff setting game, with the fundamental difference that each individual firm is considered as a different principal, which decides independently on its contribution schedule. More precisely the owner of the firm's stock of specific factor is a principal that decides whether to participate in lobbying efforts and how much to contribute to the government. The concepts of firm and owner of the firm's specific factor are used interchangeably. In this chapter I take the set of firms lobbying as given and I refer to the following chapter for the determination of the set of firms participating in political activity.

The players of this game are the individual firms in each sector's lobby and the government. The government chooses a vector of prices  $\mathbf{p} \in \mathbf{P}$  while the strategy space for firm  $j$  in sector  $i$  consists of a contribution schedule  $C_{ij}(\mathbf{p})$  that associates a level of monetary contribution to each price vector.

This firm's gross payoff is  $W_{ij}(\mathbf{p}) = l_{ij} + \Pi_{ij}(\mathbf{p}) + \alpha_{ij}(r(\mathbf{p}) + S(\mathbf{p}))$  where  $\alpha_{ij}$  is the share of population represented by the owner of specific factors in firm  $ij$ ,  $l_{ij}$  is the labor income of the owner of firm  $ij$  specific factor. The firm's net payoff is  $V_{ij} = W_{ij}(\mathbf{p}) - C_{ij}(\mathbf{p})$  while the government's payoff is  $G = C + aW(\mathbf{p})$  as specified above.

The extensive form of the game is the following:

- (i) in the first stage, firms that belong to the sector's lobby present the government with a contribution schedule  $C_{ij}(\mathbf{p})$ ;
- (iii) in the second stage, the government chooses a vector  $\mathbf{p}$  and collects  $C_{ij}(\mathbf{p})$  from each firm.

What follows is a set of conditions for an equilibrium in the *Political Game* between the set of firms that make positive contributions and the policy maker. The interpretation of these conditions is given below. Denote by  $L_i$  the set of firms in sector  $i$  that make positive contributions, which is now taken as given. Denote by  $S_i$  the set of all firms in sector  $i$ .

A configuration  $\left(\left\{C_{ij}^o\right\}, \mathbf{p}^o\right)$  is a subgame-perfect equilibrium of the game if and only if:

1.  $C_{ij}^o$  is feasible
2.  $\mathbf{p}^o \in \arg \max \sum_i \sum_{j \in L_i} C_{ij}^o(\mathbf{p}) + aW(\mathbf{p})$
3. Given  $C_k^o(\mathbf{p}^o)$ ,  $k \neq ij$ ,  $C_{ij}^o(\mathbf{p}^o) \in \arg \max W_{ij}(\mathbf{p}^o) - C_{ij}(\mathbf{p}^o)$

where  $\mathbf{p}^o$  satisfies condition 2

Condition 1 states that contributions cannot be larger than total income of firm  $ij$  and cannot be negative. Condition 2 states that the government chooses  $\mathbf{p}$  to maximize its welfare, given the equilibrium contribution schedules presented by each firm. Condition 3 states that each firm chooses its contribution schedule to maximize its net welfare.

Condition 3 can be decomposed into two sub-conditions:

- (a) The joint surplus of the government and firm  $ij$  is maximized at  $\mathbf{p}^o$  (otherwise the firm could modify its contribution schedule to increase the joint surplus and would retain a fraction of this increased surplus):<sup>3</sup>

$$W_{ij}(\mathbf{p}^o) - C_{ij}^o(\mathbf{p}^o) + \sum_i \sum_{j \in L_i} C_{ij}^o(\mathbf{p}^o) + aW(\mathbf{p}^o) \geq W_{ij}(\mathbf{p}) - C_{ij}^o(\mathbf{p}) + \sum_i \sum_{j \in L_i} C_{ij}^o(\mathbf{p}) + aW(\mathbf{p}) \quad \forall \mathbf{p}$$

- (b) Due to the timing of the game, firm  $ij$  manages to extract all the available surplus from the government (it contributes just enough to maintain the government at the same level of welfare that it would achieve if firm  $ij$  were not participating in the political game):

$$\exists \mathbf{p}^{-ij} \forall ij \in L \text{ such that } \mathbf{p}^{-ij} \in \arg \max \sum_i \sum_{j \in L_i} C_{ij}^o(\mathbf{p}) + aW(\mathbf{p}) \text{ and } C_{ij}^o(\mathbf{p}^{-ij}) = 0$$

This condition will be used to calculate contributions in equilibrium, so details are provided in Chapter 2.

---

<sup>3</sup>The first sub-condition is found as follows:

$$\begin{aligned} W_{ij}(\mathbf{p}^o) - C_{ij}^o(\mathbf{p}^o) &\geq W_{ij}(\mathbf{p}) - \left( \sum_i \sum_{j \in L_i} C_{ij}^o(\mathbf{p}^o) + aW(\mathbf{p}^o) - \left( \sum_i \sum_{k \in L_i, k \neq j} C_k^o(\mathbf{p}) + aW(\mathbf{p}) \right) \right) \quad \forall \mathbf{p} \\ W_{ij}(\mathbf{p}^o) - C_{ij}^o(\mathbf{p}^o) + \sum_i \sum_{j \in L_i} C_{ij}^o(\mathbf{p}^o) + aW(\mathbf{p}^o) &\geq W_{ij}(\mathbf{p}) + \sum_i \sum_{k \in L_i, k \neq j} C_k^o(\mathbf{p}) + aW(\mathbf{p}) \quad \forall \mathbf{p} \\ W_{ij}(\mathbf{p}^o) - C_{ij}^o(\mathbf{p}^o) + \sum_i \sum_{j \in L_i} C_{ij}^o(\mathbf{p}^o) + aW(\mathbf{p}^o) &\geq W_{ij}(\mathbf{p}) - C_{ij}^o(\mathbf{p}) + \sum_i \sum_{j \in L_i} C_{ij}^o(\mathbf{p}) + aW(\mathbf{p}) \quad \forall \mathbf{p} \end{aligned}$$

I assume that contribution schedules are differentiable which, also according to Grossman and Helpman (1994), is reasonable if we want to prevent mistakes in the calculations of the individual firm from resulting in large swings in the contributions offered. Combining condition 2 and sub-condition (a) one obtains the following condition:

$$\nabla W_{ij}(\mathbf{p}^\circ) = \nabla C_{ij}^\circ(\mathbf{p}^\circ)$$

This condition implies that contribution schedules are locally truthful, that is, around the equilibrium price vector  $\mathbf{p}^\circ$  they reflect the willingness to pay of the firm for an increase in the domestic price. Although only differentiability is needed to obtain local truthfulness of the contribution schedule and ultimately the equilibrium price, more restrictive assumptions are needed to obtain the level of contributions of each firm. I therefore restrict the attention to contribution schedules that are globally truthful, that is they reflect everywhere the willingness to pay of the firm for a change in the domestic price. As a result I will focus on Truthful Nash Equilibria (TNE are equilibria that result from truthful contribution schedules). I refer to Bernheim and Whinston (1986) for a detailed explanation of why such contribution schedules and equilibrium concept may be focal and I summarize here the main motivations for this choice. First, firms' best-response sets always include a truthful strategy so firms cannot lose from choosing a truthful contribution schedule. Second, TNE are Pareto optimal, robust to communication among players and are therefore coalition-proof.

A globally Truthful Contribution schedule will take the following form:

$$C_{ij}(\mathbf{p}) = \max[0, W_{ij}(\mathbf{p}) - B_{ij}]$$

where  $B_{ij}$  indicates a level of welfare to be determined in equilibrium.

Given this simple expression for firms' contributions schedules the government will choose  $\mathbf{p}^\circ$  solving this program:

$$\mathbf{p}^\circ = \arg \max \left[ \sum_i \sum_{j \in L_i} W_{ij}(\mathbf{p}) + aW(\mathbf{p}) \right]$$

According to this program the objective function of the government is represented by a weighted



sum of consumers' and producers' surplus, where the weight on the welfare of firms that make positive contributions in equilibrium is larger than the weight on the welfare of firms that do not make contributions and of the rest of the population. The first order condition for this multivariate maximization problem is the following:

$$\sum_i \sum_{j \in L_i} \nabla W_{ij}(\mathbf{p}^o) + a \nabla W(\mathbf{p}^o) = 0 \quad (1.2)$$

Consider the impact of the increase in price  $p_k$  of good  $x_k$  on the welfare of firm  $ij$  owner:

$$\frac{\partial W_{ij}}{\partial p_k} = (\delta_{ik} \theta_{ij} - \alpha_{ij}) X_k + \alpha_{ij} (p_k - 1) m'_k$$

where  $\delta_{ik} = 1$  if  $i = k$  and  $\delta_{ik} = 0$  otherwise,  $x_{ij} = \theta_{ij} X_i$  and  $\theta_{ij}$  is the share of total output in sector  $i$  produced by firm  $j$ :

$$\theta_{ij} = \frac{x_{ij}}{\sum_{j \in S_i} x_{ij}}$$

Therefore aggregating over all firms in sector  $i$  that participate in the political game, I obtain the impact of an increase of price  $p_k$  on the welfare of the set of firms  $L_i$  (the firms that lobby in sector  $i$ ), call it  $W_{L_i}$ :

$$\sum_{j \in L_i} \frac{\partial W_{ij}}{\partial p_k} = \frac{\partial W_{L_i}}{\partial p_k} = (\delta_{ik} \theta_i - \alpha_{L_i}) X_k + \alpha_{L_i} (p_k - 1) m'_k \quad (1.3)$$

where  $\alpha_{L_i} = \sum_{j \in L_i} \alpha_{ij}$  and  $\theta_i = \sum_{j \in L_i} \theta_{ij}$ .  $\theta_i$  is the share of total output in sector  $i$  produced by firms that participate in the political game and it might be zero if in sector  $i$  no firm makes political contributions (the sector is therefore not politically organized). Now aggregating (1.3) over all sectors:

$$\sum_i \frac{\partial W_{L_i}}{\partial p_k} = (\theta_k - \alpha_L) X_k + \alpha_L (p_k - 1) m'_k \quad (1.4)$$

where  $\alpha_L = \sum_i \alpha_{L_i}$  is the share of the population in the economy that owns some specific factor and participates in the political game and  $\theta_k = \sum_i \delta_{ik} \theta_i$ .

Aggregate welfare is affected by an increase of the price of good  $x_k$  according to the following expression:

$$\frac{\partial W}{\partial p_k} = (p_k - 1) m'_k + m_k - d(p_k) + X_k = (p_k - 1) m'_k \quad (1.5)$$

Notice that in the absence of lobbying the welfare maximizing domestic price is the international price  $p_k = 1$ . Now substitute expressions (1.5) and (1.4) into the first-order condition (1.2) and rearrange to obtain the following expression for the domestic price of good  $x_k$ :

$$p_k^o - 1 = -\frac{\theta_k^o - \alpha_L}{a + \alpha_L} \frac{X_k^o}{m_k^o}$$

The first-order condition can be rewritten in a fashion similar to the “Protection for sale” equation:

**Proposition 1** *If firms’ contribution schedules are truthful, for a given set of firms participating in the political game, the equilibrium domestic price of good  $x_i$  is given by the following expression:*

$$\frac{\tau_i^o}{1 + \tau_i^o} = \frac{\theta_i^o - \alpha_L}{a + \alpha_L} \left( \frac{z_i^o}{e_i^o} \right) \quad (1.6)$$

where  $z_i^o = \frac{X_i^o}{m_i^o}$  is the inverse import penetration ratio,  $e_i^o = -m_i^o p_i^o / m_i^o$  is the price elasticity of imports and  $\theta_i^o$  is the equilibrium share of total output of sector  $i$  represented by firms that make positive contributions:

$$\theta_i^o = \frac{\sum_{j \in L_i} x_{ij}}{\sum_{j \in S_i} x_{ij}}$$

The level of protection  $\tau_i$  depends on several factors (apart from  $a$  which is constant across sectors). First, the larger the level of output of a sector relative to imports the larger the deviation from free trade. This is a result of the relatively smaller distortion imposed on sectors that have low levels of imports. The size of output affects the level of protection because a larger industry will, *ceteris paribus*, receive a larger benefit from the increase in price  $p_i$  and the government can expect to receive larger contributions therefore protection granted will be higher. Second, sectors characterized by lower price elasticity of imports receive larger protection as the distortion created by protection is lower. The third factor is going to be the focus of the remaining part of the theoretical section and of much of the empirical section: the equilibrium share of total output produced by firms lobbying,  $\theta_i^o$ . For a given level of

output the larger this share the larger the marginal contributions the government can expect, the higher the level of protection. The share  $\theta_i^o$  can be seen as the “intensity” of lobbying and allows sectors to be characterized by different degrees of lobby participation shares. This is conceptually different from GH insofar as it allows the choice of lobbying in a sector to be a smooth function. Remember that in GH the equilibrium tariff has the following comparable expression:

$$\frac{\tau_i^o}{1 + \tau_i^o} = \frac{I_i - \alpha_L}{a + \alpha_L} \left( \frac{z_i^o}{e_i^o} \right)$$

where  $I_i$  is one if sector  $i$  is politically organized and zero otherwise. Therefore in GH and in Mitra (1999) lobbying is a binary choice: either the sector is politically organized or it is not. This is at odds with the observation that participation shares are different across sectors as will be shown in the empirical section. In Chapter 2 and Chapter 3 the goal is to show how  $\theta_i^o$  is determined in equilibrium, what are the factors that affect its size, and how an empirical measure of this share significantly affects the explanation of the variation of protection across sectors. Proposition 1

## 1.4 Conclusions

This chapter provides a micro-foundation of individual firms’ lobbying behavior and develops a model that helps explain a number of empirical features shown in the data which will be illustrated in Chapter 3. This chapter shows that accounting for individual firm behavior and differences in participation shares across sectors should help explain a larger fraction of the variation of protection across sectors as it introduces a novel source of heterogeneity across sectors which is the “intensity” of lobbying and therefore improves on existing theoretical studies of endogenous protection that employ the "Protection for sale" framework. Chapter 2 explores how participation shares can be determined as a result of coordination among firms and provides a specific link between the distribution of firm size and equilibrium participation shares.

Nevertheless this model provides a stylized description of the interaction between lobbies and the government and there are dimensions of the political game involved in tariff setting that are not taken into account by the analysis provided in this chapter and Chapter 2. A promising line of research recently undertaken by Gawande and Li (2004) explores the consequences of

considering the government not as a unitary entity, but as a more complex and uncertain counterpart to interest groups. It would be interesting to explore from a theoretical and empirical point of view the possible competition among politicians to obtain contributions from interest groups. The conjecture is that in the presence of fixed costs for the politicians in contacting firms to obtain political support, the size distribution of firms within a sector should affect the level of protection granted to the industry. In future work I intend to develop a theoretical framework that can account for this mechanism.

Moreover it would be interesting to further explore how the decision to lobby depends on the industry and other characteristics of the firm: this might shed some light on the nature of the cost necessary to start political activity and other determinants that are not considered in this chapter.

## Chapter 2

# Endogenous lobby formation with firm heterogeneity

*Summary 2 Chapter 1 shows how the level of protection granted to a sector depends, among other factors on the share of total output produced by firms that are active in the sector's lobby. This chapter aims at endogenizing the participation decision of individual firms and offers a framework to analyze the possible coordination problems among firms in a sector. In the presence of fixed costs in playing an active role in the sector's lobby, I show that it is efficient for the largest firms to participate in the lobby and that sectors characterized by larger dispersion of firm size also exhibit larger participation shares.*

### 2.1 Introduction

In Chapter 1 I have introduced a firm-level perspective on the determination of the degree of protection in an industrial sector. I have shown that for a given set of participating firms, the level of protection should depend, among other factors, on how much of the total output actively lobbying firms produce. In this chapter I explore in detail how a lobby emerges and how some firms decide to participate in lobbying activities and others decide to stay outside the lobby. Following the empirical motivation laid out in Chapter 1, I explore the links between the characteristics of the distribution of firm size and the intensity of lobbying in a sector, measured as the share of output produced by firms making positive contributions.

In order to focus on the behavior of firms within a sector and the government I present a simplified version of the menu auction introduced in chapter 1 where firms only care about the price of the good that they produce and therefore interact uniquely with the government and amongst themselves. Therefore the model abstracts from the potential interaction among firms in different sectors and the possibility of counter-lobbying by firms that are consumers of the sector's output.

Using this simplified set-up I first present a game in which there is no cost of making contributions. In this game, in the absence of an explicit ex-ante participation decision, participation of all firms in the sector is the efficient outcome and is focal among the possible equilibria of the game if we just allow communication among firms. Full participation still does not rule out multiple equilibria in the contributions level and I characterize the set of possible contribution levels for all firms that sustain such equilibrium. Under this game structure, the distribution of firm size does not affect the intensity of lobbying, since every firm contributes. This prediction is clearly at odds with the evidence presented in chapter 1, which shows that there is a wide fraction of firms that do not participate in lobbying activities in all sectors.

The model is therefore enriched to allow for the presence of fixed set-up costs of contributing. In this framework firms take into account that the first dollars they set apart for contributions do not reach the hands of politicians, but are spent on collecting information, hiring lobbyists, etc. In this game I show that the individual firm's participation decision should depend on the firm's size: larger firms are bound to gain more from protection and create a larger surplus for the lobby, therefore in the presence of an initial fixed cost of entering the lobby, it is efficient for larger firms to participate in political activity. This logic is suggested (but not theoretically or empirically verified) in the work of Masters and Keim (1985) on the motivation behind a corporation's choice to set up Political Action Committees<sup>1</sup>: controlling for other determinants of political participation, "the economic size of the firm should also be positively related to the probability of having a PAC [i.e. entering the political game]. This is because the initial fixed costs of organizing for political activity may be spread over a larger asset base". This game structure allows for multiple equilibria, as the basic model without fixed costs, so we

---

<sup>1</sup>Commonly referred to as PAC's. I will describe in the empirical section what PAC's are and how they work. For now I simply take the choice of setting up a PAC as the decision of entering into the political game.

need to propose a reasonable selection criterion among the many equilibria. I show that, in general, firms should coordinate on equilibria in which only the larger firms participate. The precise determination of which firms should participate in the lobby depends on which group's welfare we are trying to maximize. I introduce two plausible criteria to determine which firms participate in the lobby in equilibrium, one that is optimal from the lobby participants' point of view and one that is optimal from the whole sector's point of view. I then argue in favor of the first type of equilibrium participation decision in the absence of transfers between firms that do not make political contributions and firms that belong to the lobby.

Finally I modify the initial structure of the game by adding a participation stage, in which firms explicitly and simultaneously choose whether to participate in the subsequent menu auction or not to participate. I introduce this structure of the game to illustrate how the encouraging efficient result obtained in the basic model is undermined by a modification of the game structure.

This chapter, as the previous one, adapts the menu auction set-up introduced by Bernheim and Whinston (1986) and adopted by Grossman and Helpman (1994) to a context where individual firms are the unit of analysis, although in this chapter the focus is on the plausible outcome of coordination among firms and the participation decision.

An account of where this contribution stands in the literature would be incomplete without mentioning previous work on the provision of public goods and lobby formation. In his seminal contribution Mancur Olson (1965) informally advanced the idea that "in groups of members of unequal 'size'...there is the greatest likelihood that a collective good will be provided". The motivation for this statement relies on the presumption that larger members will find it economically viable to participate in lobbying activities and that groups with a few large members will be more effective than groups with a large number of small members. The notion that large members will ensure a sizeable provision of a collective good is common to the literature on public goods and free-riding. In this chapter I intend to revisit Olson's insightful contribution and provide a more rigorous micro-foundation of firms behavior.

Two papers, one by Pecorino (1998) and one by Magee (2002), tackle the issue of free-riding in the interaction between firms in a lobby. While the two papers offer an interesting insight into the issue of how the number of identical firms in a sector affect the likelihood of

free-riding, these models do not analyze the decision of the firm to enter the lobby and do not have an immediate application to the case where firms are heterogeneous. Moreover, they adopt a repeated game framework where the participation decision of the firm in the lobby is not explicitly modeled. Gawande (1997) adopts the reduced form model of private provision of public goods first introduced by Bergstrom et al. (1986) and presents empirical evidence that the concentration of firms in a sector increases the level of protection. Their papers share a common failure to carefully micro-found the decision of firm participation into the lobby and still adopt the tariff function approach without having an explicit mechanism of interaction between the government and individual firms. The model I present substantially improves on this reduced form approach by modelling explicitly the firms' decisions about entry and the level of contributions.

The most thorough analysis of lobby formation in the framework of the Grossman and Helpman model is due to Mitra (1999). In his paper lobby formation is a discrete process: either a sector organizes into a lobby or it is unorganized. In this sense sectors are again treated as black boxes where firms do not play any role: lobby formation realizes on the sole condition that total surplus is greater than the set up cost. This seems a reasonable assumption for lobby formation if we consider, as Mitra does, sectors where firms are all identical and symmetry arguments can justify a coordination outcome. This characterization seems less innocuous if there are large differences among firms within a sector, which is what we observe in the data. Moreover, while Mitra's paper helps explain the presence or the absence of the lobby, the model in this paper describes the "intensity" of lobbying, that is the share of total industry resources that are directed to the political activity of a sector.

In presenting a modified game structure with an explicit participation stage, I obtain a result that has first been introduced, in a separate context, by Dixit and Olson (2000). They also show how voluntary decision might affect the efficiency property of the public good provision game.

Section 2.2 presents a simplified structure of the economy. Section 2.3 presents the basic menu auction game with no fixed costs of contributing. Section 2.4 introduces a fixed cost within the menu auction structure and finds the efficient equilibrium. Section 2.5 describes one further modification of the basic game in Section 2.3 by allowing for an explicit participation



stage. Section 2.6 concludes.

## 2.2 Structure of the economy

As in Chapter 1, consider an economy that trades with the rest of the world and faces fixed world prices. In this chapter I focus on an individual sector and therefore I consider a simplified economy with two traded goods: the numeraire good,  $x_0$ , which does not bear any import tax or subsidy, and good  $x$ , which can potentially bear an import or export tax or subsidy. As in Chapter 1 I will focus on import tariffs and therefore on the import-competing part of the economy, but the expressions obtained describe export subsidies as well. Denote ad valorem tariff on good  $x$  by  $\tau$  such that the domestic price for good  $x$  is:

$$p = (1 + \tau) p^* \tag{2.1}$$

where  $p^*$  is the international price of good  $x$ . I normalize the international price to one so that the expression (2.1) simplifies to  $p = 1 + \tau$ .

The population in this economy is of size one and its preferences are represented by the following quasi-linear utility function:

$$U(c_0, c_x) = c_0 + u(c_x)$$

where  $c_0$  is consumption of good  $x_0$  and  $c_x$  is consumption of good  $x$ . The function  $u(\cdot)$  is differentiable, increasing, and strictly concave.

In an economy with more than two goods adopting quasi-linear preferences allows the demand for good  $x$  to depend only on its domestic price  $p$  (relative to the price of the numeraire good  $x_0$ ), under the condition (which I will assume holds here) that income is high enough to guarantee a positive consumption of good  $x_0$ :

$$c_x = d(p)$$

Each consumer spends the amount  $c_x(p)$  on good  $x$  and devotes the rest of his income  $I$  to the numeraire good. In an economy with only two goods the demand structure would be simple

enough even with a more general utility function, but there would still be an aggregation problem since the model allows for different groups in the economy to have different levels of income. Moreover quasi-linear utility entails a simple expression for the aggregate welfare in the economy. Under these preferences, the indirect utility function  $V(I, \mathbf{p})$  is:

$$\begin{aligned} V(I, \mathbf{p}) &= I + S(p) = \\ &= I + u(d(p)) - pd(p) \end{aligned}$$

where  $I$  is income and  $S(p)$  is consumer surplus.

In this chapter I adopt a specific functional form for the utility function which allows to fully solve the model. The consumers have quadratic utility function:

$$u(c) = \frac{D}{b}c - \frac{1}{2b}c^2$$

which implies the following linear demand function:

$$d(p) = D - bp$$

With linear demand function consumer surplus is described by the following expression:

$$S(p) = \frac{1}{2b} (D - bp)^2$$

The numeraire good is produced one-to-one with labor and does not require any other input. Good  $x$  is produced using labor and a factor specific to the sector and to the firm. Free trade in the numeraire good and the production technology for  $x_0$  assures that the wage is equal to 1, assuming that the production of the numeraire good is always positive. The sector producing good  $x$  is populated by a set of firms  $S$  that are endowed with different amounts of the specific factor. While in Chapter 1 the functional form is kept general, here I adopt a more specific production function in order to obtain closed form solutions that would not be possible under a more general formulation. Firm  $j$  in sector  $x$  produces according to the following Leontief

production function:

$$x_j = \min \{K_j, L_j\}$$

where  $K_j$  is the specific factor endowment<sup>2</sup> of firm  $j$  in sector  $x$  and  $L_j$  is the amount of labor employed by firm  $j$ .

Since there is a perfectly elastic supply of labor at  $w = 1$  this amounts to the firm producing:

$$x_j = \begin{cases} K_j & \text{if } p \geq 1 \\ 0 & \text{otherwise} \end{cases}$$

Because the lower bound on the domestic price is the international price  $p^* = 1$  then firms always produce the maximum amount they can and they employ  $K_j$  units of labor. The return to the firm's specific factor,  $\Pi_j$ , depends on the domestic price for the good produced and the amount of specific factor owned:

$$\Pi_j(\mathbf{p}) = K_j(p - 1)$$

By Hotelling lemma, as the domestic price  $p$  increases the rent increases by the amount of output produced, showing how larger firms benefit more than smaller firms from a given increase in protection:

$$\frac{\partial \Pi_j}{\partial p} = K_j$$

The government is not a pure welfare maximizer. In particular, the incumbent government cares about aggregate welfare as well as monetary contributions that can be used for re-election or for other purposes. The government's objective function  $G$  depends on aggregate welfare gross of contributions,  $W(p)$ , and on the level of contributions that it receives from firms lobbying,  $C$

$$G = C + aW(p)$$

The composition of  $C$  is discussed later in the model. I restrict the set of policy tools available to the government to trade taxes and subsidies and as indicated above I allow these taxes and

---

<sup>2</sup>An alternative interpretation is that firms are endowed with the same amount of the specific factor, but each firm's specific factor exhibit a different productivity level. In this paper the underlying cause of firm heterogeneity is taken as given. This is a standard assumption, common to the literature on firm heterogeneity (Melitz (2003) and Bernard et al. (2003)).

subsidies to apply to the non-numeraire good only.

Aggregate welfare is the sum of labor income  $l = 1$ , consumer surplus  $S(p)$ , tariff revenues  $r(p)$  (that are redistributed back to consumers) and rents,  $\Pi$ ,<sup>3</sup> that accrue to the owners of the specific factors used in the production of the non-numeraire good, as described below:

$$W(p) = 1 + r(p) + S(p) + \sum_{j \in S} \Pi_j$$

Tariff revenues from sector  $x$  will be the product of the ad valorem tariff and imports,  $m(p) = d(p) - X$ :

$$r(p) = \tau(d(p) - X)$$

where  $d(p)$  is demand for good  $x$  and  $X$  is total output in sector  $x$ . Under the specific functional forms adopted here aggregate welfare can be rewritten as follows:

$$W(p) = 1 + (p - 1) \left( D - bp - \sum_{j \in S} K_j \right) + \frac{1}{2b} (D - bp)^2 + \sum_{j \in S} K_j (p - 1)$$

I assume that the owners of a sector's specific factor represent a negligible fraction of the voting population. As a result firms do not care about the price of the good as consumers, but only as producers. I therefore assume that each lobby makes contributions with the only goal of raising the price of the good it produces. In this simplified framework there are no lobbies that compete with sector  $x$  lobby, but if we had other sectors the assumption of concentrated ownership implies that firms do not contribute to lower the price of goods they consume.

## 2.3 Lobby formation with no fixed cost of contributing

In this section, as in Chapter 1, I analyze a game similar to the one described by Bernheim and Whinston (1986) and adopted by Grossman and Helpman (1994). Here firms act as a set of principals trying to induce the agent, the government, to implement a policy that might be costly for the government itself, but would benefit the firm in terms of increased specific factor

---

<sup>3</sup>Sector-level aggregate rents are  $\Pi = \sum_{j \in S} \Pi_j$  where  $S$  is the set of firms in sector  $x$ .

rent. In this framework each firm is an individual player and therefore a lobby will result from the aggregation of contribution offers that are decided on an individual level by all firms in sector  $x$ .

The players of this game are the individual firms in the sector and the government. The government chooses a domestic price  $p \in P$  while the strategy space for firm  $j$  consists of a contribution schedule  $C_j(p)$  that associates a level of monetary contribution to each price level.

The firm's gross payoff is  $W_j(p) = \Pi_j(p)$ : for simplicity I assume that a firm owner is concerned uniquely with the specific factor rent. The firm's net payoff is  $V_j = W_j(p) - C_j(p)$  while the government's payoff is  $G = C + aW(p)$  as specified above.

The extensive form of the game is as follows:

- (i) in the first stage, firms present the government with a contribution schedule  $C_j(p)$
- (ii) in the second stage, the government chooses a price  $p$  and collects  $C_j(p)$  from each firm  $j$

In what follows I lay down the conditions for an equilibrium in this game. A configuration  $(\{C_j^o\}, p^o)$  is a subgame-perfect equilibrium of the game if and only if:

1.  $C_j^o$  is feasible
2.  $p^o \in \arg \max \sum_{j \in L} C_j^o(p) + aW(p)$
3. Given  $C_h^o(p^o)$ ,  $h \neq j$ ,  $C_j^o(p^o) \in \arg \max W_j(p^o) - C_j(p^o) - F$  where  $p^o$  satisfies condition 2.

Condition 1 states that contributions cannot be larger than total income of firm  $j$  and cannot be negative. Condition 2 states that the government chooses  $p$  to maximize its welfare, given the equilibrium contribution schedules presented by each firm. Condition 3 states that each firm chooses its contribution schedule to maximize its net welfare.

Condition 3 can be decomposed into two sub-conditions:

- (a) The joint surplus of the government and firm  $j$  is maximized at  $p^o$  (otherwise the firm could modify its contribution schedule to increase the joint surplus and would retain a fraction of this increased surplus):<sup>4</sup>

---

<sup>4</sup>The first sub-condition is found as follows:

$$W_j(p^o) - C_j^o(p^o) + \sum_{j \in L} C_j^o(p^o) + aW(p^o) \geq W_j(p) - C_j^o(p) + \sum_{j \in L} C_j^o(p) + aW(p) \quad \forall p$$

(b) Due to the timing of the game, firm  $j$  manages to extract all the available surplus from the government.

$$\exists p^{-j} \forall j \in L \text{ such that } p^{-j} \in \arg \max \sum_{j \in L} C_j^o(p) + aW(p) \text{ and } C_j^o(p^{-j}) = 0$$

I assume that contribution schedules are differentiable which, also according to Grossman and Helpman (1994), is reasonable if we want to prevent mistakes in the calculations of the individual firm from resulting in large swings in the contributions offered. Under the assumption of differentiability, condition 2 can be rewritten as:

$$\left. \frac{d}{dp} \left( \sum_{j \in L} C_j^o(p) + aW(p) \right) \right|_{p=p^o} = 0$$

and sub-condition (a) can be re-written as:

$$\left. \frac{d}{dp} \left( W_j(p) - C_j^o(p) + \sum_{j \in L} C_j^o(p) + aW(p) \right) \right|_{p=p^o} = 0$$

which combined yield the following equilibrium condition:

$$\left. \frac{dW_j(p)}{dp} \right|_{p=p^o} = \left. \frac{dC_j(p)}{dp} \right|_{p=p^o}$$

This condition implies that contribution schedules are locally truthful, that is, around the equilibrium price  $p^o$  they reflect the willingness to pay of the firm for an increase in the domestic price. I refer to Chapter 1 for a discussion of the contribution schedules truthfulness property.

A globally Truthful Contribution schedule takes the following form:

$$C_j(p) = \max [0, W_j(p) - B_j]$$

---


$$W_j(p^o) - C_j^o(p^o) \geq W_j(p) - \left( \sum_{h \in L} C_h^o(p^o) + aW(p^o) - \left( \sum_{h \in L, h \neq j} C_h^o(p) + aW(p) \right) \right) \quad \forall p$$

$$W_j(p^o) - C_j^o(p^o) + \sum_{h \in L} C_h^o(p^o) + aW(p^o) \geq W_j(p) + \sum_{h \in L, h \neq j} C_h^o(p) + aW(p) + C_j^o(p) - C_j^o(p) \quad \forall p$$

where  $B_j$  indicates a level of welfare to be determined in equilibrium.

Under this form of the contribution schedules the equilibrium price chosen by the government will be one that solves the following problem:

$$p^o = \arg \max_p \left[ \sum_{j \in L} W_j(p) + aW(p) \right]$$

The function that the government maximizes is a weighted sum of firms and consumer welfare, where firms obtain a larger weight due to their contributions. The first order condition for this problem is straightforward since we have a simple functional form for  $W_j(p)$  and  $W(p)$  and yields the following equilibrium price:

$$p^o = \frac{\sum_{j \in S} K_j}{ab} + 1$$

Bernheim and Whinston (1986) argue that the efficient policy can always be sustained as an equilibrium when firms present truthful contribution schedules. In this section I concentrate on illustrating the characteristics of this equilibrium and describing the restrictions on the contribution schedules that sustain this equilibrium. In particular, given that the contribution schedules are of the form  $C_j(p) = \max[0, W_j(p) - B_j]$ , the focus will be in determining what are conditions on  $B_j$ 's that sustain the optimal policy.

From the derivation above it is clear that the optimal policy, the price that maximizes the surplus of the players in this game, is price  $p^o$ . This is what I will refer to as the Full Participation equilibrium, in which all firms make positive contributions.

The first characteristic of this equilibrium is that the government is indifferent between  $p^o$  and the free trade price  $p = 1$ . This is a consequence of the timing of the game, where firms act first and make a take-or-leave offer to the government. If the government was made strictly better off at  $p^o$  then all the firms could shift down their contribution schedules by increasing  $B_j$ 's without affecting the relative desirability (from the government point of view) of all available policies. Since firms would strictly gain from this shift, then it means that in equilibrium the government is indifferent between the free trade price and  $p^o$ .

The government is therefore exactly compensated for the welfare loss with respect to free

trade, which depends on the aggregate size of the lobby according to the following expression:

$$W(p^* = 1) - W(p^o) = \frac{\left(\sum_{j \in S} K_j\right)^2}{2b}$$

Therefore the first condition for the existence of an equilibrium where all firms make positive contributions is that the sum of all the contributions is equal to the amount of contributions necessary to compensate the government for the welfare loss relative to free trade:

$$\sum_{j \in S} K_j (p^o - 1) - B_j = \frac{\left(\sum_{j \in S} K_j\right)^2}{2ab}$$

which can be rewritten as:

$$\sum_{j \in S} B_j = \frac{\left(\sum_{j \in S} K_j\right)^2}{2ab}$$

Clearly, there are infinite combinations of  $B_j$  that satisfy this equation, but we need more restrictions to guarantee that neither the government nor the individual firms have an incentive to deviate. We need to impose conditions to rule out the following deviations:

1. In order to prevent firm  $j$  from deviating it is sufficient to find contributions schedules for the remaining firms in the lobby such that no subset of firms's contribution schedules can support a positive level of protection. Under this condition the government will always prefer free trade when any firm lowers the contribution schedule below the point at which the government is just compensated for the welfare loss with respect to free trade. Therefore, since each firm gets a strictly positive payoff  $B_j$  in the Full Participation equilibrium, it will never want to deviate and achieve a zero payoff under free trade.
2. Incidentally the same conditions on  $B_j$ 's also guarantee that, faced with the contribution schedules of all firms, the government will not choose to consider only a subset of firms and therefore choose a price below its optimal level  $p^o$ .

In what follows I lay out the conditions under which the possible deviations just described are ruled out. In particular I consider alternative "lobbies" as groups of firms within the sector. The government might have an incentive to take into account only the contributions schedules



of these firms, disregarding the remaining firms. I give conditions on the contributions schedules of all these possible sub-groups of firms such that the government has an incentive to take into account all firms' contribution schedules.

Define  $T(S)$  the set of all proper subsets of  $S$  and indicate with  $t_{ni}(S)$  the elements of this set where  $n = 1, \dots, N - 1$  indicates all the possible lobby sizes and  $i = 1, \dots, I_n$  indicates the possible subsets within the  $n$  size category. Define  $p(t_{ni}(S))$  the domestic price that would maximize the government payoff if the government took into account only the subset of firms  $t_{ni}(S)$ :  $G = \sum_{j \in t_{ni}(S)} [B_j + K_j(p - 1)] + aW(p)$  if, for simplicity, all  $B_j$ 's are zero. This is the positive price the government would choose by considering only contribution schedules of firms in subset  $t_{ni}(S)$  if the  $B_j$ 's are low enough. The following conditions guarantee that the government would be strictly worse off when considering any alternative lobby (i.e. the government would not be fully compensated for the welfare loss relative to free trade):

$$\sum_{j \in t_{ni}(S)} (K_j(p(t_{ni}(S)) - 1) - B_j) < \frac{\left(\sum_{j \in t_{ni}(S)} K_j\right)^2}{2ab} \quad (2.2)$$

$$p(t_{ni}(S)) = \frac{\sum_{j \in t_{ni}(S)} K_j}{ab} + 1$$

Notice that we need inequality (2.2) to be strict to guarantee that no other positive price would be supported if any of the firms lowered their contributions. Intuitively if this condition was holding with equality for some subset of firms, then by increasing its  $B$  to an arbitrarily high level, a firm could induce the government to choose another lower, but positive level of protection (since the contributions of the other firms would be sufficient to fully compensate the government for the welfare loss associated to this new protection level). In this case we would not be assured that the firm would choose not to deviate since it would still get a positive payoff under deviation. The above discussion is summarized in the following proposition.

**Proposition 2** *There always exists an equilibrium where all firms in the sector make positive contributions (Full Participation equilibrium). This equilibrium is characterized by the net*

payoffs  $B_j$  such that:

$$\sum_{j \in t_{ni}(S)} B_j > \frac{\left(\sum_{j \in t_{ni}(S)} K_j\right)^2}{2ab} \quad \forall t_{ni}(S) \in T(S)$$

$$\sum_{j \in S} B_j = \frac{\left(\sum_{j \in S} k_j\right)^2}{2ab}$$

It is clear that these sets of conditions define multiple contribution schedules that are compatible with the optimal level of protection. The structure of the game does not allow to further select among these possible configurations, but only defines the set of Pareto optimal contribution schedules. In the following example I illustrate the conditions laid out in Proposition 2.

#### Example

Take the case of three firms of size  $K_1 = 1$ ,  $K_2 = 2$  and  $K_3 = 3$  and coefficients  $a$  and  $b$  such that  $ab = 1$ . It is easy to verify that the optimal protection level in this case is  $p^o = 7$  and that the contributions necessary to compensate the government for the welfare loss relative to free trade is 18. The previous proposition requires that  $B_1 + B_2 + B_3 = 18$  to compensate the government for the welfare loss relative to free trade. The proposition also requires that:

$$\begin{aligned} B_1 &> 0.5 & B_2 + B_3 &> 12.5 \\ B_2 &> 2 & B_1 + B_2 &> 4.5 \\ B_3 &> 4.5 & B_1 + B_3 &> 8 \end{aligned}$$

Under these conditions if a firm lowers its  $B$  the domestic price will fall to the international price and therefore no other positive price can be sustained in equilibrium. Take for example the case of  $B_1 = 5$ ,  $B_2 = 6$  and  $B_3 = 7$ . Figure 2.1 depicts the equilibrium determination as the tangency between the function representing the sum of the contributions of the three firms and the indifference curve of the government along which  $G = 0$ .

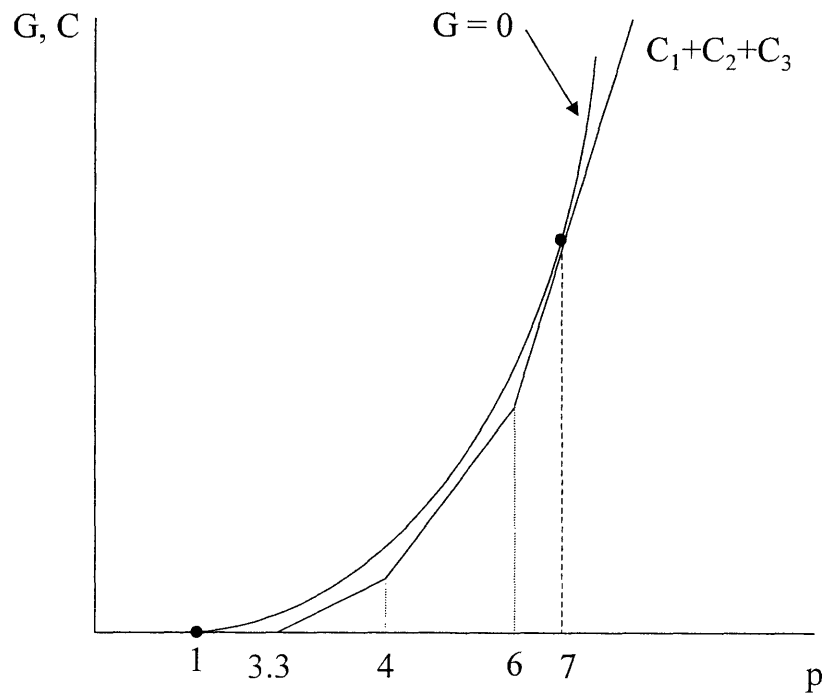


Figure 2.1

Take for example the case of  $B_1 = 2$ ,  $B_2 = 11$  and  $B_3 = 5$ , so that the contribution schedules for the three firms are:

$$C_1 = p - 3$$

$$C_2 = 2p - 13$$

$$C_3 = 3p - 8$$

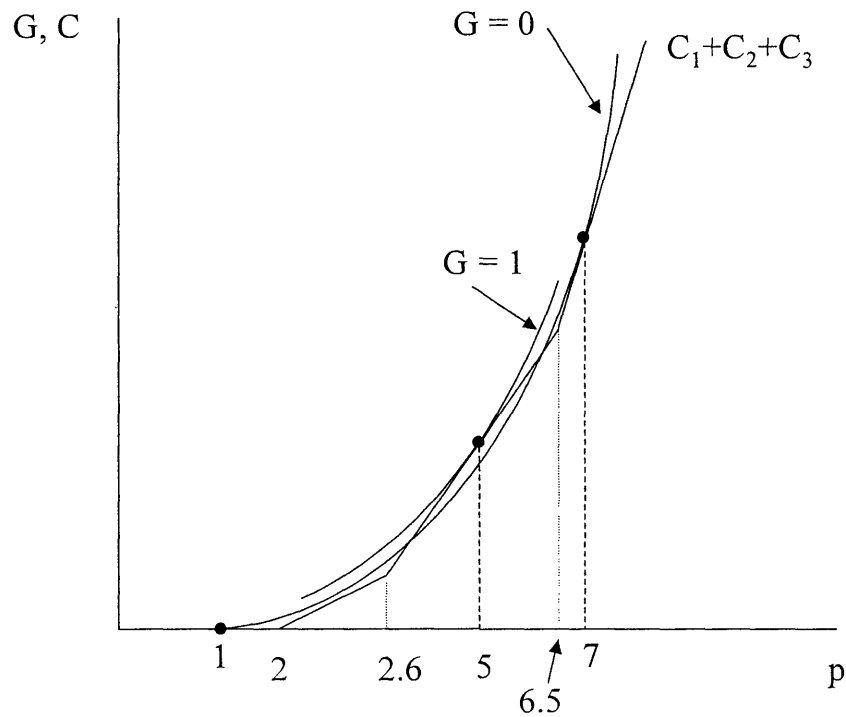


Figure 2.2

The  $B_j$ 's add up to 18 so at  $p = 7$  the government would be fully compensated for the welfare loss with respect with free trade, but the condition  $B_1 + B_3 > 8$  is violated. Faced with these contribution schedules the government would consider only firms 1 and 3 and choose  $p = 5$ . At that price the welfare loss is 8 and contributions are  $C_1 = 2$  and  $C_3 = 7$  making the government strictly better off with respect to free trade and to  $p = 7$ . This case is depicted in Figure 2.2.

## 2.4 Lobby formation with fixed cost of contributing

The main implication of the previous section is that we can expect a Full participation equilibrium to emerge as the result of communication among firms. This prediction is at odds with the observation that not all firms participate in lobbying and calls for a more realistic game that can explain why some firms might not contribute in equilibrium. This section introduces a friction in the tariff-setting game described in the previous section. The friction introduced here is a fixed cost of contributing,  $F$ , for individual firms. This is a constant amount paid by all firms

that make positive contributions in equilibrium. We can think of this as a fee that a firm has to pay to a lawyer or a lobbyist to channel a positive amount of contributions to a politician, so that any time a contribution is made the first  $F$  dollars do not reach the hands of politician. This fee is paid only by firms that in equilibrium decide to pay a positive amount therefore no firm will decide to make gross contributions that are lower than  $F$  since no money will be channeled to politicians and it would not affect the policy decision. We can think therefore in terms of gross contributions which is the money that the firm pays  $\tilde{C}_j$  and net contributions  $C_j$ , which is the amount of money that ends up in the hands of the government. The difference between these two amounts is the fixed cost  $F$ . Naturally if there are no contributions, no fixed cost is paid.

The timing for this game is very similar to the one presented in the game without fixed cost and consists of two stages:

(i) in the first stage, firms present the government with a contribution schedule  $C_j(p) = \max\{0, \tilde{C}_j(p) - F\}$

(ii) in the second stage, the government chooses a price  $p$  and collects  $C_j(p)$  from each firm  $j$

A configuration  $(\{C_j^o\}, p^o)$  is a subgame-perfect equilibrium of the game if and only if:

1.  $C_j^o$  is feasible
2.  $p^o \in \arg \max_{p \in S} \sum_{j \in S} C_j^o(p) + aW(p)$
3. Given  $\tilde{C}_h^o(p^o)$ ,  $h \neq j$ ,  $\tilde{C}_j^o(p^o) \in \arg \max W_j(p^o) - \tilde{C}_j(p^o)$  where  $p^o$  satisfies condition 2.

The introduction of a fixed cost modifies substantially the game with respect to the framework of Bernheim and Whinston (1986) and Grossman and Helpman (1994). A number of results that apply to the model without frictions will not go through under this structure of the game. First of all it is still the case that condition 3 can be decomposed into two sub-conditions:

$$(a) W_j(p^o) - \tilde{C}_j^o(p^o) + \sum_{j \in L} C_j^o(p^o) + aW(p^o) \geq W_j(p) - \tilde{C}_j^o(p) + \sum_{j \in L} C_j^o(p) + aW(p) \quad \forall p$$

$$(b) \exists p^{-j} \forall j \in L \text{ such that } p^{-j} \in \arg \max_{p \in S} \sum_{j \in L} C_j^o(p) + aW(p) \text{ and } \tilde{C}_j^o(p^{-j}) = 0$$

but in this case combining condition 2 and sub-condition *a* does not imply that contribution schedules are locally truthful for all firms. This is due to the fact that for some firms that do not contribute in equilibrium a marginal increase in gross contributions would not translate into an increase in net contributions (due to the fixed cost). The contribution schedule therefore might be flat at the equilibrium price even if the gross profit function is increasing at the same price level. For these firms, which I will consider "outside" the lobby it will be the case that:

$$\left. \frac{dW_j(p)}{dp} \right|_{p=p^\circ} > \left. \frac{d\tilde{C}_j(p)}{dp} \right|_{p=p^\circ} \quad \forall j \notin L$$

while for the firms that in equilibrium are contributing a positive amount (call these firms "inside" the lobby) it is still the case that contribution schedules are locally truthful:

$$\left. \frac{dW_j(p)}{dp} \right|_{p=p^\circ} = \left. \frac{d\tilde{C}_j(p)}{dp} \right|_{p=p^\circ} \quad \forall j \in L$$

and the derivation for this condition is analogous to the case of Section 2.3.

As in the previous section I will concentrate on a specific shape of the contribution function that allows to find closed form solutions for the individual firms contributions:

$$C_j(p) = \max[0, \Pi_j(p) - B_j - F]$$

Given the simple expression for firms' contributions schedules the government will choose  $p^\circ$  solving this program:

$$p^\circ = \arg \max \left[ \sum_{j \in L} \Pi_j(p) + aW(p) \right]$$

A similar derivation to the one in chapter 1 allows to find the equilibrium price.

**Proposition 3** *If firms adopt contribution schedules of the form  $C_j(p) = \max[0, \Pi_j(p) - B_j - F]$  the equilibrium domestic price  $p_i^\circ$  takes the following expression:*

$$p^\circ = \frac{\theta^\circ K}{ab} + 1$$

where  $K$  is the total output of sector  $x$  and  $\theta^\circ$  is the share of total output in sector  $x$  produced

*by firms making positive contributions:*

$$\theta^o = \frac{\sum_{j \in L} K_j}{K} \tag{2.3}$$

Under this modified game structure it is still the case that there are multiple equilibria, both in terms of policy chosen and in terms of the set of firms that contribute positive amounts. The scope here is limited to understanding whether one equilibrium is more likely than others to emerge.

We have seen that in the absence of fixed costs there exists an equilibrium that maximizes the welfare of the firms in the sector and that is one in which all firms make positive contributions. In that case it is natural to argue that, by just allowing communication among firms, the lobby will select this kind of equilibrium. Remember that this kind of equilibrium is generally not unique in the sense that the unique equilibrium price is supported by different levels of contributions, but among this set equilibria cannot be Pareto ranked.

In the presence of a fixed cost it will not be optimal to induce participation of all firms in the sector. Again, by just allowing all the firms in the sector to communicate, it is natural to assume that they will coordinate on a Pareto optimal equilibrium. Intuitively, given the nature of the contributing cost, which is fixed, it might not be efficient for small firms to participate. If  $F$  is small enough we might still have that the optimal equilibrium is the Full Participation one, but in general it will be efficient (from the point of view of the entire sector or the lobby) to exclude from contributing the smallest firms, because the surplus created by the small firms participation is not enough to cover the fixed cost of contributing for these firms.

Finding the efficient equilibrium requires us to define whose surplus we are trying to maximize. In the case of full participation there was no distinction between the group of beneficiaries and the group of participants in the lobby. Here it is optimal not to include everyone in the lobby, but optimal inclusion depends on whether we are trying to maximize the welfare of the entire sector or of the lobby participants. The description of the two types of equilibria follows.

### 2.4.1 Sector-optimal equilibrium

In this section I show how to determine optimal participation when the objective function is the surplus of the entire sector.

In order to find the optimal equilibrium (that is the optimal set of contributing firms) I am going to analyze all the possible set of contributing firms and compare them in terms of total surplus for the sector. First, I consider what is the optimal equilibrium set of contributing firm for each lobby size  $n$  and then I compare the different lobby sizes and determine which is the Pareto optimal set of contributing firms. Take sector subset  $t_{ni}(S)$  and calculate the total sector surplus, associated with a lobby formed by this subset of firms:

$$V(t_{ni}(S)) = \sum_{j \in t_{ni}(S)} K_j \left( \frac{\sum_{j \in t_{ni}(S)} K_j}{ab} \right) - \frac{\left( \sum_{j \in t_{ni}(S)} K_j \right)^2}{2ab} - nF$$

Now, focus on a specific lobby of size  $n$ , the one where all largest  $n$  firms make positive contributions and pay  $F$  and the remaining firms do not make any contributions. Indicate this lobby by  $t_{n\bar{i}}(S)$  Intuitively, this is the welfare maximizing lobby because for a given amount spent to pay the fixed costs, the largest firms are the ones who gain more and therefore are willing to pay more for a given increase in protection. Take any other set  $t_{ni}(S)$ : it is always possible to increase sector welfare by choosing another subset  $t_{ni'}(S)$  replacing the smallest contributing firm in  $t_{ni}(S)$  (say firm  $K_h$ ) with a larger firm that was not included in  $t_{ni}(S)$  (say firm  $K_{h'}$ ). The net change in welfare can be calculated as follows:

$$V(t_{ni'}(S)) - V(t_{ni}(S)) = \left( \frac{K_{i'} - K_i}{ab} \right) \left( \sum_{j \notin t_{ni}(S)} K_j - \frac{K_{h'}}{2} + \frac{K_h}{2} \right)$$

which is always positive given that  $K_{h'}$  is an element of the sum  $\sum_{j \notin t_{ni}(S)} K_j$ . The following proposition, which summarizes the result of this comparison among lobbies of equal size, helps reduce greatly the number of possible lobbies to analyze.

**Proposition 4** *For each possible size of the set of contributing firms,  $n$ , the optimal equilibrium is one in which the largest  $n$  firms make positive contributions and pay the fixed cost  $F$  and the remaining firms do not pay any contributions. Define this optimal set  $t_{n\bar{i}}(S)$  for each  $n$ .*



Now we just have to compare all the  $N$  possible lobbies  $t_{n\bar{i}}(S)$  and find the Pareto optimal one. I will proceed by considering the smallest possible lobby, the one formed by the largest firm  $N$ , and comparing it to the lobby formed by firm  $N$  and  $N - 1$  and so on, every time considering the benefit from increasing lobby size and the additional fixed cost to pay due to the additional member. In other words we need to compare the total sector surplus associated to lobbies  $t_{n\bar{i}}(S)$  and  $t_{(n+1)\bar{i}}(S)$  (this last set contains all the firms in  $t_{n\bar{k}}(S)$  and firm  $k_h$ ) :

$$V\left(t_{(n-1)\bar{i}}(S)\right) - V\left(t_{n\bar{i}}(S)\right) = \frac{K_h}{2ab} \left( 2 \sum_{j < h} K_j + K_h \right) - F$$

First, notice that in the absence of a fixed cost this difference is always positive and we find the familiar result that the optimal lobby is the one that entails positive contributions from all the firms. Second,  $V\left(t_{(n-1)\bar{i}}(S)\right) - V\left(t_{n\bar{i}}(S)\right)$  is monotonically increasing in  $h$ . Therefore as we consider smaller firms this gain decreases and become negative depending on the size of  $F$ . If  $F$  is small enough then Full Participation might still be the optimal equilibrium, but in general it will be optimal to include firms in the lobby as long as  $V\left(t_{(n-1)\bar{i}}(S)\right) - V\left(t_{n\bar{i}}(S)\right)$  is larger than  $F$ . This condition will define the optimal marginal firm  $h^*$  that is the smallest firm making positive contributions in the Pareto optimal equilibrium.

**Proposition 5** *In a game with fixed cost of contributing the Pareto optimal equilibrium (for the set of firms  $S$ ) is one of the following form: all firms  $j$  with  $j \geq h^*$  make a positive contribution and pay the fixed cost  $F$  and all firms  $j$  with  $j < h^*$  do not make positive contributions and do not pay the fixed cost  $F$  and  $h^*$  is determined by the following inequalities:*

$$\begin{aligned} K_{h^*} \left( \frac{\sum_{j < h^*} K_j}{ab} + \frac{1}{2} \frac{K_{h^*}}{ab} \right) &\geq F \\ K_{h^*-1} \left( \frac{\sum_{j < h^*-1} K_j}{ab} + \frac{1}{2} \frac{K_{h^*-1}}{ab} \right) &< F \end{aligned}$$

The scope here will be to simply show that even in the presence of fixed costs the efficient equilibrium can be supported by simple strategies. The net contribution schedules that support the efficient equilibrium are of the form:  $C_j = \max\{0, \Pi_j - B_j - F\}$

Define  $S(h^*)$  the set of firms  $j$  such that  $K_j \geq K_{h^*}$  and indicate with  $T(S(h^*))$  the set of

all proper subsets of  $S(h^*)$ .

**Proposition 6** *If there exists a set of  $B_j$  that satisfy the following conditions:*

$$\begin{aligned}
(i) \quad & \sum_{j \geq h^*} (B_j + F) = \frac{\left(\sum_{j \geq h^*} K_j\right)^2}{2ab} \\
(ii) \quad & \sum_{j \in t_{nk}(S(h^*))} (B_j + F) > \frac{\left(\sum_{j \in t_{nk}(S)} k_j\right)^2}{2ab} \quad \forall t_{nk}(S(h^*)) \in T(S(h^*)), \\
(iii) \quad & B_h + F \geq K_h \left(\frac{\sum_{j \geq h^*} K_j}{ab}\right) \quad \forall h < h^* \\
(iv) \quad & B_j > 0 \quad \forall j \in S
\end{aligned}$$

*the Pareto optimal set of contributing firms and protection level can be supported in equilibrium.*

**Proposition 7** *A necessary and sufficient condition for the existence of a set of  $B_j$ 's that satisfies the conditions (i) – (iv) is the following:*

$$F < \frac{\left(\sum_{j \geq h^*} K_j\right)^2}{2ab(N - h^* + 1)}$$

Under these conditions all the firms  $h$  with  $h \geq h^*$  do not have any incentive to deviate otherwise the government will choose the free trade price. Therefore we only need to check that firms  $h$  with  $h < h^*$  do not have an incentive to deviate and shift their contribution schedules such that they make positive contributions in equilibrium. Take any firm  $h$  with  $h < h^*$  and consider that the increase in rents from entering the lobby would be  $\frac{K_h^2}{ab}$ . Given the contributions schedules of the other firms presently in the lobby, their contributions would increase by  $\frac{K_h}{ab} \left(\sum_{j \geq h^*} K_j\right)$  and the necessary increase in contributions would be  $\frac{\left(\sum_{j \geq h^*} K_j + K_h\right)^2}{2ab} - \frac{\left(\sum_{j \geq h^*} K_j\right)^2}{2ab}$ . Firm  $h$  will not want to deviate if the net benefit (the difference between the increase in rents and the required contributions) is smaller than  $F$  the fixed cost of contributing:

$$F > \frac{K_h^2}{2ab}$$

which is verified for all firms  $h < h^*$ .

### Example

Take the case of four firms of size  $K_1 = 1$ ,  $K_2 = 2$ ,  $K_3 = 3$  and  $K_4 = 4$ , fixed cost  $F$  and parameters  $a$  and  $b$  such that  $ab = 1$  (although this choice of parameters simplifies the calculations it requires fixed costs that are very high relative to the size of firms). It is easy to verify that if  $4 < F \leq 13.5$  then the efficient configuration entails positive contributions from firms 3 and 4 and no contributions from firms 1 and 2 with an equilibrium price  $p^o = 8$ .

$$\begin{aligned}C_1 &= 1(p - 1) - B_1 - F \\C_2 &= 2(p - 1) - B_2 - F \\C_3 &= 3(p - 1) - B_3 - F \\C_4 &= 4(p - 1) - B_4 - F\end{aligned}$$

$B_1 + F \geq 7$ ,  $B_2 + F \geq 14$ ,  $B_3 + F \geq 4.5$ ,  $B_4 + F \geq 8$  with  $B_3 + B_4 + 2F = 24.5$ . Notice that we need to impose one further restriction on  $F$  in order to have this configuration supported in equilibrium:  $F < 12.25$ . If this condition is not satisfied then there are not positive  $B$ 's that satisfy the conditions and therefore the optimal configuration cannot be supported in equilibrium.

### 2.4.2 Lobby-optimal equilibrium

While the previous section finds the set of participating firms that maximizes the sector's surplus it might be more plausible to think that a lobby has in mind the surplus of the lobby participants when trying to coordinate on the optimal equilibrium. When I look at the optimal set of lobbying firms from a point of view of the lobby I find that the participation threshold is higher. This is because as we think of including a smaller firm we consider only the impact that it has on the lobby participants and not on the entire sector and it is optimal to "stop" including firms in the lobby at a larger firm size. In order to find such threshold I look at the joint surplus of each potential participant firm  $h$  and an arbitrary set of lobbying firms. I calculate the surplus of lobby  $L$  and candidate participant firm  $h$  under firm  $h$  participation and firm  $h$  exclusion from the lobby. Denote by  $p^o$  the equilibrium domestic price resulting

from the interaction of the set of firms  $L$  and the government:

$$p^o = \frac{\sum_{j \in L} K_j}{ab} + 1$$

The joint surplus for the lobby is the difference between the gross profits and the necessary contributions, including the fixed cost of contributing for each firm:<sup>5</sup>

$$\sum_{j \in L} (\Pi_j(p^o) - F) - a(W(1) - W(p^o)) = \sum_{j \in L} \left( K_j \left( \frac{\sum_{j \in L} K_j}{ab} \right) - F \right) - \frac{\left( \sum_{j \in L} K_j \right)^2}{2ab} \quad (2.4)$$

Now consider the price that would prevail if firm  $h$  did not make positive contributions in equilibrium,  $p^{-h}$ :

$$p^{-h} = \frac{\sum_{j \in L, j \neq h} K_j}{ab} + 1$$

The joint surplus for the lobby and firm  $h$  when firm  $h$  does not contribute in equilibrium depends on the gross profits for both the lobby and firm  $h$  and the necessary contributions at the lower price  $p^{-h}$ . With firm  $h$  exclusion there is also a benefit in terms of reduced resources spent on fixed costs of contributing:

$$\begin{aligned} & \sum_{j \in L, j \neq h} \left( \Pi_j(p^{-h}) - F \right) + \Pi_h - a \left( W(1) - W(p^{-h}) \right) \quad (2.5) \\ = & \sum_{j \in L, j \neq h} \left( K_j \left( \frac{\sum_{j \in L, j \neq h} K_j}{ab} \right) - F \right) + K_h \frac{\sum_{j \in L, j \neq h} K_j}{ab} - \frac{\left( \sum_{j \in L, j \neq h} K_j \right)^2}{2ab} \end{aligned}$$

It is optimal to include firm  $h$  in the lobby if expression (2.4) is larger than expression (2.5) and this inequality is satisfied if and only if:

$$\frac{K_h^2}{2ab} \geq F \quad (2.6)$$

This condition tells us that there is an optimal threshold for the inclusion of firms in the lobby. Therefore if we allow non-binding communication among firms we can expect the firms that

---

<sup>5</sup>In reporting the firm's benefit I omit the amount of labor income as it is a constant that drops out of all the relevant expressions.

consider forming a lobby to select such an equilibrium among the set of Nash equilibria in this game.

Condition (2.6) can be interpreted considering two opposite effects. As a large firm considers lobbying, it must pay larger contributions because it induces the government to grant larger protection (which brings about a larger welfare loss), but it also experiences a larger gain as it produces a greater quantity of output. Only the participation of larger firms produces a benefit large enough from protection to find it profitable to pay the initial fixed cost and enter the lobby. Notice that in the absence of a fixed cost it is efficient for all firms to make positive contributions in equilibrium.

The derivation above is summarized in the following proposition where I define the lobby selected using the criterion above as the Lobby-Optimal equilibrium.

**Proposition 8** *In the Lobby-Optimal (LO) equilibrium:*

- (i) *if firm  $h$  enters the political game then all firms  $j$ , with  $j \geq h$ , enter the political game*
- (ii) *if firm  $h^*$  is the smallest firm participating in the lobby, the following conditions must be satisfied:*

$$\begin{aligned} \frac{K_{h^*}^2}{2ab} &\geq F \\ \frac{K_{h^*-1}^2}{2ab} &< F \end{aligned}$$

Proposition 8 allows to determine the equilibrium share of total output produced by firms lobbying for protection. Given the threshold participating firm  $h^*$  the equilibrium share  $\theta^o$  is:

$$\theta^o = \frac{\sum_{j \geq h^*} K_j}{\sum_{j \in S} K_j}$$

Although the two criteria that I presented seem equally reasonable the second criterion is more appropriate if we think that there are no transfers from non-participating to participating firms. The Lobby-Optimal equilibrium entails lower participation (i.e. higher threshold) than the Sector-Optimal equilibrium. The SO equilibrium would be reasonable if we think there are

transfers compensating the additional firms for the incurred costs of entry. I believe the LO equilibrium is more appropriate as we usually think of a lobby maximizing its own welfare and including members until the generated surplus is large enough to cover the fixed cost. Therefore I take the LO equilibrium to be the most likely outcome from coordination among potential lobby members. In the following section I take the LO equilibrium as the starting point to analyze the link between the distribution of firm size and the level of protection through the impact that distribution characteristics have on the participation share  $\theta^o$ .

### 2.4.3 Size distribution and the level of protection

This section investigates whether the model built in the previous sections can shed light on the impact on protection levels of certain characteristics of the size distribution of firms in a sector. In particular this section shows that basic moments of the distribution, like mean and standard deviation of firm size, affect the equilibrium level of protection. The intuition for this result relies on the likelihood that in a sector where, holding the average constant, the size distribution of firms has a larger standard deviation, we can find a greater number of firms that are large enough to overcome the initial fixed cost of lobbying and find it profitable to participate in the political game.

To simplify the problem and without loss of generality the distribution of firm size is approximated using a continuous Pareto distribution. The model so far has dealt with firms of discrete size: it is fundamental to the structure of the model that the firm perceives its impact on the price level as it decides to lobby. Nevertheless employing a continuous density function in this section does not affect the results about the impact of dispersion on protection and simplifies considerably the relevant expressions. The choice of density function is dictated by documented empirical evidence that the distribution of firm size is well approximated by a Pareto distribution as reported by Axtell (2001) and Helpman et al. (2004).

Take a continuous of firms of size  $K_j$  and let  $K_j$  be distributed over the support  $[K_M, \infty]$  according to the following probability density function:

$$K_j \sim \varepsilon \frac{K_M^\varepsilon}{K_j^{\varepsilon+1}}$$

where  $\varepsilon$  is a parameter<sup>6</sup>. Construct  $\theta^o$  as the share of output produced by firms that participate in the lobby. Indicate the threshold firm as  $h^*$ .

$$\theta^o = \frac{\int_{K_{h^*}}^{\infty} K_j \varepsilon \frac{K_M^\varepsilon}{K_j^{\varepsilon+1}} dK_j}{\int_{K_M}^{\infty} K_j \varepsilon \frac{K_M^\varepsilon}{K_j^{\varepsilon+1}} dK_j} = \left( \frac{K_{h^*}}{K_M} \right)^{1-\varepsilon}$$

We are interested in the effect on  $\theta^o$  of a mean-preserving spread in the size distribution of firms. As  $\varepsilon$  decreases, the right tail of the distribution gets thicker and dispersion increases, but in order to maintain the average size of the firm constant the lower bound  $K_M$  has to decrease. Indicate  $\mu$  as the average size of the firm. In order to keep the average size constant the lower bound  $K_M$  is lowered according to the following expression:

$$K_M = \mu \frac{\varepsilon - 1}{\varepsilon}$$

Therefore we can rewrite  $\theta^o$  as:

$$\theta^o = \left( \frac{K_{h^*} \varepsilon}{\mu (\varepsilon - 1)} \right)^{1-\varepsilon}$$

The impact of a mean-preserving spread in the size distribution of firms on  $\theta^o$  (and therefore on the domestic price level) will depend on whether the threshold firm is sufficiently above the mean of the distribution as characterized in the following proposition.

**Proposition 9** *If the following condition is satisfied:*

$$\ln \frac{K_{h^*}}{\mu} + \ln \frac{\varepsilon}{\varepsilon - 1} > \frac{1}{\varepsilon} \quad (2.7)$$

*then a decrease in  $\varepsilon$  (an increase in dispersion), ceteris paribus, brings about an increase in the domestic price  $p$ .*

Condition (2.7) is always satisfied if  $K_{h^*} > \mu$  which is reasonable by looking at the sectors analyzed in chapter 1.

---

<sup>6</sup>I impose the condition  $\varepsilon > 2$  to guarantee that the distribution has finite variance.

## 2.5 Lobby formation with a participation stage

In this section I modify the structure of the basic menu auction game to show that the results obtained from the game structure analyzed change with an explicit participation decision stage. Here I add a preliminary stage at which firms decide simultaneously whether to participate or not in the rest of the game. Subsequently the game is the same as in Section 2.3.

The extensive form of the game is the following:

- (i) in the first stage, each firm chooses whether to participate in the tariff-setting game ( $T_j = 1$ ) or not to participate ( $T_j = 0$ ) (*Lobby Participation Stage*);
- (ii) in the second stage, firms that decided to participate present the government with a contribution schedule  $C_j(p)$  which associates a monetary amount to each level of protection;
- (iii) in the third stage, the government chooses a vector  $p$  and collects  $C_j(p)$  from each firm (the last two stages are the *Tariff-setting Stage*)

The timing of the game is reported in Figure 2.3

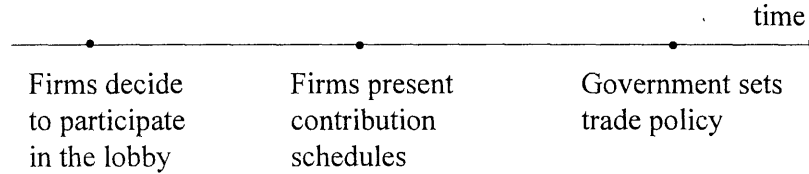


Figure 2.3

A configuration  $\left(\{C_j^o\}, p^o, L\right)$  is a subgame-perfect equilibrium of the game if and only if:

1.  $C_j^o$  is feasible
2.  $p^o \in \arg \max \sum_{j \in L} C_j^o(p) + aW(p)$
3. Given  $C_k^o(p^o)$ ,  $k \neq j$ ,  $C_j^o(p^o) \in \arg \max W_j(p^o) - C_j(p^o)$  where  $p^o$  satisfies condition 2
4. Given  $T_h$ ,  $h \neq j$ ,  $T_j = 1$  if and only if  $\Pi_j(p^{-j}) \geq V_j(p^o)$  where  $p^{-j} \in \arg \max_{\substack{h \in L \\ h \neq j}} C_h^o(p) + aW(p)$



Condition 1 states that contributions cannot be larger than total income of firm  $j$  and cannot be negative. Condition 2 states that the government chooses  $p$  to maximize its welfare, given the equilibrium contribution schedules presented by each firm. Condition 3 states that each firm chooses its contribution schedule to maximize its net welfare. Condition 4 states that each firm decides to participate only if, given the participation decision of other firms, it obtains a larger payoff from participating than from not entering the tariff-setting game.

Since stages 2 and 3 of the game are the focus of Section 2.3 of this chapter, I refer to the discussion in that section about the type of equilibria that we can expect to emerge in this part of the game. Here I focus on the Participation Stage. In particular I illustrate the condition under which the Full Participation equilibrium can be achieved in this modified game structure.

Consider firm  $j$ : if it participates in the lobby (remember we are focusing on the case in which the lobby coincides with the sector) the equilibrium price chosen by the government is

$$p^o = \frac{\sum_{i \in S} K_i}{ab} + 1$$

and the benefit for the firm is:

$$V_j(p^o) = K_j \left( \frac{\sum_{i \in S} K_i}{ab} \right)$$

If firm  $j$  decided not to participate then it could expect that the other firms would form an efficient lobby where all participants make positive contributions and the equilibrium price is:

$$p^{-j} = \frac{\sum_{i \in S, i \neq j} K_i}{ab} + 1$$

and the gross benefit for firm  $j$  is:

$$\Pi_j(p^{-j}) = K_j \left( \frac{\sum_{i \in S, i \neq j} K_i}{ab} \right)$$

so the maximum amount of contributions firm  $j$  would be willing to make is:

$$C_j^{\max} = K_j \left( \frac{\sum_{i \in S} K_i}{ab} \right) - K_j \left( \frac{\sum_{i \in S, i \neq j} K_i}{ab} \right) = \frac{K_j^2}{ab}$$

A Full Participation lobby in this game is an equilibrium only if the sum of the maximum contributions is large enough to compensate the government for the welfare loss associated to  $p^o$ :

$$\frac{\sum_{j \in S} K_j^2}{ab} \geq \frac{1}{2} \frac{\left(\sum_{j \in S} K_j\right)^2}{ab}$$

Notice that the welfare loss compensation depends only on the sum of the size of firms in the lobby, while the left-hand side of the inequality is affected by the distribution of firm size in the sector. In particular notice the relationship between the variance and the left-hand side of the inequality:

$$Var(K_j) = \frac{\sum_{j \in S} K_j^2}{n} - \frac{\sum_{j \in S} K_j}{n}$$

Holding the total size of the sector and the number of firms constant, a sector where the dispersion of firm size (measured in terms of variance) is higher, is more likely to have full participation and therefore a higher level of protection. This is because the willingness to contribute increases quadratically with size and therefore the higher willingness to contribute of larger firms more than compensates the lower willingness to contribute of smaller firms.

This conclusion confirms the intuition put forward by Olson (1965) reported in the introduction. Sectors in which a given amount of output is produced mainly by large firms will have a higher probability of providing the efficient amount of public goods. This is because large firms have a more than proportional incentive to fund public goods as they benefit more from them and would cause a larger drop in the provision of the good if they defected from the lobby.

## 2.6 Conclusions

This chapter presents a model that rationalizes the empirical patterns illustrated in the previous chapter according to which larger firms are more likely to participate in lobbying activities and that sectors that are characterized by larger dispersion of firm size exhibit larger participation shares. The main contribution of this chapter is to present a tractable theory of lobby formation in the presence of heterogeneous firms.

One of the shortcomings of this simple framework is that it abstracts, as mentioned throughout the paper, from possible competition among lobbies. Although the most general formulation

adopted in Chapter 1 does not allow to analyze the impact of the distribution of firm size when there is competition among lobbies, it would be interesting to extend the simple set-up in this chapter to analyze the interaction among two sectors' lobbies and the government. A simple model in which one of the sectors is a large consumer of the goods produced by the other sector will lobby to lower the price of the good it consumes. Such a model would allow to analyze the interaction between the participation decision of firms in the two sectors and to explore the importance of size dispersion in such a framework. It would be important to extend the model in this direction to address a factor that is important empirically and that arises specially when we consider protection granted to intermediate versus final goods.

## Chapter 3

# Firm heterogeneity and lobby participation: empirical evidence

**Summary 3** *This chapter provides empirical evidence which tests the theoretical predictions developed in the previous chapters. It employs data on individual firms political contributions to show that larger firms are more likely to participate in the sector's lobby, that the intensity of lobbying, measured as the share of output produced by firms lobbying, is an significant explanatory variable of the degree of protection of different sectors and that the participation shares are positively related to the dispersion of firm size in the sector. Moreover, employing measures of the intensity of lobbying yields parameter estimates that improve on the existing empirical studies of the "Protection for sale" framework.*

### 3.1 Introduction

Why do industries with higher dispersion of firm size receive more protection than others? The previous chapters have provided theoretical foundation for an explanation of this empirical pattern based on the incentives of individual firms to participate in the sector's lobby. This chapter aims at showing this pattern and testing the direct predictions of the model.

Chapter 1 shows that, among other factors, the degree of protection granted to an industry depends positively on the Participation Share in the sector, that is the share of output produced by firms participating in the sector's lobby. This chapter will show how participation shares

can be measured and employed to explain the variation of protection across sectors.

In Chapter 2 I concentrate on explaining what determines the participation of firms in the industry's lobby. There I show that the share of the industry output produced by firms participating in the lobby is determined in equilibrium as a result of the contribution decision of individual firms and depends crucially on the size distribution of firms within the sector. I show that the individual firm's participation decision depends on the firm's size: it is efficient for larger firms to participate in political activity. As a result, the model predicts that under certain conditions (that I find verified in the data), industrial sectors where the distribution of firm size is more dispersed are more likely to have a larger fraction of the sector output produced by firms large enough to gain from participating in the lobby. Therefore a larger firm size dispersion will result in a larger participation share and in a higher level of protection.

This chapter tests the predictions of the model employing data on protection measures, the size of sectors, the size distribution of firms within sectors and political contributions by individual firms.

It is worth emphasizing that, differently from this chapter, previous empirical studies of the "Protection for Sale" model, like Goldberg and Maggi (1999) and Gawande and Bandyopadhyay (2000), have made use of sector-level aggregate political contributions data. These papers have provided evidence that the level of protection across industries is consistent with a lobbying model a la Grossman and Helpman (1994) where a sector that is politically organized is more protected when the output is large relative to imports, the elasticity of imports is low and import penetration is low. They have also shown estimates of the parameters of the GH model based on the coefficients obtained from the regressions derived from the tariff equation proposed by GH. In these studies the data on political contributions are used to identify whether the sector is politically organized or not. In these papers there is no differentiation in terms of intensity of lobbying and therefore these studies reflect the lack of attention to individual firms that the original Protection for Sale contribution presents. In this chapter, by matching firm-level contributions data obtained from records of the Federal Election Commission to individual company information available on COMPUSTAT, I am able to test a number of predictions about individual firms' lobbying behavior and I am able to measure how intense lobbying in a specific sector is by measuring the share of output produced by firms that make political

contributions in the sector.

This chapter starts by providing reduced form evidence that characteristics of the size distribution of firms are important in explaining the pattern of protection across industries. In particular I show that firm size dispersion is a significant explanatory variable when we try to understand the different degrees of protection across industrial sectors. More importantly, in this chapter I provide evidence that a number of predictions of the model presented in Chapter 1 and Chapter 2 are consistent with the data. First, I show that, both at the industry level and over all sectors, larger firms are more likely to participate in the political game and make larger contributions. Second, using firm-level data on output and political contributions, I measure the share of total output in a sector produced by firms that lobby and I show that this share is an increasing function of the average firm size and the firm size dispersion within the sector, as predicted by the model. Third, I show that accounting for differences in participation shares across sectors in the way predicted by the model gives sensible parameter estimates. I find strong support that the correct specification for the equation that determines the level of protection should account for participation shares as well as the total size of the sector. Finally I test the model presented in this paper against the “Protection for Sale” benchmark and I show that the Heterogeneity model helps explain a larger fraction of the variation of protection levels across sectors.

The remainder of the chapter is divided into three sections: Section 3.2 describes the data used in this study and presents preliminary regressions that emphasize the distribution of firms within a sector as a statistically and economically significant determinant of protection levels. Section 3.3 tests several direct predictions of the model presented in Chapter 1 and Chapter 2 and compares the performance of the model presented in this study with the performance of the "Protection for Sale" model. Section 3.4 concludes.

## **3.2 Empirical strategy and data description**

This chapter is organized according to the following road map. First, I provide evidence of the motivating fact of Chapter 1 and Chapter 2, using a reduced form approach: sectors characterized by a higher dispersion of firm size present higher levels of protection.

Second, the model in Chapter 2 predicts that larger firms are more likely to take part in the lobby and are likely to contribute more. Making use of firm-level data I show that this prediction is confirmed. Third, employing the same firm-level data, I build the share of total output in each sector produced by firms that are part of the lobby. The model predicts that these participation shares are increasing in the level of firm size dispersion. I show that this is confirmed by the data. Fourth, I test the prediction that the level of protection depends not simply on the sector's total output, but on the share of output produced by lobbying firms. Fifth, I test the model developed in this paper against the benchmark "Protection for sale" model and show that it explains a significantly larger fraction of the variation in protection levels across sectors.

### **3.2.1 Reduced form evidence: the effect of firm size dispersion on protection**

This chapter makes use of several data sources: the data used in previous empirical studies to test the original GH model is the same as in Gawande and Bandyopadhyay (2000); the data on sector-level firm size distribution is from the 1987 US Census of Manufactures; the data on firms political contributions is taken from Federal Election Commission records for electoral cycle 1986-88 and individually matched to COMPUSTAT firm information about sales, employment and industry classification.

The motivation of these three chapters stems from an empirical pattern observed in the data: sectors where firm size distribution is more dispersed are more highly protected. This section presents evidence of this pattern. I first need to introduce all the other variables that have been used in the previous empirical tests of the "Protection for sale" framework and the data used to measure firm size dispersion.

### **3.2.2 The benchmark model and data description**

I will use the model presented by Gawande and Bandyopadhyay (2000) (from now on GB) as benchmark of the empirical test of the original "Protection for Sale" model, because the same data set is employed here. Their specification is a system of three equations, of which I will

emphasize only one as it is relevant to this study:

$$\frac{t_i}{1+t_i} = \gamma_0 + \gamma_1 I_i \frac{z_i}{e_i} + \gamma_2 \frac{z_i}{e_i} + Z_{1i} + \varepsilon_i \quad (3.1)$$

where  $t_i$  is the coverage ratio for industry  $i$ ,  $z_i$  is the inverse of the import penetration ratio,  $e_i$  is the price elasticity of imports and  $I_i$  is a dummy that describes whether the sector is politically organized, while  $Z_{1i}$  includes tariffs on intermediate goods as controls as in GB. This specification reflects the main prediction of the "Protection for Sale" model:

$$\frac{t_i}{1+t_i} = \frac{I_i - \alpha_L z_i}{a + \alpha_L e_i}$$

(Grossman and Helpman (1994) p.842). As a reminder, the paper by GB aims at verifying the predictions of the model, according to which  $\gamma_1$  is positive,  $\gamma_2$  is negative and the sum  $\gamma_1 + \gamma_2$  is positive.

The equation:

$$\frac{1}{z_i} = \phi \frac{t_i}{1+t_i} + \xi_i \quad (3.2)$$

accounts for the simultaneity problem first studied by Trefler (1993): we can expect higher tariffs to reduce import penetration as this equation illustrates. This system accounts for the fact that import penetration and tariff levels are determined simultaneously.

As a measure of protection  $t_i$  the literature has widely adopted the use of coverage ratios for non-tariff barriers,<sup>1</sup> which represent the share of products in an industry covered by one or more quantitative or qualitative restrictions to trade. Although the model deals with tariffs, from a practical point of view we generally regard tariffs as the result of multilateral agreements that take place among governments. It is standard to consider NTB's to be a more flexible instrument available to governments since qualitative and quantitative restrictions to trade are not governed by the same strict rules that apply to tariffs and are set by international organizations such as the WTO. Moreover, interest groups are aware that tariffs are set at the international level and that NTB's are easier to set unilaterally, therefore becoming the

---

<sup>1</sup>Data on Non-Tariff Barriers is relative to year 1987 and is collected by UNCTAD. The data was kindly provided by Kishore Gawande.



target of industry lobbying. Furthermore, tariffs are generally very low on all manufacturing products following the rounds of negotiations under the GATT and WTO and variation in tariff levels is not likely to be very wide. Import penetration ratios measure the share of imports to total production in sector  $i$ . In the equation above  $z_i$  is the inverse of the import penetration. Data on import penetration ratios are the same as in Treffer (1993). As for  $e_i$ , the literature has reached a consensus in considering the study by Shiells et al. (1986) as the most accurate estimate of sector-level price elasticity of imports.  $I_i$  is a dummy variable that indicates whether the sector is politically organized and represented by a lobby. In this study I use the dummy constructed by GB<sup>2</sup>, but I show alternative results under a dummy that I construct using other data sources. The data on political contributions used by GB to construct  $I_i$  are originally from the Federal Election Commission.<sup>3</sup>

I employ the instruments used by Treffer to correct for the simultaneity bias intrinsic to the system of equations (3.1) and (3.2). The two variables employed here are sector-level capital labor ratios interacted with industry dummies and the fractions of managers, scientists and unskilled labor per industry as measures of comparative advantage that determine import penetration independently of the level of protection.

### 3.2.3 Introducing characteristics of the size distribution of firms

The novel fact that this study uncovers is that sectors that are characterized by higher firm size dispersion receive higher protection. I present here reduced form evidence, which is not directly a test of the model, but that suggests that relevant variables are omitted in previous empirical studies of the GH model. The basic specification employed in this section is:

$$\frac{t_i}{1+t_i} = \gamma_0 + \gamma_1 I_i \frac{z_i}{e_i} + \gamma_2 \frac{z_i}{e_i} + \gamma_3 \sigma_i + \gamma_4 \mu_i + \gamma_5 I_i + Z_{1i} + \varepsilon_i \quad (3.3)$$

where  $\mu_i$  and  $\sigma_i$  are respectively average and standard deviation of firm size within sector  $i$ . Notice that GH would imply that  $\gamma_3$  and  $\gamma_4$  are both zero as the size distribution of firms should have no impact on the level of protection. The source of data employed to measure these

<sup>2</sup>See Gawande and Bandyopadhyay (2000) for detailed explanation of the derivation of  $I_i$ .

<sup>3</sup>The data provided by Kishore Gawande reports sector-level aggregate contributions by Political Activity Committees (PAC's) for the 1981-82 and 1983-84 election cycles.

two variables is the 1987 US Census of Manufactures<sup>4</sup>. The Industry Series of the Census of Manufactures include data on 4-digit SIC industry firm size distribution. I treat each 4-digit SIC code as an individual sector and I approximate firm size using total annual sales.<sup>5</sup> The average size and size dispersion are respectively the mean  $\mu_i$  and the standard deviation  $\sigma_i$  of the firm sales distribution. Publicly available US Census data sets do not report individual firm information, but they report ten size brackets according to employment size. For each bracket total shipments and the number of establishments is reported. As a result of this data limitation the method employed is to calculate the average size per employment bracket and then derive the weighted average and standard deviation across the ten available employment bins.<sup>6</sup> *Table 1* reports summary statistics for size distribution variables. The first part of the table includes 226 4-digit SIC sectors.

To correct for the possibility of reverse causality in the relationship between firm size distribution and the level of protection I instrument for the standard deviation of firm size using size dispersion measures for European firms. The data on firm size dispersion for European firms (the mean and the standard deviation of sales), used as an instrument for the characteristics of the size distribution of US firms is from Helpman et al. (2004)<sup>7</sup>. In principle the instrumenting strategy should also correct for the fact that  $\sigma_i$  and  $\mu_i$  are estimates of the true moments of the sector-level distribution of firm size.

### 3.2.4 Results

Column GB in *Table 2* reports the results for specification (3.1)<sup>8</sup>. As predicted by the general GH model, for politically unorganized sectors a larger size of the industry output relative to imports and a smaller price elasticity of imports decreases the tariff level ( $\gamma_2 < 0$ ). The point estimate of  $\gamma_2$  is  $-1.73$  with a robust standard error of 0.70. For politically organized sectors this relationship has the opposite sign ( $\gamma_1 > 0$ ). The point estimate of  $\gamma_1$  is 1.83 with a

---

<sup>4</sup>1987 Census of Manufactures Volume 1E - Industry Series MC87-I. Industry statistics by employment size of establishment MC87I4

<sup>5</sup>The entry reported in the US Census of Manufactures data is "shipments".

<sup>6</sup>See Appendix for details. A similar calculation of average and standard deviation is made in Helpman et al. (2004).

<sup>7</sup>Data on European firms is originally from Amadeus (1997).

<sup>8</sup>The results are consistent with the coefficients reported in the paper by Gawande and Bandyopadhyay (2000) and qualitatively similar to the values obtained by Goldberg and Maggi (1999).

standard error of 0.74. Both point estimates are of the same magnitude as in GB. Although the prediction that the sign of  $\gamma_1$  is positive is confirmed by the data, the positive sign of  $\gamma_1 + \gamma_2$  is not statistically significant. It is important to stress that this prediction is confirmed when considering the specification that is closest to the model presented in this chapter, as emphasized in the following section.

The results from specification (3.3) appear in column *I* of *Table 2*. While the coefficients on  $I_i(z_i/e_i)$  and  $z_i/e_i$  remain of the same sign and magnitude (suggesting that the GH model is robust), the standard deviation of firm size presents a positive and very significant impact on protection levels, controlling for the average size of the firms in the sector. The point estimate of  $\gamma_3$  is 0.44 (precisely estimated with a robust standard error of 0.063). This is consistent with the prediction of the model that sectors where firms' distribution is more dispersed receive more protection. The coefficient  $\gamma_4$  is 0.04 on average firm size (not statistically significant with a robust standard error of 0.04).

The centered  $R^2$  for column *I* is 33 percent larger than the benchmark GB column which suggests that including measures of firm size distribution explains a larger fraction of the variation of protection levels across sectors.

In other columns of *Table 2* I control for other variables that could be affecting the structure of protection across industries. I control for Total Sales in the sector, accounting for the fact that the data used for import penetration might not be the same as the Sales data used to calculate firm size dispersion. I also control for Total Value Added per sector and for more partial measures of firm distribution as the Herfindahl index and the Concentration4 index<sup>9</sup>. When included in the same regression the measure of dispersion presented here remains the only significant distribution variable affecting the structure of protection<sup>10</sup>.

---

<sup>9</sup>Concentration4 reports the share of total sales accounted for by the top four firms in the sector.

<sup>10</sup>Davis (1990) suggests an alternative way to compute statistics of the distribution of firm size. In particular Davis proposes the following "size-weighted" average firm size, define it  $w\mu_i$ :

$$w\mu_i = \sum_{j \in S_i} x_{ij} \frac{x_{ij} n_{ij}}{X_i}$$

where  $n_{ij}$  is the number of firms with same size index  $j$ . The relationship between  $w\mu_i$  and  $\mu_i$  and  $\sigma_i$  is the following:

$$w\mu_i = \mu_i + \frac{\sigma_i^2}{\mu_i}$$

Empirically  $w\mu_i$  affects positively the level of protection as both its components  $\mu_i$  and  $\sigma_i$  have been shown to

### 3.3 Testing the model

This section employs data on firm-level contributions and firm characteristics to test the last four predictions listed in the road map laid out in the empirical strategy.

One new source of data is a collection of records of the Federal Election Commission of political contributions. I refer to the Appendix for more details about these data. The FEC holds a record of all Political Action Committees formed. PAC's are a channel through which corporations, among other entities, make contributions to politicians (mostly to incumbent politicians).<sup>11</sup> The data set used in this study reports information for various electoral cycles. In order to make the data on contributions compatible with 1987 US Census of Manufactures data I consider the political cycles 1986 and 1988. This data set though, originally lacks a standard identifier for the company sponsor of the PAC, which required to individually match each PAC to a firm. Therefore each PAC was matched to a firm in COMPUSTAT using the PAC name, as explained in detail in the Appendix.

The fourth source of data is COMPUSTAT North America Industrial Annual 1987. This data set provides information on company's employment size, annual net sales and 4-digit SIC. As described in the Appendix, data on PAC contributions and COMPUSTAT data on firm size allow to find the threshold participating firm for each SIC 4 industry. Once the threshold firm is identified,  $\theta_i$  can be calculated as the share of total output in the industry represented by the firms participating in the political game. In the second and third part of *Table 1* firm level summary statistics of PAC contributions, net sales and employment levels are reported. The number of firms for which data are available in 1988 is 3089, of which 478 make positive contributions (15.47% of the available sample). Among the contributing firms the average contribution is 62,241 dollars. The fact that political contributions are small relative to the size of contributing firms has been documented by Ansolobehere et al. (2003). The small size of political contributions should not be surprising when what should matter is the leverage that a given amount of money obtains. Furthermore it is plausible that political contributions are not the only channel through which lobbying takes place. In particular many corporations decide to hire lobbyists whose task is to promote legislation that is favorable to a specific industry.

---

have a positive impact on protection.

<sup>11</sup>I thank Jim Snyder for kindly sharing these data.

Although this study does not show evidence of this channel, the logic of the model should apply as long as this form of lobbying also involves an initial fixed cost independent of firm size.

I will refer in many instances to the Data Appendix for a thorough description of both the data and the methodology used to link the different data sets.

### 3.3.1 Firm size and the likelihood of participating in the political game

A prediction of the model is that larger firms are more likely to participate in the political game. I also show here that larger firms make larger contributions than smaller firms as one reasonably expects, although the level of contributions is undetermined in the model presented in the previous chapter. It would be naive to expect that all large firms in an industry contribute. This is because contributions are not the only way in which firms might try to influence policy choices. Nevertheless, in this section evidence is reported to show that larger firms are indeed more likely to make positive contributions and make larger contributions.

The model presented in these chapters distinguishes theoretically between the participation and the contribution decision of the firm. Therefore it would be optimal to estimate the participation and the contribution decision simultaneously.<sup>12</sup> This would require a measure of the fixed cost in order to identify the participation decision separately from the contribution decision. Since such measure is not available, evidence of the two decisions is reported separately. Furthermore, as previously mentioned there are a number of contribution levels that are compatible with the same pattern of participation therefore contributions can theoretically take several values within a certain range.

According to the first panel in *Table 3* the amount of contributions by each firm increases as a function of size (measured as the logarithm of sales). The model also predicts that contributions should be zero up to the industry participation threshold and then be positive. The evidence shows that they also increase with the size of the firm. This convex shape of contributions as a function of size is confirmed by *Graph 1* and by the pooled regression in *Table 3* where square of the logarithm of sales has the predicted positive coefficient (0.001 with SIC 4 clustered standard error of 0.0002). The average intercept across sectors is  $-0.013$  and the average slope is 0.004 (see column *III*, *Table 3*).

---

<sup>12</sup>This is the standard Heckman (1979) correction for sample selection.

The second panel in *Table 3* also shows that the probability that a firm participates in the lobby is increasing in the size of the firm both across sectors and within each sector. Moreover, the third panel in *Table 3* shows that the ratio of participating firms to non-participating firms is increasing as we consider larger firm size categories (with a coefficient of 0.058), both at the aggregate and sector level.

### 3.3.2 The relationship between $\theta_i$ and size distribution parameters

Proposition 9 in Chapter 2 predicts that the share of total output represented by firms that participate in the lobby increases as the average size and standard deviation of the size distribution of firms increase.

$$\begin{aligned}\frac{\partial \theta_i}{\partial \sigma_i} &\geq 0 \\ \frac{\partial \theta_i}{\partial \mu_i} &\geq 0\end{aligned}$$

Using firm-level data on size and contributions one can identify the threshold contributing firm for each sector  $i$ , that is the smallest firm that makes positive contributions (in the model firm  $h^*$  for each sector  $i$ ) and one can measure the share of total output of sector  $i$  represented by firms participating in the political game, that is what I call "true"  $\theta_i$ .<sup>13</sup>

Identifying the threshold participating firm allows to check that the condition, under which a mean-preserving spread of the firm size distribution induces an increase in  $\theta_i$ , is satisfied. In a the sample of 226 sectors, the condition that the threshold participating firm is larger than the average firm is satisfied for 225 of these industries and is not satisfied for 1.

The share of total output of sector  $i$  represented by the firms contributing is positively correlated to both the mean and the standard deviation of the firm size distribution. *Table 4* reports a correlation of 0.47 between  $\theta_i$  and  $\sigma_i$  and a correlation of 0.39 between  $\theta_i$  and  $\mu_i$ . Both correlations are positive and significant at the 1 percent confidence level, consistently with what is predicted by the model.

---

<sup>13</sup>I define this  $\theta_i$  "true" because it is calculated using actual data on contributions. I distinguish this from the "constructed"  $\theta_i$  which is the function described below.

### 3.3.3 The Heterogeneity specification

The model predicts that the correct specification that describes the equilibrium level of protection of an industry should account for different participation shares  $\theta_i$ 's. Once firm-level data allows to calculate the share of total output produced by firms lobbying, the model predicts exactly how it should enter the protection equation:

$$\frac{t_i}{1+t_i} = \frac{\theta_i - \alpha_L z_i}{a + \alpha_L e_i}$$

which corresponds to the following specification:<sup>14</sup>

$$\frac{t_i}{1+t_i} = \gamma_0 + \gamma_1 I_i \frac{z_i}{e_i} \theta_i(\sigma_i, \mu_i) + \gamma_2 \frac{z_i}{e_i} + Z_{1i} + \varepsilon_i \quad (3.4)$$

where  $\theta_i(\sigma_i, \mu_i)$  is an increasing function of both  $\sigma_i$  and  $\mu_i$  (as shown in the previous section).

I show in the following sections the results for this specification using:

- the participation shares, that are calculated using firm-level contribution and size data (call them “true” participation shares)
- the “constructed” shares, that is shares that are function of parameters that, according to the model, determine  $\theta_i$ 's:  $\theta_i(\sigma_i, \mu_i)$

The model predicts that  $\gamma_1 > 0$ : in sectors where firms make political contributions the level of protection is higher the higher the output, the lower the imports, the lower the price elasticity of imports and the higher participation share  $\theta_i$ . The model also predicts  $\gamma_2 < 0$ : in sectors that are not politically organized the level of protection is lower the higher the output, the lower the imports, the lower the price elasticity of imports.

The third prediction is that  $\gamma_1 \theta_i + \gamma_2 > 0$ . In principle the sign of  $\gamma_1 \theta_i + \gamma_2$  should depend on whether  $\theta_i - \alpha_L$  is smaller or greater than zero, but if we maintain the assumption that ownership is very concentrated,  $\alpha_L$  will be relatively small and the sign of  $\gamma_1 \theta_i + \gamma_2$  should be

---

<sup>14</sup>The specification still includes  $I_i$  to account for the fact that some sectors cannot be considered politically organized even though they make some small political contributions. This choice is made in order to maintain the set of organized sectors the same as in GB. The results are therefore comparable and the differences are not due to a different set of organized sectors.

positive. In other words it seems reasonable to expect the political effort to lower a product's price on the part of consumers of the good to be weaker than the political effort to increase it by its producers.

### 3.3.4 The heterogeneity specification with “true” participation shares

I here test the main prediction of the model (Proposition 1 in Chapter 1), the equation:

$$\frac{t_i}{1+t_i} = \gamma_0 + \gamma_1 I_i \frac{z_i}{e_i} \theta_i + \gamma_2 \frac{z_i}{e_i} + Z_{1i} + \varepsilon_i \quad (3.5)$$

using the share  $\theta_i$ 's calculated by finding the threshold participating firm for each sector.

As *Table 5* reports, both coefficients  $\gamma_1$  and  $\gamma_2$  have the predicted sign:  $\gamma_1 > 0$  and  $\gamma_2 < 0$ . The point estimate for  $\gamma_1$  is 13.78 with a standard error of 3.24 and the coefficient  $\gamma_2$  is  $-0.28$  with a standard error of 0.11. The implication of the results of this specifications is that an increase of 1 percent of the share of sales represented by contributing firms induces an increase of 13.78 percentage points in the coverage ratio. Moreover this specification supports the hypothesis that  $\gamma_1 \theta_i + \gamma_2 > 0$ : calculated at the average  $\bar{\theta}$ ,  $\gamma_1 \bar{\theta} + \gamma_2 = 3.34$  and the 95 percent confidence interval is [2.88, 3.80]. Notice that the equivalent prediction in the GH model is not supported by the results obtained by GB.

Estimating  $\gamma_1$  and  $\gamma_2$  allows to find the weight that the government places on aggregate welfare relative to contributions. We can rewrite the government's utility as  $G = C + a(W^N + C)$  where  $W^N$  is the aggregate welfare net of contributions. Therefore the weight on net aggregate welfare is  $a$  while the weight on contributions is  $(1 + a)$ . The estimates of  $\gamma_1$  and  $\gamma_2$  imply that  $a = 725$  and that the government places an equal weight on net welfare and contributions.

Another important implication of this regression is that the value for  $\alpha_L$  is around 0.02,<sup>15</sup> which implies that a low fraction of the population is represented by interest groups. This value for  $\alpha_L$  is much lower than the values obtained by Gawande and Bandyopadhyay (2000), who find  $\alpha_L \approx 1$ , and Goldberg and Maggi (1999), who find values of  $\alpha_L$  between 0.84 and 0.88. These values of  $\alpha_L$  have been recognized as unrealistically high for the US and are commonly indicated as a failure of the empirical tests of the “Protection for sale” model. The more

---

<sup>15</sup>The model implies that  $\alpha_L = -\frac{\gamma_2}{\gamma_1}$ .



reasonable estimate of  $\alpha_L$  obtained under the Heterogeneity specification offers further support to the need to account for different participation shares ( $\theta_i$ 's) across sectors.

### 3.3.5 The heterogeneity specification with “constructed” participation shares

I here test the equation (3.5) using “constructed” thetas.  $\theta_i$ 's are shown to depend positively on both the mean and the standard deviation of the size distribution in the sector. I choose the simplest functional form for  $\theta_i(\sigma_i, \mu_i)$ :

$$\tilde{\theta}_i = \rho\mu_{iF} + (1 - \rho)\sigma_{iF} \quad (3.6)$$

where  $\mu_{iF} = F_\mu(\mu_i)$ <sup>16</sup> and  $\sigma_{iF} = F_\sigma(\sigma_i)$ <sup>17</sup> are normalized values of  $\sigma_i, \mu_i$ .<sup>18</sup>

Results in *Table 6* show that different weights ( $\rho$ 's) do not substantially affect the coefficients  $\gamma_1$  and  $\gamma_2$  in specification (3.5). The coefficients have the predicted sign with  $\gamma_1$  positive and significant and  $\gamma_2$  negative and significant. Moreover the prediction that  $\gamma_1\theta_i + \gamma_2 > 0$  is supported by the data. These last findings might also be a consequence of the re-scaling of the variable  $I_i(z_i/e_i)$  by  $\theta_i$  which is a quantity between 0 and 1, but using  $\theta_i$ 's seems to bring the data closer to the predictions of the model.

### 3.3.6 Comparing the Heterogeneity model and the "Protection for sale" model

It is difficult to draw any sharp conclusions from comparing results from specifications (3.1) and (3.4) because the two models are such that model (3.4) is not nested into model (3.1).

I adopt a methodology introduced by Davidson and MacKinnon (1981) and employed by Eicher and Osang (2002) to compare the two models' power in explaining the pattern of protection across sectors. The goal is to test whether the model proposed in this study explains significantly more of the variation in observed NTB's than the original GH model does.

The procedure introduced by (Davidson and MacKinnon (1981)) consists in non-nested J-tests where two types of tests are performed.

---

<sup>16</sup> Empirical cumulative distribution function of  $\mu_i$

<sup>17</sup> Empirical cumulative distribution function of  $\sigma_i$

<sup>18</sup>  $\rho \in (0, 1)$  is a weight to which I assign several values. I report results for different values of  $\rho$  in *Table 6*.

*Table 7* reports results for these two tests under “true”  $\theta_i$ 's . In *Test I* the null hypothesis is that the GH model is the correct one and the alternative hypothesis is that the model proposed in these chapters, which I call "Heterogeneity" model, does not add any explanatory power. I reject the null hypothesis that the GH model is the correct one as I find that the Heterogeneity model adds explanatory power.

*Test II* considers as null hypothesis that the correct model is the Heterogeneity model and as alternative hypothesis the GH model. This test finds that one cannot reject the null hypothesis that the Heterogeneity model is the correct one at the 1 percent confidence level (one can reject that the Heterogeneity model is the most informative at the 5 percent confidence level, which suggests that there might be some information in the GH model that is not encompassed by the Heterogeneity model).

*Table 8* reports results for the same two tests under “constructed”  $\theta_i$ 's. In this case both tests strongly support the Heterogeneity model as having stronger explanatory power than the original GH model. In particular, *Test II* here cannot reject the null hypothesis that the Heterogeneity model is the correct one at all confidence levels.

I conclude that according to these tests the model proposed in this paper seems to have substantially greater explanatory power over the original GH model and therefore that a correct model of the political economy of trade policy should include firm-level decisions and account for the fact that sectors present different size distributions of firms and difference lobby participation shares.

### 3.4 Conclusions

This chapter shows how the model developed in the previous chapters helps explain a number of empirical features shown in the data. In particular I show how the model explains why larger firms are more likely to lobby and offers a channel through which the size distribution of firms affects lobby participation shares and therefore the level of protection in a sector. This chapter shows that accounting for individual firm behavior and differences in participation shares across sectors helps explain a larger fraction of the variation of protection across sectors and therefore improves on existing empirical studies of endogenous protection that employ the "Protection

for sale" framework.

One of the main contributions of this chapter is to build a data set by matching data on political contributions with characteristics of individual firms such as total output and industrial sector. This data set has a time dimension that this chapter has not exploited and should be the subject of a different study. In particular the cyclical behavior of contributions, depending on the shock that affects the sector, has been the subject of several theoretical contributions, but has not been studied from an empirical point of view. In the future I plan on using the data set developed here to find out whether contributions increase or decrease during booms or recessions and whether the cyclical behavior depends on the sector where the firm operates.

## **3.5 Appendix**

### **3.5.1 Federal Election Commission contributions data and COMPUSTAT individual company information**

The data set used to identify the firms that participate in the political game was provided by Jim Snyder and is taken from the Federal Election Commission (FEC). The FEC collects information about all Political Action Committees formed: it provides the PAC's name and the sponsor's name, along with data on contributions for all electoral cycles from 1978 to 1998. The FEC identifier does not correspond to any standard company classification so it is necessary to use the name of the PAC sponsor to individually match each PAC to a company listed in COMPUSTAT. In this process I made use of a publication by Congressional Quarterly that describes the sponsors of most corporate PAC's. I was not able to match all the PAC's to an individual firm using COMPUSTAT company information, but a reasonable effort was made to look for links between PAC's and companies through company affiliations and subsidiaries (this information was taken from the each company's website). The PAC data set included 3700 entries of which 2040 were matched to individual companies available on COMPUSTAT. Disregarding the banking, insurance, utilities and health sectors, that are not relevant to this study, I can assess the number of unmatched firms to below 500. This number includes several PAC's that I could not classify in any other sector and I therefore reported as potentially relevant to my study (i.e. manufacturing sectors). It is plausible to have introduced some selection bias

using this matching procedure: COMPUSTAT covers publicly traded companies, which are plausibly the largest in the industry. In identifying the industry participation threshold with the smallest contributing firm that matched I am potentially overestimating the participation threshold and underestimating the share of total industry output represented by contributing firms. Nevertheless companies that contribute in manufacturing industries are predominantly publicly traded and, among the PAC's I was not able to match, a large number is private and large (according to CQ PAC's Directory which reports the assets value owned by each sponsor company).

### **3.5.2 Construction of the characteristics of the size distribution of firms**

This section describes the construction of sector-level size dispersion measure. The 1987 US Census of Manufacturing (henceforth USCM) reports the value of total shipments by SIC 4 and provides a breakdown of the total shipments by employment size of the establishment according to ten brackets reported below. The variable *Emplsize* indicates the employment bracket and associated to it is a range that describes the number of employees per establishment in that size category. Below I will describe the implications for my study of the choice of establishment as the unit of observation and I will report the adjustments that I was able to make.

US Census of Manufacturing 1987

Employment brackets

Emplsize	Number of Employees*
1	0 – 4
2	5 – 9
3	10 – 19
4	20 – 49
5	50 – 99
6	100 – 249
7	250 – 499
8	500 – 999
9	1000 – 2499
10	> 2500

\*per establishment

The USCM reports the total value of shipments  $S_i$  and the total number of establishments  $n_i$  for each employment size category  $i$ ,  $i = 1, \dots, 10$ . The average and the standard deviation of shipments are calculated as follows:

$$\mu = \frac{\sum_{i=1}^{10} S_i}{\sum_{i=1}^{10} n_i}$$

$$\sigma = \left( \frac{\sum_{i=1}^{10} n_i \left( \frac{S_i}{n_i} - \mu \right)^2}{\sum_{i=1}^{10} n_i} \right)^{\frac{1}{2}}$$

### 3.5.3 Determination of the participation threshold

The FEC reports data on individual firm contributions and therefore cannot be matched to the Census of Manufacturing data directly as firms are generally composed by several establishments. An establishment is defined by the USCM as the "A single physical location where business is conducted or where services or industrial operations are performed", whereas a firm is defined as "A firm is a business organization consisting of one or more domestic establishments in the same state and industry that were specified under common ownership or control". We therefore need to know how many establishments belong on average to each firm of a given size in a given sector. The method used to impute a firm to one of the ten employment categories in the 1987 Census of Manufacturing requires the use of the 1992 Statistics of US Businesses (henceforth SUSB) data on industry (SIC 4) employment. The 1992 SUSB classifies enterprises<sup>19</sup> in each industry according to the number of employees and reports for each of the six employment categories (which are different from the USCM employment breakdown) the total number of firms and the total number of establishments. It is possible to derive the average number of establishments per firm for a company of a certain size (in terms of employees). After assigning each individual company to an industry and employment bracket (using COMPUSTAT data on employment and SIC category), I divide the number of employees of each firm by the corresponding number of average establishment per firm. I finally used this average number of employees per establishment to assign the firm to the USCM employment category. Identifying the smallest firm contributing in each sector then allows to find the participation threshold, which is the USCM employment bin where the threshold firm is classified.

---

<sup>19</sup>The SUSB distinguishes between firms and enterprise using the following criterion. An enterprise is a company that operates in more than one industry and therefore controls several firms across different industries (SIC 4). For my scope I do not make a distinction between the two entities.

Table 1 Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
<i>SIC 4 sample - US Census of Manufactures 1987</i>					
Coverage Ratio	226	0.1	0.2	0.0	1.0
Total Shipments	226	6247.4	13639.8	92.9	133345.8
Average Shipments	226	23.3	59.8	0.5	639.2
Shipments St. Dev.	226	43.0	88.8	0.8	797.3
<i>Firm full sample - COMPUSTAT</i>					
PAC Contributions	3089	8668.1	40517.9	0	526956
Total sales	3089	1524.5	8110.8	0	121816.6
Employees	2893	9389.4	46777.3	1	765700
<i>Contributing firm sample - COMPUSTAT</i>					
PAC Contributions	478	62241.12	88590	100	526956
Total sales	374	7171.8	18988.1	3.496	121816.6
Employees	368	43507.86	110162.2	60	765700

Notes: Coverage Ratios from UNCTAD 1983. Shipments in millions USD.  
 Compustat sample refers to North America Industrial Annual for year 1988. Net annual sales (Compustat series DATA12) in millions USD. PAC contributions in USD. Full sample refers to Compustat firms with available total sales data. Contributing firm sample includes only firms contributing to respective PACs.

Table 2 - Size distribution characteristics- Reduced form

Dependent Variable: $NTB_i$	Regression using Gawande Organization Dummy						Organization Dummy FEC data	
	GB*	I	II	III	IV	V	VI	VII
$I_i(z_i/e_i)$	1.83 (0.74)	1.97 (0.87)	1.47 (0.75)	1.56 (1.04)	1.53 (0.77)	1.58 (0.81)	2.3 (1.16)	1.55 (0.6)
$z_i/e_i$	-1.73 (0.70)	-1.82 (0.85)	-1.38 (0.73)	-1.46 (1.022)	-1.43 (0.75)	-1.44 (0.79)	-2.21 (1.15)	-1.62 (0.58)
$\sigma_i/1000$		0.44 (0.063)	0.37 (0.12)	0.04 (0.018)	0.39 (0.08)	0.48 (0.06)	0.42 (0.06)	
$\mu_i/1000$		0.04 (0.04)	0.04 (0.05)	0.01 (0.08)	0.05 (0.05)	0.037 (0.047)	0.033 (0.049)	
$I_i$			0.01 (0.02)	0 (0.00)	0.01 (0.02)	0.008 (0.019)	0.021 (0.022)	0.024 (0.006)
Total Sales (/10M)			5.6 (7.61)	0.015 (0.007)				
Total Value Added (/1M)					1.5 (1.69)			
Concentration4						-0.015 (0.37)		
Herfindhal						-0.01 (0.009)		
$I_i\sigma_i/1000$								0.42 (0.02)
$I_i\mu_i/1000$								0.031 (0.008)
$N_i\sigma_i/1000$								-1.93 (0.92)
$N_i\mu_i/1000$								6.77 (2.1)
F-test joint $\sigma_i \mu_i^{**}$		0.00	0.00	0.04	0.00	0.00	0.00	0.00
F-test model**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
J-test overidentification**	0.33	0.2	0.26	0.47	0.23	0.19	0.35	0.37
Centered $R^2$	0.24	0.32	0.33	0.3	0.32	0.33	0.32	0.33
No. of Observations	226	226	226	226	226	226	226	226
Estimator	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS

Notes: \*Gawande and Bandyopadhyay (2000) benchmark. \*\*p-value reported. Robust s.e. in parentheses. All specifications include a constant and controls for intermediate goods tariffs and intermediate goods ntb's, not reported.  $I_i$  is a dummy variable taking value 1 if the sector is politically organized (from Gawande and Bandyopadhyay (2000));  $z_i$  is the inverse import penetration ratio divided by 10000 (the import penetration ratio is the ratio of imports to domestic production);  $e_i$  is the price elasticity of imports;  $\mu_i$  is the average of per firm shipments in sector  $i$ ;  $\sigma_i$  is the standard deviation of per firm shipments in sector  $i$ ;  $N_i$  is defined as  $(1-I_i)$ . In column III the average and the standard deviation of  $\log(\text{shipments})$  are reported. Instrument set defined in Appendix Table A1.



Table 3 - Likelihood of participating in the political game as a function of size

Dependent Variable	All Sectors	Distribution of coefficients across sectors						
		Mean	St. Dev.	Min	Max	No. of sectors		
		I	II	III	IV	V	VI	VII
Contribution	Intercept	-0.014 (0.003)	-0.003 (0.001)	-0.013	0.033	-0.186	0.124	186
	log(Sales)	0.005 (0.001)	-0.005 (0.001)	0.004	0.008	-0.002	0.049	186
	log(Sales) squared		0.001 (0.0002)					
	No. of Firms	3027	3027					
	No. of Sectors	216	216					
	Estimator	OLS	OLS			OLS		
Probability of participating	log(Sales)	0.032 (0.003)		0.056	0.075	-0.090	0.447	189
	No. of Firms	3032						
	No. of Sectors	189						
	Estimator	Probit				Linear Probability		
Industry-level ratio of participating/non-participating firms	Intercept	-0.248 (0.031)		-0.267	0.423	-1.841	0.108	124
	Employment bin	0.058 (0.007)		0.058	0.079	-0.001	0.350	124
	No. of Sectors	210						
	Estimator	OLS				OLS		

Notes: COMPUSTAT sample. s.e. are clustered by industry in the full sample estimations (columns 1 and 2). Sales in million USD. The all sectors Probit model (column 1) reports the marginal effect of log(Sales) computed at the mean. Probit estimation may not be feasible by sector: in several sectors all firms above a certain threshold participate in the political game. The linear probability model allows to estimate the slope of log(Sales) in such cases as well. The number of SIC 4 sectors for which coefficients are estimated is limited by the number of observations per sector. The minimum number allowed in this Table is 4 (qualitatively similar results obtain with higher minima).

Table 4 - Correlation between  $\theta_i$ ,  $\mu_i$  and  $\sigma_i$

	$\mu_i$	$\sigma_i$	$\theta_i$
$\mu_i$	-		
$\sigma_i$	0.6849 (0.00)	-	
$\theta_i$	0.386 (0.00)	0.4738 (0.00)	-

Notes: p-values for pairwise correlation reported in parentheses. Number of obs.: 226. Variable  $\theta_i$  is defined as the share of total output in sector i produced by firms making positive contributions; remaining variables defined in Notes of Table 2.

Table 5 - True Participation Shares

Dependent Variable NTB <sub>i</sub>	
$\theta_i I_i(z_i/e_i)$	13.78 (3.24)
$z_i/e_i$	-0.28 (0.11)
Implied $a/(1+a)$	1.00
Implied $\alpha_L$	0.02
Estimator	GMM
F-test joint significance $\theta_i I_i(z_i/e_i)$ ( $z_i/e_i$ ) p-value	0.00
F-test model p-value	0.00
J-test overidentification p-value	0.18
Shea** Partl R <sup>2</sup> /Partl. R <sup>2</sup>	.92/.91
Shea** Partl R <sup>2</sup> /Partl. R <sup>2</sup>	.86/.86
Centered R <sup>2</sup>	0.25

Notes:  $\gamma_1$  is the coefficient on  $\theta_i I_i(z_i/e_i)$  and  $\gamma_2$  is the coefficient on  $(z_i/e_i)$  \*\*First stage Goodness of fit stats for  $\theta_i I_i(z_i/e_i)$  and  $z_i/e_i$ . Two-step efficient GMM standard errors in parentheses below coefficients. Intercept included, not reported. All variables are defined in Notes of Table 2, except from  $\theta_i$ , defined in Notes of Table 2 and Table 4. Instrument set defined in Appendix Table A1. All regressions include a constant and controls for intermediate goods tariffs and intermediate goods ntb's, not reported.

Table 6 - Constructed Participation Shares

Dependent Variable $NTB_i$	$\rho = 1/2$	$\rho = 1/3$	$\rho = 2/3$	$\rho = 1/2$	$\rho = 1/2$
$\theta_i I_i(z_i/e_i)$	7.52 (0.73)	7.52 (0.76)	7.51 (0.71)	6.6 (0.94)	8.82 (0.71)
$z_i/e_i$	-0.98 (0.11)	-0.88 (0.11)	-1.07 (0.12)	-0.82 (0.15)	-1.61 (0.79)
Implied $a/(1+a)$	1.00	1.00	1.00	1.00	1.00
Implied $\alpha_L$	0.13	0.12	0.14	0.12	0.18
Estimator	GMM	GMM	GMM	2SLS	Censored 2SLS
F-test joint $\theta_i I_i(z_i/e_i)$ ( $z_i/e_i$ )	0	0	0	0	0.02
F-test model	0	0	0	0	0
J-Test overidentification*	0.26	0.3	0.24	0.26	0.26
Shea** Partl $R^2$ /Partl. $R^2$	.94/.89	.94/.89	.94/.88	.94/.88	.94/.88
Shea** Partl $R^2$ /Partl. $R^2$	.91/.86	.91/.86	.92/.86	.92/.86	.92/.86
Centered $R^2$	0.26	0.26	0.26	0.27	0.38***

Notes: All specifications include an intercept. Two-step efficient GMM standard errors in parentheses below coefficients. \* Hansen J-Test p-value reported. For instruments see GB and Melitz et al. \*\*Goodness of fit stats for  $\theta_i I_i(z_i/e_i)$  and  $z_i/e_i$ . \*\*\*Pseudo  $R^2$  reported. Variables defined in notes to Table 2 and Table 4.

Instrument set defined in Appendix Table A1. All regressions include a constant and controls for intermediate goods tariffs and intermediate goods ntb's, not reported.

Table 7 - Non-Nested Hypothesis Testing for True Theta

Null Hp.	Alternative Hp.	J-Test p-value	Interpretation	Test
GH	Heterogeneity	0.001	Reject null	I
Heterogeneity	GH	0.041	Reject null	II

Notes: Davidson and MacKinnon (1981) specification test for non nested models.

The null hypothesis tested is that the model associated to the null is the "correct model" and that the model under the alternative is uninformative.

Test I supports the Heterogeneity model. Also see Eicher and Osang (2002)

Table 8 - Non-Nested Hypothesis Testing for Constructed Theta

Null Hp.	Alternative Hp.	J-Test p-value	Interpretation	Test
GH	Heterogeneity	0	Reject null	I
Heterogeneity	GH	0.5758	Cannot reject null	II

Notes: Davidson and MacKinnon (1981) specification test for non nested models.

The null hypothesis tested is that the model associated to the null is the "correct model" and that the model under the alternative is uninformative.

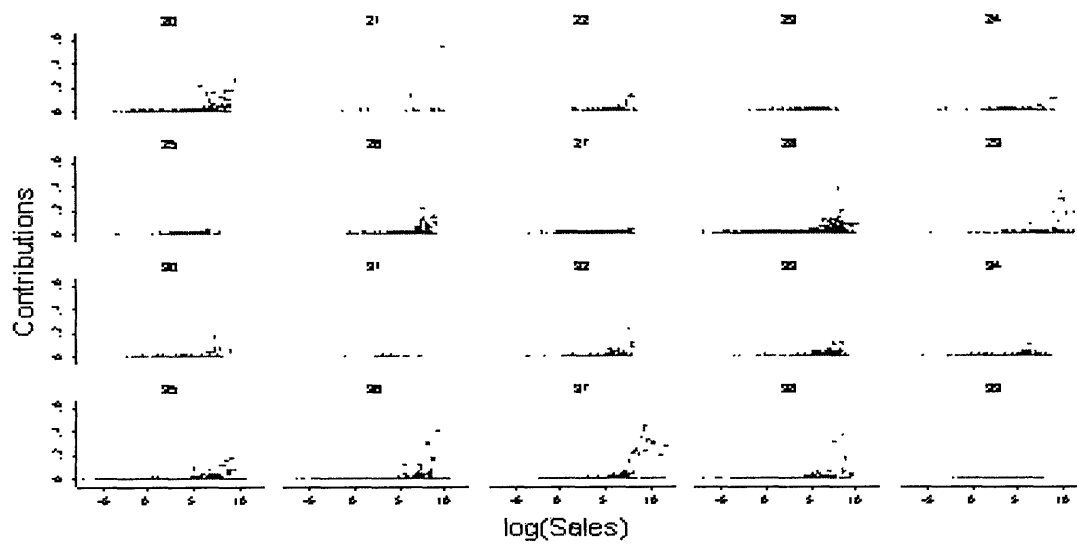
Both test I and II support the Heterogeneity model. Also see Eicher and Osang (2002)

Table A1 - Instruments list

Instruments	Description
1	Average tariff on intermediate goods used in an industry
2	Average coverage ratio on intermediate goods used in an industry
3	Logarithm of the price elasticity of imports (1986)
4	Log percentage of an industry's output used as intermediate good in other sectors
5	Logarithm of the intermediate goods buyer concentration
6	Herfindahl index of the industry
7	Measure of the scale of firms in an industry (value added per firm) (1982)
8	Concentration 4 (share of output in a sector produced by the four largest producers)
9	Share of industry employees defined as Unskilled (1982)
10	Share of industry employees defined as Scientists and Engineers (1982)
11	Share of industry employees defined as Managerial (1982)
12	Real exchange rate lelasticity of imports and exports
13	Cross price elasticity between home production and imports (Shiells et al.)
14	Ad valorem tariff
15	Price elasticity of imports (1986)
16	Capital-labor ratio of the industry x Dummy for Food Processing Industry
17	Capital-labor ratio of the industry x Dummy for Resource-intensive Industry
18	Capital-labor ratio of the industry x Dummy for General Manufacturing Industry
19	Capital-labor ratio of the industry x Dummy for Capital Intensive Industry
20	Average log(sales) by industry from European data (Amadeus Dataset)*
21	Average log(sales) by industry from French data*
	Interactions between instrument 1-9 and 1-21

Notes: Instruments 1-19 are obtained from Gawande and Bandyopadhyay (2000). The set of instruments interactions was selected to optimize the fit of the first stage. \*As reported in Helpman, Melitz, Yeaple (2003)

Graph 1  
PAC Contributions as a function of firm size  
SIC2 level



Graphs by sic2



## Chapter 4

# Product differentiation and waves of outsourcing

*Summary 4* Outsourcing as a mode of production has become known in recent years mainly due to the extraordinarily rapid diffusion among a large number of firms. These “waves” of outsourcing seem to coincide with the creation of large intermediate goods producers and with a certain degree of product homogenization. I build a model where firms face a trade-off between procurement of cheap intermediate goods through outsourcing and the choice of differentiation of their product, which affects the firm’s mark-up. The existence of outsourcing opportunities depends in turn on the number of firms opting for outsourcing and on the extent of economies of scale in the production of intermediate goods. I find that this economy admits multiple equilibria in the choice of the degree of product differentiation and outsourcing. I show that international trade can affect the number of equilibria through market-size effects.

### 4.1 Introduction

In recent years outsourcing has become the focus of much discussion in the policy debate and in the business press. There are several aspects of this phenomenon that have been studied as the availability of outsourcing has had an impact on industrial organization of several sectors as well as on the amount of jobs reallocation overseas chosen by numerous multinationals.

The focus of this chapter will be limited to a few features that have characterized the

emergence of outsourcing in recent years. First it is useful to identify the meaning of outsourcing that this chapter will be describing, as this mode of production is often associated with a number of activities, from service outsourcing (IT, accounting and other services) to the purchase of small components. In this chapter outsourcing indicates a substantial shift in the mode of production from in-house to external procurement of inputs or the transfer of entire production of the good to an external supplier. The final good producer in this last case might not operate any physical modification of the good, but simply add "branding" to the good. This qualification explains why the model presented here will not be a good description of the case of final good producers purchasing several small components from different suppliers, but rather the case of final good producers acquiring the almost finished product from a unique producer.

As mentioned above this chapter is concerned with a few features that previous research has not analyzed and that I shortly describe here.

First, the choice of outsourcing is often associated with a the trade-off between cost advantage and loss of product differentiation deriving from having the good produced by the same supplier. Michael Porter describes this trade-off as follows: "when you outsource something, you tend to make it more generic. You tend to lose control over it. You tend to pass a lot of the technology, particularly on the manufacturing or service delivery side, to your suppliers. That creates strategic vulnerabilities and also tends to commoditize your product. You're sourcing from people who also supply your competitors." This is specially true if large intermediate goods suppliers produce similar products for several final good producers. As *The Economist* puts it, at one of these large intermediate good producers, Flextronics, "One of the lines churns out Web TV set-top boxes, which connect television with the net, for Philips, a Dutch consumer-electronics giant. The line next to it makes the same device for Sony, Philips's arch-rival". The possible loss of product differentiation here clearly comes from a potential infringement of intellectual property rights on the part of the outsourcee and on the fact that economies of scale are achievable only if the production of similar products happens through a standardized process which inevitably makes product more substitutable among each other.

The second feature of this type of outsourcing is that outsourcees are very large firms that manufacture the entire product. I will argue that this points to the existence of scale economies at the level of the intermediate good producer that cannot be achieved by individual final good

producers.

The third feature under analysis here is the fact that within certain industries (e.g. several consumer-electronics sectors) the adoption of outsourcing by several firms happens contemporaneously or at a very short distance in time and we observe "waves" of outsourcing. The chapter argues that the adoption of outsourcing by one firm imposes a positive externality on other firms that are considering outsourcing and this strategic complementarity leads to the possibility of multiple equilibria. In particular I argue that the possibility of multiple equilibria is related to the size of the market and therefore international trade plays a role in increasing the amount of outsourcing in the economy. In this study factor price differences (e.g. lower wages), which are among the determinants of international outsourcing, will not play any role, but international trade will have an effect on the amount of outsourcing purely through market-size effects.

Although concerned with a different trade-off, this chapter is related to previous research aimed at understanding the way firms organize their production. The "make-or-buy" decision has been the subject of much research aimed at understanding the determinants of the boundary of the firm. A line of research dating back to Coase, Williamson and Grossman and Hart (1986) has investigated the role of transaction costs, investment specificity and incomplete contracts in the determination of the boundary of the firm and therefore on the "make-or-buy" decision. According to this literature ownership provides incentives for efficient investment levels when contracts are incomplete. In the trade literature the interest for the integration versus outsourcing decision stems primarily from the desire to understand patterns of intra-firm trade and the way multinational firms organize across borders. The approach introduced by Grossman and Hart (1986) has been adopted by Antras (2003) in exploring the choice of integration versus outsourcing in the context of international transactions.

In Antras (2003) the choice of integration versus outsourcing depends crucially on the capital intensity of the final good produced and on the fact that cost sharing between intermediate good suppliers and final good producers tends to be stronger for capital intensive goods. If labor costs are not shared by the final good producer then it is efficient for labor-intensive intermediate good production to be undertaken by an independent (i.e. not integrated) supplier. Antras and Helpman (2004) present a model where firm heterogeneity, along with contractual incompleteness and investment specificity, determines the choice of organization of the firm.

These contributions share a common feature: the choice of organizational form by one firm is not affected by the decision of other firms. In this sense this chapter is more similar to McLaren (2000) and Grossman and Helpman (2002) where the choice of organizational form by the single firm imposes an externality on other firms and leads to the possibility of multiple equilibria.

In McLaren (2000) the choice of vertical integration has a negative externality on firms considering outsourcing as a mode of production by thinning the market for intermediate goods and worsening the outside option of firms engaging in arm's length transactions. International trade increases the attractiveness of outsourcing by thickening the market for intermediate goods and therefore plays a role that is similar to the one described later in this chapter.

In Grossman and Helpman (2002) on the one hand firms face larger organizational costs associated with vertical integration, but on the other hand searching more efficient suppliers involves search costs (including the possibility of not finding a supplier) and potential hold-up problems which make outsourcing less attractive despite the better quality of the intermediate good supplied by specialized producers. Grossman and Helpman (2002) show that when there are increasing returns to matching there can be multiple equilibria in the organizational form chosen by firms in the industry. This is because, if more firms decide to dis-integrate the production of the final good the market becomes thicker and finding a match becomes easier.

In this chapter outsourcing and in-house production are also treated as industry equilibrium phenomena as in Grossman and Helpman (2002) and McLaren (2000), but the nature of the externality imposed by the choice of production mode by a single firm on other firms in the same industry is of a different nature. Grossman and Helpman (2002) describe the main trade-off as one in which vertical integration or in-house production entails exogenously larger costs, while outsourcing can procure cheaper intermediate goods, but involves search costs and hold-up problems with potential suppliers. In this chapter the cost of in-house production might be endogenously higher, but this is an equilibrium result and firms have ex-ante access to the same technology and choose to adopt different technologies in equilibrium.

This chapter therefore focuses on a different trade-off associated with outsourcing versus in-house production and on the industry equilibrium that results from the interaction of production mode decisions of all firms in the sector.

Section 4.2 presents an economy in which firms face two choices: they can choose to produce their own intermediate good or to buy the intermediate good from a supplier and they can choose to produce with two different technologies (which are available to both final good producers and intermediate good suppliers), one of which exhibits stronger increasing returns to scale. If firms produce their own input then the final product is characterized by a smaller elasticity of substitution vis-a-vis other products. If the firm employs intermediate goods that are produced an external supplier, that also provides inputs for other firms then the final good will exhibit a higher elasticity of substitution with respect to the goods produced with the same intermediate input as products are more similar.

Section 4.3 describes the case of an economy where the unique equilibrium is characterized by in-house production by all firms in the industry: all firms produce relatively more differentiated products and no firm adopts the stronger IRS technology.

Section 4.4 presents the case of multiple equilibria in the industry: if a sufficiently large number of firms adopts outsourcing, then the intermediate good producer will employ a technology with strong IRS and will make it profitable to outsource despite the loss in product differentiation. This equilibrium will in general be characterized by a strictly positive number of firms that decide to keep production in-house. This model therefore justifies the existence of both vertically integrated and outsourcing firms in the same industry, a feature that seems realistic and that the model proposed by Grossman and Helpman (2002) does not justify. In their model either all firms in the sector produce their components in-house or they all outsource production of intermediate goods.

Section 4.5 presents comparative statics with respect to market size and the degree of loss of product differentiation. In particular market size determines the presence of multiple equilibria: larger market size makes it profitable to employ a strong IRS technology and therefore bring about the possibility of an equilibrium with outsourcing. Section 4.6 concludes.

## 4.2 Structure of the economy

Consider an economy where the utility of the representative consumer is given by the following function:

$$U = \left( \sum_i d_i^{\frac{\delta-1}{\delta}} + \sum_k H_k^{\frac{\delta-1}{\delta}} \right)^{\frac{\delta}{\delta-1}}, \quad \delta > 1$$

where  $d_i$  is the consumption of variety  $i$  of differentiated products, henceforth referred to as D-goods and  $H_k$  is the utility index associated with the consumption of an aggregate of more homogeneous products, henceforth referred to as H-goods. :

$$H_k = \left( \sum_j h_{kj}^{\frac{\eta-1}{\eta}} \right)^{\frac{\eta}{\eta-1}}, \quad \eta > \delta$$

The element that distinguishes the two sets of goods is the degree of substitutability among the products. H-goods are more substitutable among each other than D-goods are: the elasticity of substitution among D-goods is  $\delta$  which is smaller than the elasticity of substitution among H-goods, indicated as  $\eta$ . As I will clarify in Section 4.4 the source of this heterogeneity in the degree of substitutability of products is the source of intermediate goods employed in the production of final goods. If final good producers make use of the same intermediate input then their products belong to the same sub-group of H-goods, which are more substitutable among each other than D-goods.

For simplicity I assume for now that the number of final good producers is fixed at  $n$  and therefore the total number of varieties is determined. Of these  $n$  firms some might decide to produce in-house and some might decide to outsource in equilibrium. The only primary factor of production is labor and the total endowment of labor in the economy is  $L$ . The wage is normalized to 1.

All firms need one unit of intermediate input to produce one unit of the final good that they sell and for the production of this good they have access to two kinds of technology, which in equilibrium will be associated with two different modes of production: in-house and outsourcing. The first technology requires a cost of  $\alpha$  units of labor per unit of output of the intermediate good. I will refer to it as the D-technology. The second technology, which I refer

to as the O-technology, is such that the total cost to produce  $z$  units of intermediate good is:

$$TC_O(z) = F_O z^\gamma \quad \gamma < 1$$

Notice that this technology exhibits increasing returns to scale in the production of intermediate goods such that the average cost declines and might not be profitable for low levels of output, compared to the D-technology.

### 4.3 Unique equilibrium with differentiated products

In an equilibrium with only differentiated products the number of differentiated products,  $n_d$  is equal to  $n$ , the total number of firms. Define  $p_i$  as the price of variety of D-good  $i$ ,  $d_i$  the quantity produced (and consumed) of variety  $i$  and  $\pi_{d_i}$  the profit of the producer of variety of D-good  $i$ . The demand function for each variety  $d_i$  is iso-elastic:

$$d_i = \frac{p_i^{-\delta} I}{\sum_{i=1}^n p_i^{1-\delta}}$$

where  $I$  is income. The producer of good  $i$  will choose a price for good  $i$  following the "fixed-markup" rule:

$$p_i = \frac{\delta}{\delta - 1} \alpha$$

In a symmetric equilibrium all varieties are priced the same and are produced in same quantity:  $p_i = p$  and  $d_i = d$ . Each firm earns profits:

$$\pi_d = (p - \alpha) d - F_d$$

where  $F_d$  is a fixed cost necessary to set up production. Labor market clearing requires the following full employment condition to be satisfied:

$$F_d n_d + n_d d \alpha = L$$

The quantities and prices in this equilibrium with only production of differentiated products are therefore the following:

$$\begin{aligned} n &= n_d \\ p &= \frac{\delta}{\delta - 1} \alpha \\ d &= \frac{L - F_d n}{n \alpha} \\ \pi_d &= \frac{L - F_d n \delta}{n (\delta - 1)} \end{aligned}$$

#### 4.4 Multiple equilibria case

I concentrate on the case in which in equilibrium only one outsourcee exists and therefore we observe only one group of H-goods. This is a reasonable case to concentrate on if we think that increasing returns to scale are the reason behind the existence of outsourcing as it is the case in this model and having more than one outsourcee decreases the benefits of achieving higher returns to scale. Indicate with  $n_h$  the number of homogeneous products. The source of homogeneity is purely the fact that producers of this good choose to use intermediate goods that are produced by the same outsourcee.

I drop the index  $k$  as I concentrate on only one subgroup of homogeneous goods. Define  $H$  as the aggregate of H-goods:

$$H = \left( \sum_{j=1}^{n_h} h_j^{\frac{\eta-1}{\eta}} \right)^{\frac{\eta}{\eta-1}}$$

and indicate with  $q_j$  the price of individual variety  $j$  of H-good, with  $Q$  the price index for the aggregate  $H$ .

$$Q = \left( \sum_{j=1}^{n_h} q_j^{1-\eta} \right)^{\frac{1}{1-\eta}}$$

Also indicate with  $E_H$  the expenditure on all H-goods. Demand for variety  $i$  of D-goods will depend on variety  $i$  price  $p_i$  and the price index faced by the representative consumer, which



depends on all D-good prices, but also on H-goods price index  $Q$ .

$$d_i = \frac{p_i^{-\delta} I}{\sum_{i=1}^{n_d} p_i^{1-\delta} + Q^{1-\delta}}$$

The demand for the aggregate  $H$  of homogeneous goods takes a similar form:

$$H = \frac{Q^{-\delta} I}{\sum_{i=1}^{n_d} p_i^{1-\delta} + Q^{1-\delta}}$$

A two-step budgeting procedure allows to find the demand for individual H-good variety  $j$ , denote it  $h_j$ . First we need to find the expenditure allocated to H-goods,  $E_H$ :

$$E_H = HQ = \frac{Q^{-\delta} I}{Q^{1-\delta} + n_d p^{1-\delta}} Q \quad (4.1)$$

Once  $E_H$  is determined, the demand for individual variety  $j$  takes the following form:

$$h_j = \frac{q_j^{-\eta} E_H}{\sum_{i=1}^{n_h} q_i^{1-\eta}}$$

If we replace  $E_H$  with the expression found in 4.1 we find the demand for  $h_j$ :

$$h_j = \frac{q_j^{-\eta}}{\sum_{i=1}^{n_h} q_i^{1-\eta}} \frac{Q^{1-\delta} I}{Q^{1-\delta} + n_d p^{1-\delta}}$$

For simplicity I assume that monopolistic firms ignore the effect of  $q_j$  on  $Q$  even when  $n_h$  becomes very small.

I now concentrate on the production of intermediate goods by the outsourcee. I argue that what characterizes and distinguishes outsourcing is the utilization of an increasing returns to scale technology that would not be profitably employed by the single producers, but is convenient when the outsourcee serves several final good producers. I present for now the case of a single outsourcee and to reduce the complications deriving from strategic behavior I will assume that the outsourcee does not behave as a monopolist and prices at average cost. This

simplifying assumption can be justified if we think of the market for intermediate goods as a contestable market, that is one in which free-entry is allowed by the fact that intermediate goods are quite standardized. We will later argue that the presence of profits would not modify substantially the conclusions we draw.

Define the outsourcee average cost as  $\phi$ :

$$AC = \phi = \frac{F_O \left( \sum_{j=1}^{n_h} h_j \right)^\gamma}{\sum_{j=1}^{n_h} h_j}$$

therefore  $\phi$  is the input cost for each of the H-goods producers. From the H-good producers' perspective,  $\phi$  is perceived as a constant marginal cost as the firm has no monopsony power. Given the constant marginal cost, each H-good producer will price according to the following "fixed markup" rule:

$$q_j = \frac{1}{1 - \frac{1}{\eta}} \phi$$

In a symmetric equilibrium  $h_j = h$  and  $q_j = q$ . The profits for the each producer of H-good will be:

$$\pi_h = (q - \phi) h - F_h$$

where  $F_h$  is a fixed cost necessary to set up production. As for the production of differentiated products the firm behavior will be similar to the one described in the case of only differentiated products.

#### 4.4.1 Equilibrium conditions

I here summarize the equilibrium conditions for the case of production with outsourcing. The demand for each variety of the H-good and the D-good take the following form:

$$h = \frac{q^{-\eta} Q^{1-\delta} (L + n_d \pi_d + n_h \pi_h)}{Q^{1-\eta} Q^{1-\delta} + n_d p^{1-\delta}} \quad (1)$$

$$d = \frac{p^{-\delta} (L + n_d \pi_d + n_h \pi_h)}{Q^{1-\delta} + n_d p^{1-\delta}} \quad (2)$$

where income is the sum of wages and profits and the price index  $Q$  for the homogeneous goods is defined as:

$$Q = (n_h q^{1-\eta})^{\frac{1}{1-\eta}} \quad (3)$$

We saw that the pricing equation for the D-good and the H-good are respectively:

$$p = \frac{\delta}{\delta - 1} \alpha \quad (4)$$

$$q = \frac{\eta}{\eta - 1} \phi \quad (5)$$

with the price of intermediate good produced by the outsourcee:

$$\phi = \frac{F_O}{(n_h h)^{1-\gamma}} \quad (6)$$

Full employment in the labor market requires that the production of H-goods and D-goods exhaust the supply of labor in the economy:

$$n_h (\phi h + F_h) + n_d (\alpha d + F_d) = L \quad (7)$$

Profits for D-goods and H-goods producers will be respectively:

$$\pi_d = (p - \alpha) d - F_d$$

$$\pi_h = (q - \phi) h - F_h$$

In equilibrium it must be the case that no firm finds it profitable to switch mode of production and therefore in an interior solution  $\pi_d = \pi_h$  and  $n_d, n_h > 0$ ,  $n_d + n_h = n$ . In a corner solution we can have two cases. The first case is one in which in-house production is more profitable than outsourcing,  $\pi_d > \pi_h$  and all firms are producing in house  $n_d = n$ . The second case is one in which outsourcing is more profitable than in-house production,  $\pi_d < \pi_h$  and all firms produce using outsourced intermediate goods,  $n_d = 0$ .

I proceed to solve this model numerically since the analytical solution can be found only for certain values of the parameters. The way I proceed is to derive  $d$ ,  $q$ ,  $h$  and subsequently

$\pi_d$  and  $\pi_h$  as a function of  $n_h$  and find the equilibrium number of firms that produce the final good using outsourced intermediate goods by imposing that in equilibrium:

$$\pi_d(n_h) = \pi_h(n_h)$$

Graph 1 shows  $\pi_d$  and  $\pi_h$  as functions of  $\frac{n_h}{n}$ . The following Figure 4.1 describes qualitatively what Graph 1 shows numerically (the numerical values employed in the simulation are reported in Table 1 and the equilibrium values for  $n_h$  are reported in Table 2). On the horizontal axis we read  $n_h$  and therefore  $n_d$  (as the difference between  $n$  and  $n_h$ ). The solid line indicates the profit of H-good producers  $\pi_h$ . The number  $n_h$  has two effects on the profit of H-good producers: first, the larger  $n_h$  the larger the returns to scale achieved by the outsourcee in the production of intermediate inputs; second, the larger  $n_h$  the larger the competition from more substitutable goods. The first effect, call it the *positive externality* effect, makes profit  $\pi_h$  an increasing function of  $n_h$ , the second effect, call it the *competition* effect, makes  $\pi_h$  a decreasing function of  $n_h$ . In Figure 4.1 we see the *positive externality* effect prevailing over a low range of  $n_h$  and the *competition* effect prevailing over a higher range of  $n_h$ .

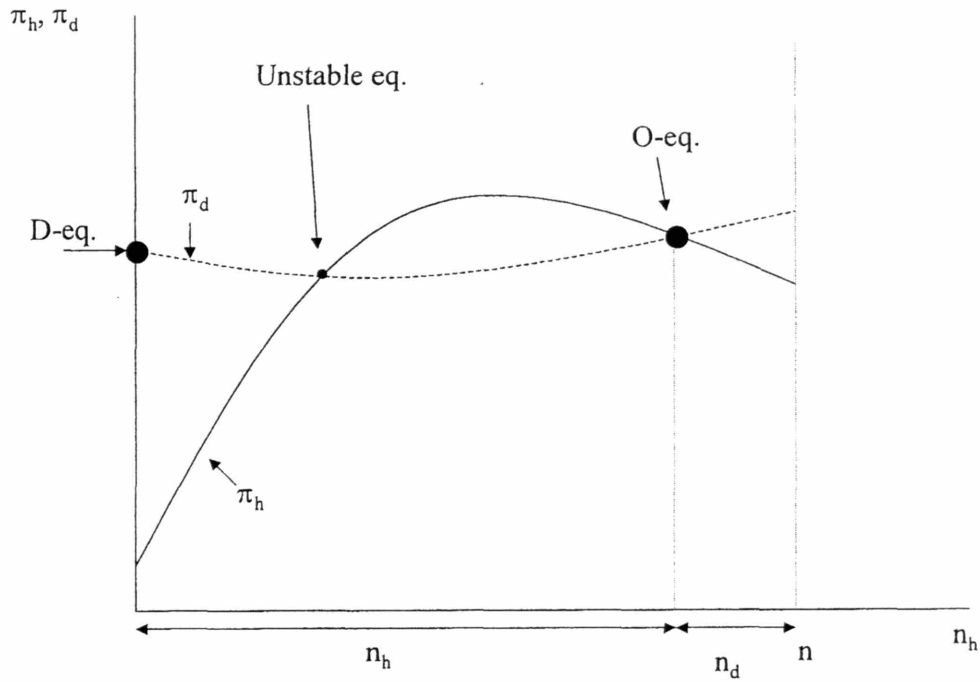


Figure 4.1

There are two equilibria with strictly positive  $n_h$  and  $n_d$ : one equilibrium is unstable and therefore I concentrate on the stable equilibrium, indicated in Figure 4.1 with O-equilibrium. In this equilibrium the ex-ante identical  $n$  firms endogenously sort into in-house producers and "outsourcing" producers. The reason why there is an interior equilibrium in which some firms outsource intermediate good production and some firms produce in house is that for a low  $n_h$  there is a benefit to outsource because there are still large gains from increasing the scale of production of the intermediate goods producer. When the number of H-good producers becomes large enough, "remaining differentiated" becomes profitable as the returns to scale are exhausted and there is low competition from a relatively large group of homogeneous goods. Therefore, unless the loss of product differentiation deriving from outsourcing is very low the O-equilibrium is always an interior one, which is a realistic feature of the model as we observe several firms in the same industry making different decisions about their organization form.

The other stable equilibrium, indicated as the D-equilibrium, is one in which there is no production through outsourcing and no firm has an incentive to switch to outsourcing as a mode of production since at low levels of output (which would be produced by a single firm)

average costs are very high compared to the low IRS in-house technology.

The model does not provide guidance on what mechanism can favor one equilibrium over the other. One might argue that if we allow the intermediate good producer to make some profits, that firm could act as a coordinator which always favors the prevalence of the O-equilibrium over the D-equilibrium. In this case the model would entail only one equilibrium, the O-equilibrium. Nevertheless this coordination requires a certain degree of commitment from final good producers in order for the intermediate good producer to make profits. The intermediate good producer must be able to coordinate the switch from in-house to outsourcing of several firms in the sector.

## 4.5 Comparative statics

This section presents a number of comparative statics with respect to the parameters of the model. Although there is no analytical comparative statics, the value employed here are representative of the qualitative behavior of the model.

**Market size** - Graph 2 presents the impact of a reduction in the market size on the number of equilibria.<sup>1</sup> If the market size is sufficiently small then outsourcing is never profitable enough as a mode of production and the D equilibrium, that is the equilibrium with only in-house production, is the only equilibrium in the economy.

**Large loss of product differentiation** - Graph 3 presents the impact of an increase in the loss of product differentiation associated with outsourcing.<sup>2</sup> In the model this is described by an increase in the elasticity of substitution  $\eta$  among goods produced used the same intermediate input supplied by the outsourcee. If the loss of product differentiation is very large then it might never be profitable to switch to outsourcing as a mode of production and the D equilibrium, that is the equilibrium with only in-house production will be the only equilibrium.

**Small loss of product differentiation** - Graph 4 presents the impact of a decrease in the loss of product differentiation associated with outsourcing.<sup>3</sup> When  $\eta$  decreases the level of substitutability among goods produced using outsourced intermediate inputs becomes similar

---

<sup>1</sup>The value of  $L$  goes from 1000 to 500.

<sup>2</sup>The value of  $\eta$  goes from 2.5 to 3.

<sup>3</sup>The value of  $\eta$  goes from 2.5 to 1.9.

to the one among in-house produced goods. Therefore this might increase the profitability of outsourcing and induce all firms to choose outsourcing as a mode of production. In this case the O-equilibrium will be one in which all firms choose to produce the H-good. This case illustrates how the loss of product differentiation associated with the choice of outsourcing is important in distinguishing this model from a "Big-Push" model a la Shleifer. If choosing to produce using the same intermediate goods employed by other firms did not entail any loss in product differentiation then we would have a bang-bang solution were either  $n_h = n$  and  $n_d = 0$  or  $n_d = n$  and  $n_h = 0$ .

**Cost reduction for the outsourcee** - Graph 5 presents the impact of a decrease in the cost parameter  $F_O$  which makes outsourcing more desirable. As a result the function  $\pi_h$  shifts up and the fraction of firms outsourcing increases with respect to the case of higher outsourcee costs.

**Cost increase for the D-technology** - Graph 6 presents the impact of an increase in the cost parameter  $\alpha$  which makes outsourcing more desirable and in-house production more expensive.<sup>4</sup> As a result the function  $\pi_d$  shifts down and the fraction of firms outsourcing increases with respect to the case of lower costs.

## 4.6 Conclusions

This chapter considers a trade-off associated with the decision to outsource which has not been analyzed before. In particular it shows that waves of outsourcing can be associated with enlargements of the market size, which can be the result of an increase in the amount of international trade of the economy with other countries. These waves are justified in this context as a larger market increases the profitability of the use of technologies which exhibit higher returns to scale. The use of such technologies is profitable only if adopted by one or few intermediate good producers which supply several final good producers.

One feature that the model does not address is the fact that we observe within the same sector several types of outsourcing relationships. The difference among these different relationships concerns the number of final good producers served by the outsourcee. Some intermediate

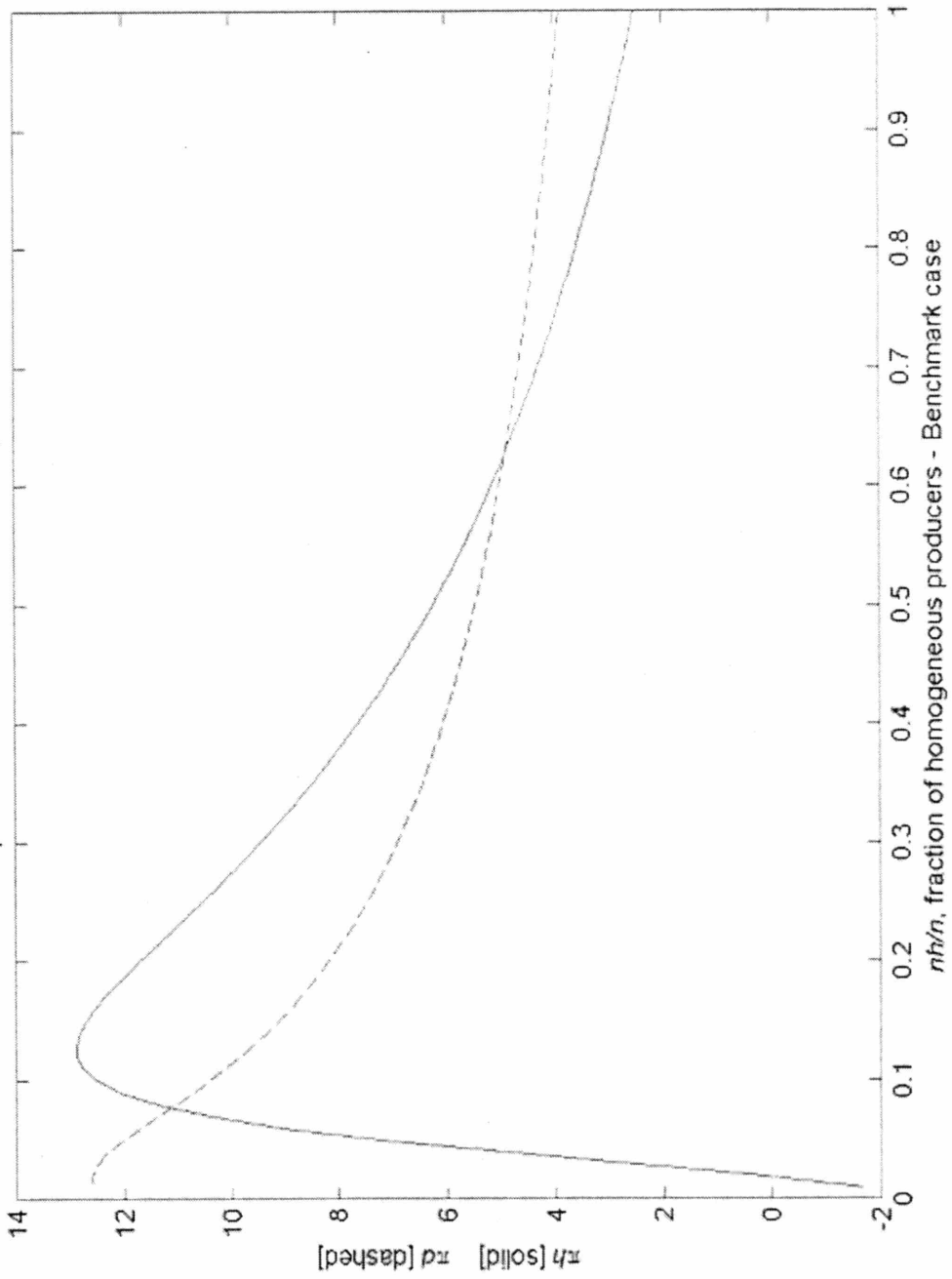
---

<sup>4</sup>The value of  $\alpha$  goes from 3 to 4.5.

good producers supply several firms while some have an almost exclusive relationship with the final good producer that they serve. Future research should aim at explaining the determinants of different relationships between intermediate good providers and outsourcing final good producers.



Graph 1: Profit functions for  $h$  and  $d$  producers



**Table 1**

Parameter values		
Preference parameters	Sector technology parameters	Sector size parameters
$\delta = 1.8$	$F_0 = 10$	$L = 1000$
$\eta = 2.5$	$\gamma = 0.5$	$n = 100$
	$F_h = 2.5$	h - producer
	$F_d = 0$	d - producer
	$\alpha = 3$	

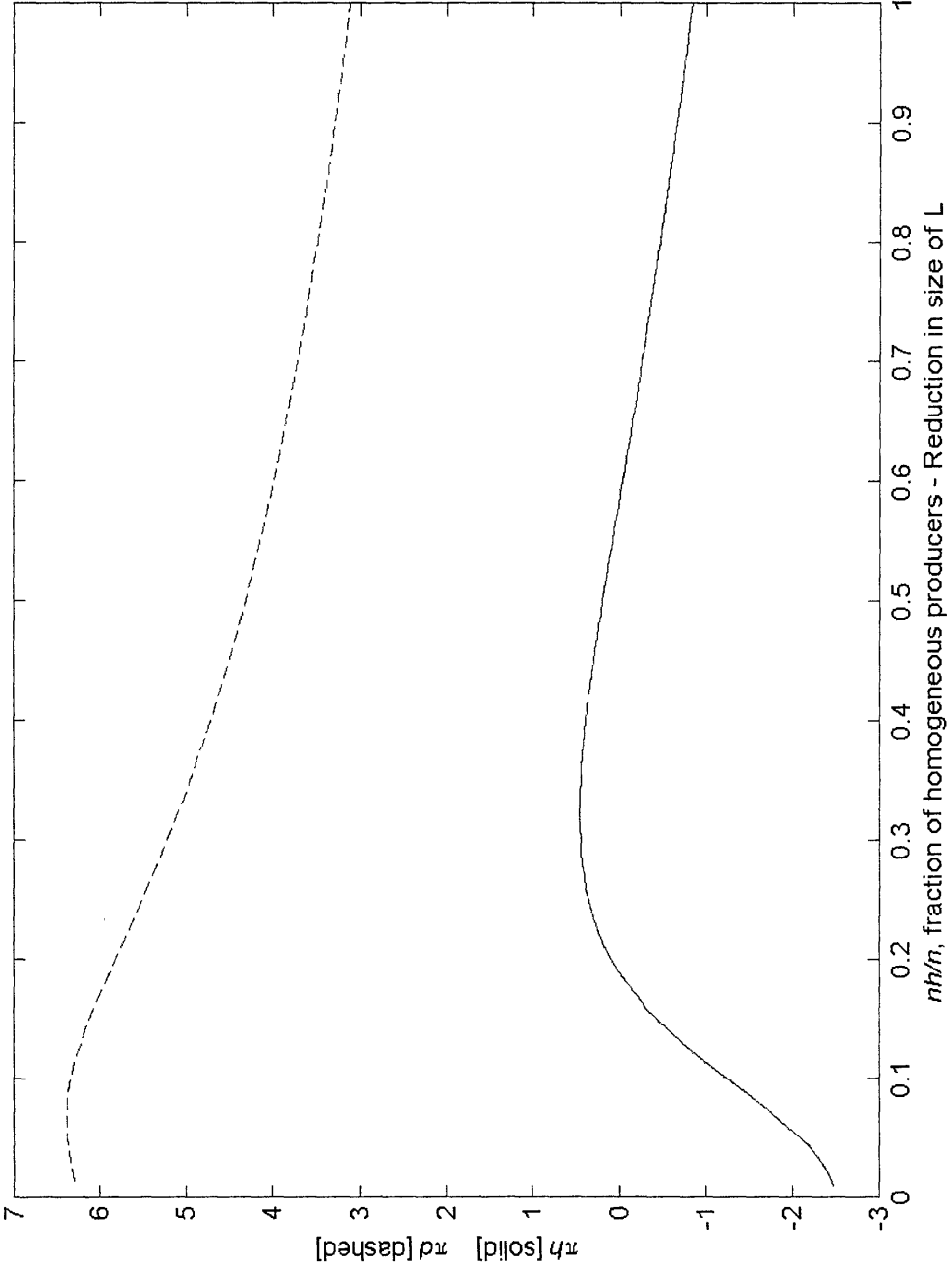
**Table 2**

Predicted profits under the alternative technologies - Benchmark case

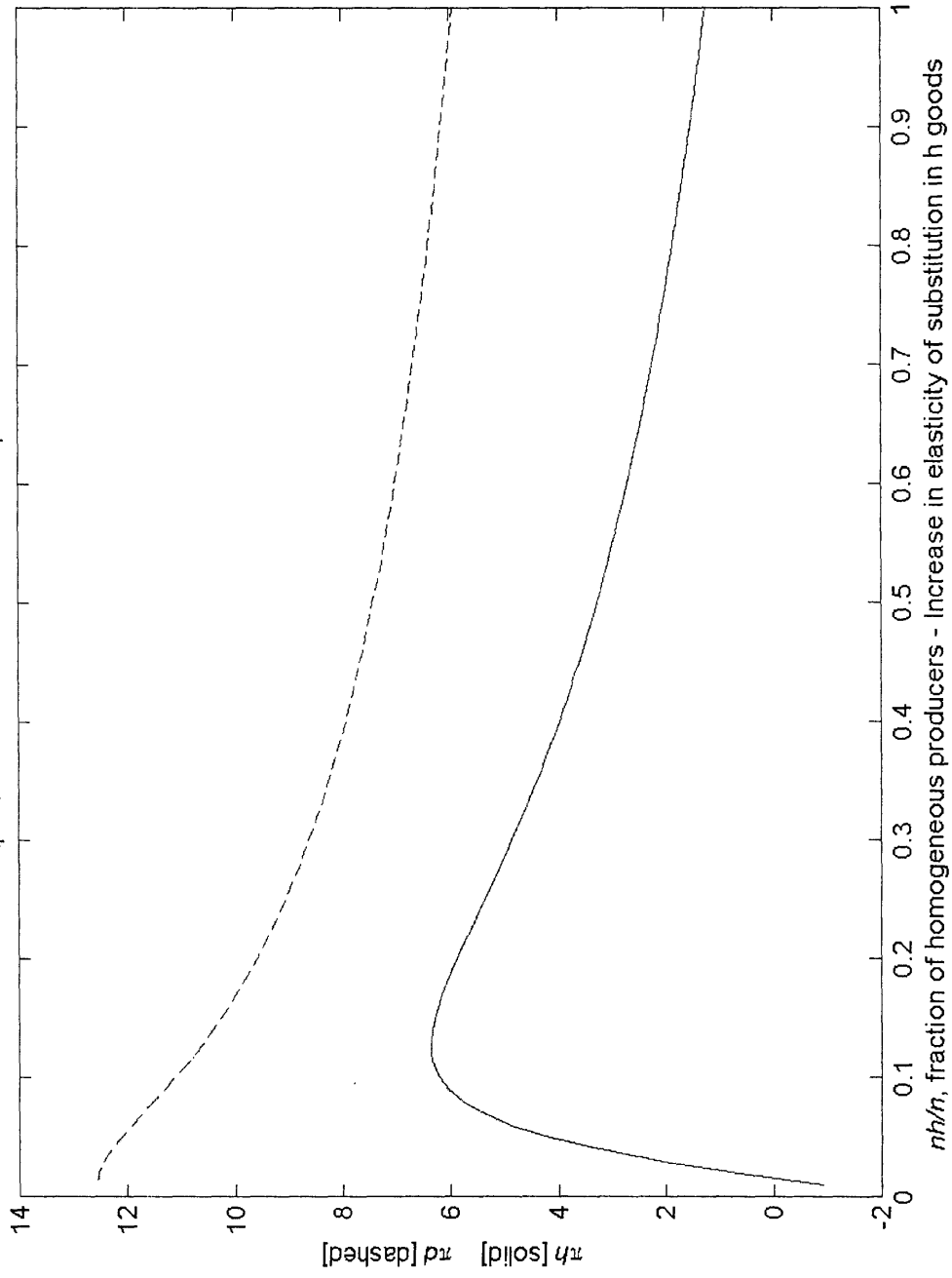
$n_h/n$	$\pi_d$	$\pi_h$	Type
0.00	5.56	--	Stable equilibrium
0.01	<b>12.58</b>	<b>-1.67</b>	Unstable
0.10	<b>10.42</b>	<b>12.50</b>	equilibrium
0.20	8.18	11.72	
0.30	6.90	9.47	
0.40	6.07	7.65	
0.50	5.47	6.25	
0.60	<b>5.01</b>	<b>5.16</b>	Stable
0.70	<b>4.65</b>	<b>4.29</b>	equilibrium
0.80	4.35	3.59	
0.90	4.10	3.00	
0.99	3.90	2.55	
1.00	--	2.50	

Note: Crossing intervals of profit functions in bold. Table 1 reports parameter values.

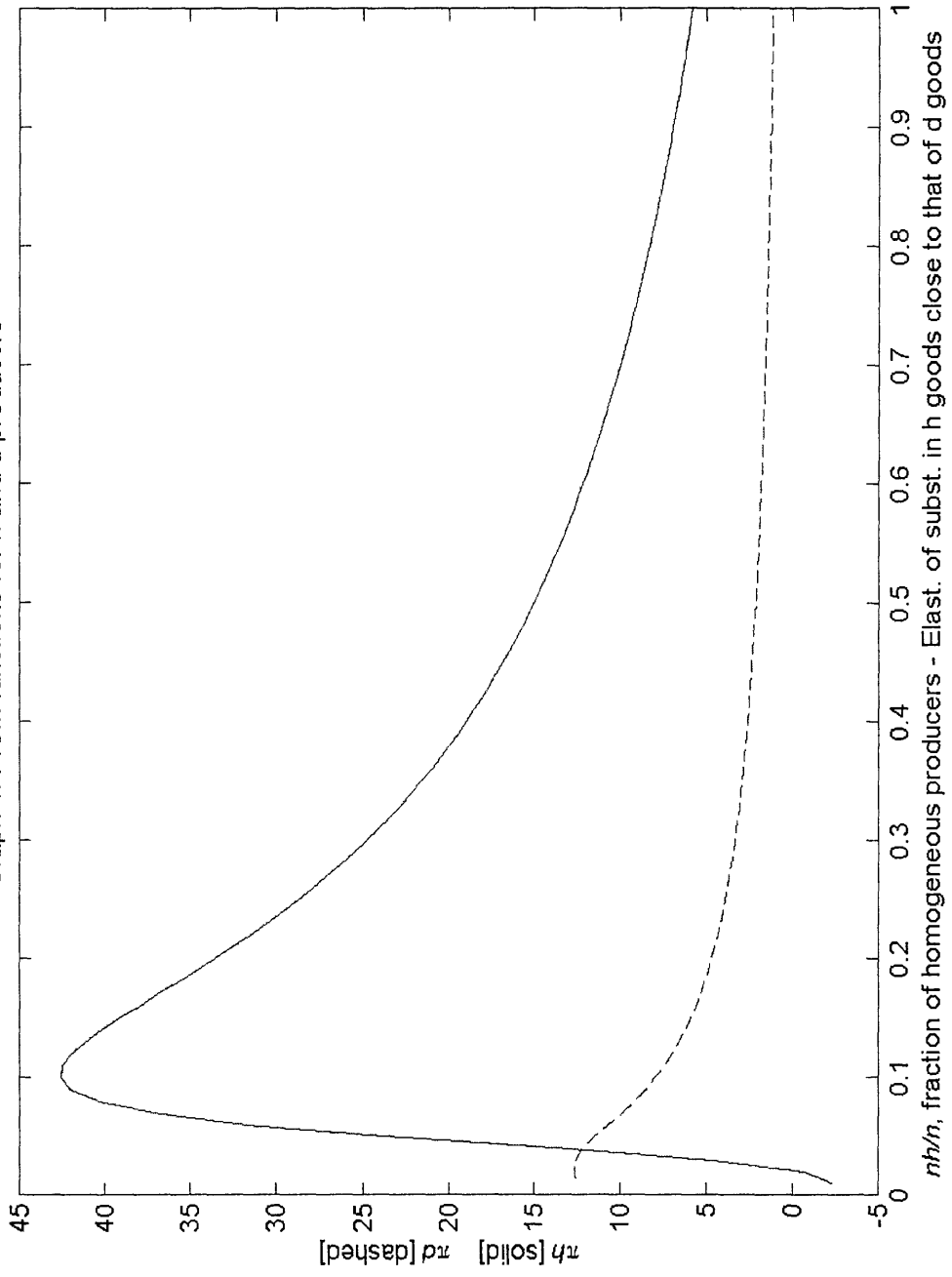
Graph 2: Profit functions for  $h$  and  $d$  producers



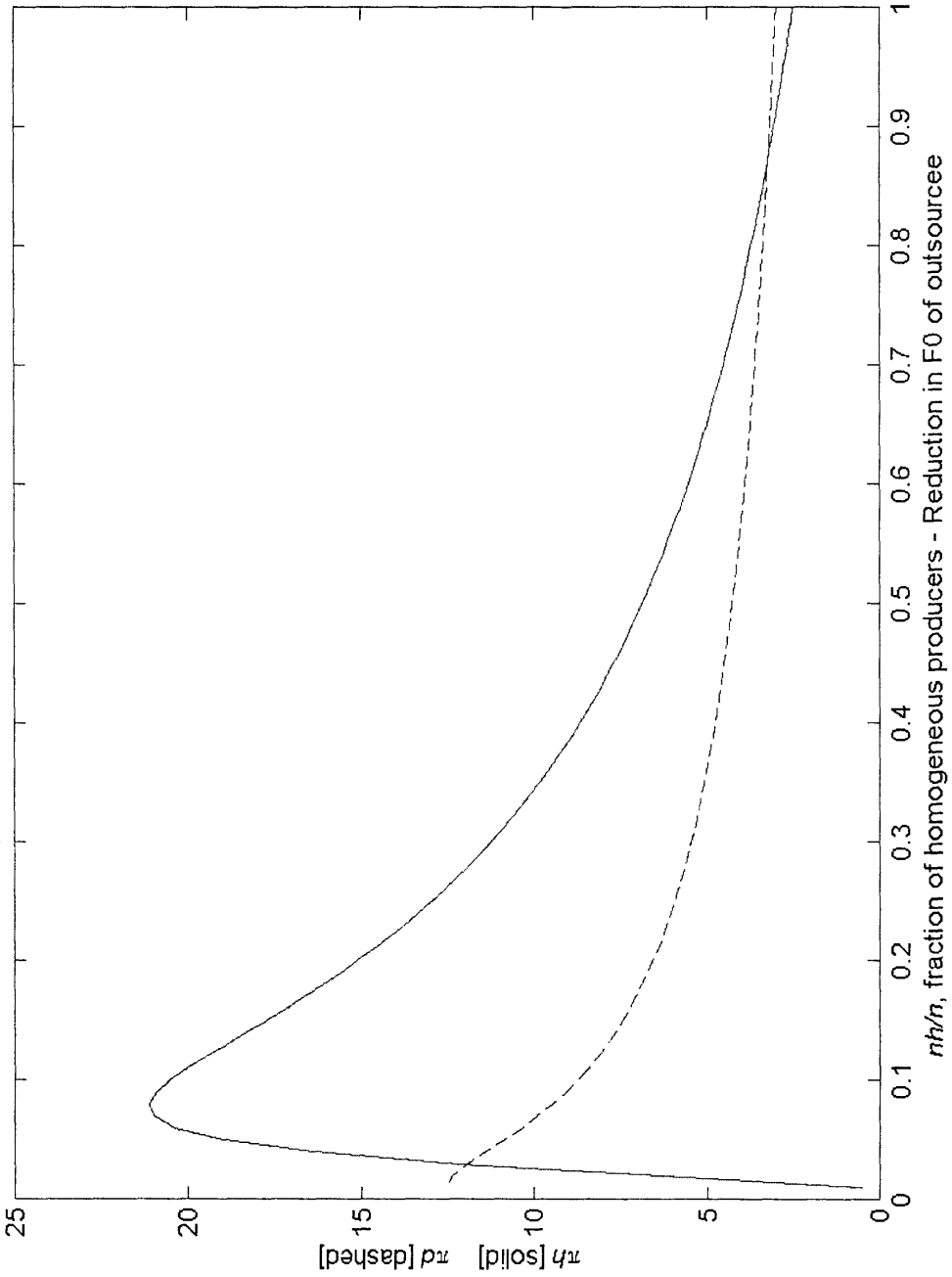
Graph 3: Profit functions for  $h$  and  $d$  producers



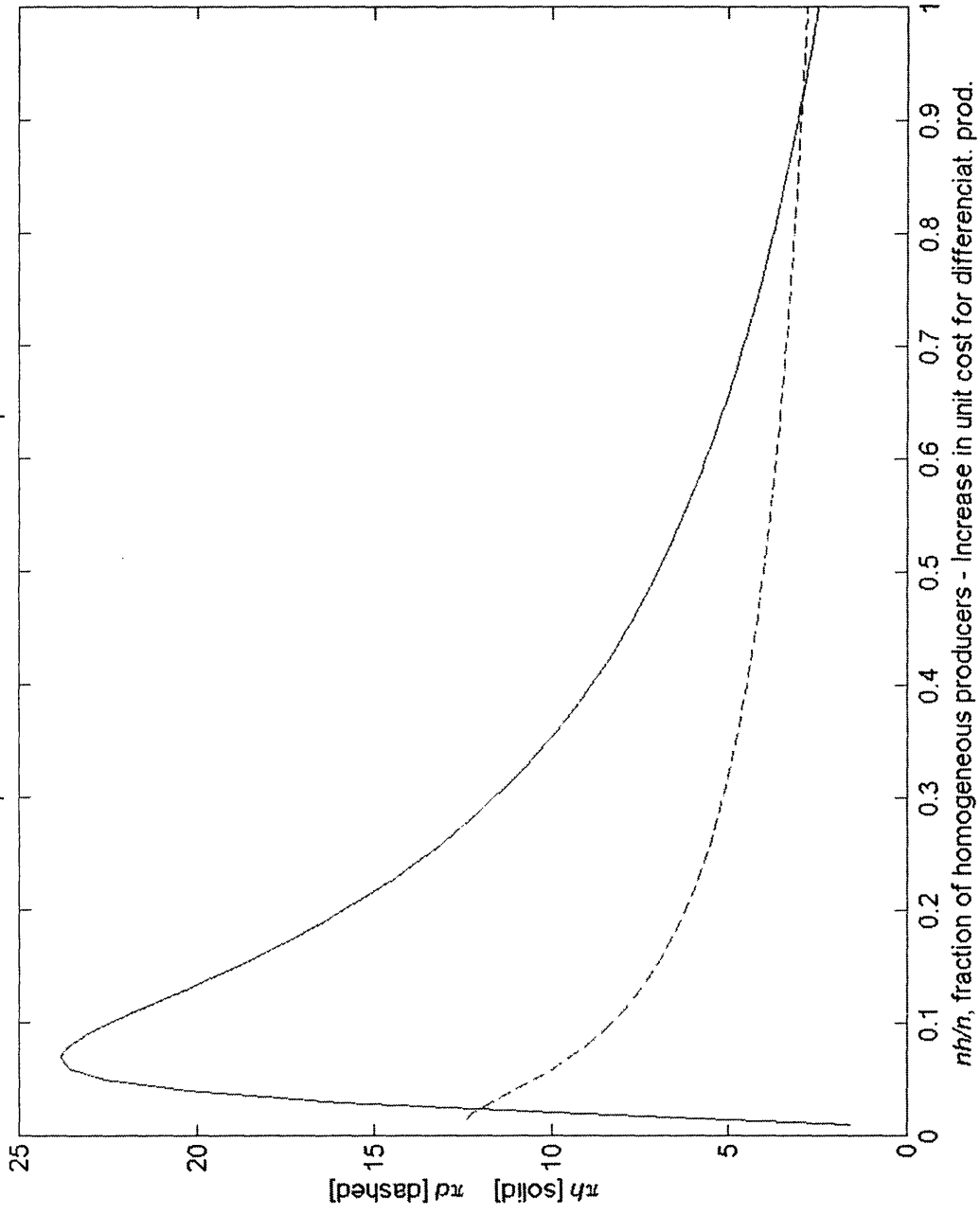
Graph 4: Profit functions for  $h$  and  $d$  producers



Graph 5: Profit functions for  $h$  and  $d$  producers



Graph 6: Profit functions for  $h$  and  $d$  producers





# Bibliography

- Ansolobehere, Stephen, John M de Figueiredo, and James M Snyder**, “Why Is There So Little Money in Politics?,” 2003.
- Antras, Pol**, “Firms, Contracts, and Trade Structure,” *Quarterly Journal of Economics*, 2003, 118 (4), 1375–1418.
- and **Elhanan Helpman**, “Global Sourcing,” *Journal of Political Economy*, 2004, 112 (3), 552–80.
- Aw, Bee Yan, Sukkyun Chung, and Mark J Roberts**, “Productivity and Turnover in the Export Market: Micro-level Evidence from the Republic of Korea and Taiwan (China),” *World Bank Economic Review*, 2000, 14 (1), 65–90.
- Axtell, Robert L**, “Zipf Distribution of U.S. Firm Sizes,” *Science*, 2001.
- Bergstrom, Theodore, Lawrence Blume, and Hal Varian**, “On the Private Provision of Public Goods,” *Journal of Public Economics*, 1986, 29 (1), 25–49.
- Bernard, Andrew B and J Bradford Jensen**, “Exceptional Exporter Performance: Cause, Effect, or Both?,” *Journal of International Economics*, 1999, 47 (1), 1–25.
- , **Jonathan Eaton, J Bradford Jensen, and Samuel Kortum**, “Plants and Productivity in International Trade,” *American Economic Review*, 2003, 93 (4), 1268–1290.
- Bernheim, B Douglas and Michael D Whinston**, “Menu Auctions, Resource Allocation, and Economic Influence,” *Quarterly Journal of Economics*, 1986, 101 (1), 1–31.

- Davidson, Russell and James G MacKinnon**, “Several Tests for Model Specification in the Presence of Alternative Hypotheses,” *Econometrica*, 1981, 49 (3), 781–93.
- Dixit, Avinash and Mancur Olson**, “Does Voluntary Participation Undermine the Coase Theorem?,” *Journal of Public Economics*, 2000, 76 (3), 309–35.
- Eicher, Theo and Thomas Osang**, “Protection for Sale: An Empirical Investigation: Comment,” *American Economic Review*, 2002, 92 (5), 1702–10.
- Findlay, Ronald and Stanislaw Wellisz**, “Endogenous Tariffs, the Political Economy of Trade Restrictions, and Welfare,” in J.N. Bhagwati, ed., *Import competition and response*, Chicago: University of Chicago Press, 1982, pp. 223–234.
- Gawande, Kishore**, “US Non-tariff Barriers as Privately Provided Public Goods,” *Journal of Public Economics*, 1997, 64 (1), 61–81.
- **and Hui Li**, “The Case of the Missing Contributions,” 2004.
- **and Usree Bandyopadhyay**, “Is Protection for Sale? Evidence on the Grossman-Helpman Theory of Endogenous Protection,” *Review of Economics and Statistics*, 2000, 82 (1), 139–52.
- Goldberg, Pinelopi Koujianou and Giovanni Maggi**, “Protection for Sale: An Empirical Investigation,” *American Economic Review*, 1999, 89 (5), 1135–55.
- Grossman, Gene M and Elhanan Helpman**, “Protection for Sale,” *American Economic Review*, 1994, 84 (4), 833–50.
- **and –**, “Integration versus Outsourcing in Industry Equilibrium,” *Quarterly Journal of Economics*, 2002, 117 (1), 85–120.
- Grossman, Sanford J and Oliver D Hart**, “The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration,” *Journal of Political Economy*, 1986, 94 (4), 691–719.
- Helpman, Elhanan, Marc J Melitz, and Stephen R Yeaple**, “Export versus FDI with Heterogeneous Firms,” *American Economic Review*, 2004, 94 (1), 300–316.

- Hillman, Arye L**, *The political economy of protection*, Fundamentals of Pure and Applied Economics series, vol. 32 International Trade section. Chur, Switzerland; London; New York and Camberwell, Australia: Harwood Academic, 1989.
- Magee, Christopher**, "Endogenous Trade Policy and Lobby Formation: An Application to the Free-Rider Problem," *Journal of International Economics*, 2002, 57 (2), 449–71.
- Magee, Stephen P, William A Brock, and Leslie Young**, *Black hole tariffs and endogenous policy theory: Political economy in general equilibrium*, Cambridge; New York and Melbourne: Cambridge University Press, 1989.
- Masters, Marick F. and Gerald D. Keim**, "Determinants of PAC Participation Among Large Corporations," *The Journal of Politics*, 1985, 47 (4), 1158–1173.
- McLaren, John**, "'Globalization" and Vertical Structure," *American Economic Review*, 2000, 90 (5), 1239–54.
- Melitz, Marc J**, "The Impact of Trade on Intra-industry Reallocations and Aggregate Industry Productivity," *Econometrica*, 2003, 71 (6), 1695–1725.
- Mitra, Devashish**, "Endogenous Lobby Formation and Endogenous Protection: A Long-Run Model of Trade Policy Determination," *American Economic Review*, 1999, 89 (5), 1116–34.
- Olson, Mancur**, *The logic of collective action; public goods and the theory of groups* Harvard economic studies, v. 124, Cambridge, Mass.: Harvard University Press, 1965.
- Pecorino, Paul**, "Is There a Free-Rider Problem in Lobbying? Endogenous Tariffs, Trigger Strategies, and the Number of Firms," *American Economic Review*, 1998, 88 (3), 652–60.
- Quarterly, Congressional**, *Congressional Quarterly's federal PACs directory*, Washington, D.C.: Congressional Quarterly Inc., 1998.
- Rodrik, Dani**, "Political Economy of Trade Policy," in Gene M. Grossman and Kenneth eds Rogoff, eds., *Handbook of international economics. Volume 3*, 1995.

**Shiells, Clinton R, Robert M Stern, and Alan V Deardorff**, "Estimates of the Elasticities of Substitution between Imports and Home Goods for the United States," *Weltwirtschaftliches Archiv*, 1986, *122* (3), 497-519.

**Trefler, Daniel**, "Trade Liberalization and the Theory of Endogenous Protection: An Econometric Study of U.S. Import Policy," *Journal of Political Economy*, 1993, *101* (1), 138-60.