2003s-15

A Theory of Favoritism under International Oligopoly

Ngo Van Long, Antoine Soubeyran

Série Scientifique
Scientific Series

Montréal
Avril 2003

CIRANO
Centre interuniversitaire de recherche en analyse des organisations

ISSN 1198-8177

A Theory of Favoritism under International Oligopoly

Ngo Van Long[†], *Antoine Soubeyran*[‡]

Résumé / *Abstract*

On offre une explication du fait que certaines firmes étrangères sont mieux traitées que d'autres. On caractérise la distribution des faveurs qui sont associées à l'asymétrie des coûts. On modélise la situation où les faveurs sont achetées. On compare ce modèle de la recherche des rentes au modèle standard où le gouvernement maximise le bien-être social. On caractérise la différence entre les distributions des faveurs de ces deux modèles.

Mots clés : Favoritisme, oligopole asymétrique, manipulation de coûts, taxes discriminatoires.

This paper offers an explanation of the fact that some foreign firms are favored at the expense of others, and characterizes the distribution of favors in terms of the cost parameters of firms, and a preference parameter in the government's objective function. We present a model where favors must be bought: they come from competing contributions. This model is compared with a benchmark model with a benevolent government. We show how the distribution of favors in the favor-seeking model deviates from the distribution that would be obtained if the government were really benevolent.

Keywords: *Favoritism, Asymmetric Oligopoly, Cost Manipulation, Discriminatory Taxes.*

Codes JEL : D43, H21, L13.

---

† CIRANO, CIREQ, and McGill University.

‡ GREQAM, Université de la Méditerranée.

1. Introduction: A Theory of Favoritism in an International Oligopoly

The strategic trade literature has contributed much to our understanding of the reasons why governments favor home firms at the expense of foreign firms. However, there is another kind of favoritism that has been observed yet not quite fully explained. We refer to favoritism in favor of some foreign firms, at the expense of some other foreign firms. In fact, governments quite often give differential tax treatments to different foreign firms in the same industry[1]. This is true both in the case where foreign firms are located in different foreign countries and export to the home country, and in the case where foreign-owned firms produce in the home country. For example, until 2001, in Canada, the three big car manufacturers[2] whose parent companies are in the US were favored at the expense of those[3] whose parent companies are in Japan: the first group was allowed to import European cars (to resell them in Canada) without tariffs, while the second group must pay a 6% tariff. As soon as this discrimination was abolished because it was struck down[4] by the WTO, a new form of favoritism was sought. The Canadian Vehicle Manufacturers Association (CVMA) recently proposed that auto makers employing more than 5000 people receive a 5% tax credit for new investment. (The CVMA is a lobby group for the Big Three, to which Honda Canada Ltd.and Toyota Canada Ltd. do not belong.) If this proposal is adopted, Honda Canada Ltd. and Toyota Canada Ltd. will again be a victim of discrimination[5].

---

[1] According to Rodrick (1989), firm-specific taxes and subsidies are more common than one thinks.

[2] Namely, DaimlerChrysler Canada Inc., Ford Motor Co. of Canada Ltd., and General Motors of Canada Ltd.

[3] Namely Honda Canada Inc. and Toyota Canada Inc.

[4] See the Globe and Mail, April 16, 2002, page B10.

[5] See The Globe and Mail, April 16, 2002, pages B1 and B10. Honda employs about 4600 Canadians at assembly plants in Alliston, Ontario, and head office in Toronto. Toyota employs around 4000 Canadians at assembly plants in Cambridge,

In this paper, we seek to explain why a government might want to give favor to some foreign …rms and hurt other foreign …rms. Models that explain government behavior toward foreign …rms fall into two major categories. The traditional view o¤ers the "benevolent government model," according to which the home government maximizes some social objective, by setting tax rates, or tari¤ rates. A more modern view sees the government as reacting to pressure groups. This view has given rise to the "political economy" approach of trade polices. To model government behavior under this approach, a convenient way is to postulate that the government seeks to maximize a political support function, without explicitly modelling the behavior of pressure groups[6]. Alternatively, one can be more explicit about the optimization behavior of pressure groups, by, for example, adopting the common agency model proposed by Berheim and Whinston (1986). In the context of international trade, Grossman and Helpman (1994) posit pressure groups seeking protection as "principals" and the goverment as their "common agency." The principals non-cooperatively o¤er the government a menu of payments conditional on actions that the government may take. Such menus are called "contribution schedules." In the common agency model, favors come from competing contributions.

We set up a common agency model to explain favors granted to foreign …rms. Our model of common agency di¤ers from that of Grossman and Helpman, in that while they assume that all …rms are price-takers, we speci…cally pay attention to the fact that in the case of oligopoly, …rms know that their output levels a¤ect the price. This adds a second dimension of rivalry to the common agency model. When …rms with heterogeneous production costs seek favors, the equilibrium structure of …rm-speci…c tari¤s (or subsidies) displays what may be described as "favoritism". We want to determine whether higher cost …rms received less favored treatments, in the common agency model. To sharpen our understanding of the structure of fa-

---

Ontario, parts operations in British Columbia, and head o¢ce in Totonto.

[6]See, for example, Hillman and Ursprung (1988), Long and Vousden (1991).

vors we compare the results of our common agency model with the benchmark model which posits that the government is benevolent.

The benchmark model and the common agency model that we set up in this paper have several common characteristics. Both are presented as multistage games. In the last stage of the game (which we call stage two), firms take tax rates as given and compete as Cournot rivals in the final good market. In the stage preceding the last stage (which we call stage one), the home government chooses firm-specific tax rates, to maximize a certain objective function. In the benchmark model, stage one is the first stage of the game, and the objective of the government is to maximize social welfare. In the common agency model, there is an earlier stage, which we call stage 0, in which firms take actions to influence the government's behavior in stage one. Specifically, each of the rival firms offers the government a menu, or contribution schedule, which states how much money it would give to the government, according to how the government changes the price or tax structure in the economy[7]. From each firm's point of view, favors are not free goods. Firms must pay to get favors, in direct competition with their rivals. It is this feature, which is absent in the benchmark model, that gives rise to a structure of firm-specific tariff rates that is quite different from the structure obtained in the bechmark model.

By using an equilibrium approach that we develop specifically for the analysis of oligopolistic market structure, we are able to obtain remarkably simple tax formulas for the general case of ex-ante non-identical firms. We also link optimal tax formulas to concepts such as concentration index and degree of heterogeneity of firms, and interpret optimal discriminatory taxes as a means of reducing the degree of concentration of an industry. We show that the firm-specific tariff formula in the common agency model differ from that obtained in the benchmark model by a term which depends on both the relative weight

[7] The contributions are just pure transfers: they do not use up real resources. For a model which deals with the implications of the use of real resources to influence government policies, see Hillman, Long and Soubeyran (2001). In this paper, we will focus on the "contribution schedule", or "common agency", approach.

of domestic social welfare in the government's objective function, and on the deviation of a …rm's unit cost from the industry's mean unit cost. The two formula would be identical if the relative weight were in…nite. In particular, we show that (i) for low cost foreign …rms, the deviation of a …rm-speci…c tari¤ rate from the mean tari¤ rate under lobbying, is smaller than the corresponding …rm-speci…c tari¤ rate from the mean tari¤ rate under a benevolent government, while (ii) for high cost foreign …rms, the deviation of a …rm-speci…c tari¤ rate from the mean tari¤ rate under lobbying, is greater than the corresponding …rm-speci…c tari¤ rate from the mean tari¤ rate under a benevolent government. These results are intuitively appealing. Low cost foreign …rms can a¤ord to bribe the government more than high cost ones, and therefore are able to tilt the tari¤ structure in their favors relative to the benchmark structure.

Two important features of our models are: (a) …rms are not identical, and (b) the government can give di¤erential treatments to di¤erent …rms. The …rst feature, asymmetry in costs, has been studied by Collie (1993, 1998) and Long and Soubeyran (1997a), but in these papers it was assumed that the rate of tax or subsidy per unit of output must be the same for all …rms. Di¤erential tax treatment was dealt with in Long and Soubeyran (1997b) and Leahy and Montagna (1998), but only in the traditional "social welfare maximization" framework. In our model, we go a step further by being able to characterize the direction of the favors given to …rms as function of the initial dispersion of unit costs in the industry. We show that distributing favors and harms is a means of changing the concentration of the international oligopoly.

The paper is organized as follows. In Section 2, we develop a common framework for the analysis of Cournot equilibrium with an asymmetric cost structure, and study the change in equilibrium outputs and pro…ts when the asymmetric cost structure is changed by taxation. In section 3, we show how the objective function of the government can be represented in terms of a distance function of the tax vector from a certain reference point and we derive the properties of the tax structure in the benchmark model. Section 4 shows that the optimal tax structure in the benchmark model reduces the degree of industry concentration. In Section 5, we formulate and analyse the common agency model. The results are compared with those of the benchmark model. Section 6 offers some concluding remarks.

2. Oligopoly and Cost Structure: An Equilibrium Approach

In the analysis of industries under perfect competition, it is often convenient to use the indirect profit function: profit is expressed as a function of the vector of prices of inputs and outputs. That approach has proved to be both elegant and powerful. In this section, we show how a similar approach can be developed for oligopoly, where equilibrium profit is expressed as a function of tax rates and input prices, which the oligopolists take as given when they make their output decisions. A number of formulas are generated which greatly simplify the analysis of equilibrium responses in an oligopoly.

We consider an asymmetric oligopoly consisting of n firms that produce a homogenous good. Let $N \equiv \{1, 2, ..., n\}$. Let q_i denotes firm i's output, $i \in N$. The inverse demand function is

$$P = P(Z); \qquad P'(Z) < 0$$

where $Z = \sum_{i \in N} q_i$. Assume that the firm i's marginal cost of production is independent[8] of its output level q_i. Denote this marginal cost by c_i^0. The firm must also pay a tax t_i per unit of output (if t_i is negative, the firm receives an output subsidy). Here we allow the tax (or subsidy) to be firm-specific. The 'modified marginal cost' of firm i is $c_i \equiv c_i^0 + t_i$. Firm i's profit is $\pi_i = Pq_i - c_i q_i$.

We use a two-stage approach: in the first stage, tax rates are set, and in the second stage, firms, taking tax rates as given, compete as Cournot rivals. We will begin our analysis by studying the equilibrium in the second stage.

[8] The analysis can be extended to the case of non-constant marginal costs, see Long and Soubeyran (2001a).

2.1. Stage two: Cournot equilibrium

At the beginning of stage two, the variables c_i have been determined. Firms compete à la Cournot. The necessary conditions at a Cournot equilibrium are:

$$\frac{\partial \pi_i}{\partial q_i} = P'(Z)q_i + P(Z) - c_i \leq 0 \tag{1}$$

$$q_i \geq 0; \qquad q_i \frac{\partial \pi_i}{\partial q_i} = 0 \tag{2}$$

In addition, if $q_i > 0$ then the second order condition is: $P''(Z)q_i + 2P'(Z) \leq 0$. This condition may be expressed as

$$2 - s_i E \geq 0 \tag{3}$$

where $E \equiv -P''(Z)Z/P'(Z)$ is the elasticity of the slope of the demand curve and $s_i \equiv q_i/Z$ is firm i's market share.

We restrict attention to interior equilibria[9]. Assume (1) holds with equality for all firms, we sum these n equations to get

$$P'(Z)Z + nP(Z) = \sum_{i \in N} c_i \equiv C \tag{4}$$

where C is the sum of the marginal costs. As pointed out by Bergstrom and Varian (1985a), equation (4) shows that equilibrium industry output depends only on the sum of the marginal costs.

Define the function

$$\psi(Z) = P'(Z)Z + nP(Z); \qquad \psi(0) = nP(0) > 0$$

If $\psi(Z)$ is a decreasing function and if there exists some $Z^{\#} > 0$ such that $\psi(Z) < 0$ for all Z greater $Z^{\#}$, then (4) has a unique solution

[9] For a set of sufficient conditions for the existence and uniqueness of Cournot equilibrium, see Long and Soubeyran (2000).

$\hat{Z} = \hat{Z}(C)$ for each C in the interval $nP(0) \geq C \geq 0$. The condition that $\psi(Z)$ is strictly decreasing can be expressed as

$$E < n + 1 \qquad (5)$$

Condition (5) is also a familiar stability condition for Cournot equilibria (see Dixit (1986), for example). We are now ready to state a few important lemmas[10]

Lemma 1: Equilibrium output $\hat{Z}$ is determined by C and is independent of the distribution of marginal costs among the oligopolists. Furthermore,

$$\frac{d\hat{Z}}{dC} = \left(\frac{1}{P'}\right)\left(\frac{1}{n + 1 - E}\right) < 0. \qquad (6)$$

Proof: Use (4).

Lemma 1 gives us a function $\hat{Z}(C)$, which we now use to express the equilibrium output of firm i, and its profit, as a function of only two parameters, C and c_i. In what follows, we will use a hat to denote equilibrium values.

Lemma 2:(The Equilibrium Profit Function): Firm i's equilibrium output is

$$\hat{q}_i = \frac{P(\hat{Z}(C)) - c_i}{[-P'(\hat{Z}(C))]} \equiv \hat{q}_i(c_i; C) \qquad (7)$$

and its equilibrium profit is given by the following profit function:

$$\hat{\pi}_i = \left[\hat{P} - c_i\right]\hat{q}_i = \frac{\left[P(\hat{Z}(C)) - c_i\right]^2}{[-P'(\hat{Z}(C))]} = [-\hat{P}'][\hat{q}_i(c_i; C)]^2 \equiv \hat{\pi}_i(c_i; C) \qquad (8)$$

[10] Lemma 1 was stated in Bergstrom and Varian (1985a,b) who noted that several authors had been aware of this result.

Remark 1: The expressions[11] in Lemma 2 are very useful, due to the equilibrium approach embodied in the definitions of $\hat{\pi}_i(c_i; C)$ and $\hat{q}_i(c_i; C)$. The equilibrium profit function $\hat{\pi}_i(c_i; C)$ achieves considerable economies over the direct profit function $\Pi_i(q_i; Z; c_i) \equiv [P(Z) - c_i]q_i$. Furthermore it highlights a formal link between oligopoly theory and the theory of contributions to a public good, as systematized by Bergstrom et al. (1986).

Let us turn to equilibrium industry profit. Using Lemma 2, one can prove the following result[12]:

Proposition 1 (The Equilibrium Industry Profit Function): Given the sum of marginal costs, C, average industry profit in a Cournot equilibrium is a linear and increasing function of the variance of the distribution of marginal costs:

$$\sum_{i \in N} \frac{\hat{\pi}_i(c_i; C)}{n} = \frac{V_N(c; C) + [P(\hat{Z}(C)) - (C/n)]^2}{[-P'(\hat{Z}(C))]} \equiv \hat{\pi}_N(c; C) \quad (9)$$

where $c \equiv (c_1, \ldots, c_n)$ is the vector of marginal costs and $V_N(c; C)$ is the variance of their distribution:

$$V_N(c; C) \equiv \frac{1}{n} \sum_{i \in N} [c_i - (C/n)]^2 \equiv \frac{1}{n} \sum_{i \in N} [c_i - c_N]^2 \quad (10)$$

Proof: Use Lemma 2 and write

$$\hat{\pi}_i = \frac{1}{[-\hat{P}']} \left[(\hat{P} - c_N) - (c_i - c_N) \right]^2$$

Since C is kept constant, $\hat{P}$ and $-\hat{P}'$ are constant. Summing the above equation over all i yields the result.

---

[11] Note that

$$\frac{\partial \hat{\pi}_i(c_i; C)}{\partial c_i} = -2\hat{q}_i < 0; \qquad \frac{\partial \hat{\pi}_i(c_i; C)}{\partial C} = \frac{[2 - s_i E]\hat{q}_i}{n + 1 - E} > 0.$$

[12] Proposition 1 was proved by Long and Soubeyran (1996) but the equilibrium approach was not made explicit there. Bergstrom and Varian (1985a) obtained a similar formula.

Our next proposition links average equilibrium industry profit to the Herfindahl index of industry concentration. Recall that, if n is the number of firms in an industry, the Herfindahl index is given by

$$H_N = \sum_{i \in N} \left(\frac{q_i}{Z} \right)^2$$

and that this index at its maximum ($H_N = 1$) when there is just one firm in the industry (monopoly), and, given n, H_N is at its minimum ($H_N = 1/n^2$) when the firms are identical:

Proposition 2:(Link between Industry Profit and the Herfindahl Index) Given the marginal cost sum C, the equilibrium industry profit is an increasing function of the Herfindahl index of concentration.

Proof: See the Appendix.

All of the above results can be modified in a simple way if the set N is partitioned into two subsets M and M^* such that $N = M \cup M^*$ and $M \cap M^*$ is the null set. To fix ideas, let $M = \{1, 2, ..., m\}$ be the set of domestic firms and $M^* = \{m+1, ..., m+m^*\}$ be the set of foreign firms ($m + m^* = n$). In this case, we define $c_M \equiv (1/m)\sum_{i \in M} c_i$, $c_{M^*} \equiv (1/m^*)\sum_{j \in M^*} c_j$, $C \equiv mc_M + m^*c_{M^*}$, $Q \equiv \sum_{i \in M} q_i \equiv mq_M$ and $Q^* \equiv \sum_{j \in M^*} q_j \equiv m^*q_{M^*}$.

2.2. Stage 1: Manipulation of marginal costs by taxation

We now turn to stage 1. In this stage the government seeks to maximize a certain objective function, by setting firm-specific taxes to influence equilibrium outputs in Stage 2. We will consider two types of objective function, specified for the benchmark model, and for the common agency model.

In the benchmark model, the government maximizes a weighted sum of (i) domestic consumers's surplus, (ii) the profits of domestic firms, and (iii) tax revenue. Consumers' surplus is

$$S(\hat{Z}) \equiv \int_0^{\hat{Z}} P(Z)dZ - P(\hat{Z})\hat{Z}$$

where $\hat{Z} = \hat{Z}(C)$ in a Cournot equilibrium. The conventional social welfare is

$$\hat{W}(c; C) \equiv S(\hat{Z}(C)) + m\hat{\pi}_M(c; C) + \hat{T} \tag{11}$$

where $\hat{T}$ is the tax revenue at the Cournot equilibrium (if $\hat{T}$ is negative, it is the subsidy costs) and $\hat{\pi}_M = (1/m)\sum_{i \in M} \hat{\pi}_i$. More generally, we will consider the following objective function of the government:

$$\hat{W}(c; C) \equiv \beta S(\hat{Z}(C)) + \mu m\hat{\pi}_M(c; C) + \delta\hat{T} \tag{12}$$

where δ and μ are positive weights given to tax revenue and profits respectively. The parameter $\beta \geq 0$ is the weight given to consumers' surplus. For example, if the goods are produced only for exporting to a third country, and the home government does not care about the foreign consumers' surplus, then it sets $\beta = 0$. On the other hand, if all the output is sold in the home market, then it seems reasonable to set $\beta = 1$. If $0 < \mu < 1$; we may interpret this as corresponding to a situation where all the m domestic firms are partially owned by foreigners. Here, the cost of manipulating marginal costs, by means of firm-specific subsidies to domestic firms, is the leakage of the subsidies to foreign shareholders of domestic firms: The specification that $\delta \geq 1$ may be justified on the ground that the social cost of a dollar of subsidy is greater than a dollar if such subsidies are financed by distortionary taxes. The concept of marginal cost of public funds, $\delta > 1$, is familiar to the students of public economics, and has recently been imported into the literature on strategic trade policy (see Neary (1994)). Here the costs of manipulating marginal costs is the deadweight losses associating with raising distortionary taxes in other markets to subsidize the oligopolists. Notice that in (12), only the ratios β/δ and m/δ matter, not the absolute values of β, μ and δ. Therefore in what follows we will normalize by setting $\delta = 1$.

In the common agency, we assume that the government is interested in contributions offered by foreign firms to influence policies. This will be spelled out in more detail in a later section.

In this paper, we focus on taxation of foreign firms by the domestic government. For a given objective function of the home government, we wish to determine the optimal firm-specific per unit tax, t_j, $j \in M^*$. To facilitate an intuitive comprehension of the nature of the problem, and in particular, to sharpen the focus on the crucial issue of asymmetric versus symmetric solutions, in what follows, we will solve the stage 1 problem by using a two-step procedure.

In the first step, for a given average tax on the foreign firms, $t_{M^*} = (1/M^*)\sum_{j \in M^*} t_j$; we determine the optimal t_j conditional on the given t_{M^*}. In the second step, we determine the optimal t_{M^*}. It is the first step that commands our attention here, because the question of optimal asymmetric tax treatment for heterogenous firms is not well understood. The separation of the two steps has the flavor of the traditional separation of income and substitution effects in the theory of the consumer, or the separation of cost minimization from profit maximization in the theory of the firm. In our heterogenous oligopoly context, the decomposition separates the cost dispersion effect (for a fixed price) from the demand effect of optimal taxes and subsidies.

3. The Benchmark Model: Benevolent Favoritism

In this model, there are m domestic firms and m^* foreign firms. They compete in the home market. The home government sets firm-specific tariffs on foreign firms' products in order to maximize a conventional welfare function, which is a weighted sum of (i) domestic consumers' surplus, (ii) profits of home firms, and (iii) tariff revenue. We seek to determine the optimal structure of favors distributed to foreign firms: which foreign firms are more favorably treated relative to other foreign firms? The technique we use to find the answer to this question is geometric and global: we show below that the optimal structure of favors is determined by choosing a tariff vector on a certain convex set to minimize the distance between a reference vector and the convex set. As will be explained below, the reference vector is the vector of gross profit margins. The optimal tariff structure is thus a projection of the reference vector on the convex set. The basic steps are described below.

3.1. A transformation of the stage-one objective function

Let t_j denote the tariff rate per unit of domestic imports from foreign firm $j \in M^*$. Let $t_{M^*} = (1/m^*)\sum_{j\in M^*} t_j$. Assume for simplicity that there are no tax or subsidy on domestic outputs. Let c_j^0 denote firm j's before-tax unit cost, and

$$c_j = c_j^0 + t_j$$

denote its tax-inclusive unit cots. Recall that we have, from Lemmas 1 and 2, $\hat{Q} = \hat{Q}(C)$. Since $C = \sum_{i\in M} c_i + \sum_{j\in M^*} c_j$ we can write equilibrium industry output as $\hat{Q} = \hat{Q}(t_{M^*})$. Denote equilibrium price by $\hat{P} = P(\hat{Q}(t_{M^*}))$. Our task is to characterize the optimal firm-specific tariff vectors. For this purpose, it is useful to prove a number of technical results. The following lemma expresses the stage 2 tariff revenue (in a Cournot equilibrium) as a distance function between the vector of firm-specific tariff rates $t = (t_{m+1}, \ldots, t_{m+m^*})$ and a reference vector $t^* = (t^*_{m+1}, \ldots, t^*_{m+m^*})$, where

$$t_j^* \equiv \frac{\hat{P} - c_j^0}{2} \tag{13}$$

is an indicator of the gross profit margin of firm j.

Lemma 3: (i) The tariff revenue in the Cournot equilibrium is given by the following distance function:

$$T = \psi(t_{M^*}) - \frac{1}{[-P']}\|t - t^*\|^2 = \psi(t_{M^*}) - \frac{1}{[-P']}\sum_{j\in M^*}\left(t_j - t_j^*\right)^2 \tag{14}$$

where

$$\psi(t_{M^*}) \equiv \frac{1/4}{[-\hat{P}']} \sum_{j \in M^*} \left(\hat{P}(t_{M^*}) - c_j^0 \right)^2 \tag{15}$$

(ii) The objective function of the home government, given by (12), can be represented by the following distance function:

$$\hat{W} = \phi(t_{M^*}) - \frac{1}{[-\hat{P}']} \| t - t^* \|^2 \tag{16}$$

where

$$\phi(t_{M^*}) = \psi(t_{M^*}) + \beta S(\hat{Q}(t_{M^*})) + \mu m \hat{\pi}_M (t_{M^*}): \tag{17}$$

Proof: See the Appendix.

In the next sub-section we will make use of Lemma 3 to obtain an insightful characterization of optimal tariff rates.

3.2. Characterization of the optimal tariffs

Proposition 3: The benevolent government favors the inefficient foreign firms. In particular, optimal firm-specific tariff per unit of output is related to the mean tariff rate by the following formula

$$t_j - t_{M^*} = -\frac{1}{2} \left(c_j^0 - c_{M^*}^0 \right) \tag{18}$$

That is, the optimal tariff rates on high cost firms are below the average, and the optimal tariffs on low cost firms are above the average. The relationship between tax-inclusive marginal cost deviations and pre-tax marginal cost deviations is given by

$$c_j - c_{M^*} = \frac{1}{2} \left(c_j^0 - c_{M^*}^0 \right) \tag{19}$$

That is, firm-specific tariff rates reduce the deviations from the mean marginal cost.

Proof: See the Appendix.

Remark 2: Equation (18) shows that in an international oligopoly, higher costs foreign firms receive a more favorable tariff treament than lower cost ones. This reflects the reality of anti-dumping duties. Firms with lower c_j^0 face higher tariff rates. To see the intuition behind our result, consider the simple case where there are just two foreign firms, say h and k, and firm h has lower cost: $c_h < c_k$. Then, for a given t_{M^*}, foreign industry output is fixed. For the sake of argument, suppose that initially the government does not optimize, and sets $t_h = t_k = t_{M^*}$. Then firm h will produce more than firm k; and, using Lemma 1,

$$q_h - q_k = \frac{1}{[-P']}[c_k - c_k] = \frac{1}{[-P']}\left[(c_k^0 + t_{M^*}) - (c_k^0 - t_{M^*})\right] > 0$$

and the tariff revenue will be

$$T = t_h q_h + t_k q_k = t_{M^*} q_h + t_{M^*}[Q^*(t_{M^*}) - q_h]$$

Clearly, by raising t_h marginally above t_{M^*}, by a small amount ϵ, and at the same time reducing t_k below t_{M^*} by ϵ, industry output and price will be unaffected, but tariff revenue will rise, because $q_h > q_k$. A further increase in t_h (and decrease in t_k) may be therefore increase tariff revenue. Bearing in mind, however, that as t_h is raised, and t_k is reduced, the quantity q_h will be adjusted downwards, and the quantity q_k will be adjusted upwards. Thus, for a given t_{M^*}, there is an optimal gap between t_h and t_k. When the gap is optimally set, then, from (18),

$$c_h = t_h + c_h^0 = t_{M^*} + \frac{1}{2}c_{M^*}^0 + \frac{1}{2}c_h^0$$

Observe that the lower cost firm still produces more than the higher cost firm.

4. Tariff Favors and Industry Concentration

In this section we provide another intuitive interpretation of the tariff rule derived in the preceding section. We will do this by establishing a link between the Herfindahl index of concentration of the foreign industry with the variance of the distribution of their tax-inclusive marginal costs. Starting from the distribution of the tax-exclusive marginal costs, the imposition of firm-specific taxes or subsidies change the concentration of the foreign industry. We have seen from Proposition 2 that, with a given sum of marginal costs, i.e., C = constant, equilibrium industry profit is an increasing function of the industry Herfindahl index.

Recall that $N = \{1, 2, \ldots, n\}$ is the set of all firms in the industry, and M^* is a subset consisting of m^* foreign firms. Let $q_{M^*} = (1/m^*) \sum_{j \in M^*} q_j$. Define the Herfindahl index of concentration of the foreign industry as

$$H_M^* = \sum_{j \in M^*} \left(\frac{q_j}{m^* q_{M^*}} \right)^2$$

Let $V_{M^*}[c]$ denote the variance of the tax-inclusive marginal costs in M^*:

$$V_{M^*}[c] = \frac{1}{m^*} \sum_{j \in M^*} [c_j - c_{M^*}]^2$$

and let η_{M^*} denote the equilibrium average mark-up

$$\eta_M^* = \hat{p} - c_{M^*}$$

where $c_{M^*} = (1/m^*) \sum_{j \in M^*} c_j$. The following lemma states an important relationship between H_{M^*} and $V_{M^*}[c]$:

Lemma 5: Given the sum of tax-inclusive marginal costs, C, the Herfindahl index H_{M^*} is an increasing function of the variance of the distribution of marginal costs:

$$H_{M^*} = \frac{1}{m^*} \left[1 + \frac{V_{M^*}[c]}{(\eta_{M^*})^2} \right]$$

Proof: See the Appendix.

Lemma 6: Minimizing kt ¡ t¤k^2 is the same as minimizing the variance of the distribution of tax-inclusive marginal costs among foreign …rms.
Proof: See the Appendix.

Using Lemmas 5 and 6, we obtain an important characterization of optimal frim-speci…c tari¤s for the benchmark model (benevolent government.)
Proposition 4: (The anti-concentration motive theorem) Optimal discriminatory tari¤s chosen by the benevolent government in the benchmark model decrease the market power of the foreign industry.

5. Discriminatory tari¤s when foreign …rms are politically active

In the preceding sections we dealt with the benchmark case in which a principal (the government) manipulates the distribution of tari¤-inclusive marginal costs among the foreign oligopolists, by means of …rm-speci…c taxation. We now turn to a di¤erent model, in which each foreign oligopolist non-cooperatively induces the government of the importing country to set …rm-speci…c tari¤s that would harm it less than other …rms. This model lies within political economy framework, which challenges the conventional normative view of public policy[13]. The foreign …rms are the principals, who incur a cost of (indirectly) manipulating their rivals' costs. This cost is the payment promised to the agent (the government of the importing country). Each foreign …rm o¤ers a contribution schedule to the agent. Thus, to get favors is costly. Our objectives are to show that in an asymmetric oligopoly, the equilibrium taxes or tari¤s are correlated to the tax-exclusive marginal costs and to compare the results of this model with those of the benchmark model.

[13] For an excellent exposition, see Dixit (1996).

5.1. A model of lobbying by foreign oligopolists

In modelling firms as principals, we follow Grossman and Helpman (1994), but our model is different from theirs in one important respect: our firms are not price-takers in the product markets. This gives rise to an additional dimension of rivalry among the principals.

Like Grossman and Helpman, we use the common agency framework developed by Bernheim and Whinston (1986), where there are many principals but only one agent. We take the basic structure of the section 3, and add another stage, called Stage 0, in which foreign firms each offer a contribution schedule $\rho_j(t)$, where t is the vector of firm-specific tariff rates: $t = (t_{m+1}, ..., t_{m+m^*})$, and $\hat{\pi}_j(t_j, t_{M^*})$ denote the equilibrium profit function of foreign firm $j \in M^*$. Its net profit is

$$J_j = \hat{\pi}_j(t_j, t_{M^*}) - \rho_j(t). \tag{20}$$

The home government's objective function is a weighted sum of the domestic social welfare and the financial contributions that the government receives from the foreign firms

$$J_0 = \theta W + \sum_{j \in M^*} \rho_j(t), \text{ where } \theta > 1, \tag{21}$$

where W is the conventional welfare measure of the home country, which consists of domestic consumers' surplus, profits of domestic firms, and tariff revenue, and where θ is the weight the home government assigns to this conventional welfare measure, perhaps because of considerations such as the probability of being re-elected. We assume that $\theta > 1$ because it seems plausible that, to survive, the incumbent government must place a lot of weight on domestic welfare. Also, $\theta > 1$ ensures that we have a concave problem, as will be seen shortly.

The game involves three stages. In Stage 0, foreign firms offer contribution schedules to the home government. In Stage 1; the home government sets the tariff rates, and receives the contributions from the foreign firms. In Stage 2 (the final stage), the firms take the tariff rates as given and compete à la Cournot.

5.2. Correlation between tariff rates and marginal costs in the contribution equilibrium

The equilibrium in Stage 2 has been described in section 2. Given the vector $t = (t_{m+1}, ..., t_{m+m^*})$, the equilibrium industry output is $\hat{Q}(t_{M^*})$ and foreign firm j's profit is $\hat{\pi}_j(t_j, t_{M^*})$ for $j \in M^*$. Domestic firm i's profit is $\hat{\pi}_i(0, t_{M^*})$, because we assume that domestic firms are not politically active. Domestic consumers' surplus is $S(\hat{Q}(t_{M^*}))$ and tariff revenue is given by (14).

In Stage 1, the government takes the contribution schedules offered by the foreign firms as given, and seeks to maximize (21) by choosing the tariff vector t. This yields the first order condition

$$\nabla J_0 = \theta \nabla \widetilde{W}(t) + \sum_{j \in M^*} \nabla \rho_j(t) = 0 \qquad (22)$$

where ∇J_0 denotes the vector of partial derivatives $\partial J_0 / \partial t_j$, for $j = m+1, ..., m+m^*$.

Turning now to Stage 0, we want to characterize the Nash equilibrium in contribution schedules. Consider any foreign firm $k \in M^*$. Given the contribution schedules of all other firms $j \in M^* - \{k\} \equiv M^*_{-k}$, consider firm k's reasoning. If firm k does not contribute (i.e., it offers the null schedule $\rho(.) \equiv 0$), we let τ denote the resulting vector of tariff rates chosen by the government. The government's payoff is then

$$\sum_{j \in M^*_{-k}} \rho_j(\tau) + \theta \widetilde{W}(\tau) \qquad (23)$$

and firm k's payoff is $\hat{\pi}_k(\tau)$.

If firm k offer a non-null contribution schedule, let the resulting vector of tariff rates be t, and the government's payoff is

$$\sum_{j \in M^*} \rho_j(t) + \theta \widetilde{W}(t) \qquad (24)$$

while firm k gets $\hat{\mu}_k(t) - \rho_k(t)$. Clearly the choice of $\rho_k(\cdot)$ must maximize the surplus to be shared between firm k and the government:

$$\sum_{j \in M^*} \rho_j(t) + \theta \hat{W}(t) - \left\{ \sum_{j \in M^*_{-k}} \rho_j(\tau) + \theta \hat{W}(\tau) \right\} + [\hat{\mu}_k(t) - \rho_k(t)] - \hat{\mu}_k(\tau) \quad (25)$$

This implies the first order condition

$$\sum_{j \in M^*_{-k}} \nabla \rho_j(t) + \nabla \hat{\mu}_k(t) + \nabla \theta \hat{W}(t) = 0 \quad (26)$$

From (22) and (26),

$$\nabla \rho_k(t) = \nabla \hat{\mu}_k(t) \quad (27)$$

This condition can be interpreted as requiring the equilibrium contribution schedules to have the "local truthfulness" property. It says that the additional payment that the firm offers to the government for a marginal change in a tax rate must equal the firm's marginal valuation of such a change. Since (27) must hold for all foreign firms k, we obtain from (22) and (27),

$$\nabla \theta \hat{W}(t) + \sum_{j \in M^*} \nabla \hat{\mu}_j(t) = 0$$

which, as can be seen from (20) and (21), is the first order condition for the maximization of

$$\theta \hat{W}(t) + \sum_{j \in M^*} \hat{\mu}_j(t) = J_0(t) + \sum_{j \in M^*} J_j(t) \equiv \Omega. \quad (28)$$

This condition shows that the equilibrium is Pareto efficient from the point of view of the set of actors consisting of the government and the foreign firms.

Now let us assume for simplicity that domestic firms do not receive any subsidy or face any tax. Then Ω in (28) may be written as

$$\Omega = \theta m \hat{\pi}_M + \theta \hat{S} + \theta \hat{T} + \left\{ \hat{P}\hat{Q}^* - \sum_{j \in M^*} c_j^0 \hat{q}_j - \hat{T} \right\} \qquad (29)$$

where $\hat{T}$ is the tariff revenue at the Cournot equilibrium, and $\hat{Q}^* = \sum_{j \in M^*} \hat{q}_j$. From (29), we get

$$\Omega = \psi - \frac{\theta - 1}{[-\hat{P}']} \| t - t^* \|^2 \qquad (30)$$

where $t = (t_{m+1}, \ldots, t_{m+m^*})$, $t_j^* = \hat{P} - \left[\frac{\theta - 2}{2(\theta - 1)} \right] c_j^0 \quad \forall j \in M^*$, and

$$\psi(t_{M^*}) = \theta \hat{S} + \theta m \hat{\pi}_M + \theta \left\{ \hat{P}\hat{Q}^* + \frac{\theta}{4(\theta - 1)[-\hat{P}']} \sum_{j \in M^*} \{c_j^0\}^2 \right\} \qquad (31)$$

In order to obtain a neat characterization of firm-specific tariff rates, we use here the two-step procedure explained in Section 3.2. For any given t_{M^*}, the maximization of (30) with respect to t subject to $\sum_{j \in M^*} t_j = m^* t_{M^*}$ is a concave problem (recall that $\theta > 1$) and yields the first order condition

$$t_j - t_{M^*} = \frac{2 - \theta}{2(\theta - 1)}(c_j^0 - c_{M^*}^0) = -\frac{1}{2}(c_j^0 - c_{M^*}^0) + \frac{1}{2(\theta - 1)}(c_j^0 - c_{M^*}^0) \qquad (32)$$

Thus, the deviation of tax-inclusive marginal costs from their mean is

$$c_j - c_{M^*} = \frac{\theta}{2(\theta - 1)}(c_j^0 - c_{M^*}^0) \qquad (33)$$

To compare the optimal tariff structure in this common agency model with that obtained in the benchmark model, we use the superscript L (for lobbying) and B (for benchmark, or benevolent government) for the respective tariff rates. Then, using (18) and (32), we obtain the following proposition:

Proposition 5:

(i) For low cost foreign firms, i.e., $c_j^0 < c_{M^*}^0$, the deviation of a firm-specific tariff rate from the mean tariff rate under lobbying, $t_j^L - t_{M^*}^L$, is smaller than the corresponding firm-specific tariff rate from the mean tariff rate under a benevolent government, $t_j^B - t_{M^*}^B$:

$$t_j^L - t_{M^*}^L = t_j^B - t_{M^*}^B + \frac{1}{2(\theta - 1)}(c_j^0 - c_{M^*}^0) < t_j^B - t_{M^*}^B \text{ for } c_j^0 < c_{M^*}^0 \quad (34)$$

(ii) For high cost foreign firms, i.e., $c_j^0 > c_{M^*}^0$, the deviation of a firm-specific tariff rate from the mean tariff rate under lobbying, $t_j^L - t_{M^*}^L$, is greater than the corresponding firm-specific tariff rate from the mean tariff rate under a benevolent government, $t_j^B - t_{M^*}^B$:

$$t_j^L - t_{M^*}^L = t_j^B - t_{M^*}^B + \frac{1}{2(\theta - 1)}(c_j^0 - c_{M^*}^0) > t_j^B - t_{M^*}^B \text{ for } c_j^0 > c_{M^*}^0 \quad (35)$$

(iii) If $1 < \theta < 2$, the lower cost foreign firms will be taxed at a lower rate.

Remark: Proposition 5 is intuitively appealing. Low cost foreign firms can afford to bribe the government more than high cost ones, and therefore are able to tilt the tariff structure in their favors relative to the benchmark structure.

5.3. Equilibrium contribution schedules: global characterization

In the preceding sub-section, we characterized the local properties of the equilibrium contribution schedules. We now turn to a global characterization. To do this we now add the assumption that the demand function is linear. It follows that the equilibrium profit functions are quadratic in tariff rates, and one can verify that equilibrium contribution schedules are linear.

Let firm j's contribution schedule take the form

$$\pi_j(t) = F_j + \sum_{k \in M^*} \pi_j^k t_k \quad (36)$$

where ρ_j^k (a constant, to be determined) is the marginal incentive offered by firm j to the government in exchange for an increase in the tariff rate on firm k's output, and F_j is a fixed intercept to shift the tranfer between the firm and the government.

Let

$$R^k \equiv \sum_{j \in M^*} \rho_j^k$$

denote sum of the incentive payments offered by all foreign firms to the government for a marginal increase on the tariff rate on firm k's output. Similarly, let $F \equiv \sum_{j \in M^*} F_j$. For simplicity, in what follows we assume there are no taxes or subsidies on domestic firms. Then equilibrium industry output depends only on t_{M^*}:The government's objective function becomes

$$J_0(t) = \theta W(t; t_{M^*}) + F + \sum_{j \in M^*} R^j t_j \tag{37}$$

where $W(t; t_{M^*})$ is given by (16). For a quick result on the structure of equilibrium firm-specific tariffs, it is convenient to solve the maximization problem (37) in two steps. First, for a given t_{M^*}, we choose the vector $t = (t_{m+1}; ...; t_{m+m^*})$ to maximize $J_0(t)$ subject to $\sum_{j \in M^*} t_j = m^* t_{M^*}$. The second step consists of choosing t_{M^*}. The first step yields:

Proposition 6:

In a lobbying equilibrium, the tariffs on foreign firms satisfy the following condition

$$t_j - t_{M^*} = -\frac{1}{2}(c_j^0 - c_{M^*}^0) + \frac{[-\sum c^0]}{2\theta}(R^j - R_{M^*}) \tag{38}$$

where $R_{M^*} \equiv (1/m^*) \sum_{j \in M^*} R^j$.

Proof: See the Appendix.

Remark: (38) may seem different from (32). There is however no difference when we have solved for R^j and R_{M^*}.(This will be done below.) Comparing (38) with (18), we see that the effect of the contribution schedules is to modify the deviation of the tariff rate on firm j from the average tariff rate by an amount which reflects how much additional contribution the home government gets by increasing t_j.

We now solve for R^j. Let $C^0 \equiv \sum_{k \in N} c_k^0$, then we have $C = C^0 + m t_M + m^* t_{M^*}$. (Recall that $t_M \equiv \sum_{i \in M} t_i$, $t_{M^*} \equiv \sum_{j \in M^*} t_j$.) We begin by noting that if the demand is linear, $P = a - bZ$, then from Lemma 2, equilibrium industry output, price, and outputs of individual firms are given by

$$\hat{Z} = \frac{na - C}{b(n+1)}; \quad \hat{P} = \frac{a + C}{n+1}; \quad \hat{q}_j(c_j; C) = \frac{a + C - (n+1)c_j}{b(n+1)} \tag{39}$$

and consumers' surplus is $\hat{S} = (b/2)\hat{Z}^2$. Firm j's profit in equilibrium is

$$\hat{\pi}_j(c_j; C) = \frac{1}{b(n+1)^2}\left[a + C - (n+1)c_j\right]^2$$

The following derivatives will be useful in our calculations: holding C constant,

$$\frac{\partial \hat{q}_j}{\partial c_j} = -\frac{1}{b}; \quad \frac{\partial \hat{\pi}_j}{\partial c_j} = -2\hat{q}_j$$

And, holding c_j constant,

$$\frac{\partial \hat{q}_j}{\partial C} = \frac{1}{b(n+1)}; \quad \frac{\partial \hat{\pi}_j}{\partial C} = \frac{2\hat{q}_j}{n+1}$$

From (38) we can express t_j as a function of t_{M^*}, R_j, and R_{M^*}:

$$t_j = f_j(t_{M^*}; R^j; R_{M^*}) \tag{40}$$

Substituting this into J_0 and differentiating the resulting expression with respect to t_{M^*}, we get the first order condition

$$\frac{dJ^0}{dt_{M^*}} = m^* R_{M^*} - \frac{\theta m^* \hat{Z}}{n+1} + \frac{2\theta \hat{Q} m^*}{n+1} + \theta \hat{Q}^* - \theta m^* t_{M^*}\left[\frac{m+1}{n+1}\right] = 0 \tag{41}$$

where $\hat{Z}$, $\hat{Q}$, and $\hat{Q}^*$ are linear functions of t_{M^*}. Therefore equation (41) yields

$$t_{M^*} = g(R_{M^*}). \qquad (42)$$

Substitute this into (40) to obtain, for all $j \in M^*$

$$t_j = f_j(g(R_{M^*}); R^j; R_{M^*}) \equiv h_j(R^j; R_{M^*}) = h_j(R^j; (1/m^*) \sum_{l \in M^*} R^l) \qquad (43)$$

Note that the system of equations (43) is invertible to obtain

$$R^j = \beta_j(t); \quad j \in M^* \qquad (44)$$

We now turn to Stage 0, and determine the equilibrium contribution schedules. For any firm $k \in M^*$, define

$$R^j_{-k} = \sum_{l \in M^* - \{k\}} \rho^j_l$$

which is the sum of marginal contributions by all foreign firms other than k if the government increases the tariff on firm j's output, $j \in M^*$. Clearly, $R^j = R^j_{-k} + \rho^j_k$. Consider the bilateral surplus between firm k and the government. If firm k offers the null schedule $\rho_k(.) \equiv 0$, then $F_k = 0$, and $\rho^j_k = 0$ for all $j \in M^*$. In that case, let $\tau = (\tau_{m+1}, ..., \tau_{m+m^*})$ be the resulting tariff vector, and the government gets

$$\sum_{j \in M^*} R^j_{-k} \tau_j + \sum_{j \in M^* - \{k\}} F_j + \theta W(\tau; \tau_{M^*}) \qquad (45)$$

If firm k offers the schedule (36) then the government gets

$$\sum_{j \in M^*} \left[R^j_{-k} + \rho^j_k \right] t_j + \sum_{j \in M^*} F_j + \theta W(t; t_{M^*}) \qquad (46)$$

where t_j is given by (43). The gain to the government from having a relationship with firm k is the difference between (46) and (45):

$$\sum_{j \in M^*} (t_j - \tau_j) R^j_{-k} + \sum_{j \in M^*} \rho^j_k t_j + F_k + \theta W(t; t_{M^*}) - \theta W(\tau; \tau_{M^*}) \qquad (47)$$

The gain to firm k in this relationship is

$$\hat{\pi}_k(t_k; t_{M^*}) - \sum_{j \in M^*} \rho^j_k t_j - F_k - \hat{\pi}_k(\tau_k; \tau_{M^*}) \qquad (48)$$

The sum of these gains is

$$S \equiv \sum_{j \in M^*} (t_j - \tau_j) R^j_{-k} +$$

$$\hat{\pi}_k(t_k; t_{M^*}) - \hat{\pi}_k(\tau_k; \tau_{M^*}) + \theta \hat{W}(t; t_{M^*}) - \theta \hat{W}(\tau; \tau_{M^*}) \qquad (49)$$

where $t_j = h_j(R^j; R_{M^*})$, as given by (43). Firm k then chooses ρ^j_k, $j \in M^*$, to maximize (49), and then set F_k just high enough to ensure that the government accepts the deal (ie, just high enough so that (47) is zero). For given R^j_{-k} for all $j \in M^*$ (which are taken as having been chosen by all foreign firms other than k), firm k's choice of the vector $(\rho^{m+1}_k, \ldots, \rho^{m+m^*}_k)$ amounts to the direct choice of the vector $t = (t_{m+1}, \ldots, t_{m+m^*})$.

Differentiating S in (49) with respect to t_j totally (ie, t_{M^*}, defined as $(1/m^*) \sum_{k \in M^*} t_k$ is not kept constant), we get the first order conditions:

$$R^j_{-k} + 2\hat{\pi}_k \left(\frac{1}{n+1} - \delta_{jk} \right) + \theta \left(\hat{\pi}_j - \frac{t_j}{b} + \frac{m^* t_{M^*}}{b(n+1)} + \frac{\hat{Q} - \hat{Q}^*}{n+1} \right) = 0 \qquad (50)$$

or, equivalently

$$R^j + \theta \left(\hat{\pi}_j - \frac{t_j}{b} + \frac{m^* t_{M^*}}{b(n+1)} + \frac{\hat{Q} - \hat{Q}^*}{n+1} \right) = \rho^j_k - 2\hat{\pi}_k \left[\frac{1}{n+1} - \delta_{jk} \right] \qquad (51)$$

where $\delta_{jk} = 1$ if $j = k$ and $\delta_{jk} = 0$ if $j \neq k$. Now the left-hand side of (51) is equal to zero due to (41) and (38). Therefore

$$\rho^j_k = 2\hat{\pi}_k \left[\frac{1}{n+1} - \delta_{jk} \right] \qquad (52)$$

(It can be verified that the right-hand side of (52) is the total derivative of $\hat{q}_k$ with respect to t_j.) Summing (52) over all $k \in M^*$ to get

$$R^j = \frac{2\hat{Q}^*}{n+1} - 2\hat{q}_j \quad ; \quad j \in M^* \tag{53}$$

Therefore

$$R^j - R_{M^*} = -2(\hat{q}_j - \hat{q}_{M^*}) = \frac{2}{b}\left[(t_j - t_M) + (c_j^0 - c_{M^*}^0)\right]$$

Combining this equation with (38) we obtain the relationship among equilibrium tariff rates:

$$t_j - t_{M^*} = \frac{2-\theta}{2(\theta-1)}\left[c_j^0 - c_{M^*}^0\right] \tag{54}$$

which is, of course, the same as (32). We can therefore state:

Proposition 7: The global approach and the local approach yield identical results.

Remark: The advantage of the global approach is that it is easy to proceed to determine t_{M^*}. To do this, use (53) to get

$$R_{M^*} = -\frac{2(m+1)}{n+1}\hat{Q}^*(t_{M^*})$$

This equation and (42) determine t_{M^*}. Finally, having found the equilibrium tariff rates, we can determine the equilibrium output of each firm, and from this we can calculate ρ_j^k using (52).

6. Conclusion

In this paper, we have used the "common agency" approach to explain and characterize the equilibrium distribution of favors and harms when the government can use firm-specific tariff rates, and compare the results with the benchmark model of welfare maximization. According to the benchmark approach, the government is the principal and firms are agents.We found that, in the benchmark model, the

…rms whose costs are below the industry average face higher than average tari¤ rates. Thus, benevolent favoritism favors ine¢cient foreign …rms relative to e¢cient foreign …rms. The common agency approach reverses the roles of the players: foreign …rms are principals and the government is their common agent. The low cost …rms will try to attenuate the discrminations against them, by o¤ering contributions. Thus, the equilibrium in the common agency game displays a di¤erent tari¤ structure. In fact, for $1 < \mu < 2$, under the common agency equilibrium, foreign …rms that have higher costs will face higher tari¤ rates. This is because lower costs …rms are able to bribe the government more e¤ectively.

In order to focus on cost heterogeneity, we have assumed that there is no informational asymmetry. Dealing with both types of asymmetry is the next item in our research agenda.

APPENDIX

Proof of Proposition 2:

From (8) and (7), industry profit is

$$n\pi_N \equiv \sum_{i \in N} \pi_i(c_i; C) = \sum_{i \in N} (-P')q_i^2$$

and the Herfindahl index is

$$H_N \equiv \sum_{i \in N} \left[\frac{q_i}{Z}\right]^2 = \frac{1}{Z^2} \sum_{i \in N} q_i^2$$

Therefore

$$n\pi_N = (-P')Z^2 H_N$$

This completes the proof. ■

Proof of Lemma 3:

From (7) and the definition of c_j,

$$T = \sum_{j \in M^*} t_j \hat{q}_j = \sum_{j \in M^*} (c_j - c_j^0)\frac{\hat{P} - c_j}{[-\hat{P}']}$$

Let $y_j = \hat{P} - c_j$ and $y_j^0 = \hat{P} - c_j^0$. Then $c_j - c_j^0 = y_j^0 - y_j$ and $(c_j - c_j^0)(\hat{P} - c_j) = (y_j^0 - y_j)y_j = \frac{1}{4}\left(y_j^0\right)^2 - [y_j - \frac{y_j^0}{2}]^2$. Thus

$$T = \frac{1}{[-\hat{P}']}\left[\frac{1}{4}\sum_{j \in M^*} (\hat{P} - c_j^0)^2 - \sum_{j \in M^*} \left(\frac{\hat{P} - c_j^0}{2} - c_j\right)^2\right]$$

(from $y_j - \frac{y_j^0}{2} = \frac{\hat{P} + c_j^0}{2} - c_j$).

Define $\rho_j = \frac{\hat{P} + c_j^0}{2}$, and $t_j^* = \frac{\hat{P} - c_j^0}{2}$, then $\rho_j - c_j = t_j^* - t_j$. This completes the proof.

Proof of Proposition 3 (The geometry of tariffs in an asymmetric oligopoly: projecting on a hyperplane)

The objective function in the benchmark model has an important characteristic: the equilibrium price $\hat{p}$, and the associated $\hat{p}'$, depend only on the mean tax rate t_{M^*} and is independent of the individual values t_j. In addition, the function $\phi(.)$ given by (17) depends only on t_{M^*}. Consider then the following general formulation:

$$\max_t J = \frac{\alpha}{[-\hat{p}']} \| t - t^* \|^2 + \phi(t_{M^*}) \qquad (55)$$

(where in our special case $\alpha = -1$, see (16)). The maximization is subject to

$$\hat{p} = \hat{p}(t^*_M) \qquad (56)$$

and

$$\sum_{j \in M^*} t_j = m^* t_{M^*} \qquad (57)$$

$$\hat{p} - c^0_j - t_j \geq 0 \qquad (58)$$

where, from (13),

$$t^*_j = t^*_j(t_{M^*}) \qquad (59)$$

The separable structure of this problem suggests that an efficient resolution involves a two-step procedure. In the first step, we fix t_{M^*} (and thus fixing $\hat{p}$ and $\hat{p}'$) and maximize J with respect to the vector $t = (t_{m+1}, ..., t_{m+m^*})$ subject to (57) and (58). In the second step, we choose t_{M^*}.

This two-step procedure has an obvious economic interpretation. Given a fixed t_{M^*}, the industry output is fixed and therefore the price is fixed. This allows us to concentrate on the effect of tax rates on the composition (as distinct from level) of industry output. This step shows how discriminatory taxes on the outputs of ex-ante asymmetric firms serve to minimize the total cost (not just production cost, as the total cost may include cost of public finance, and/or political support cost) of a given industry output. The second step isolates the effect of the average tax on industry output, taking into account the properties of the demand function.

As we will see below, our approach allows an intuitive and global resolution, with a clear geometric interpretation. Calculus is not required.

Given t_{M^*}, define the hyperplane $H(t_{M^*})$ by:

$$H(t_{M^*}) = \{(t_{m+1}, \ldots, t_{m+m^*}) : \sum_{j \in M^*} t_j = m^* t_{M^*}\}$$

Also, define the hypercube $K(t_{M^*})$ by:

$$K(t_{M^*}) = \{(t_{m+1}, \ldots, t_{m+m^*}) : \hat{p}(t_{M^*}) - c_j^0 - t_j \geq 0\}$$

This set ensures that all outputs are non-negative. The intersection of these two sets is a closed and convex set. The first step in the resolution can be stated formally as:

$$\max_t \alpha \| t - t^* \|^2 \quad ; \quad t \in H(t_{M^*}) \cap K(t_{M^*}) \tag{60}$$

The solution of this problem depends on the sign of α. In the problem formulated in the preceding section, α is negative[14].

Since in the present model $\alpha < 0$, the solution of (60) consists of finding in the set $H(t_{M^*}) \cap K(t_{M^*})$ a point t that is closest to the reference point t^*. In other words, the optimal solution is simply a

[14] In the case $\alpha > 0$ we obtain the following proposition .

Proposition F1:(Unequal treatment of equal agents)

If $\alpha > 0$ then a corner solution is obtained. This implies that even if firms are ex-ante identical, they will be given non-identical treatments.

(The case $\alpha > 0$ applies if we are dealing with taxation of domestic firms , with $0 < \mu < 1$.)

projection of the reference point t^* onto the set $H(t_{M^*}) \cap K(t_{M^*})$: See Figure 1.

PLEASE PLACE FIGURE 1 HERE.

Since this is an important result, some elaboration is given below.

Lemma 4:

Let $\hat{t}$ be the projection of t^* on the convex set $H(t_{M^*}) \cap K(t_{M^*})$: Then $\hat{t}$ is given by the following formula:

$$\hat{t} = t^* + (t_{M^*} - t^*_{M^*}).u \tag{61}$$

where $u \equiv (1; 1; \ldots; 1) \in R^m$ and $t^*_{M^*} \equiv (1/m^*) \sum_{j \in M^*} t^*_j$.

Proof:

Write $t^* = \hat{t} + (t^* - \hat{t})$. Since $\hat{t}$ is the projection of t^* on the set $H(t_{M^*}) \cap K(t_{M^*})$, it must be the case that $t^* - \hat{t} = \rho(1; 1; \ldots; 1)$ for some ρ. Thus $t^*_j = \hat{t}_j + \rho$ for all $j \in M^*$: From $\sum_{j \in M^*} \hat{t}_j = m^* t_{M^*}$ we get $m^* t_{M^*} = \sum_{j \in M^*} t_j - m^* \rho$ or $\rho = t^*_{M^*} - t_{M^*}$. Then $t_j = t^*_j - (t^*_{M^*} - t_{M^*})$; for all $j \in M^*$. This gives the result. The above result is illustrated in Figure 1: the optimal solution $\hat{t}$ is the projection of the reference point t^* on the convex set $H(t_{M^*}) \cap K(t_{M^*})$:

Using lemma 4, the proof of proposition 3 follows from (13) and (61).

Proof of Lemma 5:

$$H_{M^*} = \frac{1}{[m^* q_{M^*}]^2} \sum_{j \in M^*} q_j^2 = \frac{1}{m^{*2}} \frac{[-P']}{[P - c_{M^*}]^2} \sum_{j \in M^*} [-P'] q_j^2$$

$$= \frac{1}{m^*} \frac{[-P']\pi_{M^*}}{[P - c_{M^*}]^2} = \frac{1}{m^*} \frac{[-P']}{\sigma^2_{M^*}} \left[\frac{V_{M^*}(c) + \sigma^2_{M^*}}{[-P']} \right]$$

Proof of Lemma 6:

Recall that

$$\|t - t^*\|^2 = \sum_{j \in M^*} (t_j - t^*_j)^2$$

Now

$$Var_{M^*}(c) = \frac{1}{m^*} \sum_{j \in M^*} (c_j - c_{M^*})^2$$

where $c_j = c_j^0 + t_j$, $(c_j - c_{M^*})^2 = [(c_j^0 - c_{M^*}^0) + (t_j - t_{M^*})]^2$. Hence

$$Var_{M^*}(c) = Var_{M^*}(c^0) + Var_{M^*}(t_j) + 2cov_{M^*}(c^0; t) \qquad (62)$$

where $cov_{M^*}(c^0; t)$ denotes the covariance. On the other hand

$$Var_{M^*}(t) = \frac{1}{m^*} \sum_{j \in M^*} [(t_j - t_j^*) + (t_j^* - t_{M^*}^*) + (t_{M^*}^* - t_M)]^2$$

Therefore, upon simplification,

$$Var_{M^*}(t) = \frac{1}{m^*} \|t - t^*\|^2 + Var_{M^*}(t^*) \qquad (63)$$

where we have used the facts that $t_j^* - t_{M^*}^* = (-c_j^* + c_{M^*}^*)/2$ by (13) and that $t_j - t_j^* = t_{M^*} - (1/2)(c_j^* - c_{M^*}^*) - (1/2)(\hat{P}(t_{M^*}) - c_j^0)$. by Proposition 3.

From (62) and (63), we get

$$\frac{1}{m^*} \|t - t^*\|^2 = Var_{M^*}(c) - Var_{M^*}(c^0) - 2cov_{M^*}(c^0; t) - Var_{M^*}(t^*)$$

where

$$cov_{M^*}(c^0; t) = \frac{1}{m^*} \sum_{j \in M^*} (c_j^0 - c_{M^*}^0)(t_j - t_{M^*}) = -\frac{1}{2} Var_{M^*}(c^0)$$

It follows that

$$\frac{1}{m^*} \|t - t^*\|^2 = Var_{M^*}(c) - Var_{M^*}(t^*)$$

and hence, for a given t_{M^*}, minimizing $\|t - t^*\|^2$ is equivalent to minimizing $Var_{M^*}(c)$.

Proof of Proposition 6:

Write the Lagrangian for problem (37) as

$$L = J_0 + \lambda\left[m^* t_{M^*} - \sum_{j \in M^*} t_j\right]$$

This yields the first order conditions

$$R^j + \theta \frac{\partial W}{\partial t_j} - \lambda = 0 \quad ; \quad \forall j \in M^* \tag{64}$$

where, from (16)

$$\frac{\partial W}{\partial t_j} = \frac{-2}{[-P']}\left[t_j - t_j^*\right] \quad ; t_j^* = \frac{P - c_j'}{2} \tag{65}$$

Summing (64) over all $j \in M^*$, we get

$$\lambda = R_{M^*} + \frac{\theta}{[-P']}\left[P - c_{M^*}' - 2t_{M^*}\right] \tag{66}$$

where $R_{M^*} \equiv \frac{1}{m^*}\sum_{j \in M^*} R^j$

Substituting (66) into (64) we get (38).

References

Bagwell, K. and R. Staiger, 1994, The Sensitivity of Strategic and Corrective R&D Policy in Oligopolistic Industries, Journal of International Economics, 36, 133-50

Bergstrom, Theodore and Hal Varian, 1985a, When are Nash Equilibria Independent of the Distribution of Agents 'Characteristics ?, Review of Economic Studies 52, 715-18.

Bergstrom, Theodore and Hal Varian, 1985b, Two Remarks on Cournot Equilibria, Economics Letters 19, 5-8.

Bergstrom, Theodore, Lawrence Blume, and Hal Varian, 1986, On the Private Provision of Public Goods, Journal of Public Economics 29, 25-49.

Bernheim, B. Douglas and Michael Whinston, 1986, Menu Auctions, Resource Allocation, and Economic In‡uence, Quarterly Journal of Economics, 101, 1-31.

Collie, David, 1993, Strategic Trade Policy under Asymmetric Oligopolies, European Journal of Political Economy, 9, 275-280.

Collie, David, 1998, Tari¤s and Subsidies Under Asymmetric Oligopoly: Ad Valorem versus Speci…c Instruments, Memeo, Cardi¤ Business School.

Dixit, Avinash, 1986, Comparative Statics for Oligopoly, International Economic Review 27, 107-22.

Dixit, Avinash, 1995, Special-Interest Lobbying and Endogenous Commodity Taxation, Working Paper 68.95, Foundation Eni Enrico Mattei.

Dixit, Avinash, 1996, The Making of Economic Policy: A Transactions-Cost Politics Perspectives, MIT Press, Cambridge, Mass.

Grossman, Gene M. and Elhanan Helpman, 1994, Protection for Sale, American Economic Review 84, 833-50.

Hillman, Arye L., and H. Ursprung, 1988, Domestic Politics, Foreign Interests, and International Trade Policie, American Economic Review 78, pp 729-745.

Hillman, Arye L., Ngo Van Long and Antoine Soubeyran, 2001, Protection, Lobbying, and Market Structure, Journal of International Economics, 54, pp 383-409.

Leahy, Dermot, and Catia Montagna, 1998, Targeted Strategic Trade Policy with Domestic Cost Heterogeneity, Typescript, Department of Economics, University College Dublin.

Long, Ngo Van and Antoine Soubeyran, 1996, Lobbying for Protection by Heterogenous Firms, European Journal of Political Economy 12, 1, 19-32.

Long, Ngo Van and Antoine Soubeyran, 1997a, Cost Heterogeneity, Industry Concentration, and Strategic Trade Policies, Journal of International Economics, 43, 207-220.

Long, Ngo Van and Antoine Soubeyran, 1997b, Cost Manipulation in an Asymmetric Oligopoly: The Taxaxion Problem, S.E.E.D.S. Discussion Paper 173, Universites d Aix-Marseille.

Long, Ngo Van and Antoine Soubeyran, 2000, Existence and Uniqueness of Cournot Equilibrium: A Contraction Mapping Approach, Economics Letters, 67, 231-6.

Long, Ngo Van and Antoine Soubeyran, 2001a, Cost Manipulation Games in Oligopoly, with Costs of Manipulating, International Economic Review, 42, pp505-533.

Long, Ngo Van and Antoine Soubeyran, 2001b, International Cross-ownership and Strategic Trade Policies, Review of International Economics 9(1),1-15.

Long, Ngo Van and Neil Vousden, 1991, Protectionist Responses and Declining Industries, Journal of International Economics, 30, pp 87-104..

Neary, Peter, 1994, Cost Asymmetries in International Subsidy Games: Should Government Help Winners or Losers? Journal of International Economics 37, 197-218.

Rodrick, Dani, 1989, Optimal Trade Taxes for a Large Country with Non-atomistic Firms, Journal of International Economics, 26, 157-67.