Institutional Design and Antidumping

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Abstract

I study a government's optimal design problem for a particular institution dealing with dumping cases initiated by the domestic industry, and analyse firm behaviour in the presence of such antidumping rules. The government chooses the dumping duties and other costs that foreign and domestic firms incur during an antidumping case. Government's payoff function is a weighted average of domestic profits and consumer surpluses over two periods. Predicted home firm petitioning choices, foreign firm responses and imposed dumping duties are close to observed antidumping procedures in most countries. The model predicts that the domestic industry will always use the existing framework against its foreign competitor, and therefore, free trade only occurs when the tribunal rules against the home firm's petition. This is true for any relative weight the government places on domestic profits. The foreign firm's equilibrium strategies involve fighting in the trade tribunal when the government's concern with domestic profits is very low. Restrained sales in period 1 of the game are always part of foreign firm strategies. Unlike in Cheng, Qiu and Wong's (2001) model, (unrestricted) equilibrium fees and AD duties are always non-negative.

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1 Introduction.

A tool rarely used by GATT/WTO members before 1970, antidumping has become a substitute for tariffs and quotas as these protection measures were progressively lowered in the process of world trade liberalization. From the late 1970's and to the mid-1980's the US, EU, Canada, Australia and a few of other industrialized countries were the major users of antidumping (henceforth, AD), accounting for 99% of the AD cases during that period (according to Finger, 1993). However, by the early 1990's developing countries' share in the AD case filings increased to approximately one half. New users of AD became not only more numerous but also more active in using AD as an alternative form of protection for their domestic industries.

This phenomenon has been reflected in a considerable literature documenting the frequency of dumping allegations and the use of the AD laws by industries and countries, as well as the magnitude of the estimated dumping margins and calculated duties. In parallel with that, theoretical work has explained tariff jumping and voluntary export restraints by foreign firms as a response to antidumping legislation. Multi-period games with either perfect or imperfect competition and involving firm competition in both the domestic and foreign market have been employed for this purpose.

Less analysed in the theoretical literature is the problem of designing the mechanism (or institution) to deal with dumping petitions filed by domestic industries and of the foreign firm and government responses. Kohler and Moore (1998) and Cheng, Qiu and Wong (2001) are the only papers that aim at designing optimal mechanisms for AD measures under incomplete information. These models develop games in which three rational agents pursue their interests and make optimal choices (leading to subgame perfect Nash equilibria). The government's payoff depends on both the domestic firm's profits and the consumers surplus, and in maximizing his objective function, has to rely on incomplete information –which it attempts at extracting from the two firms. To do that, the government uses a 'carrot-and-stick' strategy in which the fees and the dumping duty are monotonic in the reported cost values.

However, in both models the reporting of costs is by only one of the firms –either the home or the foreign firm. It also leads to some unusual results in Cheng, Qiu and Wong (2001). As predicted by their model, for relatively low weights on the domestic profits, the government would ideally subsidize the foreign firm to report the true cost[1]. They also obtain that calculated AD duties are constant with respect to the dumping margin (i.e. the difference between the estimated fair value of the product and the sales price) when the weights exceed a certain threshold.

A first step in the right direction is the recognition that it is not straightforward to say what is meant by *dumping*. Typically, dumping is taken to mean selling a product at a price less than "fair value", which is typically translated as either a price which is less than the seller's production cost (marginal cost) or a price below what the good sells for in foreign markets. However, any (static) oligopoly model will predict equilibrium prices above marginal cost and the product could sell at a price lower than in another market. Therefore, the "unfair trade practice" of dumping as defined above is (at best) a price discrimination phenomenon, and there is no economic justification for antidumping measures. One will find a great deal of truth in Finger's (1993) remark:

> "Dumping is the rhetoric justifying action against imports; it is not the criterion that determines when such action will or will not be taken. (...) The pragmatic definition of dumping is the following: *dumping is whatever you can get the government to act against under the antidumping law."*

In analyzing firm behaviour in the presence of AD laws, it is then natural to model AD petitions as actions of the domestic industry that are meant to win some protection against foreign competitors. Home firms can use the petition mechanism both when the foreign production costs are high and when they happen to be low. Whether the price of imports is above a "fair value", or not, is actually immaterial for the domestic firms facing foreign competition.

While increased competition in the home market benefits consumers via lower prices, it is detrimental to domestic firm profits. A government solely concerned with consumers' welfare would find free trade as optimal outcome. If concerned with the domestic firm profits, the government would like to impose tariffs or duties that reduce the competition from the foreign firms, but such (traditional) means of protection may violate trade agreements and therefore impossible to enact. The alternative to tariff protection is then legislation against unfair trade between countries –which legislation is acceptable under international agreements.

[1]By imposing a restriction on the non-negativity of duties and fees, the equilibrium AD duty in their model becomes equal to zero.

In the model developed here, government payoff is a weighted average of the home firm profits, on one hand, and of the consumer surplus and the duties and fees paid by the foreign firm, on the other, over the two periods in which firms are engaged in oligopoly competition. Before uncertainty regarding the foreign marginal cost is resolved (by nature's move), the government chooses the dumping duties and the costs incurred by firms at different stages of the dumping process to maximize its expected payoff.

The model predicts that the government chooses the institutional parameters such that the domestic industry always petitions against foreign competitors no matter what foreign marginal cost value is chosen by nature. The actual value of the weight on home firm profits affects the optimal fees and duties, and consequently, the foreign firm's equilibrium strategy. However, any level of government concern with home firm's profits will lead to equilibria in which the home firm always uses the institutional framework and free trade occurs only if the trade tribunal rules against the AD petition.

For high values of the relative weight on the home firm profits, government strategies leading to domestic firm's refraining from petitioning for either cost value –and thus to free trade– are dominated by strategies that induce the foreign firm to accept potential dumping allegations by the home firm (and the ensuing duties and retroactive penalties) without defense before the tribunal. When the weight on home firm profits is low, free trade outcomes are dominated by outcomes in which the home firm files a petition and the foreign firm fights against it in the tribunal. In either case, foreign firm's equilibrium strategy involves period 1 sales below the free trade levels.

Under very weak assumptions on the parameters of demand, this model yields that equilibrium (unrestricted) duties and costs incurred by firms in the AD process will always be non-negative, for any level of the relative weight on domestic profits. Therefore, this model yields more realistic results than Cheng, Qiu and Wong's (2001).

The paper will proceed as follows. In Section 2, I review the procedural steps taken in an antidumping petition, as well as the relevant empirical and theoretical literature. Section 3 will present the basic model. In Section 4, the firms' and government's equilibrium strategies are characterized. Section 5 features a discussion of the model's predictions. The last section concludes and discusses possible extensions of the model.

2 Overview.

In general, a dumping case is handled by a government agency or by the government itself through the department or commission for trade. In some cases, the injury determination and the determination of the dumping margins and duties are done by two different bodies (for example, in the US and Canada) while others delegate both tasks to a single institution (as in the EU or Australia). The common feature is that antidumping cases are heard by political appointees with a certain degree of independence of decision.

For the European Union, the competent body is the Directorate General for Trade —in particular Directorates B and C in charge of trade defence instruments. The EU procedures for dealing with dumping cases involve the submission of a complaint to the EU Commission by a representative proportion of the EU industry affected by dumping. Evidence that the sales price of the imported product on the European market is below the production cost or below the price in foreign markets as well as evidence that the complainant has potentially suffered material injury must be submitted along with the petition. Then the Commission proceeds with the investigation of importers, exporters, manufacturers and consumer groups and makes a decision as to whether dumping and injury of the domestic industry has occurred and rules for the imposition of provisional measures (up to six months) which can be changed into definitive measures (applicable for up to five years) after consultations with the Council of Ministers and after the confirmation of initial findings.

In the United States, the Department of Commerce (DOC) makes the dumping determination and calculates the dumping margin based on an estimation of the "fair value" at which the products should be sold in the US market according to the estimated costs and the prices in foreign market(s). The International Trade Commission (ITC) is entrusted with the domestic industry injury determination and –unlike the DOC– has the reputation of not always ruling in favour of the domestic industry.

In Canada, the antidumping petition is filed with the Anti-dumping and Countervailing Directorate, which is part of the Canada Border Services Agency (CBSA). Following the start of the investigation in order to assess whether dumping occurred in the Canadian market, the Canadian International Trade Tribunal independently makes a decision on the level of injury to the domestic industry. Provisional measures (duties) are applied until a definitive decision is made by the Tribunal –when they may be made permanent.

According to Shin (1992) and Bourgeois and Messerlin (1993) cited in Messerlin and Reed

(1995), the rate of success for antidumping petitions is averaging 70% for both the US and the EU. At the same time the estimates for industry-weighted average dumping margins[2] are in the range of 30-40%, but high dumping margins of 100% and above have been also found in several cases (US cases against India and Netherlands, cf. Messerlin and Reed, 1995). The implied AD duties average 20-40% of the import price, and in general they are proportional to (but less than) the estimated dumping margin, as applied by the EU, while the US duties are close to 100% of the dumping margin.

Retroactive penalties are also part of the set of instruments used by some countries after a favourable decision is made and duties have been put in place. For example, in the June 1^{st}, 2004 preliminary dumping decision against the US producers (and/or exporters) of self-rising pizza to the Canadian market, the CBSA rules that the dumping margin was 39.4% and the statement stipulates that according to the Canadian legislation

> *"Under certain circumstances, an antidumping duty can be imposed retroactively on subject goods imported into Canada. When the Tribunal conducts its inquiry on injury to the Canadian industry, it may consider if dumped goods that were imported close to, or after, the initiation of the investigation constitute massive importations spread over a relatively short period of time and have caused injury to the Canadian industry. Should the Tribunal issue a finding that there were recent massive importations of dumped goods that caused injury, and it appears necessary to the Tribunal that duty be assessed, imports of subject goods released by the CBSA in the 90 days preceding the day of the preliminary determination will be subject to anti-dumping duty."*

Most of the research in the trade area is focused either on documenting the AD laws and dumping cases brought before the trade tribunal or on the empirical estimation of the effects of AD legislation's existence on trade patterns. A smaller number of papers have studied the strategic behaviour of firms in the presence of AD laws and modelled the institutional process that leads to the imposition of dumping duties.

Reitzes (1993) investigates the welfare effects of the firms' strategic behaviour in a two-period model in which the government chooses the probability with which the AD duty

[2] Dumping margin is defined as the difference between the estimated fair value and the price at which the product is sold in the domestic market.

is imposed when the home firm files a petition in the second period, the foreign firm is a monopolist in its domestic market. The dumping duty, t, is assumed to be equal to the dumping margin as given by the previous period's price differential between the foreign and the domestic market. He finds that AD policies are beneficial to the home country under an oligopoly in quantities but not under price oligopoly. The home government's commitment to an AD regime for the firm strategies has implications for the welfare in both countries: foreign monopolist increases first period sales to its own market and reduces exports to the home country, thus lowering the price differential between the two markets and affecting the calculated dumping margin. In some cases, increased sales in the foreign market may lead to welfare improvements abroad.

Blonigen and Ohno (1998) explain the tariff jumping behaviour of some firms in conjunction with their dumping. First period dumping is aimed at raising the protection of the domestic industry before the foreign firm joins it (for example, through FDI). Afterwards, the dumper is protected against other foreign competitors, whose cost of relocation is relatively high compared to the cost of trade.

Kohler and Moore (1998) analyze the design of AD rules under incomplete information on the level of material injury to the domestic industry. While Kohler and Moore's model focuses on the domestic firm —whose cost is assumed unknown— and its behaviour, Cheng, Qiu and Wong (2001) write a model in which the foreign firm is the source of incomplete information for the government and plays a more central role. Using a mechanism design approach, they tackle the issue of optimal AD policies by analyzing two separate cases. One case is when the foreign firm provides the government with the cost information to be used during investigation—i.e. the foreign firm reports its own cost to the domestic government; in the other case it is the domestic firm which reports the cost. In equilibrium, firms report the cost truthfully and the AD duty depends on the weight of the domestic profit in the government's preferences, cost distribution and market size. However, their model predicts that (unconstrained) equilibrium duties may be negative if the cost is reported by the foreign and the weight on domestic profits is not extremely high. This

In the present paper, I design a model of institutional choices made by the government and then use it to explain the behaviour of firms and government in antidumping situations. The whole process –including the timing of firm's actions– is modelled in a manner close to reality and without the presumption, underlying the previous research in this area, that it is in government's interest to induce truthful cost reporting by either one of the firms.

3 The Model.

I consider an environment of international trade in which a domestic firm faces competition from a foreign firm and in which there is commitment by the government to free trade as per international treaties. The government is assumed to design an antidumping system for protecting the domestic industry from (potential) dumping practices by foreign firms.

Free trade is of course most beneficial to the domestic consumers. However, the government's objective function is assumed to balance the interests of the domestic industry and the consumers at large, and foreign competition lowers the profits of the former. When the foreign firm enters the domestic market, the home firm profits may decrease severely while the consumer surplus rises at more modest rates.

The government is assumed to have in place a system dealing with possible AD petitions by the domestic industry. This framework specifies a sequence of costly steps to be taken by the two competitors. It is assumed that the government is able to determine these costs when the system is designed, in a way that maximizes its objective function.

Throughout the paper, the market clearing price p and the marginal cost used in computations are net of the home firm's marginal cost –assumed known to everybody. Therefore, net marginal cost $c = c_F - c_H$ is the variable that enters the firms' reaction functions, together with demand parameters, and whose value is known to the firms but not to the government.

Domestic demand for the good in question is subject to market uncertainty every period, and therefore the true cost values cannot be inferred (by the uninformed government) from the observed quantities produced and sold by the two firms. Then, in the event of a dumping petition by the domestic firm, the determination of foreign firm costs would have to rely on the investigation process run by a trade tribunal (or a government agency).

A domestic and a foreign firm compete *a la* Cournot in this market, selling products that are perfect substitutes in consumption. Fixed costs are normalized to zero, and firm profits in a given period are

$$\begin{aligned}\pi_H &= pq_H \\ \pi_F &= pq_F - cq_F\end{aligned}$$

Period i's inverse demand function is given by

$$p_i = a - bQ_i + \varepsilon_i, \qquad i = 1, 2 \tag{1}$$

where $a, b > 0$ are constants, Q is the total output of the two firms and the random variable ε_i is $i.i.d.$ with mean 0, reflecting the uncertainty of demand each period. In each period, the realization of uncertainty parameter ε occurs after firms choose the quantities that maximize their expected profits, in the presence of a (possible) tariff/ duty t :

$$q_F = \frac{a - 2c - 2t}{3b}$$

$$q_H = \frac{a + c + t}{3b}$$

The expected price, profits (gross of any fees) and consumer surplus are

$$p = \frac{a + c + t}{3} \tag{2}$$

$$\pi_F^2(c) = \frac{[a - 2c - 2t]^2}{9b} \tag{3}$$

$$\pi_H^2(c) = \frac{[a + c + t]^2}{9b} \tag{4}$$

$$CS^2(c) = \frac{[2a - c - t]^2}{18b} \tag{5}$$

The uncertainty regarding the true cost of the foreign firm is modelled here as nature's choice between $\overline{c}$, with probability ω, and $\underline{c}$, with probability $1 - \omega$, in period 0 –that is, before the two firms compete at all. (It is assumed that $\overline{c} > \underline{c}$.) This cost is revealed to the two competitors but not to the government. In period 1, the domestic and foreign firm compete in quantities, a la Cournot, and choose the quantities to produce that period, taking into account the impact they may have on second period actions and outcomes. The firms are assumed not to discount future payoffs[3].

At the beginning of period 2, the home firm may file a dumping petition against his rival, or not. If it chooses to do so, it incurs a cost ρ. The foreign firm can then fight back in the tribunal, or acquiesce.

[3]In the presence of a discount factor, $\delta < 1$, the qualitative findings of the model do not change. Firm behaviour is only altered in as much as period 1's imports are lowered in the presence of the threat to face AD duties and retroactive penalties in the second period.

Fighting back by the foreign firm triggers the beginning of an investigation by the tribunal and comes at a cost σ for the foreign and τ for the domestic firm. The outcome of tribunal's investigation is not *a priori* known to the firms. With probability $\lambda(c)$, where $\lambda(\underline{c}) < \lambda(\overline{c})$, the result of the investigation is a decision that the foreign firm is dumping. In that case, an AD duty t is imposed on imports in the second period and the foreign firm must pay a retroactive penalty $tq_{F,1}$. In case the foreign firm acquiesces, there are no further fees charged to either firm and the dumping duty and the retroactive penalty are imposed.

If however the home firm does not file a petition or the result of the investigation is that the foreign firm did not dump, there are no other fees charged to the firms and free trade is the outcome.

The government's objective function is given by

$$W(t,\sigma,\rho,\tau) = \alpha\left[\pi_{H1}(q_{H1},q_{F1}) + \pi_{H2}(q_{H2}(t),q_{F2}(t))\right] +$$
$$+(1-\alpha)\left[CS_1(q_{H1},q_{F1}) + CS_2(q_{H2}(t),q_{F2}(t)) + t\ q_{F2} + t\ q_{F1} + \phi(f,h)\ \sigma\right]$$

Subscripts 1 and 2 indicate the period, and $\alpha \in (0,1)$ is the relative weight the government places on the domestic firm profits[4]. Function $\phi(.)$ is an indicator function and is equal to 1 iff the domestic firm petitions and the foreign firm fights back. The objective function's dependence on the rest of parameters and on the firm strategies is implicit.

The fees charged to the home firm, ρ and τ, enter the objective function with the same weight as domestic profits (i.e. α) since it is revenue collected from domestic agents, and therefore they cancel out with the amount representing lost profits by the home firm. Fees and duties collected from the foreign firm enter the government's objective function with the same weight as consumer surpluses over the two periods. This assumption is justified by the fact that government's concern is primarily with the domestic industry's profits and does not view fees collected from either firm as source of revenue *per se*. Without loss of generality, it can be assumed that the weight it places on such fees is the same as the weight on the consumer surplus.

The complete layout of the game can be summarized as follows:

Period -1 : The government chooses the fees σ, ρ and τ charged to the two firms at various stages of the process as well as the dumping duty t. These choices are made by the government before the marginal cost is revealed by nature to the two firms in the industry.

[4] For reasons pertaining to the concavity of the payoff function, assume $\alpha < \frac{11}{13}$.

Period $0:$ Nature chooses a value $\bar{c}$ (with probability ω) or $\underline{c}$ (with probability $1-\omega$) for the foreign firm's cost (net of the home firm's cost, which is known to everybody). This value is revealed to both firms but not to the government and its agents.

Period $1:$ Knowing the cost values, firms compete in quantities.

Period $2:$ The home firm may file a petition –in which case it is charged an initial fee ρ– or not. If a petition is filed, the foreign firm can acquiesce or fight back. In the former case, the dumping duty t is imposed on the imports in the second period (as well as on period 1 imports) and no other fees are incurred. In the latter case, costs σ and τ are incurred by the foreign and home firm, respectively, and a further investigation finds that there is dumping by the foreign firm with probability $\lambda(c)$, with $0<\lambda(\underline{c})<\lambda(\bar{c})<1$. In that event, dumping duty t is imposed on the second period imports and a retroactive penalty $tq_{F,1}$ is charged to the foreign firm. In the end, the firms play a Cournot game and earn profits $\pi_{i2}(q_{H2}(t),q_{F2}(t)$, where $i\in\{H,F\}$.

In solving the model, I will characterize the (pure strategy) subgame perfect equilibria in this game.

4 Equilibrium.

Using backward induction, equilibrium strategies for the firms are derived first. Equilibrium strategies for the government are then characterized in the second part of this section.

4.1 Firms' Strategies.

Cournot competition between the home and foreign firm as well as possible actions related to the dumping petitioning occur after the marginal cost for the foreign firm is chosen by nature and made known to both firms. The equilibrium strategies in each subgame originating after nature's move implicitly depend on the true cost value. For convenience in notation, however, the dependence of probability λ, as well as of equilibrium quantities and profits, on the true cost value is omitted from notation in this sub-section.

In period 2, before the actual quantities are produced and the market clears, the foreign firm may be in the situation that the home firm has initiated a petition or under free trade. If a petition was filed with the tribunal, the foreign firm must choose whether to fight (F)

against it or to acquiesce (A). It will decide to fight if the expected payoff (after incurring the cost σ) is higher than when the duty t is imposed with probability 1 as a result of accepting the dumping allegations:

$$(1-\lambda)\,\pi^{0}_{F2} + \lambda\,\left(\pi^{t}_{F2} - t\; q_{F1}\right) - \sigma \geqslant \pi^{t}_{F2} - t\; q_{F1}$$

or

$$\frac{(1-\lambda)}{9b}\; t\;(4a - 8c - 4t + 9bq_{F1})\; \geqslant \sigma \tag{6}$$

(Superscripts $-t$ and $0-$ refer to the presence of a dumping duty or to its absence, respectively.)

In other words, the foreign firm's action will be F iff $(t,\sigma,\rho,\tau) \in \mathfrak{F}_F(c,\lambda,q_{F1})$ –where the latter denotes the set of vectors (t,σ,ρ,τ) for which (6) holds. For $(t,\sigma,\rho,\tau) \in \mathfrak{R}^4_+ \backslash \mathfrak{F}_F(c,\lambda,q^1_F)$ the optimal strategy will involve playing A at the node where the foreign firm moves after home filed a petition.

At the beginning of period 2, the home firm decides whether to file a petition or not. If $(t,\sigma,\rho,\tau) \in \mathfrak{F}_F(c,\lambda,q^1_F)$, then petitioning (P) will be the preferred action by the home firm iff

$$(1-\lambda)\,\pi^{0}_{H2} + \lambda\,\pi^{t}_{H2} - \rho - \tau \geq \pi^{0}_{H2}$$

or

$$\frac{\lambda}{9b}\;\; t\;(2a + 2c + t) \geq \rho + \tau \tag{7}$$

If however $(t,\sigma,\rho,\tau) \in \mathfrak{R}^4_+ \backslash \mathfrak{F}_F(c,\lambda,q_{F1})$ –i.e. foreign firm acquiesces when facing a dumping petition– then the necessary condition to be satisfied by the fees ρ,τ and the duty t is

$$\pi^{t}_{H2} - \rho \geq \pi^{0}_{H2}$$

or

$$\frac{1}{9b}\;\; t\;(2a + 2c + t) \geq \rho \tag{8}$$

It is easy to see that (8) is satisfied whenever (7) holds. Then the relation between the parameter sets that satisfy the above conditions is $\mathfrak{H}_P(c,\lambda,q_{F1}) \subseteq \mathfrak{h}_P(c,\lambda,q_{F1})$, where $\mathfrak{H}_P(c,\lambda,q_{F1})$ is the set of parameter values that satisfy (7). For parameter vectors outside $\mathfrak{h}_P(c,\lambda,q_{F1})$ the home firm will not petition since it is too costly to do so even when the foreign firm acquiesces.

It is worth noting that –in spite of choosing to specify the three sets as depending on the whole set of parameters and first period quantities– the definition of sets $\mathfrak{h}_P(c, \lambda, q_{F1})$ and $\mathfrak{H}_P(c, \lambda, q_{F1})$ does not involve conditions on q_{F1} and σ. Likewise, the definition of $\mathfrak{F}_F(c, \lambda, q_{F1})$ does not involve constraints on ρ and τ. This remark will be useful later on when the government's decision is analyzed.

In sum, the home firm will petition and the foreign will fight back when

$$(t, \sigma, \rho, \tau) \in \mathfrak{H}_P(c, \lambda, q_{F1}) \cap \mathfrak{F}_F(c, \lambda, q_{F1}) \quad ;$$

the home firm will petition and the foreign firm will acquiesce when

$$(t, \sigma, \rho, \tau) \in \mathfrak{h}_P(c, \lambda, q_{F1}) \backslash \mathfrak{F}_F(c, \lambda, q_{F1}) \ .$$

For $(t, \sigma, \rho, \tau) \notin \mathfrak{h}_P(c, \lambda, q_{F1})$, there will be no petitioning by the home firm. To simplify notation, the dependence of $\mathfrak{F}_F$, $\mathfrak{h}_P$ and $\mathfrak{H}_P$ on c, λ and q_{F1} will be omitted from the formulae below whenever clarity and rigor are not compromised.

One period earlier, knowing the true value of c as well as government's pick for (t, σ, ρ, τ), firms choose the quantities to sell in that period. However, for the foreign firm that also means choosing the amount of retroactive penalties it will have to pay in the second period when facing a dumping petition and the dumping duty t is applied.

The foreign firm will maximize

$$\pi_F(q_F^1) = \begin{cases} \begin{array}{l} (a - c - b(q_{H1} + q_{F1}))\ \ q_{F1} + \\ +(1-\lambda)\frac{(a-2c)^2}{9b} + \lambda \frac{(a-2c-2\ t)^2 - 9bt\ q_{F1}}{9b} - \sigma \end{array} & \text{if } (t, \sigma, \rho, \tau) \in \mathfrak{H}_P \cap \mathfrak{F}_F \\ \begin{array}{l} (a - c - b(q_{H1} + q_{F1}))\ \ q_{F1} + \\ + \frac{(a-2c-2\ t)^2}{9b} - t\ q_{F1} \end{array} & \text{if } (t, \sigma, \rho, \tau) \in \mathfrak{h}_P \backslash \mathfrak{F}_F \\ (a - c - b(q_{H1} + q_{F1}))\ \ q_{F1} + \frac{(a-2c)^2}{9b} & \begin{array}{l} \text{if } (t, \sigma, \rho, \tau) \notin \mathfrak{h}_P \quad \text{OR} \\ \text{if } (t, \sigma, \rho, \tau) \in (\mathfrak{h}_P \backslash \mathfrak{h}_P) \cap \mathfrak{F}_F \end{array} \end{cases}$$

For given values of σ, higher q_{F1} implies a wider range of AD duties t such that (6) holds. It then becomes profitable for the foreign firm to fight against dumping petitions that may bring about duties t over larger intervals: fighting the petition in the tribunal becomes less costly relative to the potential retroactive penalties to be paid with probability 1 when acquiescing.

Denote $D = \frac{9\sigma b - (1-\lambda)(4a - 8c - 4t)t}{9b(1-\lambda)t}$ and assume for the time being that D is a positive quantity. Condition $(t, \sigma, \rho, \tau) \in \mathfrak{F}_F$ translates into $q_{F1} \geq D$. Then re-writing the foreign's profit function such that the conditions become more transparent from the firm's standpoint, one obtains

$$\pi_F(q_{H1},q_{F1}) = \begin{cases} \begin{array}{l}(a-c-b(q_{H1}+q_{F1}))\ \ q_{F1}+\\ +(1-\lambda)\frac{(a-2c)^2}{9b}+\lambda\frac{(a-2c-2\ t)^2-9bt\ \ q_{F1}}{9b}-\sigma\end{array} & \text{if } (t,\sigma,\rho,\tau)\in\mathfrak{H}_P \ \&\ q_{F1}\geq D \\ \begin{array}{l}(a-c-b(q_{H1}+q_{F1}))\ \ q_{F1}+\\ +\frac{(a-2c-2\ t)^2-9bt\ \ q_{F1}}{9b}\end{array} & \text{if } (t,\sigma,\rho,\tau)\in\mathfrak{H}_P \ \&\ q_{F1}\leq D \\ (a-c-b(q_{H1}+q_{F1}))\ \ q_{F1}+\frac{(a-2c)^2}{9b} & \begin{array}{l}\text{if } (t,\sigma,\rho,\tau)\notin\mathfrak{h}_P \quad \text{OR}\\ \text{if } ((t,\sigma,\rho,\tau)\in\mathfrak{h}_P\backslash\mathfrak{H}_P\\ \qquad\qquad \&\ q_{F1}\geq D\ \ )\end{array}\end{cases}$$

If $(t,\sigma,\rho,\tau)\notin\mathfrak{h}_P$, i.e. $\rho\geq\frac{1}{9b}\ \ t\ (2a+2c+t)$, then free trade will be played in both periods in equilibrium. The period 1 quantity produced by the foreign firm is the Cournot quantity, $\frac{a-2c}{3b}$, because by changing it the foreign would only affect the set $\mathfrak{F}$ and determines whether the particular (t,σ,ρ,τ) belongs to this set or not; however, it will not change the set $\mathfrak{H}$ and the home firm's optimal strategy.

If the government chooses $(t,\sigma,\rho,\tau)\in\mathfrak{h}_P\backslash\mathfrak{H}_P$,the home firm petitions only if the foreign firm would acquiesce afterwards. The foreign firm will find it optimal to choose q_{F1} that maximizes its free trade profit in period 1 while being high enough to induce it to fight AD petitions in period 2 –should the home firm decide to petition. Foreign firm's optimal strategy will therefore require producing $\min\{D,\frac{a-2c}{3b}\}$ in this case. By increasing its first period sales about the threshold level, D, the foreign firm commits to fighting against the AD petition, should it be the case that the home firm petitions at the beginning of period 2.

If however $(t,\sigma,\rho,\tau)\in\mathfrak{H}_P$ the home firm petitions anyway, and the foreign firm will want to choose the quantity that maximizes its profits over the two periods. For a given q_{H1} and contingent on $q_{F1}\geq D$, the F.O.C. for foreign firm's maximization problem yields $q_{F1}^{\mathfrak{F}}=\frac{a-c-bq_H^1(c)-\lambda t}{2b}$. This will be an interior solution iff

$$q_{H1}\leq\frac{9\,(1-\lambda)\,(a-c-\lambda t)t+8(1-\lambda)(a-2c-t)t-18b\sigma}{9b\,(1-\lambda)\,t}\overset{notation}{=}\Phi_1(c,\lambda,t,\sigma).$$

For $q_{F1}\leq D$, foreign profits in period 1 will be maximized when the foreign firm chooses $q_{F1}^{\mathfrak{R}_+^4\backslash\mathfrak{F}}=\frac{a-c-b\ q_{H1}-t}{2b}$, and this will be lower than D for

$$q_{H1}\geq\frac{9\,(1-\lambda)\,(a-c-t)t+8(1-\lambda)(a-2c-t)t-18b\sigma}{9b\,(1-\lambda)\,t}\overset{notation}{=}\Phi_2(c,\lambda,t,\sigma)$$

It is immediately clear that $\Phi_2(c,\lambda,t,\sigma) < \Phi_1(c,\lambda,t,\sigma)$ for all values of λ, c and for all possible values taken by other parameters.

One can easily show that there is $\widetilde{\Phi}(c,\lambda,t,\sigma) \in (\Phi_2(c,\lambda,t,\sigma), \Phi_1(c,\lambda,t,\sigma))$ such that $\pi_F(q_{H1}, q_{F1}^{\mathfrak{R}_+^4 \backslash \mathfrak{F}}(c)) < \pi_F(q_{H1}, q_{F1}^{\mathfrak{F}}(c))$ iff $q_{H1} < \widetilde{\Phi}(c,\lambda,t,\sigma)$. Then by solving the home and foreign firms maximization problems, one can prove the following

Lemma 1 *: Assume a non-prohibitive tariff,* $t \leq \frac{a-2\overline{c}}{2}$, *and that* $\widetilde{\Phi}(c,\lambda,t,\sigma)$ *is non-negative for given* c, σ, ρ, τ *and* t. *Then firms' equilibrium strategies in period 1 are*

$$q_H^{1,*}(c) = \begin{cases} \frac{a+c+\lambda t}{3b} & if \ \frac{a+c+\lambda t}{3b} \leq \widetilde{\Phi}(c,\lambda,t,\sigma) \ \& \ (t,\sigma,\rho,\tau) \in \mathfrak{H}_P \\ \frac{a+c+t}{3b} & if \ \frac{a+c+\lambda t}{3b} > \widetilde{\Phi}(c,\lambda,t,\sigma) \ \& \ (t,\sigma,\rho,\tau) \in \mathfrak{h}_P \\ \frac{a+c}{3b} & \begin{array}{l} if \ \left((t,\sigma,\rho,\tau) \in \mathfrak{h}_P \backslash \mathfrak{H}_P \ \& \ \frac{a+c+\lambda t}{3b} \leq \widetilde{\Phi}(c,\lambda,t,\sigma)\right) \\ OR \ \ if \ (t,\sigma,\rho,\tau) \notin \mathfrak{h}_P \end{array} \end{cases} \tag{9}$$

$$q_F^{1,*}(c) = \begin{cases} \frac{a-2c-2\lambda t}{3b} & if \ \frac{a+c+\lambda t}{3b} \leq \widetilde{\Phi}(c,\lambda,t,\sigma) \ \& \ (t,\sigma,\rho,\tau) \in \mathfrak{H}_P \\ \frac{a-2c-2t}{3b} & if \ \frac{a+c+\lambda t}{3b} > \widetilde{\Phi}(c,\lambda,t,\sigma) \ \& \ (t,\sigma,\rho,\tau) \in \mathfrak{h}_P \\ \frac{a-2c}{3b} & \begin{array}{l} if \ \left((t,\sigma,\rho,\tau) \in \mathfrak{h}_P \backslash \mathfrak{H}_P \ \& \ \frac{a+c+\lambda t}{3b} \leq \widetilde{\Phi}(c,\lambda,t,\sigma)\right) \\ OR \ \ if \ (t,\sigma,\rho,\tau) \notin \mathfrak{h}_P \end{array} \end{cases} \tag{10}$$

Now we can write the firms' strategies in a formal manner. A firm's strategy specifies the actions taken by the firm at every node. For firm $j = H$, F, let $q_{j1}, d, q_{j2}^0, q_{j2}^{f=F,t}, q_{j2}^{f=F,0}, q_{j2}^{f=A}$ denote period 1's sales, the decision regarding the petition, and period 2' sales when there is no petition, when the tribunal rules for an AD duty or against, and when the foreign firm acquiesces –respectively.

Therefore, the home firm's strategy space can be written as
$S_H = \{(q_{H1}, h, q_{H2}^0, q_{H2}^{f=F,t}, q_{H2}^{f=F,0}, q_{H2}^{f=A}) \mid q_{H1}, q_{H2}^0, q_{H2}^{f=F,t}, q_{H2}^{f=F,0}, q_{H2}^{f=A} \in [0,\infty) \ ; \ h \in \{P,N\}\}$
and the foreign firm's strategy space
$S_F = \{(q_{F1}, f, q_{F2}^0, q_{F2}^{f=F,t}, q_{F2}^{f=F,0}, q_{F2}^{f=A}) \mid q_{F1}, q_{F2}^0, q_{F2}^{f=F,t}, q_{F2}^{f=F,0}, q_{F2}^{f=A} \in [0,\infty) \ ; \ f \in \{F,A\}\}$.

Conditional on (t,σ,ρ,τ) and c, and for the case of non-prohibitive tariffs, the firms' equilibrium strategies are then determined as follows:

a) If $\frac{a+c+\lambda(c)\ t}{3b} \leq \widetilde{\Phi}(c,\lambda(c),t,\sigma)$ & $(t,\sigma,\rho,\tau) \in \mathfrak{H}_P$,

$$\begin{aligned} s_F^* &= \left(\frac{a-2c-2\lambda(c)\ t}{3b}, F, \frac{a-2c}{3b}, \frac{a-2c-2t}{3b}, \frac{a-2c}{3b}, \frac{a-2c-2t}{3b}\right) \\ s_H^* &= \left(\frac{a+c+\lambda(c)\ t}{3b}, P, \frac{a+c}{3b}, \frac{a+c+t}{3b}, \frac{a-2c}{2b}, \frac{a+c+t}{3b}\right) \end{aligned}$$

b) If $\frac{a+c+\lambda(c)\ t}{3b} > \widetilde{\Phi}(c,\lambda(c),t,\sigma)$ & $(t,\sigma,\rho,\tau)\in\mathfrak{h}_P$,

$$\begin{aligned} s_F^* &= \left(\frac{a-2c-2t}{3b}, A, \frac{a-2c}{3b}, \frac{a-2c-2t}{3b}, \frac{a-2c}{3b}, \frac{a-2c-2t}{3b}\right) \\ s_H^* &= \left(\frac{a+c+t}{3b}, P, \frac{a+c}{3b}, \frac{a+c+t}{3b}, \frac{a-2c}{2b}, \frac{a+c+t}{3b}\right) \end{aligned}$$

c) If $(t,\sigma,\rho,\tau)\in\mathfrak{h}_P\backslash\mathfrak{H}_P$ & $\frac{a+c+\lambda(c)\ t}{3b} \leq \widetilde{\Phi}(c,\lambda(c),t,\sigma)$,

$$\begin{aligned} s_F^* &= \left(\frac{a-2c}{3b}, F, \frac{a-2c}{3b}, \frac{a-2c-2t}{3b}, \frac{a-2c}{3b}, \frac{a-2c-2t}{3b}\right) \\ s_H^* &= \left(\frac{a+c}{3b}, N, \frac{a+c}{3b}, \frac{a+c+t}{3b}, \frac{a-2c}{2b}, \frac{a+c+t}{3b}\right) \end{aligned}$$

d) If $(t,\sigma,\rho,\tau)\notin\mathfrak{h}_P$,

$$\begin{aligned} s_F^* &= \left(\frac{a-2c}{3b}, F, \frac{a-2c}{3b}, \frac{a-2c-2t}{3b}, \frac{a-2c}{3b}, \frac{a-2c-2t}{3b}\right) \\ s_H^* &= \left(\frac{a+c}{3b}, N, \frac{a+c}{3b}, \frac{a+c+t}{3b}, \frac{a-2c}{2b}, \frac{a+c+t}{3b}\right) \end{aligned}$$

Equilibrium strategies are therefore functions of $(c;t,\sigma,\rho,\tau)$. Note that for a $\widetilde{\Phi}(c,\lambda(c),t,\sigma) < 0$, case (a) and (c) are eliminated from the picture –which means that in equilibrium the only possible outcomes for period 2 are free trade and a petition that is not challenged in the tribunal.

4.2 Government's Strategies.

When setting up the institution (in period -1), the government decides on what dumping duty and lump sum fees to impose at various stages in the game without knowing the true cost value c, nor the quantities $q_{F1}(c)$ and $q_{H1}(c)$ the foreign and home firm will choose as a result of that.

However, the government knows that –conditional on the cost value drawn by nature and the vector $\overrightarrow{g} = (t,\sigma,\rho,\tau)$ it chooses– the two firms' strategies in equilibrium will be as above. Therefore, for every possible vector $\overrightarrow{g}$, the government can determine which of the conditions (a)– (d) would be satisfied by $\overline{c}$ and $\overrightarrow{g}$, on one hand, and by $\underline{c}$ and $\overrightarrow{g}$, on the other, and thus calculate the value of its payoff function, $W(\overline{c},t,\sigma,\rho,\tau)$ and $W(\underline{c},t,\sigma,\rho,\tau)$. A given pair $(\overline{c}, \overrightarrow{g})$ may satisfy the conditions for case $k(\overline{c})\in\{$(a), (b), (c), (d)$\}$, while the pair $(\underline{c}, \overrightarrow{g})$ may satisfy the condition for another case, $k(\underline{c})\neq k(\overline{c})$.

In choosing $\overrightarrow{g}$ the government solves the following maximization problem

$$\max_{\overrightarrow{g}} E_c W(c, \overrightarrow{g})$$

where $\overline{c}$ occurs with probability ω and $\underline{c}$ with probability $1-\omega$.

The expected value of $E_c W$ is an average of the government payoffs in cases $k(\overline{c})$ and $k(\underline{c})$, weighted by the probability ω:

$$E_c W(c, \overrightarrow{g}) = \omega W_{[k(\overline{c})]}(\overline{c}, \overrightarrow{g}) + (1-\omega) W_{[k(\underline{c})]}(\underline{c}, \overrightarrow{g})$$

For a given $\overrightarrow{g}$ which satisfies the assumptions in Lemma 1, the case-dependent payoff $W_{[k(c)]}(.)$ used in the government's maximization problem is as follows:

a) If $\frac{a+c+\lambda(c)\ t}{3b} \leq \widetilde{\Phi}(c, \lambda(c), t, \sigma)$ & $(t, \sigma, \rho, \tau) \in \mathfrak{H}_P$,

$$W_{[a]}(c, \overrightarrow{g}) = \alpha \left(\frac{(a+c+\lambda(c)\ t)^2}{9b} + \frac{(a+c)^2 + \lambda(c)\ t(2a+2c+t)}{9b} \right) +$$
$$+(1-\alpha) \left(\frac{(2a-c-\lambda(c)\ t)^2}{18b} + \frac{(2a-c)^2 - \lambda(c)\ t\ (4a-2c-t)}{18b} + \lambda(c)\ t \left(\frac{a-2c-2t}{3b} + \frac{a-2c-2\lambda(c)\ t}{3b} \right) + \sigma \right)$$

b) If $\frac{a+c+\lambda(c)\ t}{3b} > \widetilde{\Phi}(c, \lambda(c), t, \sigma)$ & $(t, \sigma, \rho, \tau) \in \mathfrak{h}_P$,

$$W_{[b]}(c, \overrightarrow{g}) = \alpha \left(\frac{(a+c+t)^2}{9b} + \frac{(a+c+t)^2}{9b} \right) +$$
$$+(1-\alpha) \left(\frac{(2a-c-t)^2}{18b} + \frac{(2a-c-t)^2}{18b} + t\frac{a-2c-2t}{3b} + t\frac{a-2c-2t}{3b} \right)$$

c) If $(t, \sigma, \rho, \tau) \in \mathfrak{h}_P \backslash \mathfrak{H}_P$ & $\frac{a+c+\lambda(c)\ t}{3b} \leq \widetilde{\Phi}(c, \lambda(c), t, \sigma)$,

$$W_{[c]}(c, \overrightarrow{g}) = \alpha \left(2\frac{(a+c)^2}{9b} \right) + (1-\alpha) \left(2\frac{(2a-c)^2}{18b} \right)$$

d) If $(t, \sigma, \rho, \tau) \notin \mathfrak{h}_P$,

$$W_{[d]}(c, \overrightarrow{g}) = \alpha \left(2\frac{(a+c)^2}{9b} \right) + (1-\alpha) \left(2\frac{(2a-c)^2}{18b} \right)$$

A first step in the characterization of the optimal strategy for the government is to determine the combinations of cases that will never occur in equilibrium. That is, one would first like to eliminate the combinations of cases which are derived from strategies which are strictly dominated, for either one of the firms or for the government.

One situation which cannot arise in equilibrium is the following. Given a vector of government choices $\overrightarrow{g}$, in the event of a petition by the home firm, the foreign firm decides to fight in the tribunal when the true cost is high ($\overline{c}$) but finds it optimal to acquiesce when its cost is low ($\underline{c}$). In other words, if the cost of representation in front of the tribunal is lower than the expected gain[5] when its marginal cost is high, then fighting back when the

[5] For the foreign firm, the expected gain from fighting the AD petition is the difference (gross of lump-sum fees) between the expected profits it earns when the duty t is imposed with probability λ, on one hand, and the profits earned when the same duty is imposed with probability 1, on the other.

true marginal cost is low will be part of the (strictly) dominant strategy. The reason for that is straightforward: the expected gains from fighting in the tribunal are higher when the foreign marginal cost is low, than when the marginal cost is large[6]. (In other words, the more competitive the foreign firm is, the more it has to gain from a rejection of the petition by the tribunal.) By not fighting against the petition in such circumstances, the foreign firm would not behave optimally given the equilibrium continuation of the game at the end of period 2 –when the two firms will produce the Cournot quantities that correspond to the given level of AD, $t \geq 0$. Therefore, the combinations of cases (**b,a**) and (**b,c**) can never occur in equilibrium, and in the table below, this is indicated by a 'no' in the corresponding cells.

$\underline{c} \setminus \overline{c}$	**a**	**b**	**c**	**d**
a	$*$	$*$	no	no
b	no	$*$	no	no
c	x	x	x	no
d	x	x	x	x

Another situation that cannot arise in equilibrium would have the home firm find that petitioning is too costly when the foreign marginal cost is high ($c = \overline{c}$), but it decides to file a petition when the same cost is low. Given that home firm's expected gains from increased protection are increasing in the foreign marginal cost, if petitioning is prohibitively costly when foreign marginal cost is high, it will also be prohibitive in case of a low foreign cost. (The result follows from the monotonicity and convexity of the domestic profits in a manner similar to the one mentioned above.) By choosing to petition in the latter case while anticipating a Cournot equilibrium being played at the end nodes of the game, the home firm would not behave optimally, since the initial cost of petitioning ρ is larger than the gains from the imposition of duty t on imports, for any value of the foreign marginal cost. Then the following combinations of cases cannot occur in equilibrium: (**a,d**), (**b,d**) and (**c,d**), and in the table above they are marked accordingly (with a 'no').

A third outcome incompatible with equilibrium is the following: the home firm finds it profitable to petition when cost c is low and the foreign firm would fight back, but refrains

[6]This is driven by the fact that, for any duty $t \geq 0$, foreign profit function $\pi_F^t(c) = \frac{[a-2c-2t]^2}{9b}$ (gross of any fees) is decreasing and convex in c, and the rate at which profits decline is higher for the free trade profits than when duty $t > 0$ is in place. The expected gain from fighting in the tribunal is $(1-\lambda)(\pi_F^0(c) - \pi_F^t(c))$ and will be decreasing in c.

from petitioning if the foreign firm would fight when its cost is high. Home firm's petitioning when marginal cost is low and the foreign firm fighting back is a situation requiring that the total cost of petitioning $(\rho+\tau)$ be below the home firm's expected gains from protection. On the other hand, the home firm will not petition when the initial cost of petitioning is too high compared to the expected gains from doing so. However, that will never happen when the foreign marginal cost is high and the total cost of petitioning $\rho+\tau$ is at the levels mentioned above. (The result is driven by the fact that expected gains from protection increase in the marginal cost differential between the two firms, $c = c_F - c_H$.) Thus, the combination (**a,c**) will never occur in equilibrium.

After eliminating the combinations incompatible with firms' maximizing behaviour, one tries to identify combinations that are the result of government strategies that can be shown to be strictly dominated[7]. In determining the cases that are the outcome of strictly dominated strategies, I will first prove two lemmas which establish results for certain particular cases. I will use these results in constructing the proof for a general result.

For any t and c, let $\sigma_{\max}(t,c)$ be the largest value of cost of fighting in the tribunal such that foreign firm's equilibrium strategy will be to not acquiesce, in the event of a dumping petition. (When proving further results, it will be useful to note that $\sigma_{\max}(t,\overline{c}) < \sigma_{\max}(t,\underline{c})$.)

The first result is

Lemma 2 *: For the subgame originating after either realization of c and for any AD duty t, a government strategy setting the cost of fighting in the tribunal equal to $\sigma_{\max}(t,c)$ and an arbitrarily low cost of petitioning for the home firm strictly dominates any strategy that induces the home firm to not petition.*

(Proof in Appendix.)

This lemma establishes that, should the government know the value of the foreign marginal cost at the time it chooses the fees and the AD duty, the optimal strategy for the government would be to set low petitioning fees for the home firm such that free trade never occurs as a result of home firm's inaction. The rationale behind this result is the following: given that consumer surplus enters government's payoff function with a weight which is less than 1, it is not in government's interest to observe free trade occur with probability 1. Therefore, low fees are needed to induce the home firm to file a petition.

[7] These combinations will be marked with an 'x' in the table above.

A second result needed in the characterization of subgame perfect equilibria is the following

Lemma 3 *: If $\alpha > \frac{7a-2\underline{c}}{17a+2\underline{c}}$, a government strategy that always induces the home firm to petition and the foreign firm to acquiesce strictly dominates any strategy whose outcome is free trade with probability 1.*

(Proof in Appendix.)

The interpretation of this result is straightforward: when the government assigns sufficiently large relative weight to domestic profits in its payoff function, it is not optimal for the government to set fees that would discourage the home firm's petition under any circumstance. In other words, a government that cares enough about the domestic firm would not design an institution that the home firm would ever find suboptimal to use.

Lemmas 2 and 3 are building blocks for the result in

Proposition 1 *: Under the assumptions in Lemma 1, for any value of the relative weight on domestic profits, α, a government strategy $\overrightarrow{g} = (t, \sigma, \rho, \tau)$ that induces the home firm to not petition, for either of the marginal cost values chosen by nature, is strictly dominated.*

(Proof in the Appendix)

The Proposition above generalizes the results in Lemma 3 for the case when the relative weight, α, takes more modest values. In these circumstances, government strategies that trigger a petition by the home firm and then involve a decision by the trade tribunal dominate strategies leading to free trade in equilibrium.

It follows from Proposition 1 that the equilibria for this game can only be found among government strategies that places the firms in one of the combinations marked with asterisk in the table above.

5 Discussion of Results.

This section features a discussion of several assumptions that were implicit in the analysis in previous sections, as well as of the model's predictions.

A first assumption was that the equilibrium characterized in the previous section involves an AD duty t that is non-prohibitive, $t < \frac{a-2c}{2}$. When this assumption is relaxed, the solution in the game becomes trivial. In case the foreign firm acquiesces, it is eliminated from the domestic market in period 2. As long as the costs of petitioning and fighting (ρ and τ) are not excessively high, the home firm will always choose to file a petition and the foreign firm will always fight in the tribunal. A decision by the tribunal that the foreign firm dumped would amount to the elimination of the foreign firm from the market.

Under the GATT/WTO regulations dumping duties cannot be larger than the dumping margin, and therefore, they are in fact non-prohibitive. Since this is the environment in which AD policies are used, the focus of the present research is on cases in which the government would not deliberately set fees and duties that eliminate competition to the domestic industry completely.

In Section 3 and 4, $t < \frac{a-2c}{2}$ is the only restriction imposed on the vector $\overrightarrow{g}$. The assumptions on the demand parameters and costs are common to all oligopoly models: market demand is large enough relative to production costs such that firms do not operate at a loss.

When threshold $\widetilde{\Phi}(.) < 0$ –thus violating one of the assumptions in Lemma 1– the set of possible equilibria will be restricted to combinations involving only cases (**b**) or (**d**) after nature chooses the foreign marginal cost. Determining equilibria for this particular game leads one to qualitatively identical results.

A legitimate question arising from a comparison with Cheng, Qiu and Wong's (2001) model –which yields negative (unrestricted) duties and fees for certain ranges of the relative weight placed on home firm profits– is whether equilibrium fees and AD duties in this model can be negative. In this model, negative duties and fees could possibly arise in equilibrium only if the relative weight on domestic profits, α, takes values close to zero. Since a negative duty increases consumer surplus (and foreign profits) at the expense of the domestic industry, government's concern with consumer welfare must be extremely large in order to obtain negative duties (and fees[8]).

For a low relative weight α, however, a subsidy on imports would increase the government's payoff above the free trade level if and only iff the (net) marginal cost is disproportionately large relative to the demand parameter, that is $c > \frac{a}{5}$. Given that virtually every country

[8] A negative duty t (i.e. a per-unit subsidy on the imports) needs to be bundled with a lump-sum subsidy to the foreign firm, to compensate for the expected drop in profits the foreign firm would experience if the tribunal were to rule against the petition. The home firm has to be subsidized as well since a negative duty on imports would lower its (gross) expected profits below the free trade level.

has a trade tribunal and antidumping legislation in place, and that we never observe the government subsidizing either firm in the antidumping process, the assumption that $a > 5c$ seems to best mirror reality.

Moreover, most real AD cases feature sales by a foreign competitor whose (marginal) costs are lower than domestic industry's. In this model, such situation is translated into $c = c_F - c_H < 0$, and therefore $a > 5c$ is automatically satisfied. Under these assumptions, the unrestricted optimal duties and fees yielded by this model are always non-negative[9].

In discussing firm behaviour in the presence of antidumping legislation, the starting point is the analysis of the equilibrium government strategies. Proposition 1 proves that equilibrium government strategies will always induce the home firm to petition, but whether it is always in government's interest to encourage the foreign firm to fight back is not immediately clear. For low values of the relative weight ($\alpha < \frac{7a-2\overline{c}}{17a+2\overline{c}}$), government's payoff in free trade is higher than when the home firm petitions and the foreign firm acquiesces. However, lowering the fee on the foreign firm to a level $\sigma = \sigma_{\max}(t, \overline{c})$ leads to higher (expected) payoffs than in free trade –as shown in the proof of Proposition 1. When government's concern with the domestic industry is rather limited it will be in government's interest to bring competitors in front of the trade tribunal. In other words, the government is interested in having free trade occur with non-zero probability at the same time it wants the home firm to use the existing framework for protection.

If the relative weight α is higher, the government may find it optimal to choose a vector $\overrightarrow{g} = (t, \sigma, \rho, \tau)$ such that the foreign firm acquiesces when its true marginal cost is high. (This happens when firms are placed in situations (**a**,**b**) and (**b**,**b**).) Conditions needed for this to be true can be derived after solving

$$\max_{\overrightarrow{g}} E_c W(c, \overrightarrow{g})$$

for each of the three combinations of cases– (**a**,**a**), (**a**,**b**) and (**b**,**b**)– and comparing the maximized expected payoffs for each of these particular situations. These conditions will depend on the probability with which marginal cost values are chosen by nature, i.e. on ω.

While pinpointing the exact solution for the government's maximization problem may require additional assumptions on the model parameters, it is clear that for virtually any

[9] In Cheng, Qiu and Wong (2001), zero is imposed as a lower bound for tariffs in the game in which the foreign firm reports the cost value, and therefore they obtain that no duty is levied even in case of a positive ruling by the tribunal. This result holds even for relatively large weights α.

significant level of government concern with the home firm's profits, the institution dealing with AD petitions will be designed such that the domestic industry always gains some degree of protection by petitioning against the foreign firm. When this concern is not overwhelming, the government wants the foreign firm actively involved in the dumping determination process and will create incentives for it to fight in the trade tribunal.

6 Conclusion.

A government's optimal design problem for a particular institution dealing with dumping cases initiated by the domestic industry is studied in a multi-stage game involving the government and two firms –home and foreign. I analyse the firms' behaviour in the presence of antidumping rules, which are modelled as government's choices of AD duties and costs incurred by firms before uncertainty regarding foreign costs is resolved.

The model predicts that the government chooses the institutional parameters such that the domestic industry always petitions against foreign competitors no matter what marginal cost value was chosen by nature. Any level of government concern with home firm's profits leads to equilibria in which the home firm always uses the institutional framework, and free trade occurs only if the trade tribunal rules against the AD petition.

When the relative weight on the home firm profits is high, government strategies leading to domestic firm's refraining from petitioning –and thus to free trade– are dominated by strategies inducing the home firm to petition and the foreign firm to acquiesce. When the same weight is low, free trade outcomes are dominated by outcomes in which the home firm files a petition and the foreign firm fights against it in the tribunal. In both cases, foreign firm's equilibrium strategy involves period 1 sales below the free trade levels.

Under very general assumptions on the demand parameters, this model yields that equilibrium duties and costs incurred by firms in the AD process are always non-negative, for any level of the relative weight the government places on domestic profits. Therefore, this model yields results which are more general and more realistic than obtained by Cheng, Qiu and Wong (2001).

By explicitly modelling the institutional design and government's uncertainty regarding the foreign marginal cost, one obtains an environment in which, in equilibrium, the home firm will always enjoy a certain degree of protection against the foreign competitors by using the petition mechanism. Unlike in Reitzes (1993), voluntary export restraints in period 1 are justified by foreign firm's strategy to lower retroactive penalties it would have to pay in the event of the tribunal ruling that dumping occurs.

Possible extensions of the model involve allowing probability λ (with which the foreign firm is found to have dumped) to depend on a noisy signal received by the tribunal. This way, the likelihood of AD duties being imposed on period 2 imports and of retroactive penalties could be a function of tribunal's observation of the market outcome in period 1. Firms' strategic interaction would take a new dimension: sales in period 1 can affect the noisy signal received by the trade tribunal and, therefore, firms can have an impact on the probability of tribunal ruling in favor of the domestic industry.

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7 Appendix

Proof of Lemma 2:

For given parameters of demand, marginal cost and AD duties, the largest fee σ that satisfies (6) with equality is

$$\sigma_{\max}(t,c) = (1-\lambda(c))\, t\, \frac{7(a-2c)-2t\ (2+3\lambda(c))}{9b} \tag{11}$$

Then

$$\begin{aligned}
&W_{[a]}(c,t,\sigma_{\max},\rho,\tau) - W_{[c]}(c,t,\sigma,\rho',\tau') = \\
&= \alpha\left(\tfrac{(a+c+\lambda(c)\ t)^2}{9b} + \tfrac{(a+c)^2+\lambda\ t(2a+2c+t)}{9b} - 2\tfrac{(a+c)^2}{9b}\right) + \\
&+(1-\alpha)\left(\tfrac{(2a-c-\lambda(c)\ t)^2}{18b} + \tfrac{(2a-c)^2-\lambda(c)\ t\ (4a-2c-t)}{18b} + \lambda(c)\ t\left(\tfrac{a-2c-2t}{3b} + \tfrac{a-2c-2\lambda t}{3b}\right) + \right. \\
&\left. + (1-\lambda(\underline{c}))\, t\tfrac{7(a-2c)-2t(2+3\lambda(c))}{9b} - 2\tfrac{(2a-c)^2}{18b}\right) \\
&= t\tfrac{8\lambda(c)\ c+8\alpha t+18\alpha\lambda(c)\ a-14a\alpha+28\alpha c+\alpha\lambda(c)^2 t+17\alpha\lambda(c)\ t-10\lambda(c)\ a+14a-28c-15\lambda(c)\ t+\lambda(c)^2 t-8t}{18b} > 0
\end{aligned}$$

for any non-prohibitive tariff, t, and for any α, $\lambda(c)$. This happens because the numerator of the ratio is decreasing in t and it can be shown that its only root is larger than the prohibitive tariff, $\frac{a-2\underline{c}}{2}$. *QED.*

Proof of Lemma 3 :

$$\begin{aligned}
&W_{[b]}(c,\overrightarrow{g}) - W_{[c,d]}(c,\overrightarrow{g}) = t\tfrac{2a(1+\alpha)-2(5-7\alpha)c+(13\alpha-11)t}{9b} = \\
&= t\tfrac{2a(1+\alpha)-(10-14\alpha)c-(11-13\alpha)t}{9b} > t\tfrac{2a(1+\alpha)-2(5-7\alpha)c-(11-13\alpha)\frac{a-2c}{2}}{9b} = \\
&= t\tfrac{-(7-17\alpha)a+2c(1+\alpha)}{18b} > 0\ ,\quad \text{for all } \alpha > \tfrac{7a-2\underline{c}}{17a+2\underline{c}}.\ \textit{QED.}
\end{aligned}$$

Proof of Proposition 1 :

Let $\overrightarrow{g}$ be a vector such that the equilibrium outcome places the agents in case (**a**), and $\overrightarrow{g'}$ be a vector leading to case (**c**); both vectors involve the same values for t and σ. Then

$W_{[a]}(c, \overrightarrow{g}) - W_{[c]}(c, \overrightarrow{g}') =$

$= \alpha \left(\frac{(a+c+\lambda(c)\ t)^2}{9b} + \frac{(a+c)^2+\lambda(c)\ t(2a+2c+t)}{9b} - 2\frac{(a+c)^2}{9b} \right) +$

$+(1-\alpha)(\frac{(2a-c-\lambda(c)\ t)^2}{18b} + \frac{(2a-c)^2-\lambda(c)\ t\ (4a-2c-t)}{18b} + \lambda(c)\, t \left(\frac{a-2c-2t}{3b} + \frac{a-2c-2\lambda(c)\ t}{3b} \right) + \sigma - 2\frac{(2a-c)^2}{18b}) =$

$= \lambda(c)\ t \frac{4\alpha a+28\alpha c+13\alpha\lambda(c)\ t+13\alpha t+4a-20c-11\lambda(c)\ t-11t}{18b} + (1-\alpha)\sigma$

It is easy to see that $W_{[a]}(c, \overrightarrow{g}) - W_{[c]}(c, \overrightarrow{g}') \geq 0$ iff $\sigma \geq \widetilde{\sigma}(c,t)$, where

$$\widetilde{\sigma}(t,c) = \lambda(c)\ t\ \frac{4(5-7\alpha)c - 4(1+\alpha)a + (11-13\alpha)(1+\lambda)t}{18(1-\alpha)b}$$

By Lemma 2, it must be the case then that $\widetilde{\sigma}(c) \leq \sigma_{\max}(t,c)$ –for any value of c.

For all $\alpha < \frac{5}{7}$,one obtains that $\widetilde{\sigma}(c)$ is increasing in c. This and the remark on the monotonicity of $\sigma_{\max}(t,.)$ imply

$$\widetilde{\sigma}(t,\underline{c}) < \widetilde{\sigma}(t,\overline{c}) \leq \sigma_{\max}(t,\overline{c}) < \sigma_{\max}(t,\underline{c})$$

Setting $\rho = \tau = 0$ (or arbitrarily close to zero!) such that the home firm always petitions, a duty t and a fee σ such that $\sigma = \sigma_{\max}(t,\overline{c})$, the government would channel the equilibrium towards case (**a**,**a**) and government's expected payoff is than larger than in any of the situations involving free trade with probability 1 (i.e. when the home firm refrains from filing a petition).

For all $\alpha \geq \frac{5}{7} > \frac{7a-2\underline{c}}{17a+2\underline{c}}$, Lemma 3 indicates the strategies that strictly dominate the strategies leading to free trade. *QED*.