Antidumping: Welfare Enhancing Retaliation?

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Abstract

Over the last two decades, the use of antidumping (AD) measures has been characterized by two main features. First and foremost, it has increased dramatically. Moreover, it has apparently not - to a large extent - been used to counteract the existence of dumping, but rather in a strategic or retaliatory fashion. These empirical findings have led many to propose the elimination of this instrument altogether, on the basis that its current use is arbitrary and, consequently, welfare reducing.

We argue that these concerns may be unfounded since, in a world of restricted trade policy instruments, a retaliatory use of AD might be welfare enhancing. By modeling the trade relationship between countries as a repeated game of hidden information, we show that retaliation can be welfare increasing with respect to a rigid rule on the use of AD. We stress the fact that, underlying this result, is the unavailability of transfers or export subsidies in the current world trading system.

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1 Introduction

Over the last two decades, the use of antidumping (henceforth, AD) has increased significantly. According to Prusa [25], there were 69 AD complaints filed or reported to GATT in 1980: by 1998, this figure had increased to 246. Not only did the use of AD intensify among "traditional" users during this period, but it was also adopted by countries who had not used it before, tripling the total number of nations using it by 1998.

Along with this increase in the use of AD, there has been a shift in the perception of the incentives that underlie its use. The traditional explanation was based on the existence of dumped imports, goods sold either at a price below the one in the exporter's domestic market or at a price below his costs of production. The use of AD duties under such circumstances is allowed by the GATT/WTO code whenever the dumped imports are proven to have caused material injury to domestic firms.

More recently, however, various authors have suggested that the underlying reasons for AD could be "strategic" in nature. In particular, there seems to be ample evidence that a significant motive behind AD filings lies in its retaliatory use by the involved parties. In this sense, Finger [15] has argued that countries that use AD tend to apply it against each other, and not against countries that do not use this instrument to begin with. To back this claim, he notes that during the 1980's approximately two thirds of AD cases were filed against countries who also used this type of duties. Along the same lines, Prusa [25] has argued that many countries appear to file for AD duties against countries who have done the same to them in the past.

In an extensive empirical study, Prusa and Skeath [26] have analyzed the trends in worldwide AD filing during the past two decades, trying to explain the motives underlying the use of this measure. To do so, they use data on all AD cases filed or reported to the GATT/WTO between 1980 and 1998 to test for evidence of economic and strategic motives. In terms of the former, they look for evidence of AD cases being filed against large suppliers or suppliers who have large percentage surge in imports. In terms of strategic motives, they look for indications of "club" or retaliatory filings of AD cases. "Club" filings refer to the use of AD against countries that have previously used this instrument themselves, regardless of whom they have used it against. Retaliatory filings, on the other hand, are those carried out by a country against trading partners that have in turn used AD against it in the past.

Their results seem to provide strong support for the strategic view of antidumping. In particular, they find that of all AD cases filed between 1980 and 1998, three-quarters of them are consistent with the club effect and one half are consistent with retaliation incentives. Additionally, their statistical tests on annual filings at the country level suggest that about 50% of the observations provide statistically significant support for the strategic hypothesis.

Adopting a different line of research that focuses on industry filing decisions in the United

States, Blonigen and Bown [12] have recently found evidence suggesting that the use of AD is affected by the threat of retaliation through the same channel. In particular, they find that industries seem less likely to initiate petitions against firms from countries which have active AD provisions and are at the same time an important destination for their exports.

This mounting evidence regarding the discretionary use of antidumping has led many to argue in favor of eliminating this policy tool altogether. To illustrate these opinions we can mention Kitgaard and Schiele [19], who critisize both the theory behind AD regulations and the way in which they are applied. Regarding the former, they consider the concept of dumping itself to be seriously flawed from an economic perspective, while they also question the procedures used to review dumping allegations. In a similar spirit, Barfield [7] argues that AD measures are "fundamentally at odds with the free trade policies that have dramatically increased global welfare over the last half century."[1]

The object of the present paper is to provide a theoretical explanation for the empirical evidence regarding the strategic use of AD, and to argue that the latter may be welfare enhancing. Within the aforementioned evidence, we focus on retaliatory AD filings, which seems to be the most significant form of strategic application of this instrument.

We must stress that, since it refers to the observed use of AD *in the absence of evidence suggestive of dumping*, our model abstracts from the latter phenomenon.[2] We therefore treat AD as tariffs that may be adjusted by governments at their discretion, an assumption that - in our view - is not overly restrictive when applied to the use of AD in which we are interested. In essence, then, our model applies to the discretionary use of tariffs in general: in light of the evidence and debate regarding the use of AD, though, we choose to focus on this policy instrument.

Within the GATT/WTO framework, AD is a discriminatory and unilateral form of protection. The latter feature, in particular, generates room for incentive problems if this instrument can be used in a discretionary manner. Although it is true that the use of AD is governed by rules and procedures and is therefore not fully discretionary, we assume this to be the case. Once again, insofar as the underlying empirical evidence seems to find that a substantial proportion of AD use is not explained by the existence of dumping, we feel justified in adopting this approach.

We use a stylized model of bilateral trade based on Bagwell and Staiger [10], which we analyze in a repeated scenario and modify to include unobserved political preferences. The latter feature is included to accommodate the empirical importance of political considerations in understanding the use of AD,[3] and we thus interpret AD as part of a mechanism that grants tariffs the flexibility

[1] Barfield's critiques of AD refer mostly to its use in high-tech sectors, which may have some particular characteristics that our model does not address.

[2] We must stress that when we mention the use of AD in the absence of dumping, we refer to the lack of evidence suggestive of dumping in the data. We do not consider whether, formally, dumping has been shown to exist by the pertinent legal authority.

[3] See Hansen (1990), Moore (1992) and Hansen and Prusa (1997) for evidence regarding the importance of political

required to adjust to changing political preferences.

In our two good, two country model, governments maximize welfare by raising their import tariffs when their valuation of the import competing sector is high, and by decreasing them otherwise. However, since political preferences are unobservable, governments have an incentive to raise their tariffs above efficiency levels in order to affect the terms of trade in their favor. We show that, in the presence of transfers or export subsidies, it is possible to achieve efficiency by offsetting the terms of trade gains through the use of other instruments. However, since the former are seldom observed in the world and the use of the latter is restricted under GATT/WTO, we then analyze the maximum level of efficiency attainable in their absence.

In such a scenario, the only instrument that governments control at any point in time are import tariffs; thus, if governments are to be truthful about their political preferences, present actions must have some impact on expected future payoffs. Within this setting, we show how a retaliatory use of AD may be welfare enhancing with respect to the adoption of static rules governing its use.

Our underlying argument is conceptually very simple: once governments are refrained from freely using all their instruments, it might well be that a retaliatory use of the remaining ones is welfare enhancing. Note how this notion is reminiscent of Tinbergen's work, which we believe is particularly useful to interpret our results. In designing rules for international cooperation, it must be considered that the elimination of some instruments which are normally available to governments might trigger the use of the remaining ones in new and unforseen ways. In our particular setup, this is exactly the case of retaliation, which may increase overall welfare when the use of other instruments is restricted but the objectives to be attained remain unchanged.

To obtain our results, we draw on the theoretical work regarding repeated games of imperfect information. From the work of Abreu, Pierce and Stachetti [1], in particular, and Fudenberg, Levine and Maskin [16], we adopt the concept of Perfect Public Equilibrium (PPE). However, the former work deals mostly with existence of equilibria, whereas we are mainly interested in their precise characterization: additionally, our model is one of private information for a continuum of types, for which - as far as we know - there are yet no results regarding the possibility of supporting efficient allocations as PPE's. Due to these reasons, we prove our main argument building on recent results obtained in the repeated auctions literature ([2], [3], [4], [5], [28]), specifically making use of Aoyagi [3] for our structure and main results.

Within the trade literature, our paper is most closely related to the work of Bagwell and Staiger [8] and Feenstra and Lewis [14]. The former deals with a repeated setting very similar to ours, but in which there is no private information: thus, the equilibrium strategies are not subject to the additional constraint of inducing truthtelling, and must only guarantee that governments have

considerations in the use of AD by the United States.

no incentives to openly abandon cooperation. Since these incentives fluctuate with the economic environment, so does the level of cooperation that is sustainable at equilibrium. Feenstra and Lewis, on the other hand, deal with static setting in which - at the moment of negotiating trade restrictions - one government has private information regarding the political pressure it faces from domestic producers. As in our model, then, there is an incentive to misreport this private information in order to induce a favorable shift the terms of trade. Although similar in spirit, our approach differs from theirs in two ways. The first and most important difference is that they assume that governments behave in a cooperative manner: our setting is noncooperative and the behavior of governments is obtained as an equilibrium to a game of repeated interaction. A second difference is that they assume one-sided private information, whereas we analyze a game in which both governments have private information regarding their domestic environment.

Our model displays interesting characteristics at different levels. In the first place, it differs from previous theoretical research on the use of AD by abstracting from the role played by firms and analyzing it instead within the context of strategic interaction between governments (henceforth, "strategic trade framework").[4] The latter framework has been increasingly useful in understanding the role of the world trade system and its particular regulations, and our analysis of AD is compatible with existing research in this direction. Second, the modelling strategy is relatively new within the aforementioned framework itself, which has not yet fully developed the potential of repeated games of private information.[5] Our paper tries to do so while hopefully yielding some insights on the ongoing debate regarding the use of AD.

The structure of the paper is as follows: we first present the static game in Section 2 and briefly comment on its properties. Section 3 explains the basic setup and notation of the repeated game. In Section 4, equilibria of the latter are analyzed under the assumption that governments can resort to more than one instrument: in particular, we show how the model allows for efficient equilibria in the presence of transfers or export subsidies. Section 5 concentrates on the repeated game when import tariffs are the only instruments that governments can use, and it contains our main results regarding the retaliatory use of AD. Finally, Section 6 contains a brief discussion of our results and provides a possible interpretation for them.

[4] It may seem strange to analyze AD in a context of repeated interaction between governments, since dumping investigations are initiated at the request of producers who presumably do not take such interaction into account. But in our model, as will become clear, the "political preference" parameter could be interpreted as the political influence of producers: the fact that governments interact repeatedly, though, affects the way in which this influence translates into trade policy.

[5] Although for different purposes, Lee [20] also analyzes issues of international trade policy within a repeated framework of private information.

2 The Static Model

2.1 Basic Setup

This section lays the foundations of the simple two country, two good model that will be used throughout the paper, which draws heavily on Bagwell and Staiger [10]. Suppose there are two countries, which we call home and foreign, that trade two competitively-produced goods, x and y. Each of these goods is demanded in both countries according to a symmetric demand function D, and we assume x (y) to be the natural import good of the home (foreign) country. Let p_i represent the domestic price of good $i = x, y$ in the home country and let the domestic demand and supply functions for good i be represented by the linear functions $D(p_i)$ and $Q_i(p_i)$, respectively. In particular, we assume that $D(p_i) = \alpha - \beta p_i$, $Q_x(p_x) = \gamma p_x$ and $Q_y(p_y) = \phi p_y$. Analogously, we denote foreign demand and supply functions by $D(p_i^*) = \alpha - \beta p_i^*$, $Q_y^*(p_y^*) = \gamma p_y^*$ and $Q_x^*(p_x^*) = \phi p_x^*$. It is assumed that $\gamma < \phi$ in order to capture the fact that x is the natural import good of home. In the present model, countries are free to choose import tariffs and export subsidies, denoted by τ_x and τ_y in the case of home. The import tariff and export subsidy of foreign are denoted respectively by τ_y^* and τ_x^*.[6]

The market equilibrium of the static model is easily characterized, for given levels of import tariffs and export subsidies. Consider first the market for good x. For any given domestic price, home has an import function of

$$M_x = \alpha - (\beta + \gamma)p_x \tag{1}$$

On the other hand, the export function of foreign is given by,

$$E_x^* = (\phi + \beta)p_x^* - \alpha \tag{2}$$

Note also that, if we define p_x^w to be the world price of good x, it must be the case that $p_x = p_x^w + \tau_x$, while $p_x^* = p_x^w + \tau_x^*$. Thus, replacing these expressions in (1) and (2) and solving for the value of p_x^w that equals world imports and exports of good x, we obtain that

$$p_x^w = \frac{2\alpha - (\beta + \gamma)\tau_x - (\phi + \beta)\tau_x^*}{2\beta + \gamma + \phi} \tag{3}$$

Hence

$$\begin{aligned} p_x &= p_x^w + \tau_x = \frac{2\alpha + (\beta + \phi)\tau_x - (\phi + \beta)\tau_x^*}{2\beta + \gamma + \phi} && (4) \\ p_x^* &= p_x^w + \tau_x^* = \frac{2\alpha - (\beta + \gamma)\tau_x + (\gamma + \beta)\tau_x^*}{2\beta + \gamma + \phi} && (5) \end{aligned}$$

The equilibrium conditions for market y are defined in an analogous manner.

[6] As a convention, we let $\tau_j > 0$ denote a positive level of tariff (subsidy) levied on the import (export) good j.

2.2 Trade Policy

As we saw in the previous section, trade policy will affect the equilibrium prices and the volumes of trade in the markets for both goods. The present section characterizes government objectives and analyzes the equilibrium trade policies under symmetric and asymmetric information, while comparing them to the first-best choices.

It is assumed that each government's preferences are influenced by a political economy parameter, ζ (ζ^*), which affects its valuation of the import-competing sector and is drawn randomly and independently in each period from a common uniform distribution with support $[\zeta_L, \zeta_H]$ and density g. We will first assume that governments can observe each other's political parameter and will later solve the static game under the assumption of private information.

We assume that governments maximize the sum of tariff revenues, consumer surplus and producer's surplus in each of the markets: in the case of the import good, the valuation given to the latter is adjusted by the political economy parameter.[7] Thus, the objective function of the home government can be expressed as,

$$W(p_x, p_y, p_x^w, p_y^w) = W_x(p_x, p_x^w) + W_y(p_y, p_y^w)$$

where W_x and W_y represent welfare derived from the x and y markets, respectively. These are in turn defined by

$$\begin{aligned} W_x(p_x, p_x^w) &= \int_{\hat{p}_x}^{\frac{\alpha}{\beta}} D_x dp_x + \zeta\lambda_x(p_x) + [p_x - p_x^w]M_x \\ W_y(p_y, p_y^w) &= \int_{\hat{p}_y}^{\frac{\alpha}{\beta}} D_y dp_y + \lambda_y(p_y) - [p_y - p_y^w]E_y \end{aligned}$$

where $\lambda_x(p_x)$ and $\lambda_y(p_y)$ denote the profits of home producers of goods x and y as functions of domestic prices, respectively, and - as was said earlier - ζ represents the political economy parameter. Note that the welfare functions as expressed above depend solely on the world and domestic prices of both goods and, ultimately, in the values of home and foreign's import tariffs and export subsidies. In the case of the foreign government, its welfare functions are analogous to the ones depicted above with the difference that the corresponding political economy parameter (ζ^*) affects the weight given to producers of good y. In order to simplify the exposition, we will not derive closed form solutions for the general model. Instead, we will prove our results for the

[7] Thus, we follow Baldwin in interpreting the weights on producer surplus that exceed unity as representing domestic political economy forces.

general case and will sometimes invoke a particular parametrization of the model.[8]

Let us first analyze the stage game under symmetric information. In such a case, both governments observe each other's political parameter and then simultaneously set their tariffs and subsidies, so as to unilaterally maximize their welfare. In other words, for given values of ζ and ζ^*, home chooses τ_x and τ_y so as to solve,.

$$\max_{\tau_x, \tau_y} \quad W(p_x, p_y, p_x^w, p_y^w) \tag{6}$$

while foreign chooses τ_x^* and τ_y^* in order to solve an analogous problem. From (6) we can derive home's best response functions, which must satisfy the first order conditions,

$$W_{p_x^w} \frac{\partial p_x^w}{\partial \tau_x} + W_{p_x} \frac{\partial p_x}{\partial \tau_x} = 0 \tag{7}$$

$$W_{p_y^w} \frac{\partial p_y^w}{\partial \tau_y} + W_{p_y} \frac{\partial p_y}{\partial \tau_y} = 0 \tag{8}$$

These conditions reflect the well-known fact that trade policy influences welfare through its impact on the terms of trade and on domestic prices. For the importing government, an increase in tariffs has the following effects: it increases the domestic price of the good, redistributing wealth from consumers to producers while inducing a welfare loss, and it has a favorable effect on the terms of trade. The higher the political economy parameter, the higher is the positive weight given to the redistributive effect and the higher will be the desired tariffs.

The Nash equilibria of the present model have been studied at length in the literature and are well understood.[9] In order to assess their properties in terms of efficiency, however, let us first characterize the properties of efficient tariffs.

Note that, in order for pairs of tariffs (τ_x, τ_x^*) and (τ_y, τ_y^*) to be efficient, it must be the case that they maximize the sum of home and foreign's welfare, i.e., they must be a solution to the following maximization problem:

$$\max_{\tau_x, \tau_x^*} \quad W_x(p_x, p_x^w) + W_x^*(p_x^*, p_x^w) \tag{9}$$

$$\max_{\tau_y, \tau_y^*} \quad W_y(p_y, p_y^w) + W_y^*(p_y^*, p_y^w) \tag{10}$$

[8] The benchmark parametrization that we will refer to is similar to the one used by Bagwell and Staiger in [10], and is given by

$$\begin{array}{lll} \alpha = 1 & \beta = 1 & \gamma = \frac{1}{2} \\ \phi = 1 & \zeta_L = 1 & \zeta_H = 1.5 \end{array}$$

[9] See, for example, [10].

It is straightforward to show from (9) and (10), as Bagwell and Staiger have done, that in the present model aggregate welfare depends only on the net tariffs in each market, i.e. on $\tau_x - \tau_x^*$ and $\tau_y - \tau_y^*$, while the precise values of the tariffs and subsidies determine the way in which total welfare is distributed among governments. More precisely, we use a particular pair of efficient tariffs and subsidies as our benchmark, which we call "politically optimal" tariffs, denoted by τ_x^{PO} and τ_x^{*PO}, and implicitly defined by the following first order conditions,

$$W_{p_x} \frac{\partial p_x}{\partial \tau_x} = 0 \quad (11)$$

$$W_{p_x^*}^* \frac{\partial p_x^*}{\partial \tau_x^*} = 0 \quad (12)$$

Thus, politically optimal tariffs are defined as the tariffs (and subsidies) that governments would choose if they did not take the terms of trade effect into account, being therefore lower (higher) than their Nash counterparts obtained from (7) and (8).

Due to the lack of political economy considerations in the export market, the politically optimal export subsidy in the present model is always zero. Regarding the import market, on the other hand, the politically optimal tariff will be strictly positive for all values of $\zeta > 1$, and it will be increasing in ζ. Thus, the net tariff that arises from governments choosing their politically optimal tariffs and subsidies is simply $\tau_x^{PO}(\zeta)$, and all combinations (τ_x, τ_x^*) for which $\tau_x^{PO}(\zeta) = \tau_x - \tau_x^*$ deliver the same total welfare.

Before proceeding, it is worthwhile at this point to highlight one characteristic of welfare functions in our model. Since they depend directly on world and local prices, which are in turn determined solely by tariffs and subsidies, welfare of home and foreign is ultimately a function of the latter and can therefore be expressed indirectly in those terms. This is the approach we take throughout the rest of the paper, and we therefore briefly state the properties of welfare functions so expressed. We can write the welfare of home's government as $W(\tau, \tau^*, \zeta)$, where $\tau = (\tau_x, \tau_y)$ and $\tau^* = \left(\tau_x^*, \tau_y^*\right)$. The support for ζ is chosen so that W is twice continuously differentiable with respect to τ and τ^*.[10]

Since we will always use politically optimal tariffs as our benchmark, we will mostly be concerned with efficient tariffs that lie below the reaction function (below the Nash-tariffs) and for these we have that welfare is increasing in the import tariff, $\frac{\partial W}{\partial \tau_x} > 0$, decreasing in the export subsidy, $\frac{\partial W}{\partial \tau_y} < 0$ and strictly concave in τ_x ; $\frac{\partial^2 W}{\partial \tau_x^2} < 0$. Also, it is always the case that $\frac{\partial^2 W}{\partial \tau_x \partial \zeta} > 0$. Obviously, because of symmetry, the same assumptions and results hold for foreign.

[10] The support of ζ is relevant for this because, if the possible values of the parameter are too far apart there are efficient equilibria with no trade: at this point, then, W would clearly not be twice continuously differentiable on the tariffs.

Finally, it must be taken into account that the model presents a continuum of Nash equilibria in which there is no international trade: to see this, imagine a situation in which import tariffs (export subsidies) are set so high (low) as to individually eliminate the exchange of goods between both governments. Any such situation is clearly a Nash equilibrium, since no country can induce trade by unilaterally lowering (raising) its tariff (subsidy). The following remark, which is taken directly from Bagwell and Staiger, summarizes the discussion on the static model with symmetric information.

Remark 1 *In the static tariff game with symmetric information,*

1. *There exists a unique Nash equilibrium with positive trade volume (this follows from the strict concavity of the welfare function).*
2. *In the aforementioned equilibrium, the Nash import tariff is positive while the Nash export subsidy is negative, and all tariffs are higher than their political optimal values.*
3. *There also exists a continuum of autarchy Nash equilibria.*

The previous remark highlights a well known result of the strategic trade literature, by which Nash tariffs are inefficient due to governments' desire to overexploit them in order to affect the terms of trade in their favor. In this sense, both governments could benefit from a reciprocal reduction of their tariffs, since such a change could leave the terms of trade constant while reducing everyone's domestic prices.

Since in the present paper we are interested in the case of asymmetric information, we now briefly analyze the static model for the case in which governments cannot observe each other's political preferences. In this case, the game is assumed to be as follows: governments learn their 'types' at the beginning of each period, after which they set their tariffs and subsidies in a simultaneous fashion and trade takes place.

In such a scenario, welfare functions are determined exactly as before, with the only difference being that governments are uncertain about each other's preferences. Thus, they choose the tariffs and subsidies that maximize expected welfare: in particular, we define the welfare function of home in the *interim* stage (i.e., after observing its own type, but not that of foreign) as,

$$W(\tau_x, \tau_y, \tau_x^*, \tau_y^*) = W_x(\tau_x, \tau_x^*) + \int_{\zeta^*} W_y(\tau_y, \tau_y^*(\zeta^*))g(\zeta^*)d\zeta^* \qquad (13)$$

while that of foreign takes an analogous form (with the obvious difference that welfare is deterministic in the y market and random in the x market). Note from (13) that welfare on the x market depends only on home's type, since foreign has no private information regarding this good. In the y market, however, foreign's type will affect its tariff and - consequently - the world price of this good. Thus, in choosing its level of subsidy, home maximizes expected welfare in the market for its export good.

It is easy to show that the equilibrium of the asymmetric information case involves the same kind of inefficiency that was previously described. This must indeed be the case, since the introduction of asymmetric information does not eliminate the terms of trade externality and - consequently - governments have an incentive to set inefficiently high (low) import tariffs (export subsidies).

Lemma 1 *The Nash equilibrium of the static game with asymmetric information entails suboptimally high (low) import tariffs (export subsidies).*

Proof. This result stems directly from our previous analysis and the proof is therefore omitted. ■

Thus, the properties of the original equilibria are preserved under asymmetric information, entailing suboptimally high tariffs and a consequent loss of efficiency due to the existence of a terms of trade externality. We now analyze a repeated version of the aforementioned game and study its equilibrium payoffs under different scenarios.

3 Repeated Game

We maintain the assumption of two countries, home and foreign, and extend the static model to an infinitely repeated scenario. As before, both governments receive a private signal ζ (ζ^*) about their political preference, which are independently drawn from a common, uniform distribution with support $[\zeta_L, \zeta_H]$ and density g. Depending on the scenario considered, each government can set the level of one or more policy instruments.

We analyze this repeated game by using a mechanism design approach (see e.g. Athey et al. [5], Athey and Bagwell [4] and Aoyagi [2]). In particular, [2] discusses collusion in repeated auctions and introduces a mechanism where the players communicate their private values to a coordination center, which in turn instructs them how much to bid. We believe communication between governments before tariff-setting to be a realistic assumption and therefore follow this approach. Intuitively, all we require then is that governments communicate before deciding on the level at which to set their instruments.[11]

Coordination in our repeated game is modelled as follows: at the beginning of each period, both governments report their private signals to the center according to a reporting rule $\zeta(\zeta^*) : [\zeta_L, \zeta_H] \rightarrow [\zeta_L, \zeta_H]$. Having received the reports $\hat{\zeta} = (\hat{\zeta}, \hat{\zeta}^*)$, the center tells each government the levels at which the available policy variables should be set. To do so, it uses an instruction rule $i = (i, i^*) : [\zeta_L, \zeta_H]^2 \rightarrow R^{2n}$, where R^{2n} represents the policy space for both countries and n

[11] We also require the existence of a randomization device which countries can use to correlate their actions whenever this is necessary. This assumption is standard in the repeated game literature.

denotes the number of available instruments: in our case, these instruments will be alternatively given by import tariffs, export subsidies and transfers of the numeraire good. The levels of the policy instruments ultimately chosen by any of the governments are publicly observed. Given this communication structure we model the behavior of governments as simply choosing a tariff rule $\rho(\rho^*) : [\zeta_L, \zeta_H]^2 \times R^n \rightarrow R^n$ which maps their type, their report and the instruction rule given by the center into actual tariffs, subsidies or transfers.

Communication history for a government in period t in the repeated game is the sequence of its reports and instructions in periods 1, 2, ..., $t-1$. Private history is the sequence of its private signals ζ in periods 1, 2, ..., $t-1$. Finally, public history in period t is a sequence of instruction rules used by the center and the values of the policy instruments actually chosen by both countries in periods 1, 2, ..., $t-1$.

Home's (foreign's) strategy σ is a pair of reporting and tariff rules (ζ, ρ) for each period defined as a function of its communication and private histories and of the public history at that time. Define $\hat{\sigma}$ to be the honest and obedient strategy which selects the pair $(\hat{\zeta}, \hat{\rho})$ for all histories.

The coordination scheme C describes the center's choice of an instruction rule as a function of communication and public histories. The game is assumed to start in a collusion phase, from which it reverts to a punishment phase forever whenever there is an observable deviation by any of the countries. In the punishment phase, countries are instructed to play the one-shot Bayesian-Nash equilibrium of the static game as described above.

The coordination scheme C is an equilibrium if the pair $\Sigma = (\hat{\sigma}, \hat{\sigma}^*)$ is a perfect public equilibrium (PPE) of the repeated game, i.e., if $\hat{\sigma}$ is optimal against $(\hat{\sigma}^*, C)$ after any public history of the game.

Note that we will characterize equilibrium strategies by using the one-shot deviation property.[12] These deviations, in turn, can be divided into two types which, following Athey and Bagwell [4], we call on- and off-schedule deviations. The latter refer to deviations that are observable, i.e., setting tariffs at a level different from the one indicated by the center. On-schedule deviations, on the other hand, are those that arise when countries misrepresent their type: obviously, these deviations are not observable. To control for the latter constraints in the present model we will focus our attention on their local properties, and then prove in each case that they are satisfied globally by the presence of a single-crossing property (SCP).

4 Repeated game with more than one instrument

The present section analyzes the equilibria of the repeated game in the presence of more than one instrument, namely, import tariffs and transfers or import tariffs and export subsidies. In such a setting, the instruction and tariff rules will refer to all of the instruments involved: for example, in

[12] The one-shot deviation property is valid in our setup due to the boundedness of per-period payoffs and discounting.

the case of import tariffs and transfers, the instruction rule will specify a level for both instruments, and so will the tariff rule used by each country. The question addressed is whether there are efficient equilibria when each country controls more than one instrument.

In the presence of transfers, this question can be answered in a rather straightforward manner. The inefficiency of the model arises precisely because, if the center were to instruct each country to apply the politically optimal import tariff associated to its report, countries would have an incentive to over-represent their type in the latter. The reason for this is that they do not consider the externality generated when they alter the terms of trade in their favor and against their trading partner. Thus, any coordination scheme that leads countries to internalize this externality will suffice to achieve efficiency. When transfers are feasible, the simplest such scheme is one that instructs each country to pay a transfer equal to the externality it generates while setting its import tariff at the politically optimal level associated to its report.

The fact that efficiency is attainable in our setting when governments can resort to transfers should not come as a surprise, as it is a common and well-understood result. Thus, we do not prove it here and refer the interested reader to the appendix. Let $\hat{t}(\hat{\zeta}_t)$ denote the mapping from announcements to transfers that - by internalizing the terms of trade externality - achieves truthtelling and use $\tau^{PO}(\hat{\zeta})$ to denote politically optimal tariffs associated to announcements. We obtain the following result:

Proposition 2 *In the presence of transfers and import tariffs there exists a critical level of the discount factor $\hat{\delta}$, such that for all $\delta \geq \hat{\delta}$, an efficient coordination scheme C characterized by instruction rules $(i_t, i_t^*) = ((\tau_x^{PO}(\hat{\zeta}_t), \hat{t}(\hat{\zeta}_t)), ((\tau_y^{*PO}(\hat{\zeta}_t^*), \hat{t}(\hat{\zeta}_t^*)))$ for all t can be supported as a perfect public equilibrium.*

Note that the possibility of resorting to these two instruments allows countries to achieve efficiency within all periods by transferring welfare between them. In other words, there is no need to resort to the manipulation of future payoffs, because the availability of sufficiently many instruments allows for the achievement of efficiency and incentive compatibility on a period-by-period basis.

However, transfers among countries is something that we seldom observe in reality. There could be a number of reasons behind this lack of transfers, ranging from issues of sovereignty to the perception that a country resorting to an AD measure has already been hurt by its trade partner, making it unfair to force him to “pay for defending itself”. Whatever these underlying reasons are, we do not wish to analyze them here: instead, we ask ourselves what would happen in our repeated game if we preclude countries from resorting to transfers.

We consider the effects of such an assumption while allowing countries to resort to export subsidies instead. Note that the preferred level of the latter are not affected by the realization of the own political economy parameter. Thus, the instruction and tariff rules will now refer to the levels of import tariffs and export subsidies. In this case, home's welfare will be given by,

$$W(\sigma, C) = W_x(\zeta, \tau_x(\hat{\zeta}), \tau_x^*(\hat{\zeta})) + \int_{\zeta^L}^{\zeta^H} W_y(\tau_y(\hat{\zeta}^*), \tau_y^*(\hat{\zeta}^*))g(\zeta^*)d\zeta^* + v \tag{14}$$

where τ_x and τ_x^* represent, respectively, home's import tariff and foreign's export subsidy in the market for x. As for foreign's welfare, it can be defined analogously. On-schedule incentive compatibility then requires that,

$$\frac{\partial W_x}{\partial \hat{\zeta}}_{|\hat{\zeta}=\zeta} = (W_{p_x^w}\frac{\partial p_x^w}{\partial \tau_x} + W_{p_x}\frac{\partial p_x}{\partial \tau_x})\frac{\partial \tau_x(\zeta)}{\partial \zeta} + (W_{p_x^w}\frac{\partial p_x^w}{\partial \tau_x^*} + W_{p_x}\frac{\partial p_x}{\partial \tau_x^*})\frac{\partial \tau_x^*(\zeta)}{\partial \zeta} = 0$$

which can be expressed as,

$$\frac{\partial W_x}{\partial \tilde{\zeta}}_{|\hat{\zeta}=\zeta} = W_{p_x}(\frac{\partial p_x}{\partial \tau_x}\frac{\partial \tau_x(\zeta)}{\partial \zeta} + \frac{\partial p_x}{\partial \tau_x^*}\frac{\partial \tau_x^*(\zeta)}{\partial \zeta}) + W_{p_x^w}(\frac{\partial p_x^w}{\partial \tau_x}\frac{\partial \tau_x(\zeta)}{\partial \zeta} + \frac{\partial p_x^w}{\partial \tau_x^*}\frac{\partial \tau_x^*(\zeta)}{\partial \zeta}) = 0 \tag{15}$$

Obviously, then, any tariff-subsidy instruction rule that satisfies,

$$\frac{\partial \tau_x(\zeta)}{\partial \zeta}\frac{\frac{\partial p_x^w}{\partial \tau_x}}{\frac{\partial p_x^w}{\partial \tau_x^*}} = -\frac{\partial \tau_x^*(\zeta)}{\partial \zeta} \tag{16}$$

$$\tau_x^{PO}(\zeta) = \tau_x(\zeta) - \tau_x^*(\zeta) \tag{17}$$

will be enough to support truthtelling and efficient tariffs.[13]

The idea behind the previous conditions is as follows: suppose that the center chooses an arbitrary value for the world prices (say, without loss of generality, the world price that would result from applying the politically optimal import tariffs when ζ is equal to its expected value). Condition (16) basically says that world prices will always remain at that level, since import tariffs and export subsidies will respond to the announcement in such a way as to keep it invariant. Thus, tariffs and subsidies will always lie on the same iso-world price locus regardless of announcements. However, the exact point on the locus on which they lie will depend on the announcement, since efficiency requires that (17) be satisfied at all points in time. Therefore, (16) and (17) jointly state that tariffs and subsidies in each market should be set at the intersection of some pre-specified iso-world price locus and the efficiency locus corresponding to the announcement.

If we denote tariffs and subsidies satisfying (16) and (17) by $\hat{\tau}_x(\hat{\zeta})$ and $\hat{\tau}_x^*(\hat{\zeta})$, a rule instructing the importing and exporting countries to set their tariffs and subsidies at such levels would clearly

[13] The condition for efficiency stems from the fact that - in our setup - world prices ultimately depend on net tariffs. This same feature guarantees that a pair of efficient and IC import tariff and export subsidy always exists.

satisfy both efficiency and incentive compatibility for the importing country.[14] Global incentive compatibility, on the other hand, stems once again from the fact that the marginal welfare of an increase in the domestic price of the import good is increasing in ζ.

These conditions are very intuitive: the desire to overclaim one's type arises from the potential benefit of favorably affecting the terms of trade. However, if the coordination scheme is such that the exporting country's subsidy decreases so as to eliminate the terms of trade effect associated to each report, there is no incentive to lie about one's type. This, in turn, can always be done in our setting since there is no private information regarding the export sector. Efficiency comes from the observation that, in the present model, all that matters for total welfare is the difference between import tariffs and export subsidies: as long as this difference is equal to the politically optimal import tariff, total welfare is maximized.[15]

Figure 1 illustrates the discussion. Suppose the world price is set at a pre-specified level which we denote $\bar{p}_x^w$: the iso-world price locus in the graph shows all the combinations of import tariffs and export subsidies that deliver this price in equilibrium. Now, for two values of the political economy parameter in the importing country, ζ_1 and ζ_2 where $\zeta_2 > \zeta_1$, the upward sloping loci represent the efficiency frontiers, i.e., combinations of tariffs and subsidies that maximize joint welfare.[16] All the mechanism does is to instruct, for each announcement made by the importing country, the tariff-subsidy pair that lies on the intersection of the iso-world price line and the corresponding efficiency locus: in this way, world prices are kept constant, eliminating the terms-of-trade externality while achieving efficiency.

Finally, since such a mechanism maximizes joint expected welfare, world prices in both markets can always be chosen so as to avoid off-schedule deviations in the presence of Nash-reversion if countries are sufficiently patient. The following proposition summarizes the previous discussion.

Proposition 3 *In the presence of export subsidies and import tariffs there exists a critical level of the discount factor $\hat{\delta}$, such that for all $\delta \geq \hat{\delta}$, an efficient coordination scheme C characterized by instruction rules $(i_t, i_t^*) = ((\hat{\tau}_x(\hat{\zeta}_t), \hat{\tau}_y(\hat{\zeta}_t^*)), ((\hat{\tau}_x^*(\zeta_t^*), \hat{\tau}_y^*(\hat{\zeta}_t^*)))$ for all t can be supported as a perfect public equilibrium.*

According to the proposition, the presence of export subsidies could in principle help to achieve efficiency on a per-period basis. However, the use of this instrument is currently restricted under the

[14] Note that efficiency rests on the assumption of private information only in the import side of the market. Thus, tariffs and subsidies need only be adjusted in response to the importing country's announcement in order to achieve efficiency.

[15] This can be seen from the fact that, when we add governments' welfare in any one market, the joint welfare depends only on; a) the difference between the import tariff and the export subsidy, and b) local prices. The latter, in turn, depend only on the former (see Section 2.1).

[16] Obviously, they yield the same joint welfare as the pair $(\tau_x^{PO}(\zeta), 0)$.

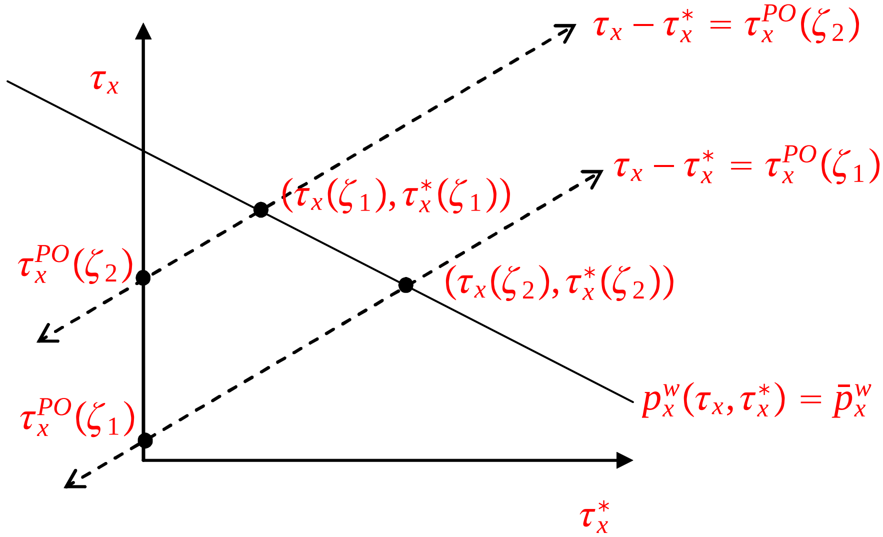

Figure 1: Efficient Coordination Scheme with Tariffs and Subsidies

GATT/WTO system.[17] Additionally, note that a coordination scheme like the one described above will repeatedly entail the use of export and/or import subsidies: although in our model countries are not assumed to be liquidity constrained, the latter would seem *a priori* to be a justifiable concern in considering a real-world implementation of the scheme.

Thus, of the two additional instruments that would allow for the implementation of an efficient allocation - transfers and export subsidies - none of them are readily available to countries interacting in the existing trading system. In the next section, we consequently analyze the efficiency of equilibria when import tariffs are the only policy instruments to which countries can resort.

5 Repeated game with one instrument

5.1 Background and Related Literature

Once we restrict the set of instruments available to each government to just the import tariff, there is a problem in supporting an efficient allocation as a PPE. The intuition is obvious: in order for an allocation to be efficient, it must be the case that - at each point in time - governments set their tariffs at the politically optimal levels. However, in order for them to do so, there must be an incentive to truthfully reveal their type: in the absence of other instruments, this can only come from a threat of future punishment, which itself must bring about some efficiency loss.

[17] In this regard, Article 3 of the Agreement on Subsidies and Countervailing Measures explicitly prohibits subsidies which are "contingent, in law or in fact, whether solely or as one of several other conditions, upon export performance."

The setup that we thus face is that of an infinitely repeated game of private information with a continuum of types. This game falls in the class of infinitely repeated games whose solution or equilibrium concept can be analyzed relying on dynamic programming techniques. Repeated games with perfect information are by now well understood, the main message being that any individually rational and feasible payoff can be supported in equilibrium as long as the parties are patient enough: this is the well known folk theorem.

When asymmetric information is introduced, however, the results are not so clear-cut. Although most of the theoretical work in this respect has focused on games with unobservable actions (moral hazard), it is possible to interpret a situation of private information in the exact same fashion by letting the actions be mappings from the types to the public signal space. By doing so, [16] state an (asymptotic) folk theorem when types are private, iid and have finite support. Athey and Bagwell [4], in one of the best known applications in the literature, interpret the repeated problem as a static one of mechanism design where future continuation payoffs play the role of transfers.[18] They obtain full collusive profits in a repeated Bertrand model with binary types. The driving force behind their results is the nature of Bertrand competition and a restriction on the distribution of the binary types, both of which allow them to redistribute welfare through continuation payoffs without sacrificing efficiency. Our model has neither of those two features.

It should be observed that, following [16], we could in principle achieve asymptotic efficiency by working with a finite typespace. However, as mentioned above, allowing for communication motivates the use of a continuum of types. Moreover, neither [1] or [16] explicitly construct PPE's, as they are mostly interested in their existence and efficiency properties. By contrast, our main interest lies precisely on the strategies played in a particular PPE and on their economic interpretation.

Under our assumptions, on the other hand, there are no (asymptotic) efficiency results available. There has, however, been a substantial amount of work devoted to analyzing this issue, particularly in settings of collusion in repeated environments (see e.g. [21], [2], [28]). Among this work, we will draw on the results of [2], in which it is shown that collusive payoffs are increased by the use of dynamic and retaliatory - as opposed to static - schemes.

5.2 The problem

The current debate regarding the use of AD seems to suggest that this policy tool is being used in a discretionary manner, which is seemingly unrelated to the objective for which it was created. In turn, this strategic and mostly retaliatory use of the instrument has led many to argue in favor of the elimination of AD altogether. We will argue that such an elimination, or - more generally - a fixed rule that determines the way in which AD may be used, can be outperformed by a

[18] This mechanism design approach has been followed in subsequent work (see [5],[6],[22]).

dynamic scheme that includes some degree of retaliation. Our argument is constructed in this way because we believe it to be simple while nonetheless illustrating the role of retaliation. We do stress, however, that we could have used a different modeling strategy in order to obtain the same qualitative results, possibly at the cost of losing the simple structure of our model.

The intuition behind our argument is simple: any static rule regarding the use of AD can be - modulo a slight asymmetric adjustment - be used as punishment or reward in a dynamic mechanism that includes the use of efficient tariffs at some of its stages. Therefore, such a mechanism will yield an average payoff between that of the political optimum and that of the static rule. This must be kept in mind when interpreting the mechanism developed in the next subsection.

As we are interested in studying how retaliation can serve as a way to keep countries from using the AD clause all too abusively, we can interpret the government that sets the highest current tariff as today's 'winner'. This interpretation leads us naturally to model the repeated game in a fashion similar to that of a repeated auction. Under such an analogy, retaliation would call for a continuation payoff penalty for today's 'winner' while rewarding the current 'loser'.

Of course, it should be stressed that this is not the only way in which strategic interaction might affect equilibrium payoffs. Another possibility would be, for example, to deter the overuse of AD through the threat of a (symmetric) trade war. Such a setting, in which high tariffs eventually trigger a trade war on equilibrium in which all countries are punished symmetrically, would be reminiscent of the work of Green and Porter [13], Rotemberg and Saloner [27] and Athey, Bagwell and Sanchirico [5]. It must be noted that a multi-country model developed to study these symmetric equilibria could shed some light on the pure 'club effect' found empirically by Prusa and Skeath [26], since it could deliver a punishment executed by all countries simultaneously regardless of who was hurt by the original AD measure.[19]

Albeit interesting, we choose to focus here on pure retaliation for the following reasons. First and foremost, retaliation seems to be empirically more common than the pure 'club effect', roughly doubling it. Additionally, in our two-country world it becomes impossible to distinguish between the two: any 'club' use of AD will necessarily be retaliatory. In the following section, then, we introduce our mechanism and show simply that some degree of retaliation always outperforms any static rule governing the use of AD.

5.3 The mechanism

The mechanism proposed is as follows. The collusive phase, which lasts as long as there are no observable deviations, is characterized by a symmetric stage (S) and two asymmetric stages (A and A^*), defined as follows:

[19] By 'pure club effect' we mean the use of AD by a government against others who have used the instrument in the past, but not against that specific country.

- In the symmetric stage, both governments announce their types to the center, which in turns instructs them to set their tariffs at the politically optimal level associated to their announcements. The per-period welfare in this phase depends on a government's type and announcement, and is thus denoted by $W^{PO}(\zeta, \hat{\zeta})$.

- Whichever country announces the highest tariff faces a probability, depending on its announcement, of being punished from the next period onwards, for T consecutive periods. We refer to the latter possibility as an asymmetric stage denoted by A or A^*, where the former (latter) refers to home (foreign) being the punished. It is not necessary to describe the exact punishments at this point, but it suffices to point out that punishments involve playing fixed rules (independent of announcements) and that the government that is punished receives lower expected welfare than its punishing counterpart. Denote expected welfare from being punished in any given period by W^P, and of punishing by W^R.

- After T periods of asymmetric phase, the game reverts back to the symmetric stage.

- If at any point there is an observable deviation from these strategies, the communication game reverts to the non-collusive phase forever (Nash - Reversion).

Definition 1 *In stage S the probability of moving to stage A is defined by*

$$p(\hat{\zeta}, \hat{\zeta}^*) \begin{cases} \pi(\hat{\zeta}) \text{ if } \hat{\zeta} > \hat{\zeta}^* \\ 0 \text{ otherwise} \end{cases}$$

whereas the probability of moving to stage A^* is defined analogously by

$$p^*(\hat{\zeta}, \hat{\zeta}^*) \begin{cases} \pi(\hat{\zeta}^*) \text{ if } \hat{\zeta} < \hat{\zeta}^* \\ 0 \text{ otherwise} \end{cases}$$

Note from the previous definition that, once the game is in the symmetric stage, it will remain in it with probability $1 - \pi(\hat{\zeta}) - \pi(\hat{\zeta}^*)$. The idea of the present mechanism is therefore straightforward: by increasing their announcements, governments are entitled to higher import tariffs in the symmetric stage, but they also increase the likelihood of being punished in the subsequent periods.

Having set up the mechanism, we can now state explicitly that communication is not a restrictive assumption. Clearly, we could achieve exactly the same structure by omitting the announcements altogether. In such a scenario, the probability of future punishments would directly depend on which government set the highest tariff and on the level at which the latter was set. Thus, the symmetric phase without communication would be equivalent to that of our mechanism, since there is a one-to-one relationship between politically optimal tariffs and announcements. In the asymmetric phase, on the other hand, communication plays no role and can be dispensed with.

In order to establish the existence of an equilibrium and to analyze its welfare properties, we formulate governments' decision problems in a recursive fashion and solve for incentive compatibility. If we let v^M denote a government's average payoff from following the mechanism M, then it must satisfy the following recursive equation of v for a given transition probability function π:[20]

$$v = (1-\delta)W^{PO} + \delta \int_{\zeta_L}^{\zeta_H} \int_{\zeta_L}^{\zeta_H} \left(v + p(\zeta,\zeta^*)(1-\delta^T)(W^P + W^R - 2v)\right) g(\zeta)g(\zeta^*)d\zeta d\zeta^* \quad (18)$$

Additionally, π must satisfy on-schedule IC constraints, since it must induce truthtelling during the symmetric stage. Working from (18), we can obtain such an expression for π,

$$\pi(\hat{\zeta}) = \frac{(1-\delta)}{\delta(1-\delta^T)(v-W^P)} \int_{\zeta_L}^{\hat{\zeta}} \frac{1}{F(\varphi)} \left(\frac{\partial W^{PO}(\varphi)}{\partial \varphi} g(\varphi)\right) e^{-\frac{(W^R-W^P)}{(v-W^P)} \int_{\varphi}^{\hat{\zeta}} \frac{f(v)}{F(v)} dv} d\varphi \quad (19)$$

From (18) and (19) it is possible to obtain the following equation for $v = v^M$ follows:

$$\phi(v) = 0 = v - W^{PO} - \frac{W^P + W^R - 2v}{v - W^P} y(v) \quad (20)$$

where $y(v)$ is defined as follows,

$$y(v) = \int_{\zeta_L}^{\zeta_H} \int_{\zeta_L}^{\zeta} \int_{\zeta_L}^{\zeta} \frac{1}{F(\varphi)} \left(\frac{\partial W^{PO}(\varphi)}{\partial \varphi} f(\varphi)\right) e^{-\frac{(W^R-W^P)}{(v-W^P)} \int_{\varphi}^{\zeta} \frac{f(v)}{F(v)} dv} d\varphi g(\zeta^*) g(\zeta) d\zeta^* d\zeta$$

This leads us to the following theorem, which replicates Aoyagi's Theorem 1.

Theorem 4 *If $\phi(v)$ has a solution v strictly greater than v^N then for a sufficiently large discount factor δ the retaliatory mechanism is an equilibrium for some probability function $\pi(.)$ and T and yields payoff $v^M = v$.*

Proof. See Appendix. ■

In terms of AD, Theorem 6 can be interpreted as follows. Assume that, instead of fixing tariffs at a given level, governments are allowed to raise them according to the claims they make regarding the degree of political pressure that they face domestically. However, in doing so, a government increases the likelihood of entering a "punishment phase". In such a phase, its trading partner is allowed to set - on average - higher tariffs. If, in expectation, governments can outperform the static Nash payoff, then our mechanism has an equilibrium. In order for it to be consequential, then, the result requires us to show that this condition holds.

Formally, what is left to show for the existence of an equilibrium is that $\phi(v)$ does in fact have a solution greater than v^N: in other words, it must be shown that $v^M > v^N$.[21] We deal with this problem in an indirect fashion. In particular, we assume the general existence of a static tariff rule (in which countries announcements do not affect next period's problem) that outperforms the

[20] Note that, formally speaking, W^{PO} includes expected welfare in both the import and export markets and thus depends through the latter on foreign's announcement. However, since we focus here on the effect of own announcements on the import market, we treat this current payoff as depending only on such announcements.

[21] Of course, this must hold in order to avoid off-schedule deviations.

Nash equilibrium. This is an uncontroversial assumption since, if that were not the case, then the discussion regarding the discretionary use of AD would be meaningless: indeed, any potential static rule designed to govern the use of AD, including its outright prohibition, would be weakly dominated by the stage game Nash equilibrium.[22] Below, we will show that this assumption holds in our benchmark parametrization of the model.

Assuming then the existence of such a rule, we will show that it can always be outperformed by a dynamic mechanism, in which countries' announcements do affect their continuation payoffs. In order to do so, note that the overall payoff of the mechanism developed above is bounded from below by a convex combination of W^{PO} and $\frac{W^P+W^R}{2}$, expressed as follows:[23]

$$v^M > L = \frac{W^R - W^P}{W^R - W^P + 2K} W^{PO} + \frac{2K}{W^R - W^P + 2K} \frac{\left(W^P + W^R\right)}{2} \tag{21}$$

where K is a constant defined by,

$$K = \int_{\zeta_L}^{\zeta_H} \int_{\zeta_L}^{\zeta} W'^{PO}(\zeta_L) g(\zeta^*) d\zeta^* d\zeta$$

Now, consider for a moment an optimal static rule. Take, for example, the class of rules by which countries must place their tariffs at a fixed, prespecified level, and denote the welfare maximizing tariff within that class by $\bar{\tau}$. As we said before, we assume that such a rule outperforms the Nash equilibrium, and we denote the expected welfare associated to its application as $\bar{v}$.

We proceed by embedding such a rule into our mechanism, so that when the game enters into a punishment stage the punished (punishing) country will be forced to slightly lower (raise) its tariff below (above) $\bar{\tau}$, so that $W^R - W^P = \varepsilon$. Note that, by definition of $\bar{\tau}$, $W^P + W^R \approx 2\bar{v}$ since minor perturbations of the fixed tariff will not have first-order effects on joint expected welfare. In the appendix we show that our mechanism can guarantee a payoff strictly greater than $\bar{v}$. We do so, following Aoyagi [3], by introducing a lower bound for the payoff of our mechanism, L, and then showing that

$$v^M > L = \frac{\varepsilon}{\varepsilon + 2K} W^{PO} + \frac{2K}{\varepsilon + 2K} \bar{v} > \bar{v}$$

proving that any static rule involving the used of a fixed tariff $\bar{\tau}$ which outperforms the Nash equilibrium can in turn be outperformed by (locally) introducing asymmetry[24]. It is not hard to see how this argument can be replicated for any such class of rules.

[22] There is an additional reason for comparing our mechanism with static rules: in many settings, these are in fact optimal within the class of symmetric PPE. For a discussion on this issue, see Athey, Bagwell and Sanchirico (2002).

[23] For a proof of this inequality, see the Appendix.

[24] This point can in fact be stressed somewhat further by highlighting that - as is well known - whenever asymmetry in payoffs during the punishment phase can be increased without substantially sacrificing efficiency, the mechanism's payoff will also increase. To see this, note that from (21) it can be assessed that the mechanism's payoffs is increasing in the difference $\left(W^R - W^P\right)$ as long as the following condition holds:

To summarize, our argument is as follows. Suppose that instead of letting governments freely adjust their tariffs, they are forced to fix them at a pre-specified rate: in particular, they fix them at the rate $\bar{\tau}$ that maximizes joint expected welfare. Then, there is an equilibrium which does strictly better. In such an equilibrium, governments are allowed to adjust their tariffs in line with their announcements. High announcements by any one of them, however, increase the likelihood of entering a second phase in which: a) the government that initiated the phase must set its tariff below $\bar{\tau}$, and b) its trading partner must set its tariff above $\bar{\tau}$. Observationally, our mechanism would imply that - for any one government - periods of intensive use of tariffs relative to its trading partner should alternate with periods in which the opposite holds.

A last issue we want to point our is the following: although the mechanism is welfare improving, it could well be the case that it requires higher levels of patience than the rigid scheme which it manages to outperform. In other words, the mechanism could fail to be an equilibrium for some patience levels that nonetheless support the rigid scheme. If this were the case, it is hard to argue that the former does unequivocally better than the latter. This issue has not been addressed in Aoyagi [3], but we believe it to be important when comparing or judging different mechanisms. In the next lemma, we prove that our mechanism can be supported for weakly lower levels of patience than the optimal rigid rule. This allows us to confirm that the asymmetric mechanism can 'fully' improve upon the rigid rule, i.e., it can do so for a given level of patience.

Lemma 5 *The critical patience level needed to avoid deviations in the mechanism involving retaliation is weakly lower than the one required to support the underlying optimal rigid rule.*

Proof. See Appendix. ■

5.4 Example[25]

We now illustrate our results for the benchmark parametrization mentioned previously. For matters of convenience and comparison we take the parameters to be very similar to the ones used by Bagwell and Staiger [10]:

$$\begin{array}{lll} \alpha = 1 & \beta = 1 & \gamma = \frac{1}{2} \\ \phi = 1 & \zeta_L = 1 & \zeta_H = 1.5 \end{array}$$

$$\begin{aligned} \frac{\partial \left(W^P + W^R\right)}{\partial \left(W^R - W^P\right)} &> \frac{W^P + W^R - 2K}{W^R - W^P + 2K} \\ &= -1 + \frac{2W^R}{W^R - W^P + 2K} > -1 \end{aligned}$$

[25] In this section we will confine ourselves to only provide the (numerical) results. For further clarification please contact the authors.

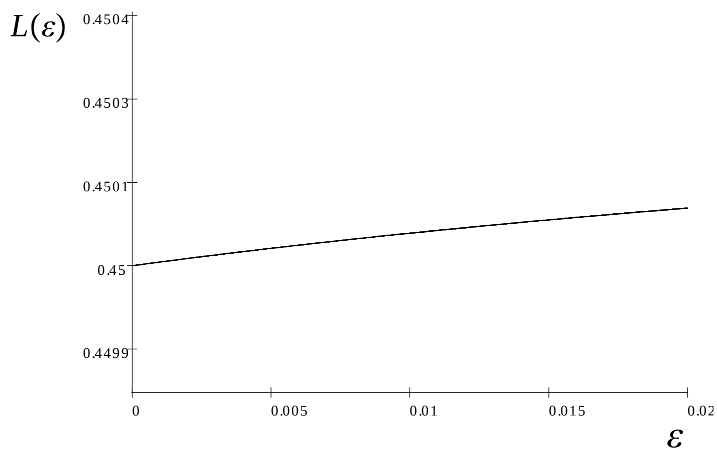

Figure 2: Lower Bound $L(\varepsilon)$

This allows us to compute the tariffs and expected welfare of each of the following regimes

	Nash	Political Optimum	fixed tariff
tariff : $\tau(\zeta)$	$\frac{8\zeta-5}{68-8\zeta}$	$\frac{8\zeta-8}{50-8\zeta}$	0.05
expected welfare	$v^N = 0.44981$	$v^{PO} = 0.45038$	$\bar{v} = 0.45$

We now show the two main results of the last section. First, we demonstrate that the asymmetric mechanism can outperform the best fixed tariff. Later, we show that it can do so for the same levels of patience.

Let us demonstrate the first claim by assuming that - in the punishment phase - the punishing and punished governments set tariffs equal to $\bar{\tau} \pm \varepsilon$ $(0.05 + \varepsilon)$. We can compute the lower bound L to the mechanism's payoff as a function of ε (for small values of ε). $L(\varepsilon)$ is given by the following relationship, which is plotted below.

$$L(\varepsilon) = 0.45 + \frac{0.003\,257\,1\varepsilon}{8.\,571\,4\varepsilon + 0.5831} > \bar{v} \text{ for all } \varepsilon > 0$$

Note that the lower bound of our mechanism's payoff is higher than the expected welfare of the fixed rule. Thus, under our parametrization, governments should set $\bar{\tau} = .05$ if they want to adopt a fixed rule. However, they can increase their expected welfare by announcing their preferences and adjusting their tariffs according to their announcements. This is done by letting higher announcements increase the likelihood of being punished, i.e., of entering a phase in which the punished government is forced to set tariffs at lower levels than its trading partner.

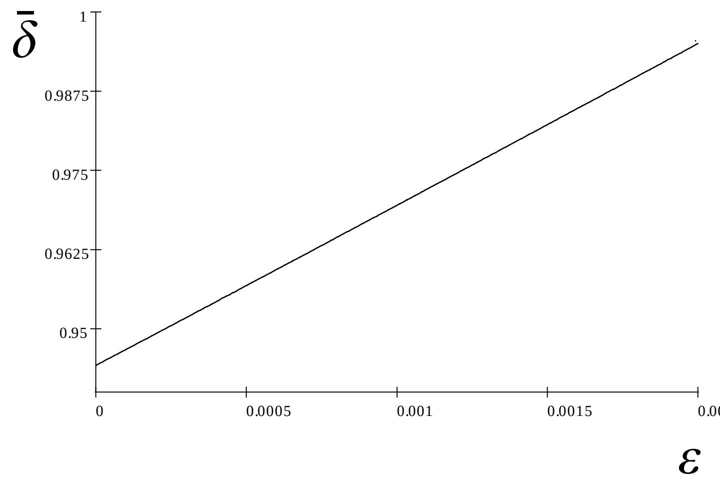

Figure 3: Lower Bound on Patience Levels

We now tackle the second issue: patience. Playing the fixed tariff each period yields current expected welfare $\bar{W}(\zeta)$ and lifetime expected welfare $\bar{v}$. In order to support this scheme we need to deter governments from deviating off-schedule. Let $\bar{\delta}$ be the critical discount factor so that, for all $\delta > \bar{\delta}$, the rigid scheme is supported. It turns out that $\bar{\delta} = 0.944\,19$. We will study how the upper bound on the critical patience level of our asymmetric mechanism changes with different levels of small punishment[26]. Again we consider punishments of size ε. The results can readily be seen from the graph below which displays a strict upper bound for the critical delta for a each (small) level of punishment. In the limit $(\varepsilon = 0)$, not surprisingly, this upper bound is as in the same as fixed tariff case. This confirms our statement that our mechanism fully outperforms the static mechanism as it yields higher expected welfare for every positive level of ε, without needing to sacrifice patience.

6 Discussion and Concluding Remarks

The present paper has tried to interpret empirical evidence regarding the use of AD. On one hand, there is strong support to the idea that governments use AD measures in a retaliatory fashion. Additionally, the use of AD seems to be significantly influenced by political lobbying, at least in the United States.

How are we to reconcile our model with the existing evidence? If the evidence were to be interpreted in an extreme way, it could be said that there is no such thing as *antidumping* measures, only premiums added to tariffs on the basis of political preferences. Of course, some of the use

[26] We only focus on incentives in the asymmetric punishment phase. In the symmetric phase a higher level of patience than $\bar{\delta}$ leads to a direct contradiction with $\bar{\tau} = 0.05$, since $\bar{\tau} < \tau^{PO}(\zeta^H) = \frac{2}{19}$(see appendix).

of AD does in fact respond to the existence of dumped imports: in any case, the latter can be explained through the traditional economic reasoning, and our model deals only with the strategic use of this instrument.

If it is assumed that baseline tariffs are relatively stable, and AD is used as a way to accommodate them to shifting political preferences, then a theory of retaliatory AD is essentially a theory of retaliatory tariffs. This is exactly the story behind our model, although some clarification is required.

In the first place, the fact that it is efficient for tariffs to change in light of changing political preferences does not seem very controversial: the problem is, what is to keep governments from abusing such an instrument in order to influence terms of trade in their favor? We have tried to answer this question by analyzing different scenarios: in particular, we have shown that an adequate system of transfers or export subsidies will prevent governments from misreporting their preferences, thus achieving efficiency on a per-period basis. The use of transfers, however, is rarely observed in the world, whereas the use of subsidies is restricted both by WTO/GATT and - potentially - by liquidity constraints.

Once we remove these policy instruments, then, we are left only with import tariffs. We show that, in such a scenario, it might well be that some degree of retaliation is welfare enhancing with respect to a static rule regulating the use of AD. Governments accommodate their tariffs to shifting political preferences, but high reports by any one of them today - and, therefore, higher tariffs today - will generate higher expected tariffs on behalf of their trading partner tomorrow. Thus, it's retaliation and the threat of retaliation what achieves incentive compatibility in our model.[27]

Of course, our model is admittedly oversimplified in treating AD simply as tariffs which may be freely adjusted by governments. This simplification, though, does not seem substantially restrictive if - as the critics of AD claim - this instrument is to a large degree being used in an arbitrary fashion that bears little relation to the objectives for which it was created. In this sense, it is important to highlight the extent to which the debate over AD has spread when compared to other policy instruments, such as safeguards: one of the reasons which might account for the difference in the treatment dispensed to these apparently similar instruments seems to be precisely that the way in which the latter is designed discourages governments from using it arbitrarily. In fact, not only is the standard for establishing injury stricter under a safeguard action than under AD regulations[28], but - for the period to which the cited empirical studies refer - the use of safeguards has also

[27] We must stress, once more, that we have tried to convey the point in the way which seemed most straightforward for the purposes of this paper. An alternative approach would have been to allow for the existence of reputational stocks between governments, so that higher announcements by any one of them allow the other government to increase future expected tariffs. We felt, however, that such a mechanism would be too involved and distractive of our main argument: the interested reader can get a flavor of this alternative from our working paper [**?**].

[28] In particular, the domestic industry must demonstrate the presence or threat of *serious* injury.

entailed compensation for the damaged party.[29]

In spite of these simplifications, however, we feel that the idea we have tried to convey is simple enough while being consistent with the evidence regarding the use of AD: namely, than in a world of restricted instruments, the strategic or retaliatory use of the remaining ones may be the most efficient way to deal with hidden information. In Tinbergen's terms, it could be said that the instruments available to countries should be analyzed jointly and in relation to the objectives which are to be attained. We believe that this should be kept in mind when designing rules for international cooperation since, in restricting the use of some of the instruments usually available to governments, these rules might trigger the use of other instruments in new and unforeseen ways.

To conclude, we comment briefly on what is possibly the main shortcoming of our setting: the use of random, i.i.d. political preferences. On this point, we believe that the use of political preferences which are correlated over time would provide a more realistic and appealing view of the problem, and we leave this extension as an area for future research.

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"When a country restricts imports in order to safeguard its domestic producers, in principle it must give something in return. The agreement says the exporting country (or exporting countries) can seek compensation through consultations. If no agreement is reached the exporting country can retaliate by taking equivalent action for instance, it can raise tariffs on exports from the country that is enforcing the safeguard measure. In some circumstances, the exporting country has to wait for three years after the safeguard measure was introduced before it can retaliate in this way..."

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7 Appendix[30]

7.1 Repeated Model with Transfers and Tariffs

In the presence of transfers and tariffs, the welfare of home would be defined as,

$$W(\sigma, C) = W_x(\tau_x^{PO}(\hat{\zeta}), \zeta) + t(\hat{\zeta}) + \int_{\zeta^L}^{\zeta^H} W_y(\tau_y^{*PO}(\zeta^*))g(\zeta^*)d\zeta^* + v \tag{22}$$

where we assume the use of an obedient tariff rule and $\tau_x^{PO}(\hat{\zeta})$ denotes the politically optimal tariff, $t(\hat{\zeta})$ denotes the transfer instructed by the center and v represents the continuation payoff.

Local on-schedule incentive compatibility then requires that,

$$\frac{\partial W}{\partial \hat{\zeta}}_{|\hat{\zeta}=\zeta} = 0$$

which, in terms of (22), implies

$$\frac{\partial W_x}{\partial \hat{\zeta}}_{|\hat{\zeta}=\zeta} + t'(\zeta) = (W_{p_x^w}\frac{\partial p_x^w}{\partial \tau_x} + W_{p_x}\frac{\partial p_x}{\partial \tau_x})\frac{\partial \tau_x^{PO}(\zeta)}{\partial \zeta} + t'(\zeta) = 0 \tag{23}$$

[30] Some of the proofs contained in this Appendix are almost exact replicas of those contained in Aoyagi (2003). Nonetheless, we choose to reproduce them here for the reader's convenience.

Obviously, then, any instruction rule that calls for the use of politically optimal tariffs and a transfer function that satisfies,

$$t'(\zeta) = -W_{p_x^w} \frac{\partial p_x^w}{\partial \tau_x} \frac{\partial \tau_x^{PO}(\zeta)}{\partial \zeta} \tag{24}$$

will be enough to achieve efficiency while satisfying on-schedule incentive compatibility constraints (henceforth, we denote a transfer function satisfying (24) as $\hat{t}$). In the first place, such an instruction rule will make it optimal for importing countries to truthfully reveal their type, for the simple reason that the incentive to over-represent disappears through the transfer.[31] Additionally, efficiency is guaranteed by the fact that the instruction rule entails the use of politically optimal tariffs for all reports: since the latter will be truthful, import tariffs will consequently be set at their efficient levels.

The last issue we need to address is whether the off-schedule incentive compatibility constraints are satisfied. In other words, will both countries use efficient tariff rules? Since, as we said before, observable deviations trigger Nash-reversion, this will be the case if countries are sufficiently patient. This proves our proposition.

7.2 Proof of Existence Theorem

First note that because of Nash reversion in the presence of observable deviations, the latter are easily deterred if $v^M > v^N$. Let $v > v^N$ be a solution to (20). Then choose T such that,

$$T > \frac{1}{(v - W^P)} \int_{\zeta_L}^{\zeta_H} \frac{1}{F(\varphi)} \left(\frac{\partial W^{PO}(\varphi)}{\partial \varphi} g(\varphi) \right) d\varphi \tag{25}$$

Since $v > v^N$ by assumption, it is clear that there exists a value $\bar{\delta} < 1$ above which off-schedule deviations are avoided. Additionally, note that (25) also assures us that

$$\frac{(1-\delta)}{\delta(1-\delta^T)(v - W^P)} \int_{\zeta_L}^{\zeta_H} \frac{1}{F(\varphi)} \left(\frac{\partial W^{PO}(\varphi)}{\partial \varphi} g(\varphi) \right) d\varphi < 1 \tag{26}$$

since

$$\lim_{\delta \to 1} \frac{(1-\delta)}{\delta(1-\delta^T)} = \frac{1}{T}$$

meaning that T can always be chosen large enough so as to make (26) be smaller than one.

Thus, given a discount factor $\delta > \bar{\delta}$ we define the probability of transition to the asymmetric stage A when home's report is higher than that of foreign as,

[31] Global incentive compatibility is given by the fact that our model satisfies the SCP, since the marginal welfare of an increase in the domestic price of the import good increases with ζ.

$$\pi(\hat{\zeta}) = \frac{(1-\delta)}{\delta(1-\delta^T)(v-W^P)} \int_{\zeta_L}^{\hat{\zeta}} \frac{1}{F(\varphi)} \left(\frac{\partial W^{PO}(\varphi)}{\partial \varphi} g(\varphi) \right) e^{-\frac{(W^R - W^P)}{(v-W^P)} \int_{\varphi}^{\hat{\zeta}} \frac{g(v)}{F(v)} dv} d\varphi \qquad (27)$$

which is indeed a probability due to our choice of T and δ.

Following Aoyagi (2003), we divide the existence proof into three steps. After fixing T, v and $\delta > \bar{\delta}$, we first prove that each government's payoff is indeed v when playing the honest and obedient strategy under the mechanism. In a second and third step we show that the on- and off-schedule incentive compatibility constraints are satisfied: in addressing these points, we invoke the one-shot deviation property as we explain in the main body of the paper.

Step 1: From (18), we can obtain

$$v = W^{PO} - \frac{\delta(1-\delta^T)}{1-\delta}(2v - W^P - W^R) \int_{\zeta_L}^{\zeta_H} \int_{\zeta_L}^{\hat{\zeta}} \pi(\zeta) d\zeta g(\zeta^*) d\zeta^*$$

If the expression for $\pi(\hat{\zeta})$ derived above is substituted in the previous equation, we obtain equation (20) from the main body of the paper. Since the latter is by assumption solved by v, it follows that $v = v^M$.

Step 2: the off-shcedule IC constraints are satisfied. This can be easily shown to be the case since, by assumption, $v > v^N$. One one hand, the one-shot gain from observable deviations is bounded from above by our welfare assumptions. Additionally, the smallest possible loss from deviation occurs during the first period of punishment, in which expected welfare yielded by the mechanism is given by,

$$(1-\delta^T)W^P + \delta^T v$$

Thus, there exists a critical value of δ, which we previously denoted by $\bar{\delta}$, such that for all $\delta > \bar{\delta}$ off-schedule deviations are avoided.

Step 3: on-schedule IC constraints are satisfied. Note that reports do not influence payoffs in the asymmetric stages A and A^*. Thus, it remains to be checked that the constraints are satisfied in the symmetric stage S. We do so by first showing that these constraints are satisfied locally, and then argue that the presence of a SCP guarantees their being satisfied globally as well.

We use $v(\zeta, \hat{\zeta})$ to denote the interim expected payoff for home when she receives signal ζ and announces $\hat{\zeta}$ (for foreign this is defined analogously) :

$$\begin{aligned} v(\zeta,\hat{\zeta}) &= (1-\delta)\int_{\zeta_L}^{\zeta_H} W^{PO}(\zeta,\zeta^*) g(\zeta^*) d\zeta^* \\ &\quad +\delta \begin{bmatrix} \int_{\zeta_L}^{\hat{\zeta}} \left(v + \pi(\hat{\zeta})(1-\delta^T)(W^P - v) \right) g(\zeta^*) d\zeta^* \\ + \int_{\hat{\zeta}}^{\zeta_H} \left(v + \pi(\zeta^*)(1-\delta^T)(W^R - v) \right) g(\zeta^*) d\zeta^* \end{bmatrix} \end{aligned}$$

which reduces to,

$$
\begin{aligned}
v(\zeta,\hat{\zeta}) &= (1-\delta)\int_{\zeta_L}^{\zeta_H} W^{PO}(\zeta,\zeta^*)g(\zeta^*)d\zeta^* \\
&\quad +\delta\left[\begin{array}{c} v-(1-\delta^T)(v-W^P)F(\hat{\zeta})\pi(\hat{\zeta}) \\ +(W^R-v)(1-\delta^T)\int_{\hat{\zeta}}^{\zeta_H}\pi(\zeta^*)g(\zeta^*)d\zeta^* \end{array}\right]
\end{aligned} \tag{28}
$$

Then local IC implies, since markets are separated, that

$$
\frac{\partial v(\zeta,\hat{\zeta})}{\partial\hat{\zeta}}_{|\zeta=\hat{\zeta}} = 0
$$

which in our setting reduces to

$$
\begin{aligned}
(1-\delta)\frac{\partial W_x^{PO}(\zeta,\hat{\zeta})}{\partial\zeta} &= \delta(1-\delta^T)(v-W^P)F(\zeta)\frac{\partial\pi(\zeta)}{\partial\zeta} \\
&\quad +\delta(W^R-W^P)(1-\delta^T)\pi(\zeta)g(\zeta)
\end{aligned}
$$

Note that the previous expression can be reduced to a linear differential equation in π,

$$
\frac{\partial\pi(\zeta)}{\partial\zeta}+\frac{(W^R-W^P)\pi(\zeta)g(\zeta)}{(v-W^P)F(\zeta)} = \frac{(1-\delta)\frac{\partial W_x^{PO}(\zeta,\zeta)}{\partial\zeta}}{\delta(1-\delta^T)(v-W^P)F(\zeta)}
$$

which is in turn satisfied by π as defined in (27). Thus, with the probability of entering the asymmetric stage defined in the aforementioned manner, the on-schedule IC constraints are locally satisfied in the symmetric stage of the collusive phase.

It thus remains only to show that the IC constraints are also satisfied globally. In our setting, this follows directly from the SCP. In fact, note from (28) that

$$
\frac{\partial v(\zeta,\hat{\zeta})}{\partial\hat{\zeta}\partial\zeta} = (1-\delta)\frac{\partial W^{PO}(\hat{\zeta},\zeta)}{\partial\hat{\zeta}\partial\zeta} > 0
$$

since there is no effect of a country's current type on its continuation payoffs, which depend only the announcements. Thus, since countries with higher political economy parameters place relatively higher values on tariff increases, we are guaranteed that the on-schedule IC constraints are satisfied globally, which concludes the proof of the theorem.

7.3 Proof of Inequality (21)

Note that (20) has a solution between $\frac{(W^P+W^R)}{2}$ and W^{PO}. This stems from the fact that $y(v) > 0$ whenever $v > W^P$, so that

$$
\begin{aligned}
\phi(W^{PO}) &= \frac{2W^{PO} - W^P - W^R}{W^{PO} - W^P} y(W^{PO}) > 0 \\
\phi(\frac{W^P + W^R}{2}) &= \frac{W^P + W^R}{2} - W^{PO} < 0
\end{aligned}
$$

By the intermediate value theorem there exists $\hat{v} \in (\frac{W^P + W^R}{2}, W^{PO})$ that makes $\phi(\hat{v}) = 0$. In turn, for any such solution $\hat{v}$ and ζ we can write,

$$
\int_{\zeta_L}^{\zeta} \frac{1}{F(\varphi)} \left(\frac{\partial W^{PO}(\varphi)}{\partial \varphi} g(\varphi) \right) e^{-\frac{(W^R - W^P)}{(\hat{v} - W^P)} \int_{\varphi}^{\zeta} \frac{g(v)}{F(v)} dv} d\varphi =
$$

$$
\left[\left(\frac{\partial W^{PO}(\varphi)}{\partial \varphi} \right) \frac{(\hat{v} - W^P)}{(W^R - W^P)} e^{-\frac{(W^R - W^P)}{(\hat{v} - W^P)} \int_{\varphi}^{\zeta} \frac{g(v)}{F(v)} dv} \right]_{\zeta_L}^{\zeta}
- \int_{\zeta_L}^{\zeta} \left(W''^{PO}(\varphi) \right) \frac{(\hat{v} - W^P)}{(W^R - W^P)} e^{-\frac{(W^R - W^P)}{(\hat{v} - W^P)} \int_{\varphi}^{\zeta} \frac{g(v)}{F(v)} dv} d\varphi
$$

$$
\begin{aligned}
< \quad & W'^{PO}(\zeta) \frac{(\hat{v} - W^P)}{(W^R - W^P)} - W'^{PO}(\zeta_L) \frac{(\hat{v} - W^P)}{(W^R - W^P)} \alpha(\zeta_L, \zeta) - \\
& - \int_{\zeta_L}^{\zeta} \left(W''^{PO}(\varphi) \right) \frac{(\hat{v} - W^P)}{(W^R - W^P)} d\varphi
\end{aligned}
\tag{29}
$$

where $\alpha(\zeta_L, \zeta) = e^{-\frac{(W^R - W^P)}{(\hat{v} - W^P)} \int_{\zeta_L}^{\zeta} \frac{g(v)}{F(v)} dv}$. Note that it is possible to rewrite (29) as

$$
\begin{aligned}
= \quad & W'^{PO}(\zeta) \frac{(\hat{v} - W^P)}{(W^R - W^P)} - W'^{PO}(\zeta_L) \frac{(\hat{v} - W^P)}{(W^R - W^P)} \alpha(\zeta_L, \zeta) - \\
& \frac{(\hat{v} - W^P)}{(W^R - W^P)} (W'^{PO}(\zeta) - W'^{PO}(\zeta_L))
\end{aligned}
$$

$$
\begin{aligned}
&= W'^{PO}(\zeta_L) \frac{(\hat{v} - W^P)}{(W^R - W^P)} (1 - \alpha(\zeta_L, \zeta)) \\
&< W'^{PO}(\zeta_L) \frac{(\hat{v} - W^P)}{(W^R - W^P)}
\end{aligned}
$$

It follows then that,

$$\begin{aligned} y(v) &< \int_{\zeta_L}^{\zeta_H} \int_{\zeta_L}^{\zeta} W'^{PO}(\zeta_L) \frac{(\hat{v} - W^P)}{(W^R - W^P)} d\zeta^* g(\zeta) d\zeta \\ &= \frac{(\hat{v} - W^P)}{(W^R - W^P)} K \end{aligned}$$

where

$$\begin{aligned} K &= W'^{PO}(\zeta_L) \int_{\zeta_L}^{\zeta_H} \int_{\zeta_L}^{\zeta} d\zeta^* g(\zeta) d\zeta \\ &= W'^{PO}(\zeta_L) \int_{\zeta_L}^{\zeta_H} (\zeta - \zeta_L) \frac{1}{\zeta_H - \zeta_L} d\zeta \\ &= W'^{PO}(\zeta_L) \frac{\zeta_H - \zeta_L}{2} \end{aligned}$$

Therefore, from (20) it follows that

$$\hat{v} \geq W^{PO} - \frac{2\hat{v} - W^P - W^R}{W^R - W^P} K$$

which delivers (21) when one solves for $\hat{v}$.

7.4 Delta comparison

Although we have shown that our (asymmetric) mechanism can outperform any optimal rigid scheme, it might concern us that this gain in efficiency could come at a cost in terms of patience. We prove we need not worry as our mechanism can be sustained at weakly lower levels of patience than the optimal rigid scheme which it outperforms.

Lemma 6 *Define $\bar{\delta}$ as the critical level of patience needed to support the best fully rigid scheme. The asymmetric mechanism can outperform the latter for weakly lower levels of patience.*

Proof. Again, let's pick the best fully rigid scheme: the fixed tariff that ex ante maximizes joint welfare, $\bar{\tau}$. Playing this tariff each period yields current expected welfare $\bar{W}(\zeta)$ and lifetime expected welfare $\bar{v}$. In order to support this scheme we need to deter countries from deviating off-schedule. Let $\bar{\delta}$ be the critical discount factor so that, for all $\delta > \bar{\delta}$, the rigid scheme is supported. This is the case when :

$$(1 - \delta) W_x^{BR}(\zeta) + \delta v^N = (1 - \delta) \bar{W}_x(\zeta) + \delta \bar{v}$$

$$\bar{\delta} = \max_{\zeta} \left\{ \frac{W_x^{BR}(\zeta) - \bar{W}_x(\zeta)}{W_x^{BR}(\zeta) - \bar{W}_x(\zeta) + \bar{v} - v^N} \right\}$$

Where $W_x^{BR}(\zeta)$ is the welfare in the import market from deviating to the current best response for a given political preference.

Since we wish to prove that the asymmetric mechanism requires a discount factor lower than $\bar{\delta}$ while still outperforming the rigid benchmark, we assume arbitrarily low levels of asymmetry. Taking this into account, we proceed in two steps: first, we show that the discount factor needed to support off-schedule IC in the asymmetric phase is lower than $\bar{\delta}$. Then we repeat the same argument for the symmetric phase.

Note that, as we have mentioned previously in the appendix, the critical level of patience required to support the asymmetric mechanism (δ^*) is also determined by the off-schedule constraint. Indeed, the on-schedule constraints are *independent* of the discount factor since they can always be taken care of by adjusting the length of the punishment T.

1. Asymmetric phase: note that the highest incentive to deviate in the asymmetric phase occurs in its first period. Hence we focus on the latter and determine, in the same fashion as above, the critical patience level δ^* in the asymmetric phase to be:

$$(1-\delta^*)W_x^{BR}(\zeta) + \delta^* v^N = (1-\delta^*)W_x^P(\zeta) + \delta^*[(1-\delta^{*T-1})W^P + \delta^{*T-1}v]$$

But since the mechanism outperforms the rigid scheme, we have that $v > \bar{v}$ and we can write

$$(1-\delta^*)W^{BR}(\zeta) + \delta^* v^N > (1-\delta^*)W_x^P(\zeta) + \delta^*[(1-\delta^{*T-1})W^P + \delta^{*T-1}\bar{v}] \tag{30}$$

Consider now the latter term: for W^P close to $\bar{v}$, there exists some small $\varepsilon > 0$ for which the following holds,

$$\begin{aligned} (1-\delta^*)W_x^P(\zeta) + \delta^*[(1-\delta^{*T-1})W^P + \delta^{*T-1}\bar{v}] \\ = \\ (1-\delta^*)\bar{W}_x(\zeta) + \bar{v}\delta^* - \varepsilon \end{aligned} \tag{31}$$

So that by replacing (30) into (31) we obtain,

$$\delta^* < \max_{\zeta} \left\{ \frac{W^{BR}(\zeta) - W_x^P(\zeta) - \varepsilon}{W^{BR}(\zeta) - W_x^P(\zeta) + \bar{v} - v^N} \right\}$$

But for every small ε the asymmetric mechanism outperforms the rigid benchmark and, in the limit,

$$\delta^* < \max_{\zeta} \left\{ \frac{W^{BR}(\zeta) - W_x^P(\zeta)}{W^{BR}(\zeta) - W_x^P(\zeta) + \bar{v} - v^N} \right\} = \bar{\delta}$$

which proves that a lower level of patience is needed in order to avoid off-equilibrium deviations in the asymmetric phase.

2. Symmetric Phase: we now prove that, if the rigid rule is optimal, the level of patience needed to avoid off equilibrium deviations along the symmetric phase is also lower than $\bar{\bar{\delta}}$.

For any given δ, the benefit of deviating off-equilibrium (assuming truthfulness) at the symmetric phase for a country of type ζ is given by

$$(1-\delta)W_x^{BR}(\zeta) + \delta v^N - (1-\delta)W_x^{PO}(\zeta) - \delta v(\zeta)$$

Note that it is always the highest type - ζ^H - the one for whom the previous difference is maximized. This can be easily seen by differentiating the expression, yielding,

$$(1-\delta)\frac{\partial W_x^{BR}(\zeta)}{\partial \zeta} - (1-\delta)\frac{\partial W_x^{PO}(\zeta)}{\partial \zeta} \tag{32}$$

A few things must be said about this differentiation. When the type changes, there is a direct impact on welfare (through the political preference parameter) and an indirect impact which is channeled through tariffs. However, the latter does not have any effects. In the case of best response tariffs, this is due to the envelope theorem, while in the case of politically optimal tariffs, this is due to the fact that the mechanism satisfies on-schedule incentive compatibility along the symmetric phase. Thus, the only determinant of (32) is the direct impact of an increase in type on a government's welfare, which in turn is increasing in producers' surplus: since the latter is always higher under best-response tariffs than under their PO counterparts, (32) does not have an interior maximum and is greatest for ζ^H.

Let's assume that the maximum gain from off-schedule deviations in the symmetric phase is higher than the one corresponding to the optimal rigid rule. Due to our previous discussion, this must imply that,

$$\begin{aligned}(1-\delta)W_x^{BR}(\zeta^H) + \delta v^N - (1-\delta)W_x^{PO}(\zeta^H) - \delta v(\zeta^H) \\ > \\ (1-\delta)W_x^{BR}(\zeta^H) + \delta v^N - (1-\delta)\bar{W}_x(\zeta^H) - \delta \bar{v}\end{aligned}$$

Which in turn reduces to,

$$\bar{W}_x(\zeta^H) - W_x^{PO}(\zeta^H) > \frac{\delta}{(1-\delta)}(v(\zeta^H) - \bar{v})$$

Obviously, for low levels of punishment $(v(\zeta^H) - \bar{v}) > 0$. Hence, the only way in which the above inequality could be satisfied is if $\bar{W}_x(\zeta^H) > W_x^{PO}(\zeta^H)$. But the latter inequality would in turn imply that $\bar{\tau} > \tau^{PO}(\zeta^H) > \tau^{PO}(\zeta)$ for all other values of ζ. This clearly contradicts $\bar{\tau}$ being an optimal rigid rule, since expected welfare could be increased by lowering it. ■