Should WTO Dispute Settlement Be Subsidized?

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Abstract

This paper develops a model of the WTO dispute settlement process (DSP) to study the proposal of subsidizing litigation costs. The high cost of litigation, so the argument, is a major obstacle for developing countries to using the DSP to enforce developed countries' compliance with WTO rules. The paper shows that this proposal may be misguided. In particular, a reduction of litigation costs may lead protectionist countries to impose larger trade impediments where before they may have raised barriers only a little. Thus, a cost reduction may even weaken the less protectionist countries' position in the DSP. Moreover, the model sheds light on the structure of the dark figure of un-accused offenses, suggesting that the observed record of disputes notified to the WTO is systematically biased.

Keywords: Protectionism, Dispute Settlement, GATT/WTO, Tariff Retaliation, Trade Disputes

JEL Classifications: F13, K33, O19

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1 Introduction

An essential change in the course of the transformation of the General Agreement on Tariffs and Trade (GATT) to the World Trade Organization in 1995 was the institutionalization of a Dispute Settlement System. From 1995 until the end of 2005 there were 335 disputes notified to the WTO, consisting of 368 individual countries' complaints. The major share of these complaints (222) was filed by high income countries and against high income countries (235), while there have been only 22 complaints and 21 defences by low-income countries.[1] This extremely asymmetric usage of the DSS has been traced back to an institutional bias of the DSS by scholars from the fields of economics, law and politics. A prominent proposal to overcome this supposed bias of the DSS is a reduction of litigation costs.[2]

Apart from the cost reduction proposal, the paper analyzes the supposed bias of the DSP as such. Some empirical studies have already examined whether or not the unbalancedness of the record of disputes with respect to income groups indicates a systematic bias of the DSS against poorer countries. In the pioneering paper by Horn et al. (1999) the hypothesis that a dispute in a given bilateral product-market-pairing (PMP) occurs randomly is tested empirically. The PMP-approach explains the observed pattern of disputes quite accurately, since bigger and richer countries with more PMPs are supposed to be involved in more disputes than smaller and poorer countries with less PMPs. Another empirical paper by Guzman and Simmons (2005) analyzes the pattern of disputes in terms of the complainants' and respondents' GDP. The authors reject the "power hypothesis" which *"...predicts that countries will file fewer complaints if they are poor and politically weak than if they are rich and politically powerful."*[3]

Although these empirical findings basically reject the hypothesis of a biased system, there is reason to believe that an institutional bias exists, even if it does not show up in the data. It is a known result in trade theory that a larger country may improve its welfare by offending a trade agreement with a smaller trading partner, even if the smaller

[1] The figures on the notified disputes are taken from the author's own dataset, which is based on the record of disputes on the WTO's website. Income classifications of countries correspond to the Worldbank's classification scheme.

[2] The proposals include legal assistance, financial assistance and the introduction of procedurally simplified "Small Claims" proceedings for complaints of minor value. See for example Busch and Reinhardt (2003) and Footer (2001).

[3] Guzman and Simmons (2005), page 559.

country retaliates.[4] Moreover, developed countries tend to be motivated more strongly by distributional concerns, such as the protection of domestic import substituting industries. Finally, some scholars conjecture that poor countries face higher costs associated with the preparation of a complaint than rich countries do.[5] In the light of just these three arguments it should already become questionable that the observed record of disputes is generated by an unbiased random process. As a matter of fact, up to now there is no information on the dark figure of disputes, which are those cases where a country experienced a violation but did not report it to the WTO. Guzman and Simmons (2005) conclude: *"In the absence of a clear sense of how many cases developing countries 'ought to' have initiated, we really do not know whether these filed cases represent equal access or not."*[6] Therefore, empirical approaches that try to shed light on the question of a systemic bias by considering the mere set of observed disputes, seem to be a dead end.

The theoretical literature on trade agreements is dominated by the employment of an infinitely repeated prisoner's dilemma game in order to explain a country's incentive to comply with, or to offend against a trade agreement.[7] The common ground of these models is the assumption that an offense by one of the trading partners leads to non-cooperative behavior of both trading partners in each of the following periods. As a consequence, existing trade agreements are assumed and required to be self-enforcing, such that the afore mentioned trigger strategy successfully deters countries from defecting.[8] Thus, in contrast to reality, violation and retaliation remain off-equilibrium strategies in these models.

All in all, existing empirical studies' inference is likely to be based on a systematically biased set of observations, while existing theory does not provide an explanation for the occurrence of disputes if one leaves alone the idea that policymakers may be possessed by a

[4] Among the first ones to find this result in theory is Johnson (1953), followed by Kennan and Riezman (1988) with their paper *"Do Big Countries Win Tariff Wars?"*. Syropoulos (2002) shows that this finding is a quite general property of standard trade models.

[5] See Bown (2005), Guzman and Simmons (2005) and Bush and Reinhardt (2003) who argue that costs play an important role in the poorer countries' decision whether or not to file a complaint. See Footer (2001) for a verbal analysis.

[6] Guzman and Simmons (2005), page 591.

[7] Bagwell and Staiger (1999) use a two country approach. Maggi (1999) uses a three country approach of the described fashion.

[8] Bagwell and Staiger (2002), page 99, believe: *"The fundamental deterrent to such behavior, and the deterrent that therefore rests at the foundation of all others, is the fear of initiating a breakdown in the entire cooperative arrangement and thereby causing a 'trade war'."*

"demon" who leads them to irrational behavior from time to time.[9]

In order to be able to (i) explain the observed occurrence of trade disputes and (ii) analyze the effects of the proposed reduction of litigation costs this paper takes a different slant by providing an explicit model of the DSP. The regulations of the Dispute Settlement Understanding (DSU), which governs the rules of retaliation, are taken at face value and applied to a two country tariff setting game. In this setup violation does not necessarily have to be an off-equilibrium strategy. It rather depends upon a country's political economy (PE) parameter and the pertinent level of litigation costs whether or not a trade agreement is violated, and whether or not the offended country decides to file a costly complaint.

The remainder of this paper is organized as follows. Section 2 starts by presenting the underlying two country trading environment. After a brief setup of the model's fundamental equations, the rules of the sequential tariff setting game are introduced. The setup is completed by modeling the WTO's provisions of retaliation. Subsequently the game is solved via backward induction, and best response functions are derived in section 3. The equilibria of the game are presented as functions of the PE paramter and litigation costs. Moreover, the proposal of a reduction of litigation costs is examined in a comparative static analysis. Section 4 aims at generalizing the findings to a broader class of trade models. Finally, section 5 summarizes the results, establishes links to empirical studies in support of the results and points out implications for the dark figure of disputes.

2 Model

The analysis is based on a trade model with two countries $J \in \{A, B\}$, one numeraire good z and two non-numeraire goods $i \in \{a, b\}$. The underlying utility functions are assumed to be quasilinear in both countries: $U(a, b, z) = u_a(a) + u_b(b) + z$. While u_a and u_b are assumed to be strictly concave, the price of z, p_z, is assumed to be fixed at unity. I consider a world with fixed endowments where each country is endowed with one unit of good z, country A is a-abundant and country B is b-abundant.

[9] The concept of a demon is found in Kovenock and Thursby (1992).

2.1 Setup of the Trading Environment

A's demand functions are obtained from the quasilinear utility function $U_A(a,b,z) := a - \frac{a^2}{2} + b - \frac{b^2}{2} + z$, while B's underlying utility function is given by $U_B(a,b,z) := a - \frac{a^2}{2} + b - \frac{b^2}{2} + z$.

A's demand functions for good a and b are given by

$$D_{Aa}(p_a) := 1 - p_a, \tag{1}$$

$$D_{Ab}(p_b) := 1 - p_b. \tag{2}$$

B's demand functions for good a and b are given by

$$D_{Ba}(p_a) := 1 - p_a, \tag{3}$$

$$D_{Bb}(p_b) := 1 - p_b. \tag{4}$$

Let S_{Ji} denote supply of good $i \in \{a,b\}$ in country $J \in \{A,B\}$. Then supplies are given by $S_{Aa} := 1/2$, $S_{Ab} := 1/4$, $S_{Ba} := 1/4$, and $S_{Bb} := 1/2$. Consequently, A becomes an importer of good b and an exporter of good a, while B becomes an importer of good a and an exporter of good b. Trade in the numeraire good z is determined residually by the condition of balanced trade.

By assumption, each country's sole policy variable is a per unit import tariff on its import good. A's import tariff on good b is denoted by τ_{Ab}, while B's import tariff on good a is denoted by τ_{Ba}. Hence, market clearing conditions are given by

$$D_{Aa}(p_a) + D_{Ba}(p_a + \tau_{Ba}) = S_{Aa} + S_{Ba}, \tag{5}$$

$$D_{Ab}(p_b + \tau_{Ab}) + D_{Bb}(p_b) = S_{Ab} + S_{Bb}. \tag{6}$$

Solving for p_a and p_b yields equilibrium world market prices as functions of the associated import tariffs

$$\hat{p}_a(\tau_{Ba}) = \frac{1}{8}(5 - 4\tau_{Ba}), \tag{7}$$

$$\hat{p}_b(\tau_{Ab}) = \frac{1}{8}(5 - 4\tau_{Ab}). \tag{8}$$

Consumer surplus from consumption of good $i \in \{a, b\}$ in country $J \in \{A, B\}$ is given by $CS_{Ji}(p_i) := \frac{1}{2}(p_i - 1)^2$. Producer surplus is simply the initial endowment multiplied by the price. That is $\Pi_{Ji}(p_i) := S_{Ji}p_i$. Tariff revenues are given by $TR_{Ab}(p_b, \tau_{Ab}) := \tau_{Ab}(D_{Ab}(p_b) - S_{Ab})$ and $TR_{Ba}(p_a, \tau_{Ba}) := \tau_{Ba}(D_{Ba}(p_a) - S_{Ba})$.

Welfare

Let country A's welfare be defined as the sum of consumer and producer surpluses and tariff revenue.

Asymmetry between the two countries is introduced by political-economy concerns.[10] In particular, let the import-competing producer's surplus in country B be weighted by a political-economy parameter ζ. Hence, for $\zeta > 1$ country B would put more weight on the well being of its import competing industry than country A did.[11]

Substituting equilibrium prices into the components of the welfare functions, welfare can be expressed as a function of tariffs. Equilibrium welfare of country A is

$$W_A(\tau_{Ab}, \tau_{Ba}) := CS_{Aa}(\tau_{Ba}) + CS_{Ab}(\tau_{Ab}) + \Pi_{Aa}(\tau_{Ba}) + \Pi_{Ab}(\tau_{Ab}) + TR_{Ab}(\tau_{Ab}) \quad (9)$$

$$:= \frac{1}{64}(39 + 4(1 - 6\tau_{Ab})\tau_{Ab} - 4\tau_{Ba} + 8\tau_{Ba}^2), \quad (10)$$

while equilibrium welfare of country B is

$$W_B(\tau_{Ab}, \tau_{Ba}, \zeta) := CS_{Ba}(\tau_{Ba}) + CS_{Bb}(\tau_{Ab}) + \zeta\Pi_{Ba}(\tau_{Ba}) + \Pi_{Bb}(\tau_{Ab}) + TR_{Ba}(\tau_{Ba}) \quad (11)$$

$$:= \frac{1}{64}(29 - 4\tau_{Ab} + 8\tau_{Ab}^2 + 2\zeta(5 + 4\tau_{Ba}) - 4\tau_{Ba}(1 + 6\tau_{Ba})). \quad (12)$$

Note that both welfare functions are concave in each country's own tariff and decreasing in

[10] An earlier version of this paper, Wilckens (2007), introduces asymmetry by means of differences in country size.

[11] In the remainder of this paper, the weight that the government of B attributes to its import competing industry's surplus may be referred to as the degree of country B's protectionism.

the other country's tariff.[12] The pair of optimal tariffs τ^*_{Ab} and τ^*_{Ba} is given by

$$\tau^*_{Ab} = \frac{1}{12}, \tag{13}$$

$$\tau^*_{Ba}(\zeta) = \frac{1}{12}(2\zeta - 1). \tag{14}$$

While A's optimal tariff is a constant, B's optimal tariff is increasing in its PE parameter and equals A's optimal tariff at $\zeta = 1$. Focussing the analysis on the set of non-negative tariffs, it is assumed that $\zeta \in [1/2, \infty)$

So far each country's optimal tariff is independent of the opponent's tariff. Interaction between the tariff choices of both countries will now be established by means of a sequential game.

2.2 Trade Disputes as Sequential Games

Suppose that there are two WTO members, and that these countries have committed themselves to an initial free trade agreement. That is, both τ_{Ab} and τ_{Ba} have to be equal to zero in order to fulfill the agreement.[13] Under such a type of agreement, countries could be tempted to violate the agreement by a unilateral increase of the import tariff in order to benefit from an increase in their own welfare.[14]

Let B be the first mover in this sequential game. B, our "bad guy", will decide whether or not to violate the agreement, by raising its tariff. A, being the second mover, observes the choice of the first mover. In case the first mover violates the agreement, the second mover can choose between doing nothing and filing a complaint at costs c at the Dispute Settlement Body (DSB) in order to be entitled to retaliate against B.[15]

[12] Consider Appendix 6.1 for a discussion and proofs of the welfare functions' properties.

[13] With regard to the Bagwell and Staiger literature, some scholars probably dislike the assumption of a symmetric initial (free) trade agreement between countries with asymmetric PE parameters. To these readers it may be suggested to imagine a symmetric trade agreement with side payments from the country with the smaller PE parameter to the one with the larger PE parameter. Consequently, what is labeled as an initial offense of B against A would not turn out to become a real offense. It would rather constitute B's threat point to extract side payments from A. Hence, the analysis of the comparative static reduction of litigation costs could be seen as an analysis of how threat points would change.

[14] A typical WTO example for such a situation would be a WTO member's obligation to grant every trading partner an import tariff that is lower than or equal to its Most-Favored-Nation import tariff, while at the same time this particular member possibly would like to discriminate among its trading partners by setting different import tariffs.

[15] Litigation costs can be thought of as incorporating the direct monetary costs of hiring a law firm or a

Although the typical dispute settlement process consists of multiple stages, starting with a request for consultations, via the ruling of panel and appellate body, up to the request for the suspension of concessions, in this model it is reduced to a single decision of the second mover (to complain or not to complain).[16]

The DSU states that *"[t]he level of the suspension of concessions or other obligations authorized by the DSB shall be equivalent to the level of the nullification or the impairment."*[17]

While the exact method of calculating the level of nullification or impairment is left to the discretion of the ruling panel, in legal practice a counterfactual trade value approach has been applied in many cases.[18] The trade value approach compares price times quantity of the traded good before and after the implementation of the disputable trade measure. The difference between these two trade values is seen as the level of nullification or impairment suffered by the complainant. Or, in terms of the model at hand, the damage to the second mover.

The trade value of B's import good TV_a, is simply B's import demand times the equilibrium world market price: $TV_a(\tau_{Ba}) := \hat{p}_a(\tau_{Ba})(D_{Ba}(\hat{p}_a(\tau_{Ba}) + \tau_{Ba}) - S_{Ba})$. Consequently, the reduction in the trade value due to an increase in B's import tariff is given by

$$\Delta TV_a(\tau_{Ba}) := TV_a(0) - TV_a(\tau_{Ba}) \tag{15}$$

$$:= \frac{1}{8}\tau_{Ba}(2\tau_{Ba} - 3). \tag{16}$$

Analogously the change in trade value of good b is

$$\Delta TV_b(\tau_{Ab}) := TV_b(0) - TV_b(\tau_{Ab}) \tag{17}$$

$$:= \frac{1}{8}\tau_{Ab}(2\tau_{Ab} - 3). \tag{18}$$

consulting company in the course of the preparation of the complaint as well as the loss of political goodwill of the trading partner. Nordström (2005) emphasizes the role of direct monetary litigation costs and provides data on its composition.

[16] This simplification of the legal process is achieved by assuming (i) the presence of perfect information, (ii) perfect monitoring and (iii) absence of legal failure. While perfect monitoring means that a violation of the trade agreement will always be detected by the harmed victim, the absence of legal failure means that the panel judges every violation to be a violation.

[17] DSU Article 22, para 4.

[18] See Jordan (2005), pages 119-124 for a discussion of the employed calculation methods. The dominating method, which is used in this paper, was employed for example in the following cases: WT/DS26 EC-Hormones, WT/DS27 EC-Bananas, WT/DS160 US-Copyright.

The equivalence condition cited above requires that the retaliatory distortion of the trade value has to be less than or equal to the distortion that was caused by the initial violation. This condition holds if $\Delta TV_b(\tau_{Ab}) \leq \Delta TV_a(\tau_{Ba})$. Solving this expression for τ_{Ab} yields A's maximum admissible retaliatory tariff $\tau_{Ab}^{eq}(\tau_{Ba})$ as a function of B's tariff. In the explicit example at hand, countries are symmetric, such that the functional relation between the two tariffs is the identity, i.e. $\tau_{Ab}^{eq}(\tau_{Ba}) := \tau_{Ba}$.[19]

The Dispute Settlement System's equivalence condition thus creates a strategic link between B's violative tariff on imports of good a and A's retaliatory tariff on imports of good b.

3 Strategic Behavior

Due to the assumption of perfect information, the subgame perfect equilibrium strategies are found by backward induction, starting with A as the second mover.

3.1 The Second Mover's Best Response

For a given violation of the initial free trade agreement A, has to make two decisions. First, how much to retaliate within the permitted interval $\tau_{Ab}^r \in [0, \tau_{Ab}^{eq}]$. Second, whether or not to file a complaint at costs c in order to be entitled to retaliate with τ_{Ab}^r.

Earlier calculations have shown that A would maximize its welfare by setting its optimal tariff $\tau_{Ab}^* = 1/12$ if it faced an unrestricted optimization problem.[20] However, if the equivalence condition restricts A's retaliation to a level below τ_{Ab}^*, A will completely exploit the admissible retaliation tariff. Hence, A's retaliatory tariff τ_{Ab}^r is given by:

$$\tau_{Ab}^r = \min\{\tau_{Ab}^*, \tau_{Ab}^{eq}(\tau_{Ba})\} \tag{19}$$

It remains to analyze whether or not A will retaliate at all.

[19]Note that for models of asymmetric country size, τ_{Ab}^{eq} would be an algebraic less trivial function of τ_{Ba} and the country size.

[20]Since A's welfare is a continuous function of its import tariff, which is strictly increasing in the interval between zero and τ_{Ab}^*, it follows that A's welfare-maximizing retaliatory tariff τ_{Ab}^r has an upper bound at its optimal tariff τ_{Ab}^*.

3.1.1 Necessary Condition for Retaliation

A will retaliate whenever the welfare gain from retaliation is higher than litigation costs (i.e. $W_A(\tau^r_{Ab}, \tau_{Ba}) - W_A(0, \tau_{Ba}) > c$ has to hold). Since the maximum achievable welfare gain is realized when A sets τ^*_{Ab} as its retaliatory tariff, it follows that litigation costs are prohibitively high if $c \geq W_A(\tau^*_{Ab}, \tau_{Ba}) - W_A(0, \tau_{Ba})$. This condition states that litigation costs are prohibitive whenever welfare from complaining and retaliating is lower than welfare from doing nothing, even though the complainant is entitled to set its optimal tariff. The consequence of such prohibitively high litigation costs would be a breakdown of the strategic link between B's and A's actions.[21] Therefore, the remainder of the analysis focuses on the case of non-prohibitive costs, such that $c \in [\underline{c}, \bar{c})$, where $\underline{c}$ stands for zero costs, and $\bar{c}$ stands for prohibitive costs.[22]

3.1.2 Sufficient Condition for Retaliation

While A's litigation costs are exogenously determined, the admissible level of A's retaliatory tariff $\tau^{eq}_{Ab}(\tau_{Ba})$ depends positively upon the level of B's initial violation. As a consequence, there will be a set of values of c and τ_{Ba} that leads A to be indifferent between retaliating and not retaliating. Since the model has tariffs as strategic instruments, it is convenient to express the locus of A's indifference in terms of B's tariff τ_{Ba}. Setting A's welfare gain from retaliation equal to litigation costs, one can solve for B's tariff that leads A to be indifferent between retaliating and not retaliating, as a function of c. This indifference-inducing tariff of B is denoted as $\tau^i_{Ba}(c)$ in the following.

$$\tau^i_{Ba}(c) = \frac{1}{12}(1 - \sqrt{1 - 384c}) \tag{20}$$

As a summary, A's best response τ^{br}_{Ab} for non-prohibitive costs is given by:

$$\tau^{br}_{Ab} = \begin{cases} 0, & \text{iff } \tau_{Ba} \leq \tau^i_{Ba}(c) \\ \tau^r_{Ab}(\tau_{Ba}), & \text{iff } \tau_{Ba} > \tau^i_{Ba}(c) \end{cases} \tag{21}$$

[21] Due to perfect information, B anticipates that A is not retaliating when costs are prohibitive. Therefore, B would always play its optimal tariff while A would never retaliate.

[22] In the model at hand $\bar{c} = 1/384$.

3.2 The First Mover's Best Response

B sets its tariff, anticipating the consequences of doing so in terms of whether or not there will be any retaliation and in terms of the extent of a possible retaliation. Note that B's welfare as a function of its import tariff τ_{Ba} is no longer a continuous function. B's welfare function will now rather have a step at the point where A switches between retaliating and not retaliating due to an incremental increase in B's offense. Therefore, one has to distinguish between two cases, depending on whether A retaliates or not. In the following, offenses triggering retaliation (i.e. $\tau_{Ba} > \tau^i_{Ba}(c)$) will be referred to as *major offenses*, while smaller levels of violation, which do not trigger retaliation (i.e. $\tau_{Ba} \leq \tau^i_{Ba}(c)$), will be referred to as *minor offenses*. In particular, B's options are (i) to play its optimal tariff $\tau^*_{Ba}(\zeta) = \frac{1}{12}(2\zeta - 1)$, yielding

$$W^*_B(\zeta) := W_B(\tau^{br}_{Ab}(\tau^*_{Ba}(\zeta)), \tau^*_{Ba}(\zeta), \zeta), \tag{22}$$

(ii) to play the current retaliation threshold $\tau^i_{Ba}(c) = \frac{1}{12}(1 - \sqrt{1 - 384c})$, yielding

$$W^i_B(c, \zeta) := W_B(0, \tau^i_{Ba}(c), \zeta), \tag{23}$$

or (iii) to play the tariff $\tau^{\S}_{Ba}(\zeta) = \frac{1}{4}(\zeta - 1)$ which is the tariff that maximizes B's welfare,[23] given that A retaliates elastically and according to a binding equivalence condition, yielding

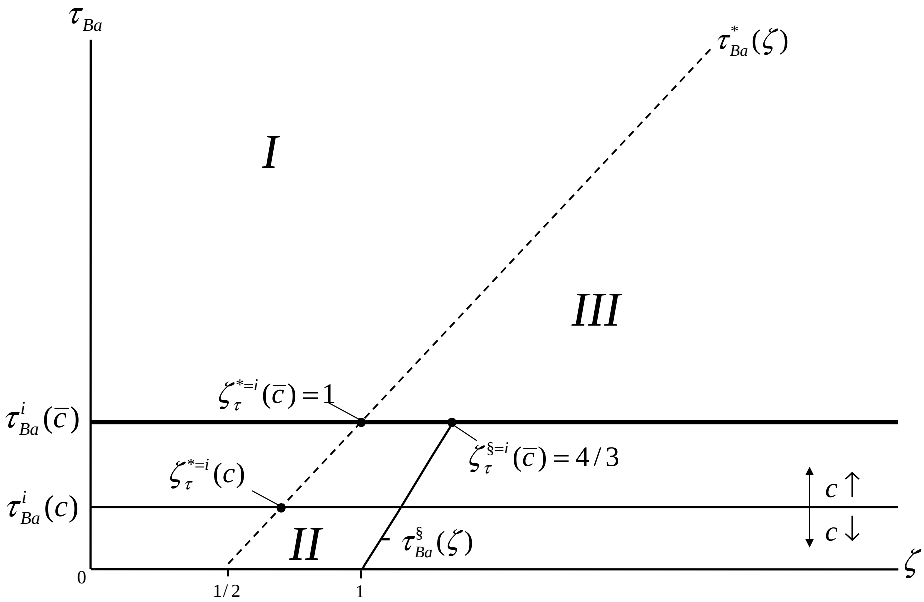
$$W^{\S}_B(\zeta) := W_B(\tau^{eq}_{Ab}(\tau^{\S}_{Ba}(\zeta)), \tau^{\S}_{Ba}(\zeta), \zeta). \tag{24}$$

Note that at for all $\zeta \geq 4/3$, $\tau^{\S}_{Ba}(\zeta)$ entitles A to retaliate with its optimal tariff. Hence for all $\zeta \geq 4/3$ A's retaliation is no longer elastic in the initial offense, such that for B, playing $\tau^{\S}_{Ba}(\zeta)$ is strictly dominated by playing $\tau^*_{Ba}(\zeta)$. Consider these tariffs in the ζ-τ_{Ba}-space of Figure 1. The bold horizontal line represents $\tau^i_{Ba}(\bar{c})$ for prohibitive costs (i.e. $c = \bar{c}$), while the thin horizontal line represents the case of $\underline{c} < c < \bar{c}$. The dashed upward sloping line depicts B's optimal tariff $\tau^*_{Ba}(\zeta)$, while the continuous upward sloping line depicts $\tau^{\S}_{Ba}(\zeta)$.

There are three sets of dominated strategies which can be ruled out right from the start.

[23] See Appendix 6.2 for further details of $\tau^{\S}_{Ba}(\zeta)$.

Figure 1: Tariff Levels of Country B



Lemma 1. *B never plays a tariff of $\tau_{Ba} > \tau^{*}_{Ba}(\zeta)$.*

Clearly all combinations of τ_{Ba} and ζ located above B's optimal tariff (set I in Figure 1) can be excluded from further analysis for the simple reason that the choice of all these locations is strictly dominated by playing $\tau^{*}_{Ba}(\zeta)$.

Lemma 2. *B never plays a tariff of $\tau_{Ba} < \tau^{*}_{Ba}(\zeta) \wedge \tau_{Ba} < \tau^{i}_{Ba}(c)$.*

For all tariffs located in this set II, B could raise its tariff, thereby getting closer to its optimal tariff, without triggering retaliation since A would only retaliate if the retaliation threshold was exceeded. Hence this set of tariffs is strictly dominated either by $\tau^{*}_{Ba}(\zeta)$ or by $\tau^{i}_{Ba}(c)$.

Lemma 3. *B never plays a tariff of $\tau^{i}_{Ba}(\bar{c}) \leq \tau_{Ba} < \tau^{*}_{Ba}(\zeta)$.*

Consider set III and recall that $\tau^{i}_{Ba}(\bar{c})$ is the set of ζ-τ_{Ba}-combinations that entitles A to retaliate exactly with its optimal tariff. Hence, any ζ-τ_{Ba}-combination located above $\tau^{i}_{Ba}(\bar{c})$

triggers the same amount of retaliation since A's maximum retaliatory capacity is already exhausted. Therefore, all these ζ-τ_{Ba}-combinations are strictly dominated by playing $\tau^*_{Ba}(\zeta)$.

A general property of the model is the finding that it does not pay for B to commit an offense against a larger - or in this case more protectionist - country, which mirrors the findings of Johnson (1953), Kennan and Riezman (1988), and Syropoulos (2002).

Lemma 4. *Given A retaliates elastically, B prefers to commit a minor offense for all $\zeta \leq 1$.*
Proof: See Appendix 6.2.

From Lemma 1, 2, and 4, B's best response for all $\zeta \leq 1$ is already obtained.

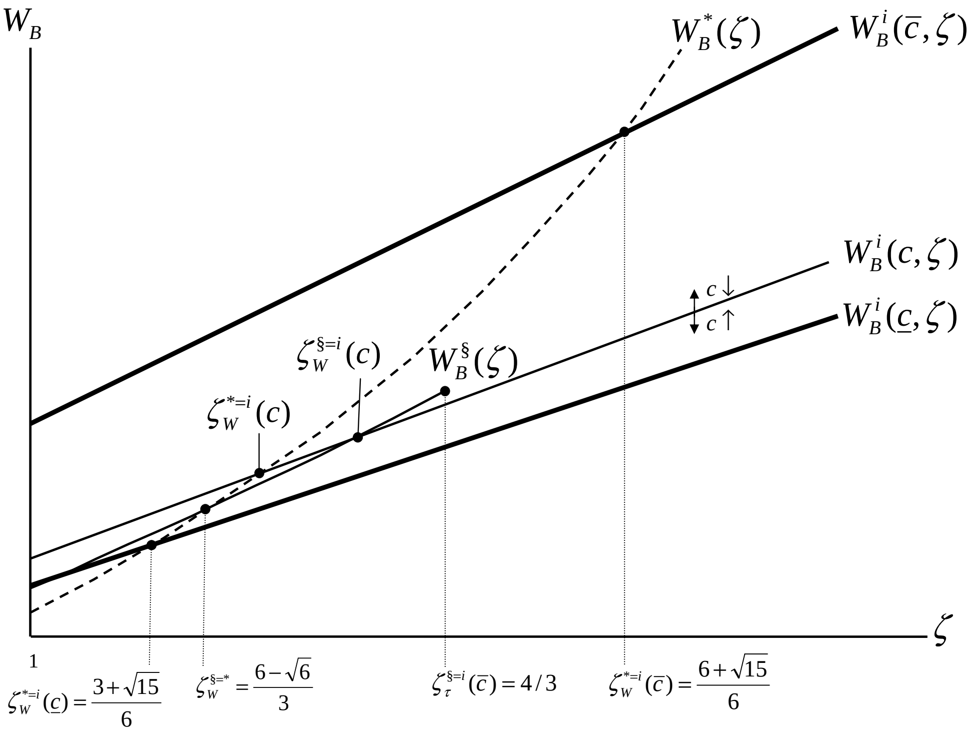
Corollary 1. *For all $\zeta \leq 1$, B's best response tariff τ^{br}_{Ba} is a minor offense. In particular,*

$$\tau^{br}_{Ba} = \begin{cases} \tau^*_{Ba}(\zeta), & \text{iff } \zeta \leq \zeta^{*=i}_{\tau}(c) \\ \tau^i_{Ba}(c,\zeta), & \text{iff } \zeta > \zeta^{*=i}_{\tau}(c) \end{cases}, \tag{25}$$

where $\zeta^{*=i}_{\tau}(c)$ denotes the value of ζ where $\tau^*_{Ba}(\zeta) = \tau^i_{Ba}(c,\zeta)$.
Proof: See Appendix 6.3.

However, for $\zeta > 1$, B's welfare under each of the three non strictly dominated tariffs, i.e. $W^*_B(\zeta)$, $W^i_B(c,\zeta)$, and $W^{\S}_B(\zeta)$ has to be compared in order to derive B's best response. Consider each of these in the ζ-W_B-space of Figure 2. Let $\zeta^{*=i}_W(c)$ denote the value of ζ where $W^*_B(\zeta)$ crosses $W^i_B(c,\zeta)$ from below in the ζ-W_B-space. Figure 2 shows that $\zeta^{*=i}_W(c)$ lies the more to the left (right), the lower (higher) litigation costs are. This means that lowering litigation costs will lead even less protectionist countries than before to committing a major offense. On the other hand, increasing litigation costs will deter even more protectionist countries than before from committing a major offense. This paradoxical property is quite general and does not depend upon the particular explicit form of the underlying model. To see this, consider any $c > \underline{c}$. Then, lowering c clearly renders W^i_B weakly less attractive, while it does not affect the other option W^*_B. Therefore, as c decreases, at some point B will prefer W^*_B to W^i_B. Note that the shifting range of $\zeta^{*=i}_W(c)$ is limited to a span of 0.5. It is bounded below at $\zeta^{*=i}_W(\underline{c}) = (3+\sqrt{15})/6 = 1.1455$ and above at $\zeta^{*=i}_W(\bar{c}) = (6+\sqrt{15})/6 = 1.6455$. Hence the most protectionist countries (i.e. $\zeta > \zeta^{*=i}_W(\bar{c})$) are not affected by changes in

Figure 2: B's Welfare Payoffs for $\zeta \geq 1$



litigation costs.

Let $\zeta_W^{\S=*} = (6 - \sqrt{6})/3 = 1.1835$ denote the value of ζ where $W_B^*(\zeta)$ crosses $W_B^\S(\zeta)$ from below in the ζ-W_B-space. Hence, for larger values of ζ, playing $\tau_{Ba}^\S$ is strictly dominated by playing τ_{Ba}^*, such that the best response tariff of B depends upon the pertinent value of $\zeta_W^{*=i}(c)$, which has been discussed in the previous paragraph.

However, if and only if ζ lies between one and $\zeta_W^{\S=*} = 1.1835$, B's best response is either τ_{Ba}^i or $\tau_{Ba}^\S$. Let $\zeta_W^{\S=i}(c)$ denote the value of ζ where $W_B^\S(\zeta)$ crosses $W_B^i(c, \zeta)$ from below in the ζ-W_B-space. Then, for ζ smaller than $\zeta_W^{\S=i}(c)$, B's best response is to play τ_{Ba}^i, while for ζ larger than $\zeta_W^{\S=i}(c)$, B's best response is to play $\tau_{Ba}^\S$.[24]

All branch cuts of B's best response tariff are summarized by Proposition 1.

[24]Note that playing $\tau_{Ba}^\S$ is only a best response for B in a very narrow set of parameters. Only if both $1 < \zeta \leq 1.1835$ and $c/\bar{c} < 0.146247$, $\tau_{Ba}^\S$ is a best response.

Proposition 1. *Country B's best response tariff* τ_{Ba}^{br} *is*

For $\zeta \in [1/2, 1]$

$$\tau_{Ba}^{br} = \begin{cases} \tau_{Ba}^{*}(\zeta), & \textit{iff } \zeta \leq \zeta_{\tau}^{*=i}(c) \\ \tau_{Ba}^{i}(c,\zeta), & \textit{iff } \zeta > \zeta_{\tau}^{*=i}(c) \end{cases}. \tag{26}$$

For $\zeta \in (1, \zeta_{W}^{\S=*}]$

$$\tau_{Ba}^{br} = \begin{cases} \tau_{Ba}^{i}(c,\zeta), & \textit{iff } \zeta \leq \zeta_{W}^{\S=i}(c) \\ \tau_{Ba}^{\S}(\zeta), & \textit{iff } \zeta > \zeta_{W}^{\S=i}(c) \end{cases}. \tag{27}$$

For $\zeta \in (\zeta_{W}^{\S=*}, \infty)$

$$\tau_{Ba}^{br} = \begin{cases} \tau_{Ba}^{i}(c,\zeta), & \textit{iff } \zeta \leq \zeta_{W}^{*=i}(c) \\ \tau_{Ba}^{*}(\zeta), & \textit{iff } \zeta > \zeta_{W}^{*=i}(c) \end{cases}. \tag{28}$$

Proof: See Appendix 6.3.

Stated verbally:

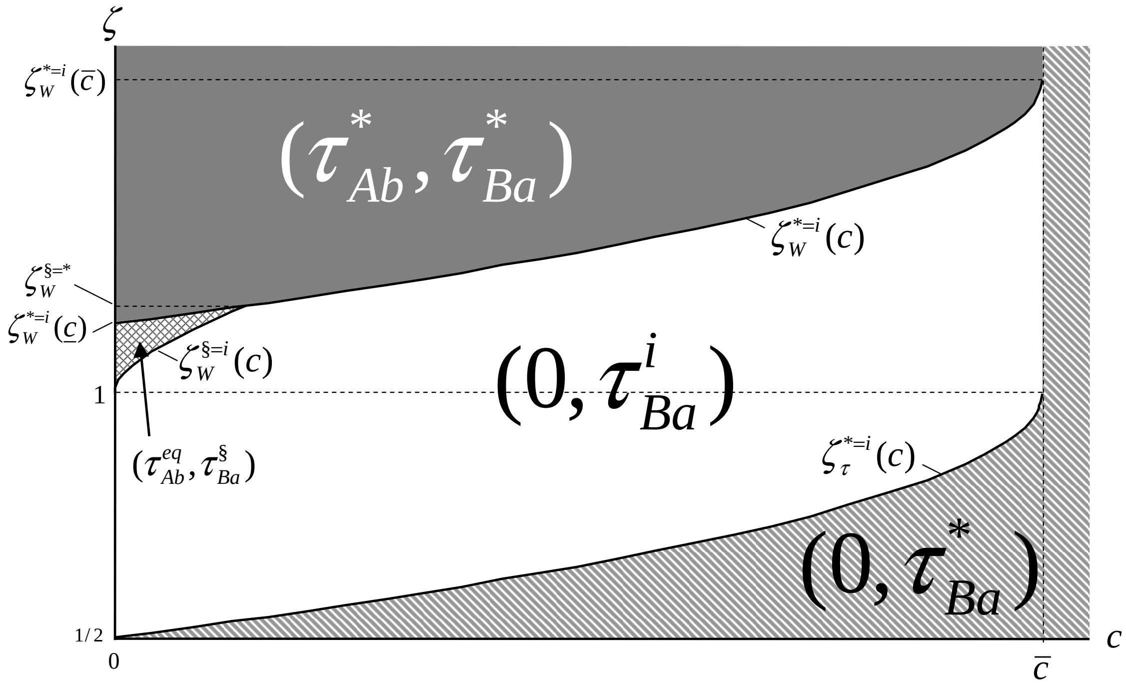
1. The least protectionist B countries will play their optimal tariff because they do not cause enough damage to trigger retaliation.
2. B countries with a lower intermediate level of protectionism will restrict their tariff to a level below their optimal tariff in order to either completely avoid retaliation by bothering A no more than the latter's tolerance level (i.e. τ_{Ba}^{i}). Or these B countries choose to trigger just a low level of retaliatory damage which is balanced against B's gain from the offense (i.e. $\tau_{Ba}^{\S}$).
3. The most protectionist B countries will play their optimal tariffs and take A's retaliation into account.

3.3 Equilibria

Combining country A's and country B's best responses, Nash equilibrium behavior may be expressed just as a function of c and ζ. Let the pair of Nash equilibrium tariffs be denoted by

$(\tau_{Ab}^N, \tau_{Ba}^N)$. Figure 3 shows that the c-ζ-space is divided into four areas of different equilibria.

Figure 3: Equilibria



The grey area to the northwest of Figure 3 represents a trade war between the two countries, where each country is playing its optimal tariff. This type of equilibrium occurs if B is protectionist enough to be willing to put up with A's retaliation.

The white area in the center of Figure 3 represents the equilibria, in which country B bothers country A just so much that retaliation is avoided. The economic intuition for the existence of this type of equilibrium is that either B is not protectionist enough to be willing to put up with retaliation, or B's opportunity costs of a minor offense[25] are relatively low, which is the case if litigation costs are relatively high. Note that both afore-mentioned types

[25]The opportunity costs of a minor offense are B's forgone benefits from a tariff increase to $\tau_{Ba}^*(\zeta)$.

of equilibria only exist for non-prohibitive costs.

The striped area, which stretches at the bottom and along the right edge of Figure 3 represents the set of equilibria where B plays its optimal tariff, while A does not retaliate. This type of equilibrium occurs if either B is not protectionist enough in order to harm A sufficiently (the cases at the bottom) or costs are prohibitive (the cases at the right edge where $c \geq \bar{c}$ holds).

The small checkered area to the west of Figure 3 depicts those rare cases where B commits a major offense by playing $\tau_{Ba}^{\S}$ while A retaliates according to the binding equivalence condition.

3.4 Comparative Statics in Litigation Costs

Finally, the comparative static effects of a reduction of litigation costs can be analyzed by consulting Figure 3 again. It is useful to distinguish between a cost reduction that passes the threshold of prohibitive costs on the one hand and a cost reduction that occurs within the range of non-prohibitive costs on the other hand.

3.4.1 Prohibitive Initial Costs

Consider the case where initial litigation costs are prohibitive (i.e. $c \geq \bar{c}$). Then the initial equilibrium tariff pair is given by $(0, \tau_{Ba}^{*})$. The effects of a reduction of litigation costs to a level just an increment below the prohibitive threshold of $\bar{c}$ are dependent upon the pertinent level of ζ.

For high values of ζ (i.e. $\zeta \geq \zeta_W^{*=i}(\bar{c})$), country B's tariff is left unchanged, although A implements retaliation of τ_{Ab}^{*}.

In the case of an intermediate level of ζ (i.e. $\zeta_\tau^{*=i}(\bar{c}) \leq \zeta < \zeta_W^{*=i}(\bar{c})$), country B's compliance is improved since the post reduction tariff pair is $(0, \tau_{Ba}^{i})$.

In the case of a small level of ζ (i.e. $\zeta < \zeta_\tau^{*=i}(\bar{c})$), both countries' tariffs and welfare levels are left unchanged.

3.4.2 Non-prohibitive Initial Costs

Now consider the case where initial non-prohibitive litigation costs (i.e. $c < \bar{c}$) are further reduced.

For high values of ζ, where the initial set of equilibrium tariffs is $(\tau^*_{Ab}, \tau^*_{Ba})$, a reduction of litigation costs will have no effect at all, and the equilibrium does not change.

Suppose the initial equilibrium set of tariffs was $(0, \tau^i_{Ba})$, which corresponds to any location inside the white area in the center of Figure 3. In this case the effects depend even further on ζ. If $\zeta \leq 1$, the reduction in litigation costs does not change the equilibrium strategies as such, since the post reduction equilibrium strategies are again $(0, \tau^i_{Ba})$. Nevertheless, B will set a lower tariff because the absolute level of τ^i_{Ba} has been reduced in the course of the cost reduction. However, if $\zeta > 1$, the cost reduction may cause more severe offenses. Either B commits a more severe offense by switching to its optimal tariff τ^*_{Ba} or to $\tau^\S_{Ba}$ thereby triggering A's retaliation. Note that this paradoxical effect only occurs if the offender is sufficiently protectionist (i.e. $\zeta > 1$).

Suppose the initial equilibrium set of tariffs was $(0, \tau^*_{Ba})$, which corresponds to the striped area at the bottom of Figure 3. In this case a reduction of costs unambiguously improves the compliance of B, who switches from playing τ^*_{Ba} to playing τ^i_{Ba}, while A's tariff remains at zero. Thus, the reduction of litigation costs may succeed in forcing countries into compliance by rendering retaliation more attractive. Note that this intuitive effect only shows up for not too protectionist countries (i.e. $\zeta \leq 1$).

4 Generalization of the Model

Let V^M be any country's welfare from setting a major offense tariff and let V^m be its welfare from setting its best minor offense tariff. Consider that V^m is a function of litigation costs, while V^M is not.

Lemma 5. *A reduction in litigation costs weakly decreases V^m, while it does not affect V^M.*

Note that Lemma 5 implies that a reduction in litigation costs cannot render a minor offense more attractive. Hence, it can already be ruled out that countries switch from a major offense to a minor offense in the course of a cost reduction.

Assumption 1. *Let V be a function of the country-specific parameter ω, where $\frac{d(V^M - V^m)}{d\omega} > 0$ for all $\omega \in [\underline{\omega}, \bar{\omega}]$. Moreover, let*

(i) $V^M = V^m|_{\underline{c}}$ *for all* $\omega = \omega_0$,

(ii) $V^M > V^m|_{\underline{c}}$ *for all* $\omega > \omega_0$,

(iii) $V^M < V^m|_{c \in [\underline{c}, \bar{c})}$ *for all* $\omega < \omega_0$,

where $\underline{\omega} < \omega_0 < \bar{\omega}$.

In words, Assumption 1 states that, a country prefers a trade war for higher values of ω, while it prefers to commit a minor offense for lower values of ω.

Building on Lemma 5, consider the consequences of a reduction in litigation costs, stated by the next proposition.

Proposition 2. *In every model that satisfies Assumption 1, a reduction of litigation costs c features the following effects.*

(i) In the subset $\omega \in (\omega_0, \bar{\omega}]$ a country whose best response has been a minor offense before the cost reduction, sets a strictly higher tariff by switching from a minor offense to a major offense when the reduction of c is sufficiently strong. A country whose best response has been a major offense before the cost reduction, will not be affected.

(ii) In the subset $\omega \in [\underline{\omega}, \omega_0)$ a country sticks to its minor offense for any reduction in c. Thereby it sets a strictly lower tariff.

Proof: See Appendix 6.4.

Proposition 2 shows that asking for the practical relevance of this model's paradoxical finding is equivalent to asking for the practical relevance of Assumption 1. Recall that Assumption 1 just states that there is some critical value of the country-specific parameter ω, denoted by ω_0, above which it pays to trigger a trade war, while it does not pay for lower values of ω. In this chapter's model, the political economy parameter ζ has been shown to achieve satisfaction of Assumption 1. However, there are various different modeling approaches that may satisfy Assumption 1. In general, a country may prefer a tariff war to free trade if either distributional concerns, such as a high weight on import-competing producer's well being and/or on tariff revenue, or the ability to influence the terms-of-trade in it's favor are strong enough to offset the deadweight loss associated with a tariff war.

Kennan and Riezman (1988) consider a two country trade model where they use differences in countries' endowments to model asymmetry. They find that a country prefers a tariff war to free trade if its share of global endowments is sufficiently high, while it prefers free trade for a lower endowment share. Thus their approach is in compliance with Assumption 1.

Syropoulos (2002) uses a Heckscher-Ohlin type model, where countries differ in their population, i.e. in their labour force. He finds that sufficiently large countries prefer a tariff war to free trade, thereby satisfying Assumption 1.

Melatos et al. (2007) show that Assumption 1 may as well be satisfied in a model setup where countries' preferences exhibit different degrees of substitutability. In simulations the authors show that a smaller country may even prefer a trade war against a larger country if the preferences of the smaller country's population exhibit a sufficiently high degree of substitutability.

In an earlier version of this chapter, Wilckens (2007) uses two different representations of country size to show that sufficiently large countries prefer a tariff war, while smaller countries prefer to avoid a tariff war.

5 Conclusion

The outcomes of the model suggest that the DSS is unable to level out existing imbalances in countries' incentives to impose import tariffs. This finding is based on the fact that a country's ability to enforce a trade agreement under the rules of the DSS depends crucially upon the country's incentive to implement retaliatory tariffs. Moreover, litigation costs have been found to be a key determinant of a violated country's decision whether or not to file a complaint. An earlier version of this paper, Wilckens (2007), features a similar analysis in a framework where countries exhibit differences in population size instead of differences in the degree of protectionism. Both models' findings coincide. In particular, the asymmetry in the countries' re-distributional motivation appears to be equivalent to an asymmetry in the countries' ability to influence the terms-of-trade in their favor.[26]

[26] In reality, a country's tariff setting incentive should be a function of both, the ability to influence the terms-of-trade and the degree of re-distributional concerns as empirical studies like Goldberg and Maggi (1999) and Broda et al. (2006) suggest.

The results have been employed to analyze the effects of a reduction of litigation costs. The findings suggest that a reduction of litigation costs succeeds in improving compliance of countries whose protectionist redistributive motivation is not too strong. However, more protectionist countries may be led to commit more severe offenses.[27]

Besides, a reduction of litigation costs is supposed to lead to more trade disputes surfacing in the dispute settlement record and cause an increase in the implementation of retaliation at the same time.

Another result of the model is related to the question whether or not the usage of the dispute settlement system is biased. The model predicts that a country is more likely to file a complaint if it (i) has a high retaliatory capacity or incentive, (ii) faces low litigation costs and (iii) suffers from an offense at a relatively high level. While these theoretical findings may explain the dominance of rich and protectionist countries in the dispute settlement record, they mean at the same time that the observable sample of reported disputes is biased in favor of countries with these particular characteristics. Therefore, the finding of Horn et al. (1999), which suggests that disputes occur randomly and reasonably proportional to the number of a country's product-market-pairings, may still be correct. However, in the light of the model at hand, the number of a country's product-market-pairings should no longer be seen as the central reason for the occurrence of a dispute, but rather as a side effect, that may be positively correlated with the real drivers of offenses and complaints which are a country's retaliatory capacity, litigation costs and the intensity of violation. Hence the theory suggests that the observable sample of disputes does not reflect the country-specific characteristics of the unobservable population of disputes. Therefore the unreported offenses (i.e. the dark figure of offenses) should contain a disproportionately large share of countries lacking retaliatory capacity, facing high litigation costs and being offended against at lower intensity. This typically applies for developing countries.

[27]This result parallels findings of the Economics of Crime literature. See for example Becker (1968), who shows that a reduction in litigation costs may lead some offenders to switch to more severe offenses, while it may reduce the offensive level of others.

6 Appendix

6.1 Properties of the Aggregated Welfare Functions

Welfare of country B is

$$W_B(\tau_{Ab}, \tau_{Ba}, \zeta) := CS_{Ba}(\tau_{Ba}) + CS_{Bb}(\tau_{Ab}) + \zeta \Pi_{Ba}(\tau_{Ba}) + \Pi_{Bb}(\tau_{Ab}) + TR_{Ba}(\tau_{Ba}) \quad (29)$$

$$:= \frac{1}{64}(29 - 4\tau_{Ab} + 8\tau_{Ab}^2 + 2\zeta(5 + 4\tau_{Ba}) - 4\tau_{Ba}(1 + 6\tau_{Ba})). \quad (30)$$

The first and second derivatives of $W_B(\tau_{Ab}, \tau_{Ba}, \zeta)$ with respect to τ_{Ba} are

$$\frac{dW_B}{d\tau_{Ba}} = \frac{1}{16}(2\zeta - 12\tau_{Ba} - 1), \quad (31)$$

$$\frac{d^2W_B}{d\tau_{Ba}^2} = -\frac{3}{4}. \quad (32)$$

Setting $\frac{dW_B}{d\tau_{Ba}}$ equal to zero and solving for τ_{Ba} yields $\tau_{Ba}^*(\zeta)$, which is B's optimal tariff.

$$\tau_{Ba}^*(\zeta) := \frac{1}{12}(2\zeta - 1) \quad (33)$$

In order to see how B's welfare is affected by A's tariff on good b, consider the first and second derivative of W_B with respect to τ_{Ab}:

$$\frac{dW_B}{d\tau_{Ab}} = \frac{1}{16}(4\tau_{Ab} - 1), \quad (34)$$

$$\frac{d^2W_B}{d\tau_{Ab}^2} = \frac{1}{4}. \quad (35)$$

Note that each country's welfare function is concave in its own tariff and decreasing in the other country's tariff.[28]

The properties shown here for country B's welfare w.r.t. both countries' tariffs apply analogously to country A's welfare.

[28]For $\tau_{Ab} \in [0, 1/4)$, $\frac{dW_B}{d\tau_{Ab}} < 0$ and vice versa for country A's welfare dependency on B's tariff. Note that tariffs higher than $\tau = 1/4$ are prohibitive in the sense that countries would stop trading.

6.2 Properties of $\tau^{\S}_{Ba}$ and $W^{\S}_{B}$

Proof of Lemma 4: If A retaliated elastically with respect to B's offense, which holds if $\zeta \leq 1$ such that $\tau_{Ba} \leq \tau^*_{Ab} = 1/12$, B's aggregated welfare from a major offense is given by:

$$W_B(\tau_{Ba}, \zeta) = W_B(\tau^{br}_{Ab}(\tau_{Ba}), \tau_{Ba}, \zeta). \tag{36}$$

$$= \frac{1}{64}(29 - 8\tau_{Ba} - 16\tau^2_{Ba} + 2\zeta(5 + 4\tau_{Ba})) \tag{37}$$

B maximizes this expression by choosing its tariff τ_{Ba}. The first derivative with respect to B's tariff is $\frac{1}{8}(\zeta - 1 - 4\tau_{Ba})$. Solving for τ_{Ba} yields $\tau^{\S}_{Ba}(\zeta)$

$$\tau^{\S}_{Ba}(\zeta) := \frac{1}{4}(\zeta - 1), \tag{38}$$

which is the tariff that maximizes B's welfare, given A retaliates elastically.

It is straightforward that $\tau^{\S}_{Ba}$ is positive only for $\zeta > 1$. Hence, B prefers to avoid A's retaliation whenever $\zeta \leq 1$.

Plugging $\tau^{\S}_{Ba}$ into A's best response tariff τ^{br}_{Ab} and substituting both tariffs into B's welfare function yields $W^{\S}_{B}$

$$W^{\S}_{B}(\zeta) := W_B(\tau^{br}_{Ab}(\tau^{\S}_{Ba}(\zeta)), \tau^{\S}_{Ba}(\zeta), \zeta) \tag{39}$$

$$:= \frac{1}{64}(30 + 8\zeta + \zeta^2), \tag{40}$$

which is B's welfare from playing $\tau^{\S}_{Ba}$. □

6.3 Proof of Proposition 1

Proof of Proposition 1: Consider that, given A retaliates elastically with respect to B's initial offense, B will prefer a minor offense. This statement follows from the finding that $\tau^{\S}_{Ba}$ is positive only for $\zeta > 1$, which has been shown in Appendix 6.2.

B's Best Response for $\zeta \leq 1$

In this set, an initial violation with $\tau_{Ba} \in [0, \tau^*_{Ba}(\zeta)]$ will translate into a binding restriction for A's retaliation since $\tau^{eq}_{Ab} \leq \tau^*_{Ab}$. As a consequence, B will choose a tariff that does not exceed the threshold $\tau^i_{Ba}(c)$ in order to avoid retaliation. Choosing from the set of minor offense tariffs, B maximizes its welfare by playing $\min\{\tau^*_{Ba}(\zeta), \tau^i_{Ba}(c)\}$. Let $\zeta^{*=i}_\tau(c)$ denote the value of ζ where $\tau^*_{Ba}(\zeta)$ intersects $\tau^i_{Ba}(c)$. Since $\frac{d\tau^*_{Ba}(\zeta)}{d\zeta} = \frac{1}{6} > 0$ while $\frac{d\tau^i_{Ba}(c)}{d\zeta} = 0$, $\tau^*_{Ba}(\zeta)$ crosses $\tau^i_{Ba}(c)$ from below at $\zeta^{*=i}_\tau(c)$.

Consequently B's best response tariff is

$$\tau^{br}_{Ba} = \begin{cases} \tau^*_{Ba}(\zeta), & \text{iff } \zeta \leq \zeta^{*=i}_\tau(c) \\ \tau^i_{Ba}(c,\zeta), & \text{iff } \zeta > \zeta^{*=i}_\tau(c) \end{cases}. \tag{41}$$

B's Best Response for $\zeta > 1$

Consider the explicit form of B's welfare function under the three remaining non-strictly-dominated tariffs $\tau^*_{Ba}(\zeta)$, $\tau^i_{Ba}(c,\zeta)$, and $\tau^\S_{Ba}(\zeta)$ for $\zeta > 1$

$$W^*_B(\zeta) = \frac{130 + 42\zeta + 3\zeta^2}{288}, \tag{42}$$

$$W^i_B(c,\zeta) = \frac{85 + 2\sqrt{1-384c} + 192c + 32\zeta - 2\zeta\sqrt{1-384c}}{192}, \tag{43}$$

$$W^\S_B(\zeta) = \frac{30 + 8\zeta + \zeta^2}{64}, \tag{44}$$

and their first derivatives with respect to ζ

$$\frac{dW^*_B}{d\zeta} = \frac{7+\zeta}{48}, \tag{45}$$

$$\frac{dW^i_B}{d\zeta} = \frac{1}{6} - \frac{1}{96}\sqrt{1-384c}, \tag{46}$$

$$\frac{dW^\S_B}{d\zeta} = \frac{4+\zeta}{32}. \tag{47}$$

There may exist up to three points in the ζ-W_B-space, where these welfare functions intersect. Let $\zeta^{*=i}_W(c)$ denote the intersection of W^*_B and W^i_B, let $\zeta^{\S=*}_W$ denote the intersection of W^*_B and $W^\S_B$ and let $\zeta^{\S=i}_W(c)$ denote the intersection of $W^\S_B$ and W^i_B.

Setting the associated welfare functions pairwise equal to each other and solving for ζ

yields

$$\zeta_W^{*=i}(c) = \frac{1}{6}(6 - \sqrt{15} - 3\sqrt{1-384c}), \tag{48}$$

$$\zeta_W^{\S=*} = \frac{6-\sqrt{6}}{3}, \tag{49}$$

$$\zeta_W^{\S=i}(c) = \frac{4 - \sqrt{1-384c} + \sqrt{2 - 2\sqrt{1-384c} + 192c}}{3}. \tag{50}$$

The currently investigated subset of $\zeta > 1$ may be further split up into the subsets $\zeta \leq \zeta_W^{\S=*}$ and $\zeta > \zeta_W^{\S=*}$.

First consider the case of $\zeta \leq \zeta_W^{\S=*}$, where it holds that $W_B^{\S} \geq W_B^*$ with $W_B^{\S} = W_B^*$ only exactly at $\zeta_W^{\S=*}$.[29] Hence, B is left with the decision between it's non-strictly dominated tariffs $\tau_{Ba}^i(c)$ and $\tau_{Ba}^{\S}$. At the intersection of the associated welfare functions, $\zeta_W^{\S=i}(c)$, it holds that $\frac{dW_B^{\S}(\zeta)}{d\zeta} > \frac{dW_B^i(c,\zeta)}{d\zeta}$.[30] So for $\zeta < \zeta_W^{\S=i}(c)$, $W_B^i(c,\zeta)$ is larger than $W_B^{\S}(\zeta)$ and vice versa.

Consequently, for $\zeta \in (1, \zeta_W^{\S=*}]$, B's best response tariff is

$$\tau_{Ba}^{br} = \begin{cases} \tau_{Ba}^i(c,\zeta), & \text{iff } \zeta \leq \zeta_W^{\S=i}(c) \\ \tau_{Ba}^{\S}(\zeta), & \text{iff } \zeta > \zeta_W^{\S=i}(c) \end{cases}. \tag{51}$$

Now the remaining subset $\zeta > \zeta_W^{\S=*}$ is investigated. Already knowing to hold in this subset that, for all $W_B^{\S} < W_B^*$, B's remaining decision is whether to play $\tau_{Ba}^*(\zeta)$ or $\tau_{Ba}^i(c,\zeta)$. At the intersection of the associated welfare functions, $\zeta_W^{*=i}(c)$ it holds that, $\frac{dW_B^*(\zeta)}{d\zeta} > \frac{dW_B^i(c,\zeta)}{d\zeta}$.[31] So for $\zeta < \zeta_W^{*=i}(c)$, $W_B^i(c,\zeta)$ is larger than $W_B^*(\zeta)$ and vice versa.

[29] At $\zeta_W^{\S=*}$ it holds that $\frac{dW_B^*}{d\zeta} > \frac{dW_B^{\S}}{d\zeta}$ since $\frac{dW_B^*}{d\zeta}|_{\zeta_W^{\S=*}} = (27-\sqrt{6})/144$ and $\frac{dW_B^{\S}}{d\zeta}|_{\zeta_W^{\S=*}} = (18-\sqrt{6})/96$. So for $\zeta < \zeta_W^{\S=*}$, W_B^* is smaller than $W_B^{\S}$ and vice versa.

[30] $\frac{dW_B^{\S}(\zeta)}{d\zeta}|_{\zeta_W^{\S=i}(c)} = (16 - \sqrt{1-384c} + \sqrt{2-2\sqrt{1-384c}+192c})/96$ which is globally (for all levels of c) larger than $\frac{dW_B^i(c,\zeta)}{d\zeta}|_{\zeta_W^{\S=i}(c)} = 1/6 - (\sqrt{1-384c})/96$.

[31] $\frac{dW_B^*(\zeta)}{d\zeta}|_{\zeta_W^{*=i}(c)} = (48 + \sqrt{15} - 3\sqrt{1-384c})/288$, which is globally (for all levels of c) larger than $\frac{dW_B^i(c,\zeta)}{d\zeta}|_{\zeta_W^{*=i}(c)} = 1/6 - (\sqrt{1-384c})/96$.

Consequently, for $\zeta \in (\zeta_W^{\S=*}, \infty)$, B's best response tariff is

$$\tau_{Ba}^{br} = \begin{cases} \tau_{Ba}^{i}(c,\zeta), & \text{iff } \zeta \leq \zeta_W^{*=i}(c) \\ \tau_{Ba}^{*}(\zeta), & \text{iff } \zeta > \zeta_W^{*=i}(c) \end{cases}. \tag{52}$$

□

6.4 Proof of Proposition 2

Proof of Proposition 2: (i) Let $\tilde{c} \in (\underline{c}, \bar{c})$ and $\tilde{\omega} \in (\omega_0, \bar{\omega}]$ denote the pair of c and ω that establishes the equality $V^M = V^m$. From Lemma 5, stating that $\frac{dV^m}{dc} > 0$, it follows that first, $V^M > V^m$ for all $c \in [\underline{c}, \tilde{c})$ and given $\tilde{\omega}$ and second, $V^M < V^m$ for all $c \in (\tilde{c}, \bar{c})$ and given $\tilde{\omega}$.

(ii) For the subset $\omega \in [\underline{\omega}, \omega_0)$, it holds that $V^M < V^m$ for all feasible values of c (i.e. $c \in [\underline{c}, \bar{c})$). Hence, a country will always choose a minor offense in this subset of ω.

□

The author would be happy to provide the associated Mathematica file upon request.

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