

An Economic Analysis of the WTO's Dispute Settlement System

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Abstract

Under the World Trade Organization's (WTO) current dispute settlement system (DSS) the utmost threat to a non-complying offender of a trade agreement is posed by the retaliation of the victorious complainant. Several scholars argue that the smaller and poorer a country is, the more difficult a country finds it to implement retaliatory measures and to bear the costs of a lawsuit. Hence, it may be conjectured that this retaliation based enforcement exhibits a disadvantage for smaller and poorer countries who seek to enforce a larger trading partner's compliance. Moreover, larger and wealthier countries may anticipate their less powerful trading partners' inability to retaliate effectively. The issue is taken up in a tripartite analysis of this dissertation.

Initially, an empirical chapter explores the link between a country's economic power and its participation in the WTO's DSS. Therefore, a simple sequential game of dispute settlement is employed in order to set the stage for a binary regression model. The regression uses an array of variables of economic power to explain a country's decision whether or not to file a complaint. The results show that a country is more likely to file a complaint if (i) it has a high income, (ii) its trading partner has a low income, (iii) the trade value of the commodity at stake is significant, and (iv) its retaliatory capacity is substantial.

The subsequent chapter sets up a two country model in order to analyze the comparative static effects of a reduction in litigation costs. The results are mixed. While the compliance of less powerful countries may be improved, more powerful countries may be led to committing even more severe offenses than before.

Another proposal for reform suggests to allow retaliatory rights to be traded between countries. The effects of this proposal are analyzed in Chapter 4 (joint work with Mathis Klepper) by means of a three country model. The results show that tradable retaliation is able to improve WTO members' compliance with their trade policy commitments, especially towards less powerful trading partners.

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Chapter 1

Introduction

1.1 Motivation

“I believe that trade opening and reducing trade barriers, has been, is and will remain, essential to promote growth and development, to improve standards of living and to tackle poverty reduction.”

Pascal Lamy (2008), Director-General of the WTO.

The belief that trade offers gains to those who do trade is at the heart of the WTO’s endeavors to reduce trade barriers. If this is true, why do countries impose trade barriers at all?

Krugman (1991), page 25, observes *“three simple rules”* on the objectives of an individual member country in trade negotiations, which he calls *“GATT-think”*:

“(1) Exports are good.

(2) Imports are bad.

(3) Other things equal, an equal increase in imports and exports is good.”

Krugman argues that GATT-think is, *“[...] to an economist, nonsense.”* However, he admits that although it *“[...] is very wrong, yet somehow turns out mostly right.”*¹

¹The last quotation refers to page 27 of Krugman (1991).

There are indeed economic reasons for why a country would want to impose import barriers. Market power is one of them. If a country has a large share in the world market demand for a particular good, this country may increase its welfare by imposing import barriers. The associated reduction in demand leads to a decreasing world market price of the imported good. This in turn leads c.p. to an improvement of the country's terms of trade and thus to an increase in its welfare.

Distributional motivation provides another reason for opposition against free trade. A country is able to increase its welfare by imposing import barriers if it attributes a sufficiently higher value either to the surplus of its domestic producers of import substitutes or to its tariff revenue than it attributes to domestic consumers' surplus.

Given that it may be individually rational, especially for a large country, to implement trade barriers and thus to reduce global welfare, the focus of the General Agreement on Tariffs and Trade (GATT) and its successor, the WTO, is to provide a set of rules that helps its 153 members to reduce trade barriers.² However, any bilateral trade agreement is only sustainable if defection can be deterred. This is where the DSS of the WTO comes into operation. Under the DSS, any member country may file a complaint against a trading partner that supposedly violated a trade agreement. If the arbitration panel of the Dispute Settlement Body (DSB) finds the disputable trade measure to constitute an infringement, it will ask the offender to bring its trade policy into agreement with the rules. If the offender fails to do so, the DSB may, according to Article 22 of the Dispute Settlement Understanding (DSU), entitle the victorious complainant to impose retaliatory trade barriers against the offender. Since the WTO does not possess supranational sovereignty, the DSB is unable to impose penalties or fines on the non-complying offender. Hence, it is its trading partner's retaliation that poses the utmost threat to an offender of a trade agreement. Obviously, the magnitude of this threat to one trading partner depends upon the other trading partner's ability to impose retaliation. As a matter of fact, smaller and poorer countries find it hard to implement retaliatory import barriers without

²As of September 29, 2008, the WTO counts 153 members.

harming their own welfare either because these countries cannot influence world market prices, or because they lack domestic substitutes for their imports.³ This enforcement flaw of smaller and poorer countries is likely to be anticipated by their trading partners, resulting in the latter's reluctance to comply with panel rulings.⁴ Anticipation may even start one step earlier, deterring smaller and poorer countries from filing a complaint in the first place. This in turn would lead to systematically more offenses against smaller and poorer countries than against wealthier and larger countries.

In other words, there is reason to conjecture that a country's economic power influences its decision whether or not to commit an offense and whether or not to file a complaint. Consequently, the DSS raises important questions about the repercussions of this power based enforcement and about the desirability of certain proposals for reform. Although a lot of the discussion on the DSS is led by scholars with a background in law or political sciences, these questions are particularly interesting and suitable for economic analysis. In the course of this dissertation the following questions are addressed: Is there evidence in support of the hypothesis that smaller and poorer countries are deterred from filing complaints? Which role do litigation costs play in a country's decision whether or not to file a complaint, and which role do they play in a country's decision whether or not to commit an offense? How would countries' behavior change if the right to retaliate became tradable, as proposed by the Permanent Mission of Mexico to the WTO?

1.2 Outline

This Introduction (Chapter 1) is completed by a brief overview of the related literature. It is followed by the three main chapters, which form the central contributions of this dissertation.

Chapter 2 starts with an empirical analysis of the DSS' usage. The aim of this chapter is to

³Anderson (2002) is among the first economic papers to make this point.

⁴The problem of non-implementation of panel rulings is highlighted by Choi (2007), who argues that, especially in cases which involve poor country complainants, the threat of retaliation does not create a sufficient incentive to enforce violating countries' compliance with their commitments.

investigate a potential link between a country's decision of whether or not to file a complaint and its economic power. Therefore, a simple sequential game of dispute settlement is employed in order to set the stage for a binary regression model. The regression uses an array of variables of economic power to explain a country's decision whether or not to file a complaint. The results show that a country is more likely to file a complaint if (i) it has a high income, (ii) its trading partner has a low income, (iii) the trade value of the commodity at stake is significant, and (iv) its retaliatory capacity is substantial.

Chapter 3 uses a theoretical two country model in order to investigate the equilibria of a tariff setting game under the current rules of the DSS. The focus of the analysis is on the comparative static effects of a proposed reduction in litigation costs. The results show that a reduction in litigation costs exhibits a trade off. While the cost reduction is able to improve the compliance of less powerful countries, some more powerful countries are led to committing even more severe offenses than before.

Chapter 4 (joint work with Mathis Klepper) employs a theoretical three country model to analyze the reform proposal of tradable retaliatory rights, that has been suggested by the Permanent Mission of Mexico to the WTO. The analysis shows that tradable retaliation is able to improve WTO members' compliance with their trade policy commitments, especially towards less powerful trading partners.

Finally, Chapter 5 summarizes the preceding chapters' results, discusses policy implications and points towards future research approaches.

1.3 Related Literature

A broad field of literature on the WTO and its predecessor GATT covers various aspects of these organizations such as membership, the composition of trade flows, the interaction with regional trade agreements, China's accession, and the perceived areas of conflict between developing and developed countries, which are protectionism in agriculture and textiles and the inclusion of labor and production standards.

However, only a rather narrow field of literature deals explicitly with aspects of trade disputes and the DSS. If one disregards case studies that deal with a particular dispute in a merely descriptive way, only very few theoretical and empirical studies remain, that investigate the systemic aspects of trade disputes and WTO dispute settlement.

One particular branch of theoretical literature examines the question under which circumstances a country prefers an equilibrium in which countries set their unilateral optimal tariffs to an equilibrium of free trade for reasons other than redistributive motivations. Johnson (1953) finds that a country prefers a tariff war equilibrium to free trade if its import demand is sufficiently price-elastic relative to the price-elasticity of its trading partner's import demand. Another two country model by Kennan and Riezman (1988) features differences in countries' endowments. The authors show that a country whose endowment is sufficiently large prefers a tariff war to free trade. Following up, Syropoulos (2002) employs a two country Heckscher-Ohlin model where countries differ in their population. Paralleling Kennan and Riezman's results, Syropoulos shows that a country whose population is sufficiently large prefers a tariff war to free trade. Melatos et al. (2007) find that a country may even prefer a tariff war to free trade if only domestic consumers' utility features a sufficiently large elasticity of substitution. As a summary, these studies suggest that, when countries are sufficiently asymmetric with respect to their endowments, population, preferences, etc., one country may actually prefer the tariff war equilibrium and would not want to arrive at a free trade equilibrium even if this could be achieved hypothetically. However, a tariff war equilibrium implies a deadweight loss, that could potentially be avoided if asymmetric countries were able to negotiate trade agreements with (asymmetric) tariff commitments, reflecting their individual threat points. Hence, for a country whose best response has been to play its unilateral optimal tariff in a setting without the possibility of contracting, this may not be a best response anymore when countries can embark on negotiations and credibly commit themselves to these.

The finding that negotiations on trade agreements between countries may entail different optimal tariffs is examined by another branch of theoretical literature. Bagwell and Staiger

(1999) and (2002) show that those unilateral optimal tariffs which are set in the absence of an agreement are inefficiently high in a framework where countries can negotiate reciprocal tariff liberalization. The authors find that the WTO's fundamental principle of reciprocity is able to neutralize a country's incentive to influence its terms of trade in its favor since the relative world market price of imports to exports does not change when reciprocal tariff liberalization occurs. In other words, in a bilateral model of trade there are several pairs of import tariffs that induce the same terms of trade. If countries can be forced to stick to their tariff commitments, they will choose a lower pair of import tariffs as compared to the non-cooperative outcome, thus increasing global welfare. A recent paper by Epifani and Vitaloni (2006) uses the two country setup that was proposed by Kennan and Riezman (1988) in order to investigate whether Bagwell and Staiger's finding holds as well in the case of asymmetric countries. Epifani and Vitaloni compare the countries' welfare under unrestricted Nash-bargaining solutions over their bilateral tariffs to Nash-bargaining solutions that fulfill the reciprocity condition. They find "[...] that the negotiated outcome under reciprocity, in addition to being inefficient, is also unequal, since it gives the weak country a lower utility than at the unconstrained Nash-bargaining solution."⁵ Yet another caveat of the Bagwell and Staiger approach is highlighted by the authors themselves. Bagwell and Staiger (1999), page 224, note that their model requires the external assumption of enforceability. This is a crucial condition since without the possibility of credible tariff commitments, countries would fall back to the tariff war equilibrium. Bown (2002) uses a two country tariff setting game where the producers' surpluses of each country's import-competing industry enter the governments welfare functions weighted by a political economy parameter. Countries experience positive shocks in their political economy parameters and thus seek to raise their import tariffs, choosing between a "legal route" and an "illegal route".⁶ While the legal route foresees using safeguards and compensating the other country for the loss of market access, the illegal route foresees raising tariffs without compensation and consequently triggering retaliation via the WTO's dispute settlement system. Bown shows that a country

⁵Epifani and Vitaloni (2006), page 438.

⁶Bown (2002), page 297.

prefers the illegal route “[...] when it has the capacity to take advantage of its own terms of trade gains and when its trading partners do not have the potential to impose terms of trade losses through retaliation.”⁷

As a summary, theoretical studies on trade disputes and the WTO dispute settlement system agree in their finding that a country may face a disadvantage in enforcing its trading partner’s compliance when it is “weaker” than its trading partner. That is, when a country has a lower ability to influence the terms of trade or when its welfare function implies a lower optimal import tariff as compared to its trading partner’s. Consequently, some proposals have been made that aim at strengthening the weaker countries’ position in the dispute settlement system. These proposals include multilateral retaliation, direct penalties, financial compensation, tradable retaliation and a reduction of litigation costs.

The effects of multilateral retaliation in the WTO are analyzed by Maggi (1999). The author constructs a three country model of trade where each country is a net importer from its right neighbor and a net exporter to its left neighbor. Maggi considers import tariffs as a country’s control variable, such that a country could be tempted to impose a tariff on imports from its right neighbor since the volume of targeted imports is relatively large compared to the volume of exports that could potentially be subject to a retaliatory tariff. Maggi compares the system’s status quo of unilateral enforcement to a system that allows for multilateral enforcement. Maggi’s model “[...] suggests that a multilateral approach to enforcement and rule-making is particularly important when there are strong power imbalances in bilateral trading relationships.”⁸

In a recent paper, Klimenko et al. (2008) analyze the effects of direct penalties on the enforceability of trade agreements. Klimenko et al. (2008) build on the Johnson (1953) model to set up a repeated game of tariff negotiations. They find that a dispute settlement system that uses direct penalties is able to render countries’ tariff commitments credible, thus leading to a cooperative equilibrium.⁹

⁷Bown (2002), page 314.

⁸Maggi (1999), page 209.

⁹The authors assume that the payment of the penalty is voluntary, but that if the offending country fails to pay it, then the dispute cannot be resolved and the repeated game will continue in the non-cooperative equilibrium.

Limao and Saggi (2006) consider the possibility of financial compensation. In their model the authors assume that the volume of trade between each pair of trading countries is covered by bonds that are posted by each government in order to serve as collateral. In different versions of their model they assume either that these bonds are exchanged bilaterally between the trading countries or that these bonds are held by a third country. Limao and Saggi show that if bonds were posted with third countries, a country's compliance would improve even if countries differed in size or market power.

The importance of third party enforcement is highlighted as well in the paper of Bagwell et al. (2007), which provides an analysis of the Mexican proposal of tradable retaliation.¹⁰ The authors find that if a violated country is allowed to auction off the retaliatory right, its trading partner's compliance with its trade policy commitments may improve.¹¹

Some experts argue that the costs that go along with the preparation of a complaint have a more pronounced adverse effect on weaker and less developed countries than on economically more powerful and higher developed countries. Bown (2005), Bush and Reinhardt (2003) as well as Guzman and Simmons (2005) argue that poorer countries may have less "*legal capacity*" than richer countries. However, since legal services are internationally traded, even a poor country may extend its legal capacity by hiring law firms or consultancies to prepare a complaint. Nevertheless, even if one adopted this view, poorer countries would face variable costs that would deter them from filing a complaint, while wealthier countries would have sunk their litigation costs by running a well-staffed trade mission. Consequently, another policy recommendation, that has been made by Footer (2001), is to reduce litigation costs.

On the empirical side there is evidence both for and against the theorists' view that the dispute settlement system favors more powerful countries.

Horn et al. (1999) show that a model, in which countries encounter random violations

¹⁰See Permanent Mission of Mexico to the WTO (2002) for the proposal of the Mexican Mission to the WTO.

¹¹The paper of Bagwell et al. (2007) is based on an imperfect information setup. Moreover, if one country executes the retaliatory right, this creates a positive externality for the other countries, except for the violating country. Thus, auction failure (no country bids for the retaliatory right) may occur if the violating country is foreclosed from bidding. As a consequence, Bagwell et al. (2007) find that compliance is improved if and only if the probability of auction failure is sufficiently low.

proportionately to the diversity and value of their trade, explains the observed pattern of disputes quite reasonably.¹² Hence, Horn et al. (1999) do not take the numbers of observable disputes as evidence of power considerations in dispute settlement. However, there is an argument against this approach. It may be the case that the set of observable disputes constitutes only a biased subset of all disputes. There is reason to believe that the dark figure of disputes exhibits a pattern that differs systematically from the pattern of the observed disputes. Smaller countries may not find it worthwhile to spend litigation costs on a complaint in anticipation of their inability to enforce even an affirmative panel ruling. If this proved to be true, the result of Horn et al. (1999) would have to be questioned since it would no longer mean that no power considerations are present at all, but rather that power considerations are absent among those countries which are powerful enough to find complaining worthwhile.

Bown (2005) proposes an approach which addresses these concerns. The author compiles a data set of disputes, in which all victim countries that have suffered from the defendant's offense are known with certainty. Subsequently, Bown regresses the binary decision of whether or not a country has filed a complaint on several country specific and dispute specific variables. All in all, Bown's empirical results suggest that economically small countries indeed face a severe disincentive in complaining as opposed to economically larger countries. Allee (2008) sets up a similar binary regression model that is based on another data set where all victim countries that have suffered from the defendant's offense are known with certainty as well. Although Allee uses a different array of explanatory variables, his findings parallel the findings of Bown (2005) in detecting a bias against less powerful countries.

Yet another empirical approach that deals with a presumed bias of the DSS' usage is presented by Guzman and Simmons (2005). The authors address the question whether a country of a given size rather complains against offenders of equal size or against offenders of larger size. Guzman and Simmons (2005) interpret their results in a way that lets them deny the presence

¹²The underlying assumption of this class of models is that a dispute is generally undesirable for a country. In order to be still able to explain the occurrence of disputes, a demon, which possesses policymakers from time to time and leads them to irrational behavior, is introduced. This demon approach was established by Kovenock and Thursby (1992).

of power considerations.

Chapter 2

Evidence of Power Considerations in WTO Dispute Settlement

Abstract

The usage of the WTO's DSS is dominated by high income countries. Since the ultimate enforcement threat of the system is based on retaliation, countries may take their economic size as well as their specific bilateral retaliatory capacity into account when deciding whether or not to respond to a detrimental infringement of a trade agreement by filing a costly complaint. Hence, various scholars conjecture that those lawsuits that surface in the record of the WTO constitute only the biased tip of an iceberg of trade disputes. In order to investigate such a potential bias, this chapter sets up a sequential game of the DSS. Subsequently, a binary choice model is employed to empirically explain a country's decision whether or not to litigate against a trading partner. The results suggest that a country is more likely to file a complaint if (i) it has a high income, (ii) its trading partner has a low income, (iii) the trade value of the commodity at stake is significant, and (iv) its retaliatory capacity is substantial.

2.1 Introduction

With the establishment of the WTO in 1995, the DSB has gained much importance as an institution in the world trading system. While a panel's decision in the GATT era became a ruling only by consensus, the panel decisions under the WTO's DSS become a ruling unless there is a consensus against it. This modification is a candid commitment to encouraging complaints of members that have suffered from a contract breach of their trading partners. However, the WTO does not possess any supranational sovereignty to enforce compliance with the rules-based trading system by imposing sanctions or fines. As a consequence, the ultimate enforcement threat of a panel ruling is based on the retaliatory capacity of the victorious complainant. While it may be worthwhile for an economically large country to implement authorized retaliatory countermeasures against a trading partner, an economically small country may shoot itself in the foot by doing so.¹

An example of this discrepancy is found in the prominent Bananas Dispute (i.e. DS16 and DS27), in which the United States of America (US) and several Latin American countries complained against the bananas import regime of the European Communities (EC), which favored bananas from the African, Caribbean and Pacific countries (ACP). Although the panel decided in favor of the complainants, the EC refused to bring their import regime into compliance with the ruling. Upon their request, Ecuador and the US were authorized to suspend concessions to the EC as a retaliatory measure.² In the outcome of this dispute the EC did not bring its import regime into conformity with the rules of the WTO, the US implemented their retaliatory measures, while Ecuador was reluctant to do so. Several experts e.g. Bronckers and van den Broek (2005) or Subramanian and Watal (2000) agree in arguing that Ecuador was virtually unable to implement retaliatory measures unless it would like to hurt its own economy even

¹It is a well known fact that a small country's optimal import tariff equals zero since a small country cannot influence world market prices, i.e. it faces a completely elastic supply. In this context the terms "large" or "small" are used synonymously to the terms "rich" and "poor" in order to capture the magnitude of a country's gross domestic product (GDP).

²Ecuador was authorized to suspend import concessions to the EC of an amount of 201.6 million US-Dollars (USD), while the US were authorized to suspend concessions to the EC of an amount of 191.4 million USD.

more.³ At the end of the day of this dispute, the EC kept the benefits of maintaining an illegal import regime, the US got at least a little compensated for the losses in the bananas business by the implementation of import barriers against the EC, while Ecuador was left with nothing but an injured bananas export sector.

Such a potential inability of poorer countries to enforce an offending trading partner’s compliance may render the usage of the DSS less attractive for poorer than for richer countries. This effect may in turn show up in the data as a bias against poorer countries. Table 2.1 provides a breakdown of all complaining and defending countries from 1995 through 2005, grouped according to the World Bank’s income classifications.⁴ Clearly the figures of Table 2.1 show that

Complainant\Defendant	High	Upper Middle	Lower Middle	Low	Sum
High	151	33	21	17	222
Upper Middle	28	19	12	1	60
Lower Middle	42	13	7	2	64
Low	14	5	2	1	22
Sum	235	70	42	21	368

Table 2.1: Usage of the DSS by Countries’ Income Groups from 1995 through 2005

wealthier countries filed the majority of all complaints. Moreover, these countries dominate the system as well among the defendants. However, this observation is by no means a proof for the claim that the DSS is biased against poorer countries.

This chapter tries to shed light on the question of what determines whether a country does or does not file a complaint against an offending trading partner. It aims at providing a non-random theoretical explanation that allows for rationally acting countries and can be empirically tested. Therefore, section 2.2 sets up a game theoretic model of the dispute settlement process.

³Note that even the arbitrators of this particular case acknowledged this problem in WT/DS27/ARB/ECU, para 177 by stating that “[...] it could be that Ecuador may find itself in a situation where it is not realistic or possible for it to implement the suspension authorized by the DSB for the full amount of the level of nullification and impairment estimated by us in all of the sectors and/or under all agreements mentioned above combined.” Moreover, the arbitrators notice that the Dispute Settlement Understanding (DSU) is not prepared for such a case in WT/DS27/ARB/ECU, para 177: “The present text of the DSU does not offer a solution for such an eventuality.”

⁴The 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 World Bank’s classification scheme.

In section 2.3, predictions on how different observable variables should influence a country's decision whether or not to file a complaint are derived. Subsequently, in section 2.4, a statistical criterion is derived and employed to create a data set of 2,409 countries that are likely to have suffered in the course of 185 disputes on import restrictions, ranging from 1995 through 2005. By means of a probit model, the binary complaining decision is regressed on the offender's and the victim's GDP, the trade value of the disputable commodity at stake, and a proxy for the retaliatory capacity of the victim. The results unambiguously suggest that victims do take power considerations into account when deciding whether or not to file a complaint. Thereby the findings of Bown (2005) are confirmed on a broader statistical basis. Section 2.7 challenges the findings of Guzman and Simmons (2005) by using the newly compiled data set to re-estimate a model that is similar to Guzman and Simmons'. Section 2.8 offers concluding remarks and relates the chapter's findings to the literature.

2.2 Game Theoretical Foundation

The handling of a dispute in the WTO occurs according to a clear-cut sequential scheme of escalation. The first stage foresees a consultation phase of 60 days, in which the conflicting parties are supposed to settle their dispute in bilateral negotiations without any judge or panel. In case the opposing parties are unable to find an agreement within these sixty days, the establishment of a panel may be requested by either party. Once a panel has ruled on a dispute, the ruling can be appealed by either party, so that an appellate body will consider the issue again. If the final ruling on the dispute judges a defendant's policy to constitute an infringement of the WTO's rules, the offending party's government will be asked to bring its measures into conformity. Should the offending country refuse to do so within a "reasonable period of time", the victorious complainant may request the retaliatory "suspension of concessions". In practice, this suspension of concessions may constitute for example an import tariff or a quota which targets the complainant's imports from the defendant. Of course, the authorized extent of retaliation is dependant upon the magnitude of the initial offense. Formally, 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."⁵ However, in legal practice there are various ways of how panels have interpreted this equivalence condition by calculating the authorized amount of retaliation. Jordan (2005) provides a discussion of the employed calculation methods. For those disputes that deal with trade in goods and violative import barriers, one particularly dominating approach is the counterfactual trade value model.⁶ This model first assesses the reduction in the trade value of the imported goods that have been subject to the defendant's disputable trade measure. This reduction in trade value is seen as the damage that was inflicted. Now in turn, the victorious complainant would be entitled to implement a retaliatory import barrier on its own imports from the defendant that leads to a trade value reduction of smaller or equal size. In other words, the retaliatory trade value distortion must not exceed the trade value distortion of the initial offense.

2.2.1 Setup of the Game

Settling a dispute involves a sequence of decisions. At different points in time, the complainant and the defendant choose actions, such as to complain, to comply or to retaliate. By making these decisions, the players affect their own as well as their opponent's welfare, such that strategic behavior may result. Hence, one possibility to facilitate empirical analysis of the central question, which variables trigger the complaining decision of an injured country, is to arrange the sequence of decisions in a game theoretical framework. In order to focus the model on the victim's decision whether or not to complain, rather than on the panel's ruling, it is convenient to employ one simplifying assumption right from the start.

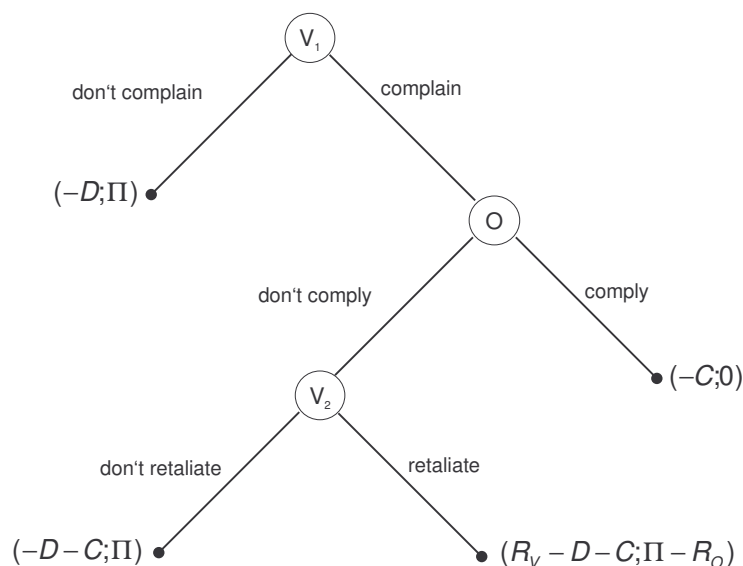
Assumption 2.1. *Whenever a violation of the WTO rules occurs, the panel correctly judges it to be a violation and consequently entitles the victim to retaliate against the offender if the latter does not comply with the ruling.*

⁵DSU Article 22, para 4.

⁶This method was used for example in the following cases: DS26 EC-Hormones, DS27 EC-Bananas, DS160 US-Copyright.

Given this assumption, the simplified sequence of decisions can be described as follows. Suppose an infringement of a bilateral trade agreement has already occurred and the disputing countries have been unable to settle the issue amicably. Let the offending country be denoted by O for offender, and let the country which is suffering from the offense be denoted by V for victim. Assume further that the infringement causes a welfare loss of D ($D \geq 0$) for the victim and a welfare gain (loot) of Π ($\Pi \geq 0$) for the offender. Then, at the initial node V_1 , it is up to

Figure 2.1: A Simplified Game of Dispute Settlement



V to decide whether or not to file a complaint at cost C (≥ 0). If V decides not to complain, the game ends with V suffering from the offense, while O is enjoying the associated loot. If V decides to complain, the game arrives at node O , where the offender can decide whether to abolish the disputable trade measure (i.e. “comply”) or to maintain it (i.e. “don’t comply”). In case O complies, the game ends, and V is relieved of its welfare loss D , while O loses its loot Π . However, if O does not comply, the game arrives at node V_2 where the victim can chose between “retaliate” and “don’t retaliate”. If no retaliation occurs, the game ends with V suffering from

the damage and litigation costs, while O enjoys the loot. If retaliation á la WTO is implemented, retaliation affects both the victim's and the offender's welfare such that R_V ($R_V \geq 0$) is added to the victim's payoff, while the offender's payoff decreases by R_O ($R_O \geq 0$). Figure 2.1 depicts the structure of the described game in an extensive form representation. The payoff vectors (π_V, π_O) are displayed at the end-nodes with π_V denoting the victim's payoff and π_O denoting the offender's payoff.

2.2.2 Strategies and Nash Equilibria

Since the dispute settlement process has been modeled as a game of perfect information, the victim's set of strategies is given by

$$S1_V := (\text{don't complain}|\text{don't retaliate})$$

$$S2_V := (\text{don't complain}|\text{retaliate})$$

$$S3_V := (\text{complain}|\text{don't retaliate})$$

$$S4_V := (\text{complain}|\text{retaliate}),$$

while the offender's set of strategies is

$$S1_O := (\text{don't comply})$$

$$S2_O := (\text{comply}).$$

Recall that the central purpose of the game theoretic foundation is to identify those equilibria that are characterized by a complaining victim. For the game at hand, two Nash equilibria involving "complain" can be identified.

Proposition 2.1. *The game exhibits two Nash equilibria in "complain":*

(i) $\{(\text{complain}|\text{retaliate}), (\text{don't comply})\}$ is a Nash equilibrium iff $\Pi > R_O \wedge R_V > C$.

(ii) $\{(\text{complain}|\text{retaliate}), (\text{comply})\}$ is a Nash equilibrium iff $\Pi \leq R_O \wedge D > C$.

Proof: See Appendix A.1.

Note that the two Nash equilibria in “complain” exclude each other since $\Pi > R_O$ excludes $\Pi \leq R_O$ and vice versa. Hence,

$$R_V > C \wedge D > C \tag{2.1}$$

is a sufficient condition for observing “complain” in equilibrium. In line with basic intuition, the following intermediate results can be verbalized.

Intermediate Results

A country that is suffering from the infringement of a bilateral trade agreement would be expected to file a complaint in equilibrium if

- (i) litigation costs are low,
- (ii) the victim’s gain from retaliation is large,
- (iii) the victim’s damage from the initial offense is large.

2.3 Payoff Proxies for the Binary Decision Model

Up to now, the payoff elements of the game that have been found to influence a victim’s binary decision whether or not to complain are entirely unobservable variables in a theoretical framework. Therefore, this section discusses the selection of appropriate “real world” proxies for these payoff elements after a brief introduction into the general structure of binary decision models.

2.3.1 General Setup of the Probit Model

Let y_i represent the choice of the i th victim, which takes the value 1 if the victim files a complaint and 0 otherwise. Consider that a rational individual would prefer to complain whenever doing so yields more utility than not complaining, but that these utility levels are unobservable. Let

the i th victim's utility from complaining be denoted by U_{i1} while utility from not complaining is denoted by U_{i0} . Moreover, define $y_i^* := U_{i1} - U_{i0}$. Then it holds that

$$y_i = \begin{cases} 1 & \text{if } y_i^* > 0 \\ 0 & \text{if } y_i^* \leq 0. \end{cases} \quad (2.2)$$

Note that in equation 2.2, y_i apparently is observable as opposed to y_i^* . The insights from the dispute settlement game suggest that a particular victim's utility from complaining and not complaining would be determined by a vector of exogenous and observable variables. Consequently y_i^* is as well determined by a vector of these exogenous variables. In particular, let

$$y_i^* := x_i' \beta + \varepsilon_i, \quad (2.3)$$

where x_i' denotes the vector of exogenous variables, β denotes the vector of unknown parameters and ε_i are random errors. Furthermore, let P_i denote the probability for $y_i = 1$. Then $1 - P_i$ is the probability for $y_i = 0$. Consequently, it follows from equations (2.2) and (2.3) that

$$P_i = \text{Prob}(y_i = 1) = \text{Prob}(y_i^* > 0) = \text{Prob}(\varepsilon_i > -x_i' \beta). \quad (2.4)$$

Assuming a symmetric probability distribution, like the normal distribution, it holds as well that

$$P_i = \text{Prob}(y_i = 1) = \text{Prob}(y_i^* > 0) = \text{Prob}(\varepsilon_i < x_i' \beta). \quad (2.5)$$

Hence, the probability for a complaint can be compactly written as

$$P_i = F(x_i' \beta), \quad (2.6)$$

where $F(\cdot)$ denotes the cumulative distribution function of the standard normal in case of the probit model.⁷

2.3.2 Selection of Proxies

The components of the payoffs in the game theoretic model are generally unobservable in reality. In order to be able to empirically test the theory's predictions, it is necessary to find observable data for the vector of exogenous variables x' that can be employed as a proxy for each of the model's payoff elements.

Litigation Costs

The victim's costs of litigation may contain various elements. One prerequisite in the course of the preparation of a complaint is to collect data on the scope of the infringement. Another one is to calculate the precise monetary value of the injury, using plausible price elasticities, which need to be estimated in advance. In order to conduct these kinds of economic assessments, the trade mission of the victim country would either have to hire consultancies that are specialized in this field, or it would have to use the working capacity of the trade mission's permanent employees. In addition to these economic calculations the complaint needs to be prepared by lawyers that have a sound knowledge of the particular legal aspects of the GATT/WTO agreement. Finally, in a lengthy dispute there will be traveling costs for several flights, hotel stays, etc. Nordström (2005) emphasizes the role that litigation costs play in deterring especially smaller countries from using the dispute settlement system. Nordström reports that "*[t]he fees charged by top-notch law firms in Brussels and Washington D.C. are in the range of \$500 to \$1.000 per hour plus expenses [...]*".⁸ Moreover, lawyers are reported to have charged their clients fees in excess of 10 million dollars.⁹ Bown and Hoekman (2005) report similar figures. In line with Nordström's findings, it may be assumed that the level of litigation costs rises with the complexity of a case,

⁷For a discussion of the nonlinear probit approach that is used here, see Greene (2003), chapter 21 or Judge et al. (1988), chapter 19.

⁸Nordström (2005), page 1.

⁹Shaffer et al. (2003).

but that it is independent of the value of the traded goods at stake in a particular dispute.

One argument that could be made to tie the level of litigation costs to a country specific variable is as follows. It may be plausible to assume that wealthier countries' governments already sunk a significant part of their litigation costs by running a large permanent trade mission in Geneva and having several trade economists and lawyers permanently on their payroll. As opposed to this, poorer countries, which usually don't have a "standing army" of economists and lawyers may regard substantial parts of the litigation costs as variable costs. However, Bown (2005), who uses data on the number of a country's delegates at the WTO Secretariat finds no evidence of such a potential influence on a country's decision whether or not to file a complaint. Guzman and Simmons (2005) model the role of litigation costs as a problem of limited legal capacity. In particular, they assume that the larger a country is in terms of its GDP (in an alternative model they use the GDP per capita), the larger is the number of disputes this country can handle.

All in all, litigation costs may either be regarded as decreasing in the victim's GDP (GDP_V) or they may be regarded as completely independent. Furthermore, there is no theory which predicts that a victim's litigation costs increase in its GDP. Hence, it may be expected that $\frac{\partial C}{\partial GDP_V} \leq 0$.

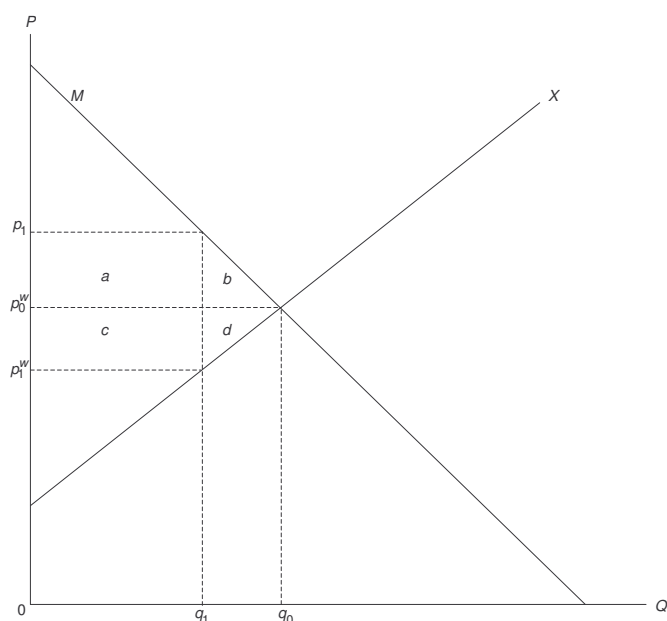
The Victim's Gains and Losses from Import Restrictions

Proposition 2.1 includes R_V as a variable reflecting a gain from an import restriction for the active (tariff setting) country and D as a variable that reflects a loss from an import restriction for the passive country.

There are two economic reasons for why the active country may benefit from implementing an import restriction. First, countries may put more weight on the producer surplus of their domestic import substituting industries than on consumer surplus in the market for a particular commodity. This stronger weight on producer surplus could be explained by industry lobbying efforts, hence by political economy models, whose empirical verification would require infor-

mation on lobbying intensities in the affected countries. The second economic reason is one that applies to those countries that are large enough to influence world market prices. These countries can influence the terms of trade in their favor such that they realize a net welfare gain from the imposition of an import barrier. Figure 2.2 schematically depicts the effects of an import tariff, levied by a large country. The downward sloping line M represents the country's

Figure 2.2: Welfare Effects of an Import Tariff



import demand while the upward sloping line X represents global export supply. Initially, when there is no tariff, the world market price p_0^w equals the domestic price p_0 , while q_0 indicates the initially traded quantity. Suppose that now the importing country levies a tariff of τ . Then the domestic price rises to p_1 and reduces import demand to a quantity of q_1 . Since global supply is not completely elastic, the reduction in import demand leads to a reduction of the world market price to p_1^w . The effects on the welfare of the importing country are ambiguous. That is, on the one hand, consumer surplus is reduced by the trapezoid area $a + b$, but on the other hand, a tariff revenue of the rectangular area $a + c$ is gained. So the net welfare gain for the importer is

$c - b$.¹⁰ Clearly this difference decreases as the global export supply gets more and more elastic. Finally, if the importer faced a completely elastic export supply, the area c would vanish, such that the complete tariff plus the deadweight loss had to be borne by domestic consumers. Consequently, a net welfare loss would be the result if world market supply were sufficiently elastic. Thus, if the offender is a large supplier on the world market for the retaliation good, its more elastic export supply function is likely to reduce the retaliatory gain for the victim. On the basis of exports to the European Union, Nordström (2005) finds empirical evidence for the claim that larger or wealthier countries are larger suppliers on the world market, both overall and in individual commodities. Moreover, Nordström finds that “[a] subdivision of GDP into population and per capita income does not change the result very much. In other words, it does not matter if the supplying nation is small because of a small population or poor population.”¹¹ Hence, it may be conjectured that the offender’s GDP (i.e. GDP_O) reduces the victim’s gain from retaliation: $\frac{\partial R_V}{\partial GDP_O} < 0$.

Furthermore, the elasticity of the importing country’s demand plays a role as well. Consider the consequences of a less elastic (i.e. steeper) import demand curve on the net welfare gain $c - b$. Obviously b would increase when holding c fixed or, vice versa c would shrink when holding b fixed, so that the net welfare gain would decrease. Note that a poor country’s import demand is more likely to be less elastic since imports are more likely to lack domestic substitutes.

The bottom line message from this little exercise is that bigger victim countries are more likely to be able to extract a large gain (i.e. large R_V) from imposing a retaliatory import restriction because (i) bigger countries usually have a more elastic import demand since they are more likely to produce domestic substitutes, and (ii) bigger countries are more likely to be able to influence world market prices and consequently face a less elastic export supply, especially if the targeted exporter is small. In a theoretical analysis, Anderson (2002) emphasizes these difficulties that are predominantly faced by smaller countries that consider the implementation

¹⁰Any increase of a potentially existing domestic import substituting producer’s surplus is out of the scope of this analysis.

¹¹Nordström (2005), page 8.

of retaliatory measures. Broda et al. (2006) found empirical evidence that is mirroring this result in the data. In their empirical study they show that countries indeed seem to take the relevant elasticities into account when setting their tariffs. Thus it may be concluded that $\frac{\partial R_V}{\partial GDP_V} > 0$.

Furthermore, two additional variables play a crucial role for the gains from retaliation. First, the value of the victim's imports from the offender constitutes an upper bound for the implementation of retaliation since retaliation can apparently only target these imports. Hence, for the trade value of the exports from the offender to the victim (X_{OV}) it may be assumed to hold that $\frac{\partial R_V}{\partial X_{OV}} > 0$. Second, since the WTO's equivalence condition authorizes retaliation up to the magnitude of the initial damage, the trade value of the disputed commodities (DTV) limits the extent of retaliation as well. Hence, it may be conjectured that $\frac{\partial R_V}{\partial DTV} > 0$.

What is left to proxy for, are the detrimental effects of the initial import restriction on the victim. Tariff equivalents of the offense would be a desirable but rarely available proxy since the files of most disputes' cases lack precise information on the concrete scale of the offense. Moreover, many dispute settlement proceedings come to an end before a panel ruled on the issue, such that there are virtually no numbers available. However, all else equal, the magnitude of the initial damage D should be positively correlated with the trade value of the disputed commodity. Hence, it seems likely that $\frac{\partial D}{\partial DTV} > 0$.

2.3.3 Summary of Hypotheses

Bringing together the selected proxies with the insights of the dispute settlement game, a link between empirically observable data and the expected behavior of a victim country can be established. In particular, the probability for observing that an injured country files a complaint is given by $P_i = F(x'_i\beta)$, where x' now incorporates the observable variables. Consequently, previous arguing leads to the following hypotheses.

$$(H1) \quad \frac{dP_i}{dGDP_V} = \overbrace{\frac{\partial P_i}{\partial R_V}}^{(+)} \overbrace{\frac{\partial R_V}{\partial GDP_V}}^{(+)} + \overbrace{\frac{\partial P_i}{\partial C}}^{(-)} \overbrace{\frac{\partial C}{\partial GDP_V}}^{(-)} > 0$$

$$(H2) \quad \frac{dP_i}{dGDP_O} = \overbrace{\frac{\partial P_i}{\partial R_V}}^{(+)} \overbrace{\frac{\partial R_V}{\partial GDP_O}}^{(-)} < 0$$

$$(H3) \quad \frac{dP_i}{dDTV} = \overbrace{\frac{\partial P_i}{\partial D}}^{(+)} \overbrace{\frac{\partial D}{\partial DTV}}^{(+)} + \overbrace{\frac{\partial P_i}{\partial R_V}}^{(+)} \overbrace{\frac{\partial R_V}{\partial DTV}}^{(+)} > 0$$

$$(H4) \quad \frac{dP_i}{dX_{OV}} = \overbrace{\frac{\partial P_i}{\partial R_V}}^{(+)} \overbrace{\frac{\partial R_V}{\partial X_{OV}}}^{(+)} > 0$$

2.4 Sample Selection

Both the variables of the game theoretic model and the suggestions for how to proxy for these are based on the assumption that the initial offense has been any measure that adversely affects imports. As a consequence, the model so far may not be applied to disputes dealing with e.g. export subsidies or violations of intellectual property rights. Moreover, it is required that the bundle of affected commodities can be determined. Practically this means that only those disputes are included that deal with import restrictions and for which information on the Harmonized System (HS) codes of the disputable commodities is available. This information is generally found in the WTO's case records, which are publicly available on the webpages of the WTO.¹²

Furthermore, since the value of the bilateral trade flow of the disputable commodity is of major interest, trade data for the particular HS codes have to be available for the selected disputes. The UN COMTRADE database provides data on the vast majority of all bilateral trade flows up to the year 2005. Trade flows from 2006 are not yet covered sufficiently. Consequently, disputes from 1995 through 2005 are included. Out of the total number of 335 disputes that have arisen in that period, 185 deal with import restrictions.¹³

Among these 185 disputes the most frequently involved articles and agreements are National

¹²In some cases, for which the WTO does not provide the HS codes, this information has been taken from Horn and Mavroidis (2006), who provide a comprehensive database on disputes from 1995 through early 2004.

¹³See Appendix A.2 for a list of these disputes.

Treatment (60 disputes), Most-Favoured-Nation Treatment (50 disputes), Anti-dumping and Countervailing Duties (41 disputes), the Agreement on Subsidies and Countervailing Measures (30 disputes), the Agreement on Technical Barriers to Trade (21 disputes), and the Agreement on Safeguards (21 disputes). Note that in the majority of the disputes the complainant addressed more than one agreement or article. Moreover, in several of these 185 disputes there are multiple complainants such that the number of countries complaining is 198.

2.4.1 Selection of Injured Countries

Clearly it is plausible to assume the 198 complainants have been injured by the 185 offenses, but who else suffered from these offenses and did not complain? There is no certain answer to this question because for most cases there is virtually no information on the “dark figure” of victims available. However, given a sample in which the distinction between those countries that did not complain although they suffered on the one hand and those countries that did neither suffer nor complain on the other hand is known with certainty, it is possible to shed some light on the dark figure by means of statistical inference. Therefore, the remainder of this subsection will suggest a procedure for how to judge whether a country has suffered from a particular import restriction.

Necessary Condition

First, only those countries that have been a member of the WTO in the year of the dispute have been entitled to file a complaint in the first place. Second, only those WTO members will be considered to have suffered from an offense, which imported the disputable commodity into the offending country either in the year of the dispute or in the year before the dispute.¹⁴

¹⁴The disputable commodity is specified with a precision of four digits according to the HS classification system. Note that most import restrictions specify the targeted commodities with a precision of four digits. Consequently the WTO’s case records as well as the database of Horn and Mavroidis (2006) is dominated by four digit HS precision. Moreover, especially for many lower middle and low income countries, four digits is the highest degree of reporting precision for most bilateral trade flows.

Sufficient Condition

One possibility to reason whether one of the countries that already satisfy the necessary condition has been affected by an offense, is to look for “suspicious” variations in the trade flow of the disputable commodity. Common sense would suggest that, all else being equal, the implementation of an import barrier should lead to a reduction in trade flows in the year of the dispute (or the year before the dispute) compared to the average trade flows of the previous years.

In order to derive an appropriate sufficient condition that is based on a variation in trade flows, data from Bown (2005) are being exploited in the following way. There are 19 cases dealing with import restrictions in Bown (2005), where not all trading partners of the disputable commodity have been affected by the offense of the respondent. For these 19 cases, Bown succeeds in identifying those trading partners that have suffered from the offense.¹⁵ In the next step, this list of injured but non-complaining trading partners of the 19 offenders is augmented by all non-complaining trading partners who exported the particular commodity to the 19 offenders. When comparing the non-injured non-complaining trading partners to the injured non-complaining trading partners, it becomes apparent that indeed the exports of the injured countries exhibit a dip, as opposed to the exports of the non-injured countries. Hence a criterion, based on this observation may be used in order to distinguish between injured and non-injured countries. In order to avoid distortions arising from variations in output levels, let the criterion be based on the relative share of exports of the disputable commodity that are shipped from the i th potential victim to the offender at time t , where t denotes the year of the dispute. Let TV_t^{io} denote the i th potential victim’s exports to the offender at time t , and let TV_t^{iw} denote the i th potential victim’s exports to the world at time t . Then the share of exports

¹⁵I am grateful to Chad Bown who was so kind to send me data on the countries which have suffered from the 19 offenses, that Bown (2005), page 9 describes as follows. “[...] 19 WTO-inconsistent policies in the sample were applied on at least a ‘quasi’-MFN basis, in that even though an MFN-violation is a key element of the dispute, we were still able to identify from other, non-WTO sources the other exporting countries in addition to the complainant facing the discrimination of the WTO-inconsistent policy.”

that is shipped from the i th victim to the offender at time t is simply

$$S_t^i := \frac{TV_t^{io}}{TV_t^{iw}}. \quad (2.7)$$

Consequently, the average share of exports that have been shipped from the i th victim to the offender from time $t - k$ until time $t - l$, with $k > l$ is

$$\mu_{kl}^i := \frac{1}{k - l + 1} \sum_{j=l}^k S_{t-j}^i. \quad (2.8)$$

Building on this, let the criterion be defined as the share of exports at time t over the average share of exports from $t - k$ to $t - 2$.¹⁶ Hence the criterion Φ_k^i is

$$\Phi_k^i := \frac{S_t^i}{\mu_{k2}^i}. \quad (2.9)$$

The distributional properties of the two alternative criteria Φ_3^i and Φ_4^i in the Bown (2005) sample are displayed in Table 2.2. For Φ_3^i the number of injured (non-injured) countries is 56 (247). For Φ_4^i the number of injured (non-injured) countries is 44 (196).¹⁷ Table 2.2 shows that

Subsample	injured countries		non-injured countries	
	Φ_3^i	Φ_4^i	Φ_3^i	Φ_4^i
Mean	1.004962804	1.001819577	2.733825779	1.675199294
Std. Dev.	0.446674356	0.632216268	10.10916218	2.66398746
Observations	56	44	247	196

Table 2.2: Distribution of Selection Criteria in the Sample

injured countries exhibit lower values of both alternative criteria than non-injured countries. A test for different means of Φ_3^i and Φ_4^i in the two subsamples rejects the Null hypothesis of a

¹⁶The trade flows in the year before the official filing of the complaint (i.e. $t - 1$) may already be affected by the offense. To avoid complications that could arise due to the potential endogenous character of the trade flow in $t - 1$, this period is being omitted.

¹⁷This difference in the number of observations is owed to the fact that the Φ_k^i criteria require the availability of bilateral trade data with a precision of four digits for several consecutive years. While Φ_3^i requires data for only three years (i.e. t , $t - 2$ and $t - 3$), Φ_4^i requires data for four years (i.e. t , $t - 2$, $t - 3$ and $t - 4$).

common mean.¹⁸ Thus, the criteria may serve to select injured countries from the population of those countries that already satisfy the necessary condition for being injured. In particular, the approach taken here defines a cut-off level for Φ_4^i , so that all countries which exhibit a Φ_4^i below this cut-off level will be judged as injured.¹⁹ To formalize the cut-off level, let μ_1 and σ_1 denote the mean and the standard deviation of Φ_4^i in the subsample of injured countries, respectively. Moreover, let α denote the the probability of an alpha error, i.e. erroneously judging an injured country to be non-injured.²⁰ Then the cut-off level is denoted by

$$\Phi_4^{cut}(\alpha) := z_{1-\alpha}(\mu_1, \sigma_1), \quad (2.10)$$

where z denotes the α quantile of a normal distribution with mean μ_1 and standard deviation σ_1 . Finally, the selection of countries is conducted according to Assumption 2.2.

Assumption 2.2. *A country i that satisfies the necessary conditions for being injured is assumed to have suffered from an offender's disputable trade measure if and only if*

$$\Phi_4^i \leq \Phi_4^{cut}(\alpha). \quad (2.11)$$

2.4.2 Description of the Data

Selecting injured countries according to the previously determined rules yields 2,409 injured countries when applying $\Phi_4^{cut}(0.05)$.²¹ Among these injured countries there are 195 countries

¹⁸The hypotheses are $H_0 : \mu_1 - \mu_2 = 0$ vs. $H_1 : \mu_1 - \mu_2 \neq 0$, where μ_1 represents a criterion's mean in the subsample of injured countries and μ_2 represents a criterion's mean in the subsample of non-injured countries. Furthermore let D be the difference of the subsample means. It follows that $D(\Phi_3^i) = 1.728862975$ and $D(\Phi_4^i) = 0.673370718$. Using a pooled standard deviation s , the test statistic $\Theta = \frac{D}{s}$ is asymptotically normal distributed. In particular $\Theta_{\Phi_3^i} = 2.670699463$ and $\Theta_{\Phi_4^i} = 3.150306819$. Hence the Null hypothesis can be rejected for both criteria on all reasonable significance levels (i.e. 10%, 5% and 1% in a two-sided test).

¹⁹The test for different means suggests that Φ_4^i is slightly more powerful than Φ_3^i for distinguishing between injured and non-injured countries. A disadvantage of Φ_4^i as opposed to Φ_3^i clearly is the more excessive data requirement and its implications for a sample selection bias. However, the section dealing with the robustness of the results shows that whether Φ_3^i or Φ_4^i is employed does not change the results qualitatively.

²⁰The trade-off between alpha and beta error as well as the rationale for preferring to have a low alpha error in this criterion are discussed in Appendix A.3.

²¹The results do not change qualitatively when $k = 3$ and/or other levels for the alpha error are employed, as the subsection on robustness shows. Hence it is an arbitrary decision, which one of the criteria is chosen. The

that filed a complaint.²² For this sample, a data set of exogenous variables is compiled. The data set includes the “primary” variables DTV , GDP_O , GDP_V and X_{OV} . Moreover, as “secondary” variables, the offender’s and victim’s GDP per capita as well as an index of economic freedom are included in the data set in order to employ these for robustness checks in a later subsection.

- DTV denotes the trade value of the exports of the disputable commodity with a precision of four digits according to the Harmonized System classification that are shipped from the victim to the offender in the year before the complaint in US Dollars.²³ Information on the HS codes is taken from the WTO’s “Documents Online”²⁴ webpage or from Horn and Mavroidis (2006). Bilateral trade values are taken from UN COMTRADE²⁵.
- GDP_O denotes the gross domestic product of the offender in the year of the complaint in US Dollars. Data on this variable are taken from the World Bank.
- GDP_{PC_O} denotes the gross domestic product of the offender in the year of the complaint in US Dollars. Data on this variable are taken from the World Bank.
- GDP_V denotes the gross domestic product of the victim in the year of the complaint in US Dollars. Data on this variable are taken from the World Bank.
- GDP_{PC_V} denotes the gross domestic product per capita of the victim in the year of the complaint. Data on this variable are taken from the World Bank.
- X_{OV} denotes the trade value of all exports that are shipped from the offender to the victim in the year before the complaint.²⁶ Data on this variable are taken from UN COMTRADE.

remainder of the chapter refers to the sample compiled by $\Phi_4^{cut}(0.05)$.

²²Note that the previously reported number of 198 complaining countries has been reduced by three. This reduction is owed to the unavailability of trade data for the Dominican Republic, which is a defendant in disputes 300, 302 and 333. Thus, X_{OV} is not available for these three disputes.

²³Since this variable should capture the amount of goods targeted, it is plausible to use the trade value at $t - 1$ in order to deal with the problem that the disputable trade measure may have already reduced the trade value at time t .

²⁴See <http://docsonline.wto.org/>.

²⁵See <http://comtrade.un.org/db/>.

²⁶It may be the case that the aggregated bilateral trade flow has already been affected by the trade dispute in the year of the filing of the complaint. To avoid this potential endogeneity problem, the trade flow at time $t - 1$ is used.

- EF_V denotes the index of economic freedom for the victim in the year of the complaint.²⁷

Table 2.3 reports mean and standard deviation for these variables separately for complaining and non-complaining countries selected according to $\Phi_4^{cut}(0.05)$. Table 2.3 already shows that the

Subsample Variable\Variate	complaining		non-complaining		all		
	mean	std. dev.	mean	std. dev.	mean	std. dev.	t-value
DTV	9.04E+8	2.78E+9	2.29E+8	1.10E+9	2.84E+8	1.33E+9	3.37***
GDP_O	4.76E+12	4.47E+12	6.95E+12	4.17E+12	6.78E+12	4.23E+12	-6.59***
$GDPPC_O$	18,337	12,890	24,620	11,623	24,111	11.852	-6.58***
GDP_V	3.64E+12	4.27E+12	8.12E+11	2.26E+12	1.04E+12	2.60E+12	9.14***
$GDPPC_V$	16,071	13,016	11,346	12,238	11,729	12,367	4.88***
X_{OV}	4.07E+10	6.03E+10	1.20E+10	2.98E+10	1.43E+10	3.42E+10	6.58***
EF_V	67.56	9.18	65.76	10.63	65.91	10.53	2.59***
Observations	195		2,214		2,409		

Table 2.3: Descriptive Statistics of Exogenous Variables

previous theoretical considerations regarding the primary variables show up in the data, at least on the basis of a comparison of conditional means. In particular, complaining victims exhibit higher trade values of the disputable commodity than non-complaining victims on average (i.e. USD 9.04E+8 > USD 2.29E+8). Moreover, complaining victims exhibit a higher GDP than non-complaining victims (i.e. USD 3.64E+12 > USD 8.12E+11) on average. The retaliatory capacity, measured by X_{OV} , shows that complaining victims feature a higher level of this variable than non-complaining victims (i.e. USD 4.07E+10 > USD 1.20E+10) on average. The offender's economic power, measured by GDP_O , exhibits a lower level in those cases where a victim filed a complaint as opposed to those cases where a victim did not file a complaint (i.e. USD 4.76E+12 < USD 6.95E+12) on average. A two-tailed t-test rejects the null hypothesis of a common mean even on the one percent significance level for each variable.

Table 2.4 shows the correlation of the employed variables. Most values' signs and magnitudes are in line with intuition e.g. GDP_O exhibits a strong positive correlation with $GDPPC_O$, and

²⁷The index of economic freedom that is used here is taken from the Heritage Foundation (2006). Missing data on particular countries are augmented by decoupling the index of economic freedom provided by the Fraser Institute (2006). The index is scaled between 0 and 100 with 100 indicating the highest degree of economic freedom and zero indicating the lowest degree of economic freedom.

Variable	<i>DTV</i>	<i>GDP_O</i>	<i>GDP_{PCO}</i>	<i>GDP_V</i>	<i>GDP_{PCV}</i>	<i>X_{OV}</i>	<i>EF_V</i>
<i>DTV</i>	1	0.0643	0.0777	0.1696	0.1506	0.3623	0.1088
<i>GDP_O</i>		1	0.8415	-0.2515	-0.1542	0.1709	-0.1665
<i>GDP_{PCO}</i>			1	-0.2259	-0.1317	0.1665	-0.1191
<i>GDP_V</i>				1	0.4867	0.4690	0.2161
<i>GDP_{PCV}</i>					1	0.3637	0.6484
<i>X_{OV}</i>						1	0.1998
<i>EF_V</i>							1

Table 2.4: Correlation Matrix of Exogenous Variables

GDP_{PCV} shows a strong positive correlation with *EF_V*. More noteworthy is the finding that all GDP based variables of the offender are negatively correlated with the GDP based variables of the victims. In a sense, this underpins the results of Guzman and Simmons (2005) that opposing parties tend to be rather of unequal size than of equal size in terms of their GDP. However, the finding here holds for all victims, whereas the finding of Guzman and Simmons refers to the subset of complaining victims.

The data presented so far are being analyzed by means of a probit model subsequently.

2.5 Estimation and Results

Treating all observations as being individual (e.g. the US complaining in 1995 is a different victim than the US complaining in 1996), there are no repeated observations available. As a consequence, the reaction of one and the same individual in more than one environment of explanatory variables does not occur.

The estimation method will therefore require the maximization of the likelihood function, which is $\ell = \prod_{i=1}^T f(y_i) = \prod_{i=1}^T F(x'_i\beta)^{y_i} [1 - F(x'_i\beta)]^{(1-y_i)}$, where $F(\cdot)$ is again the cumulative distribution function of the normal distribution. After taking the logarithm, the function becomes $\ln\ell = \sum_{i=1}^T y_i \ln F(x'_i\beta) + \sum_{i=1}^T (1 - y_i) \ln[1 - F(x'_i\beta)]$. The maximization of this function via β is conducted using the numerical iterative Newton-Raphson method, which guarantees the convergence to the global maximum of the function.²⁸ The alternative maximization algorithm

²⁸See Greene (2003), page 670 ff. for a more detailed description of the properties of the Newton-Raphson estimation method.

method of Quadratic Hill Climbing as well as the Gauss-Newton algorithm confirm the results of the Newton-Raphson algorithm by producing similar results.²⁹

Table 2.5 presents the results of five different probit regressions, where y is regressed on a vector of the previously introduced exogenous variables. The underlying sample selection criterion is $\Phi_4^{cut}(0.05)$, yielding 2,409 observations (195 complaining and 2,214 non-complaining victims). Standard errors are computed according to Huber/White (quasi maximum likelihood), while *, **, and *** indicate a variable's significance on a ten, five, and one percent level respectively.³⁰

Variable	Model 1	Model 2	Model 3a	Model 3b	Model 4
C	-1.3855***	-1.2927***	-1.1072***	-1.2903***	-1.7085***
GDP_O	-4.01E-14***	-6.40E-14***	-8.51E-14***	-6.42E-14***	
GDP_V	1.11E-13***	7.11E-14***		7.19E-14***	
DTV	8.50E-11***	5.11E-11**			5.30E-11**
X_{OV}		5.99E-12***	9.73E-12***	6.65E-12***	7.16E-12***
$\frac{DTV}{GDP_V}$			1.9513	3.7117	
$\frac{GDP_O}{GDP_V}$					0.0548***
$\frac{(GDP_V)^2}{GDP_O}$					-0.0004***
McFadden R^2	0.1239	0.1451	0.1215	0.1416	0.1316
Akaike	0.4958	0.4848	0.4972	0.4867	0.4923
Schwarz	0.5055	0.4968	0.5068	0.4987	0.5043
Hannan-Quinn	0.4993	0.4891	0.5007	0.4911	0.4967

Table 2.5: Probit Results for Level Data under $\Phi_4^{cut}(0.05)$

Model 1 shows that the estimated coefficients of a regression of y on a constant, both GDPs and the disputable trade value are in line with the earlier predictions from theory. In particular, a victim is more likely to file a complaint if it is large in terms of GDP, if the offender is small in terms of GDP, and if the disputable trade value is large. All coefficients are significant at the one percent level.

Model 2 augments Model 1 by adding the aggregated export flow from the offender to the victim as a proxy for the victim's retaliatory capacity. While X_{OV} exhibits the predicted

²⁹The software used for the estimation of the following models is EViews 5.0.

³⁰Employing other computational concepts of standard errors, such as generalized least squares, leads only to minor changes in the significance levels. The changes in significance are small enough to ensure that all *, **, and *** notations remain valid for every variable in each of the five models.

positive sign, the significance level of DTV deteriorates slightly due to a high degree of positive correlation between X_{OV} and DTV .³¹ Still the explanatory power of each variable is large enough to maintain a five percent significance level even for the least significant variable.

Model 3a and Model 3b are based on the same variables as Model 2, but they employ a relative measure of the disputable commodity by choosing $\frac{DTV}{GDP_V}$ as a regressor. This is done in order to address the question whether the relative importance of a victim's targeted exports in terms of the victim's GDP may contribute to explaining a victim's incentive to file a complaint. The results of Table 2.5 basically turn this idea down by showing an insignificant coefficient, while leaving the other variables' signs and explanatory power unaffected.

Model 4 elaborates on the idea of using the ratio of the victim's GDP to the offender's GDP as a regressor. The results show that a victim's relative economic size explains the choice between complaining and not complaining almost as well as the separate inclusion of each GDP in Model 2. Moreover, the negative sign of the squared GDP ratio indicates a positive and concave relationship between the GDP ratio and the probability to file a complaint.

All in all, the results agree with the predictions of the stylized game theory in that a country's economic power promotes its incentive to file a complaint against an offending trading partner. In line with intuition, the results show that a high trade value of the targeted commodity increases a country's probability to file a complaint as well. Moreover, the economic power of the offending country is detrimental to the injured country's probability of using the dispute settlement system. This particular result means as well that economically large countries can freeride on their own size by committing infringements of trade agreements with small trading partners since the latter are likely to be deterred from filing a complaint in the first place. While all models' findings agree with the earlier presented theory, the McFadden R^2 as well as the Akaike, Schwarz and Hannan-Quinn criteria consistently prefer Model 2 to the other four models.³²

³¹The z-Statistic of DTV falls from 3.9096 to 2.2095 in the course of the introduction of X_{OV} . The generalized least squares regression of DTV on a constant and X_{OV} , i.e. $DTV = \beta_0 + \beta_1 X_{OV} + \varepsilon$, yields a positive value for β_1 with a highly significant t-Statistic of 6.9774.

³²Hence, Model 2 will be the benchmark model for further augmentation in the subsection on robustness.

The insight from Model 3a and 3b, that the relative importance of the disputable trade value compared to the victim's GDP does not serve to explain the observed behavior, is in line with the game theoretic foundation. This is because the potential gain from complaining is tied to the absolute trade value of the commodity at stake and not to some relative measure of it. Once the potential gain of filing a complaint, which is approximated by DTV , falls short of the litigation costs C , there is no point in complaining at all.³³ Of course, a victim's ability to enforce the offender's compliance, and therefore its ability to reap any gains from compliance, is dependent on the victim's economic power. However, a victim's ability to force an offender into compliance depends upon the victim's absolute threat of retaliation, which in turn depends positively upon the victims size, positively upon its retaliatory capacity and, via the amount of authorized retaliation, positively upon the disputed trade value, but not upon the ratio of disputable trade value and GDP. As an example, consider a victim i with a low GDP_V and DTV resulting in a particular $\frac{DTV_i}{GDP_{V_i}}$. This i th victim has a lower probability of filing a complaint than a victim j that exhibits just a ratio of $\frac{DTV_j}{GDP_{V_j}} \leq \frac{DTV_i}{GDP_{V_i}}$ if this j th victim is characterized by absolutely larger values of DTV and/or GDP_V . Since the export structure of many low and lower middle income countries is rather concentrated on e.g. a few agricultural goods, textiles, raw materials, and raw products, it can be conjectured that these countries are struck relatively "hard" in terms of their GDP by any import barrier targeting their exports.³⁴ Nevertheless, as long as the absolute value of the targeted goods is not high enough to break even with litigation costs, and as long as such a victim cannot reap potential gains from retaliation, it is unlikely to file a complaint, both from the theoretical and the empirical perspective.

³³Nordström and Shaffer (2007), page 1, argue in a similar way: "*The law makes no distinction between a claim of 100 thousand dollars and a claim of 100 million dollars. In practice, however, it may be difficult to enforce a 100 thousand dollars claim because of the substantial resource commitments involved in a legal dispute.*" Hence, the absolute value of the claim compared to the absolute value of litigation costs should influence whether or not a country files a complaint.

³⁴Shaffer et al. (2003), page 15, express this observation in the following way: "*Developing countries often have high per capita stakes in individual cases, so that WTO law can be of potential benefit to them. Overall, however, developing countries simply export a vastly narrower array and limited value and volume of exports than do the United States and EC.*"

2.6 Robustness

The purpose of this subsection is to check whether the results obtained from the benchmark model of the previous chapter are robust to (i) augmenting the model by adding explanatory variables, (ii) employing the logarithm of the exogenous variables, and (iii) conducting changes in the sample selection criterion.

2.6.1 Additional Explanatory Variables

Table 2.6 shows that the estimated coefficients of the primary variables maintain their sign and remain significant at least at five percent when the victim's index of economic freedom (X_{OV}), the victim's GDP per capita (GDP_{PCV}) and the offender's GDP per capita (GDP_{PCO}) are added to the benchmark model of Table 2.5.

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
C	-1.3855***	-1.2927***	-0.5241*	-1.040***	-0.9402**
GDP_O	-4.01E-14***	-6.40E-14***	-6.89E-14***	-6.90E-14***	-2.42E-14
GDP_V	1.11E-13***	7.11E-14***	7.65E-14***	1.00E-13***	9.97E-14***
DTV	8.50E-11***	5.11E-11**	5.37E-11**	5.64E-11**	5.90E-11**
X_{OV}		5.99E-12***	6.53E-12***	6.95E-12***	7.29E-12***
EF_V			-0.0115***	-0.001	-0.0008
GDP_{PCV}				-1.59E-5**	-1.66E-05**
GDP_{PCO}					-1.89E-06***
McFadden R^2	0.1239	0.1451	0.150329	0.1560	0.1625
Akaike	0.4958	0.4848	0.4826	0.4803	0.4774
Schwarz	0.5055	0.4968	0.4970	0.4971	0.4967
Hannan-Quinn	0.4993	0.4891	0.4878	0.4864	0.4844

Table 2.6: Probit Results for the Augmented Model under $\Phi_4^{cut}(0.05)$

Wilckens (2009 forthcoming) uses a similar binary regression model that is based on the same data and adds dummy variables for those disputes where there have been multiple complainants. This is done in order to address potential synergies that may arise when several complainants share litigation costs. However, the results of Wilckens (2009 forthcoming) do not differ from the findings at hand.

2.6.2 Specification in Logarithms

Table 2.7 reports the estimated coefficients for the logarithms of the explanatory variables. Note that all results of the benchmark model prove to be robust to the specification in logarithms. There are no changes in sign nor any major changes in the significance levels. All signs and most significance levels are sustained as well if a constant is included into the logarithmic model.³⁵ Goodness-of-fit tests like the Hosmer-Lemeshow and the Andrews test even favor the log specification of Model 2 without constant to the level specification that is used in the benchmark model.

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
$\log(GDP_O)$	-0.2243***	-0.2553***	-0.2037***	-0.2491***	-0.2528***
$\log(GDP_V)$	0.1104***	0.0804***	0.1421***	0.1467***	0.1473***
$\log(DTV)$	0.1271***	0.1078***	0.1056***	0.1067***	0.1068***
$\log(X_{OV})$		0.0910***	0.0659**	0.1043***	0.1037***
$\log(EF_V)$			-0.5996***	-0.2265	-0.2222
$\log(GDPPC_V)$				-0.1426***	-0.1429***
$\log(GDPPC_O)$					0.0090
Akaike	0.4677	0.4638	0.4604	0.4576	0.4584
Schwarz	0.4749	0.4734	0.4724	0.4720	0.4753
Hannan-Quinn	0.4703	0.4673	0.4648	0.4629	0.4646

Table 2.7: Probit Results for the Augmented Model in Logs under $\Phi_4^{cut}(0.05)$

2.6.3 Alternative Sample Selection Criteria

Changes in the sample selection criterion $\Phi_k^{cut}(\alpha)$ may affect both the initial year $t - k$ of the calculated average and the level of the alpha error separately and jointly, for level data and for logarithmic data. The following Table 2.8 shows estimates for the coefficients of the benchmark Model 2 for different selection criteria, using level data. Table A.3 analogously provides estimates for Model 2 with logarithmic data.³⁶ The leftmost column of both tables shows the estimates of the original benchmark model with $k = 4$ and $\alpha = 0.05$, while the three remaining columns show the estimation results for different values of k and α . Note that the number of observations, i.e.

³⁵See Table A.2 in Appendix A.4.

³⁶See Table A.3 in Appendix A.5.

the number of countries classified as injured, varies with the changes in the selection criterion. Moreover, Wilckens (2009 forthcoming), who employs the same data and drops the selection

Variable\Criterion	$\Phi_4^{cut}(0.05)$	$\Phi_4^{cut}(0.1)$	$\Phi_3^{cut}(0.05)$	$\Phi_3^{cut}(0.1)$
C	-1.2927***	-1.2772***	-1.3544***	-1.332***
GDP_O	-6.40E-14***	-6.41E-14***	-6.14E-14***	-6.19E-14***
GDP_V	7.11E-14***	7.00E-14***	7.50E-14***	7.47E-14***
DTV	5.11E-11**	5.06E-11**	5.22E-11**	5.13E-11**
X_{OV}	5.99E-12***	6.00E-12***	6.01E-12***	6.00E-12***
McFadden R^2	0.1451	0.1436	0.1466	0.1465
Akaike	0.4848	0.4959	0.4586	0.4707
Schwarz	0.4968	0.5082	0.4699	0.4823
Hannan-Quinn	0.4891	0.5003	0.4627	0.4749
Observations	2,409	2,338	2,599	2,506

Table 2.8: Probit Results for Level Data under Various Sample Selection Criteria

criterion entirely, still ends up with consistent results.

Although the conducted alterations of the sample selection criterion do not change the main results of the regression, there are two caveats that should be mentioned.

First, consider the case where an offender infringes a trade agreement, but not even one single victim files a complaint. Clearly the offender and all victims of this infringement are not observed and not included in the analysis.³⁷ From what has been argued throughout this chapter so far, it may be conjectured that these completely invisible violations are predominantly characterized by a large offender (in terms of GDP_O) committing an offense that is not too severe (in terms of DTV) against a bunch of small victims (in terms of GDP_V) which exhibit a low retaliatory capacity (in terms of X_{OV}). Hence, the sample of victims that is used in this chapter is likely to exhibit a systematic bias against country pairings with the just described properties.

Second, data availability is generally worse for poorer countries than for wealthier countries. Hence, some of the poorest victims' trade flows may not be included in the COMTRADE database. Consequently, the previously described bias is growing even stronger since victims with low GDP_V and low DTV are more likely to be missing in the database. However, this second concern is perhaps not as problematic as the first one since it should reasonably be assumed

³⁷At present the author cannot imagine a method for making these cases visible.

that a victim which does not even keep track of its own trade flows, does not take notice of an infringement of a trade agreement. This monitoring problem of the smallest countries mitigates the bias since a victim can only make a conscious decision on whether to complain or not if it observes the offense at all. Furthermore, those smallest countries which do not take notice of a trading partner's offense against any of their exporters should not be included into the analysis, even if it were possible to do so. This is because the probit model aims at explaining deliberate decisions under the assumption of equal information for every victim. A (hypothetical) inclusion of the non-monitoring victims would cause an omitted variable bias since these victims would apparently never file a complaint. But they would do so because they exhibit the property of being unable to monitor their trade flows and not as a results of a diligent decision making process like the other monitoring victims.

As a summary, it can be stated that all central results have proved to be robust to the conducted changes in variables, model specifications and sample selection criteria. Moreover, the approach presented here is unable to overcome the problem of identifying the victims of those infringements where not even a single country filed a complaint.

2.7 A Note on Guzman and Simmons (2005)

Recall the central finding of Guzman and Simmons (2005) that the relationship between both parties' GDP is negative, that is, all else equal, smaller countries are more likely to complain against bigger countries. Consequently, their result contrasts this study's results as small victims have been found to be deterred from complaining against bigger offenders.

A possible explanation for this discrepancy may lie in the way how Guzman and Simmons take their Capacity Hypothesis to the data. Consider that a low endowment of legal resources may be understood as a high level of litigation costs. Hence, along the lines of Guzman and Simmons, small countries face a high level of litigation costs. Recall that this chapter's model produced the trivial insight that either the initial damage or the gain from retaliation must exceed litigation costs in order to render a complaint worthwhile. Thus, if one is concerned

that poor countries lack legal resources, one should be tempted to say that these countries will predominantly engage infringements that cause a high damage which lets them break even with their high level of litigation costs.³⁸ Still in line with this argument, Guzman and Simmons speak of a “*large market*”³⁹, but what they indeed use to control for the size of the affected market in their regression is the offender’s GDP. Granted, the market size or the disputable trade value at stake could be positively correlated with the offender’s GDP, but note that this correlation may be very low.⁴⁰ This is due to the fact that $\log(DTV)$ strongly varies across the individual disputes. Hence, the information that is incorporated in the trade value at stake is close to orthogonal to the offender’s GDP.

It would be an interesting question to ask, whether the relationship between both parties’ GDPs would remain negative if one augmented a regression of the Guzman and Simmons fashion by $\log(DTV)$. Thus, it would be possible to distinguish between a victim’s incentive to complain against infringements of large markets on the one hand, and its disincentive to mess with bigger countries on the other hand. From previous insights, we would hypothesize that, all else equal, the GDP of an offender should be increasing in the disputable trade value and in the victim’s GDP. This is because a complaint against a big country is more likely to be profitable if the complainant himself and/or the trade value at stake is large. Equation 2.12 describes the regression approach, where the logarithm of the offender’s GDP is regressed on a constant, the logarithm of the complaining victim’s GDP, the logarithm of the disputable trade value, a dummy that equals one if either the EC or the US are the offender ($ECorUS_O$), a dummy that equals one if there are multiple complainants in a dispute, and a random disturbance term ε .⁴¹

$$\log(GDP_O) = \alpha + \beta_1 \log(GDP_V) + \beta_2 \log(DTV) + \delta_1 ECorUS_O + \delta_2 MC1 + \varepsilon \quad (2.12)$$

³⁸On page 572 Guzman and Simmons (2005) argue analogously: “*All else equal, the capacity hypothesis suggests that a capacity-constrained state will be able to pursue only a limited number of cases. The state must prioritize the list of potential defendants and will tend to pursue larger markets rather than smaller markets. Thus, a low-capacity complainant may pursue only one case, and that case will be against a defendant with a large market.*”.

³⁹See Guzman and Simmons (2005), page 572.

⁴⁰Note Table 2.4 showing a rather low correlation coefficient of 0.1596 between $\log(DTV)$ and $\log(GDP_O)$.

⁴¹Both dummies are part of the original Guzman and Simmons model.

Equation 2.12 is estimated on the basis of the 198 complaints for which the vector of disputable trade values has already been compiled in the preparation of this study’s central (binary) model. Using feasible general least squares and consistent standard errors, the results of Table 2.9 are obtained.⁴² The results show that the estimated coefficients for the victim’s GDP as well as for

Variable	Coefficient
<i>Constant</i>	23.3059***
<i>log(GDP_V)</i>	0.0804***
<i>log(DTV)</i>	0.0422***
<i>ECorUS_O</i>	3.4968***
<i>MC1</i>	0.2398**
<i>R</i> ²	0.9969
Adjusted <i>R</i> ²	0.9968
Akaike	2.1779
Schwarz	2.2609
Observations	198

Table 2.9: Feasible General Least Squares Results for Equation 2.12

the disputable trade value are positive and significant on a one percent level. This change in the sign of the coefficient for the victim’s GDP means that, all else equal, small countries would rather complain against small countries than against large countries. Hence it may be the case that Guzman and Simmons’ result is driven by the omission of the trade value at stake, which has been found to have a highly significant influence.

2.8 Discussion

From a theoretical perspective, the results may not be too surprising since they mirror the findings of Kennan and Riezman (1988) who showed that a country can benefit from a tariff war as compared to free trade if it is only large enough. In the DSS game, it is basically up to the offender to decide between free trade and a (regulated) tariff war. If the offender is large enough compared to the victim, he will prefer the tariff war, choose not to comply and take the potential retaliation into account.

⁴²Again, the estimation is conducted using EViews 5.0.

Controlling for the value of the disputable commodities and adding a proxy for the retaliatory capacity of the victim, the theoretical predictions are generally confirmed by the results of a binary regression model, using data on 195 complaints from 1995 through 2005. One major issue in the course of the preparation of this study's data set has been to set up a statistical criterion to decide which trading partners have been injured. The criterion used here concentrates on detecting a drop in the relative bilateral trade value of the disputable commodity. Modifications of this selection criterion leave the estimated coefficients' signs and significance levels unaffected. Moreover, the empirical results reproduce the findings of a similar approach by Bown (2005), who focusses on 54 disputes from 1995 through 2000 for which there is certain information on the affectedness of victims available.

An additional empirical finding of this study is that one should not expect to observe poor countries filing complaints just because they are heavily dependent on their (disputable) exports, even if these exports are very large in terms of their own GDP. In line with theoretical arguments, the relative value of disputable exports (i.e. $\frac{DTV}{GDP_V}$) does not serve to explain the observed behavior in the sample.

At first sight, the results of this chapter seem to be contrasting Guzman and Simmons (2005) who find that a small victim is more likely to file a complaint against a bigger offender than against an offender of about the same size. However, when controlling for the value of the disputable commodity at stake, it seems to be the case that Guzman and Simmons' "David-against-Goliath-effect" is not driven by country sizes but rather by the omission of the disputable trade value at stake.

Furthermore, the empirical findings raise implications for a potential bias of the DSS' usage. The estimated coefficients of the model predict that the observed set of complainants is biased towards those cases where the victim is large, the offender is small, the disputable trade value is high and the victim's retaliatory capacity is large. Moreover, the disentanglement of the separate effects of these variables unambiguously suggests that, all else equal, bigger countries do have a greater incentive than smaller countries to use the DSS.

While this study answers the question whether the use of the system is biased towards large countries in the affirmative, it may be complementary to the results of Horn et al. (1999), who find that the number of product market pairings serves to explain how often a country has been involved into a dispute. However, their analysis is based on the set of those disputes that have been notified to the WTO, and from what has been argued in this study, this observable subset should not be representative but rather biased. Merging these two results suggests that while the binary decision of whether or not to complain depends upon the identified variables that are specific to countries and commodities, a country's frequency with which it faces an infringement may very well be proportional to the number of bilateral product market pairings.⁴³

⁴³The author cannot imagine a reason for why the number of a country's product market pairings should affect the binary decision of whether or not to complain, given a particular offense. However, the number of infringements a country commits or suffers from may very well be proportional to its product market pairings if one assumes that offenses occur randomly and separately in each product market pairing. Consequently, a sequential two step model would be needed to predict the number of a country's observed participation as a complainant. In the first step, countries would be offended randomly and proportional to their number of product market pairings in the spirit of the Horn et al. (1999) approach. In the second step, the binary decision whether or not to complain against each of these infringements would be made according to the binary decision model presented in this chapter.

Chapter 3

Should WTO Dispute Settlement Be Subsidized?

Abstract

This chapter is based on Wilckens (2007) and develops a model of the WTO dispute settlement process 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 DSS to enforce developed countries' compliance with WTO rules. The study shows that this proposal may be misguided. In particular, a reduction of litigation costs may lead economically large countries to impose larger trade impediments where before they may have raised barriers only a little. Thus, a cost reduction may even weaken the position of small countries in the DSS. Moreover, the model sheds light on the structure of the dark figure of un-accused offenses, suggesting that the observed record of disputes that have been notified to the WTO is systematically biased.

3.1 Introduction

The extremely asymmetric usage of the DSS by high income countries on the one hand and low income countries on the other hand 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.¹

Apart from the cost reduction proposal, this chapter analyzes the supposed bias of the DSS as such. Some empirical studies such as Horn et al. (1999) and Guzman and Simmons (2005) have already examined whether or not the unbalanced record of disputes with respect to income groups indicates a systematic bias of the DSS against poorer countries. Although both papers' 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. As argued in previous chapters of this dissertation, it is a well established 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 country retaliates.² 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 poorer countries face higher costs associated with the preparation of a complaint than wealthier countries do.³ 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."*⁴ 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.

¹The 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).

²Among 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.

³See 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.

⁴Guzman and Simmons (2005), page 591.

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.⁵ 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.⁶ Thus, in contrast to reality, violation and retaliation remain off-equilibrium strategies in these models.⁷

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 study takes a different slant by providing an explicit model of the DSS. The regulations of the 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 size 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 chapter is organized as follows. Section 3.2 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 3.3. The equilibria of the game are presented as functions of the country size parameter and litigation costs. Moreover, the proposal of a reduction of litigation costs is examined in a comparative static analysis. In section 3.4 the robustness of the results is verified in the course of an extension of the basic model. Section 3.5

⁵See Bagwell and Staiger (1999) who use a two country approach with an external enforcement assumption.

⁶Bagwell and Staiger (2002), page 99, note: "*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'.*"

⁷See for example Bagwell and Staiger (2001) who analyze the desirability of key WTO principles such as reciprocity and non-discrimination with respect to the efficiency of trade agreements while they do not allow for the possibility that a contracting partner violates a trade agreement.

aims at generalizing the findings to a broader class of trade models. Finally, section 3.6 offers a discussion of the results, establishes links to the literature, and points out implications for the dark figure of disputes.

3.2 The Basic Model

The analysis is based on a trade model with two countries (Home and Foreign) and three goods (x , y and z), which allows for different country or market sizes. The underlying utility functions are assumed to be quasilinear in both countries: $U(x, y, z) = u_x(x) + u_y(y) + z$. While u_x and u_y are assumed to be strictly concave, z is assumed to be a numeraire good with price p_z fixed at unity. Labor is the only factor of production. Good z is produced using a constant returns to scale technology where one unit of labor produces one unit of output. Hence, the wage is fixed at unity as well. Let trade in the numeraire good be determined residually by the condition of balanced trade.

For the sake of simplicity I first analyze a model, where both countries differ only in their demand for one of the two non-numeraire goods. In section 3.4 the analysis is extended to a more cumbersome model, where demand for both non-numeraire goods is larger in one country. While the first model is designed to analyze size differences in the market for a particular good, the second model is designed to analyze differences in country size. However, both models' results are fairly similar.

3.2.1 Setup of the Trading Environment

Home's demand functions are obtained from the quasilinear utility function $U(x, y, z) = x - \frac{x^2}{2n} + y - \frac{y^2}{2} + z$, while Foreign's underlying utility function is given by $U^*(x, y, z) = x - \frac{x^2}{2} + y - \frac{y^2}{2} + z$. Note that Home receives more (less) utility from the consumption of good x than Foreign if n is larger (smaller) than unity. An alternative way to think of the setup of this basic model is to assume two different types of consumers in each country. Consumers of type x only derive utility from the consumption of good x and the numeraire good, whereas consumers of type y

only derive utility from the consumption of good y and the numeraire good. Assume then that Home has n consumers of type x , while Foreign has one consumer of type x and that there is one consumer of type y in each country.

Home's demand functions for good x and y are

$$D_x(p_x) := (1 - p_x)n, \quad (3.1)$$

$$D_y(p_y) := 1 - p_y. \quad (3.2)$$

Foreign's demand functions for good x and y are

$$D_x^*(p_x) := 1 - p_x, \quad (3.3)$$

$$D_y^*(p_y) := 1 - p_y. \quad (3.4)$$

While both countries have a positive demand for both good x and good y , good x is produced only by Foreign, whereas good y is produced only by Home⁸:

$$S_x^*(p_x) := p_x, \quad (3.5)$$

$$S_y(p_y) := p_y. \quad (3.6)$$

Consequently, Home becomes an importer of good x and an exporter of good y , while Foreign becomes an importer of good y and an exporter of good x . Note that the two countries are symmetric except for the multiplicative parameter n , which represents the size of the home market demand for good x . For $n = 1$ the two countries would be completely symmetric, while for $n > 1$, ($n < 1$) it holds that Home's import demand is larger, (smaller) than Foreign's import demand.

By assumption, each country's sole policy variable is a per unit import tariff on its import

⁸The underlying production functions are assumed to exhibit decreasing returns to scale. The production functions for x and y are given by $x(l) = \sqrt{2l}$ and $y(l) = \sqrt{2l}$ respectively, where l denotes labor.

good. Home's import tariff on good x is denoted by τ , while Foreign's import tariff on good y is denoted by τ^* . After the introduction of tariffs, demand for each country's import good is given by $D_x(p_x) := (1 - (p_x + \tau))n$ and $D_y^*(p_y) := 1 - (p_y + \tau^*)$, respectively. Market clearing conditions are given by $D_x(p_x, \tau) + D_x^*(p_x) = S_x^*(p_x)$ and $D_y(p_y) + D_y^*(p_y, \tau^*) = S_y(p_y)$, respectively. Solving for p_x and p_y yields equilibrium world market prices as functions of the associated import tariffs:

$$\hat{p}_x(\tau) = \frac{1 + n(1 - \tau)}{2 + n}, \quad \hat{p}_y(\tau^*) = \frac{2 - \tau^*}{3}.$$

Substituting the equilibrium prices into each country's demand and supply functions yields the equilibrium quantities⁹ as functions of the import tariffs:

$$\hat{x}(\tau) = \frac{n - 2n\tau}{2 + n}, \quad \hat{y}(\tau^*) = \frac{1 - 2\tau^*}{3}.$$

Consumer surplus in sector x at Home is $\hat{c}s_x(\tau) = \frac{n(1-2\tau)^2}{2(2+n)^2}$, and Home's tariff revenue is $\hat{t}r(\tau) = \frac{n\tau(1-2\tau)}{2+n}$. Home's consumer surplus in sector y is $\hat{c}s_y(\tau^*) = \frac{(1+\tau^*)^2}{18}$. Producer surplus of Home's exporting industry is $\hat{p}s_y(\tau^*) = \frac{(\tau^*-2)^2}{18}$. All in all, Home's indirect utility function V depends upon its own import tariff τ , Foreign's import tariff τ^* and the market size parameter n :

$$V(\tau, \tau^*, n) = \frac{1}{18}(5 - 2\tau^* + 2\tau^{*2} - \frac{9n(2\tau - 1)(1 + 2(1 + n)\tau)}{(2 + n)^2}). \quad (3.7)$$

Foreign's indirect utility function V^* is obtained in an analogous manner. It is as well a function of Home's import tariff τ , Foreign's import tariff τ^* , and the market size parameter n :

$$V^*(\tau, \tau^*, n) = \frac{1}{18}(1 + 2\tau^* - 8\tau^{*2} + \frac{9(2 + 2n + n^2(1 - 2\tau + 2\tau^2))}{(2 + n)^2}). \quad (3.8)$$

V and V^* are strictly concave in each country's own tariff and decreasing in the other country's

⁹Note that for the hypothetical levels of $\tau \geq \frac{1}{2}$ and $\tau^* \geq \frac{1}{2}$ countries would stop trading.

tariff.¹⁰ The pair of optimal tariffs τ_o and τ_o^* is given by:

$$\tau_o(n) = \frac{n}{4 + 4n}, \quad (3.9)$$

$$\tau_o^* = \frac{1}{8}. \quad (3.10)$$

While Foreign's optimal tariff is a constant, Home's optimal tariff is an increasing function of its own market size n .¹¹ This dependency stems from the increasing ability to influence the terms of trade in one's favor with increasing market size. From the equations above it is obvious that Home's optimal tariff will be lower, (higher) than Foreign's optimal tariff if $n < 1$, ($n > 1$). Note that 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.

3.2.2 Trade Disputes as Sequential Games

Suppose now that there are two WTO members, and that these countries have committed themselves to an initial free trade agreement. That is, both τ and τ^* have to be equal to zero in order to fulfill the agreement. This initial agreement is efficient in the sense that it maximizes the sum of Home's and Foreign's welfare. Under such a type of agreement, countries could be tempted to violate the agreement by a unilateral increase of their import tariff in order to benefit from an increase in their own welfare. A typical WTO example for such a situation would be any 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.

Let Home be the first mover in this sequential game. Then Home will decide whether to violate the agreement, by raising its tariff above the allowed level, or to comply with the

¹⁰See Mathematical Appendix B.1.

¹¹Note that $\tau_o(n) \rightarrow \frac{1}{4}$ as $n \rightarrow \infty$. This property ensures that countries trade positive quantities at positive prices.

agreement. Foreign, 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 Home.¹²

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).¹³

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.”¹⁴

While the exact method of calculating the level of nullification or impairment is left to the discretion of the ruling panel, legal practice is dominated by a counterfactual trade value approach.¹⁵ The trade value approach simply 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 Home’s import good, $TV_x(\tau)$, is simply Home’s import demand times the equilibrium world market price: $TV_x(\tau) := (D_x(\hat{p}_x(\tau) + \tau))\hat{p}_x(\tau)$. Consequently, the change in the trade value due to an increase in Home’s import tariff is given by $\Delta TV_x(\tau) := (D_x(\hat{p}_x(\tau) +$

¹²Litigation costs can be thought of as incorporating the direct monetary costs of hiring a law firm or a 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.

¹³This simplification of the legal process is achieved by assuming (i) the presence of perfect information, (ii) perfect monitoring, and (iii) the 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.

¹⁴DSU Article 22, para 4.

¹⁵See Jordan (2005), pages 119-124 for a discussion of the employed calculation methods. The dominating method used in this paper was employed for example in the following cases: WT/DS26 EC-Hormones, WT/DS27 EC-Bananas, WT/DS160 US-Copyright.

$\tau))\hat{p}_x(\tau) - (D_x(\hat{p}_x(0) + 0))\hat{p}_x(0)$. In this model the expression becomes:

$$\Delta TV_x(\tau) = \frac{n\tau(2n\tau - 2 - 3n)}{(2 + n)^2}. \quad (3.11)$$

The change in trade value of the foreign import good $\Delta TV_y(\tau^*)$ is obtained by similar means:

$\Delta TV_y(\tau^*) := (D_y^*(\hat{p}_y(\tau^*) + \tau^*))\hat{p}_y(\tau^*) - (D_y^*(\hat{p}_y(0) + 0))\hat{p}_y(0)$, or:

$$\Delta TV_y(\tau^*) = \frac{2\tau^{*2} - 5\tau^*}{9}. \quad (3.12)$$

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 $\Delta TV_y(\tau^*) \leq \Delta TV_x(\tau)$. Solving this expression for τ^* yields Foreign's maximum admissible tariff as a function of Home's tariff τ and the market size ratio n . Let this equivalence restriction on Foreign's retaliatory tariff be denoted by τ_{eq}^* :

$$\tau_{eq}^*(\tau, n) = \frac{10 + 5n - \sqrt{25(2 + n)^2 - 72n(2 + 3n)\tau + 144n^2\tau^2}}{8 + 4n}. \quad (3.13)$$

The Dispute Settlement System's equivalence condition thus creates a strategic link between Home's violative tariff on imports of good x and Foreign's retaliatory tariff on imports of good y .

3.3 Strategic Behavior in the Basic Model

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

3.3.1 The Second Mover's Best Response

For a given violation of the initial free trade agreement (i.e. $\tau > 0$) Foreign has to make two decisions. First, how much to retaliate within the permitted interval $0 \leq \tau_r^* \leq \tau_{eq}^*$. Second,

whether or not to file a complaint at costs c in order to be entitled to retaliate with a retaliatory tariff τ_r^* .

Earlier calculations have shown that Foreign would maximize its welfare by setting its optimal tariff $\tau_o^* = \frac{1}{8}$ if it faced an unrestricted optimization problem.¹⁶ However, if the equivalence condition restricts Foreign's retaliation to a level below τ_o^* , Foreign will completely exploit the admissible retaliation tariff and set its retaliatory tariff τ_r^* equal to $\tau_{eq}^*(\tau, n)$. Thus, Foreign's retaliatory tariff τ_r^* is given by:

$$\tau_r^*(\tau, n) = \min\{\tau_o^*, \tau_{eq}^*(\tau, n)\} \quad (3.14)$$

After having determined the extent of Foreign's retaliation, I will now analyze whether or not Foreign will retaliate at all.

Necessary Condition for Retaliation

Foreign will retaliate whenever the welfare gain from retaliation is higher than litigation costs (i.e. $V^*(\tau, \tau_r^*(\tau, n), n) - V^*(\tau, 0, n) > c$ has to hold). Since the maximum achievable welfare gain is realized when Foreign implements τ_o^* as its retaliatory tariff, it follows that litigation costs are prohibitively high if $c \geq V^*(\tau, \tau_o^*, n) - V^*(\tau, 0, n)$ holds. 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 Home's and Foreign's actions.¹⁷ Therefore, the remainder of the analysis focuses on the case of non-negative and non-prohibitive costs, such that $c \in [\underline{c}, \bar{c})$ holds, where \underline{c} stands for zero costs and \bar{c} stands for the level of prohibitive costs.¹⁸ It follows that $c < \bar{c}$ is a necessary

¹⁶Since Foreign's welfare is a continuous function of its import tariff τ^* , which is strictly increasing in the interval between zero and τ_o^* , it follows that Foreign's welfare-maximizing retaliatory tariff τ_r^* has an upper bound at its optimal tariff τ_o^* .

¹⁷Due to perfect information, Home anticipates that Foreign is not retaliating when costs are prohibitive. Therefore, Home would always play its optimal tariff while Foreign would never retaliate.

¹⁸In the model at hand $\bar{c} = \frac{1}{144}$.

condition for Foreign to retaliate.

Sufficient Condition for Retaliation

While Foreign’s litigation costs are exogenously determined, the admissible level of Foreign’s retaliatory tariff $\tau_{eq}^*(\tau, n)$ depends positively upon the market size ratio n and the level of Home’s initial violation τ . In other words, the larger the offending country’s market relative to the offended country’s market and the more severe the offense, the higher will be the level of permitted retaliation according to the equivalence condition.¹⁹ As a consequence, there will be a set of values of c , n and τ that leads Foreign to be indifferent between retaliating and not retaliating. Since the model has tariffs as strategic instruments, it is convenient to express the locus of Foreign’s indifference in terms of Home’s tariff τ . Setting Foreign’s welfare gain from retaliation equal to litigation costs ($c = V^*(\tau, \tau_{eq}^*(\tau, n), n) - V^*(\tau, 0, n)$), one can solve for Home’s tariff that leads Foreign to be indifferent between retaliating and not retaliating, as a function of c and n . This indifference-inducing tariff of Home is denoted as $\tau_i(c, n)$ in the following.

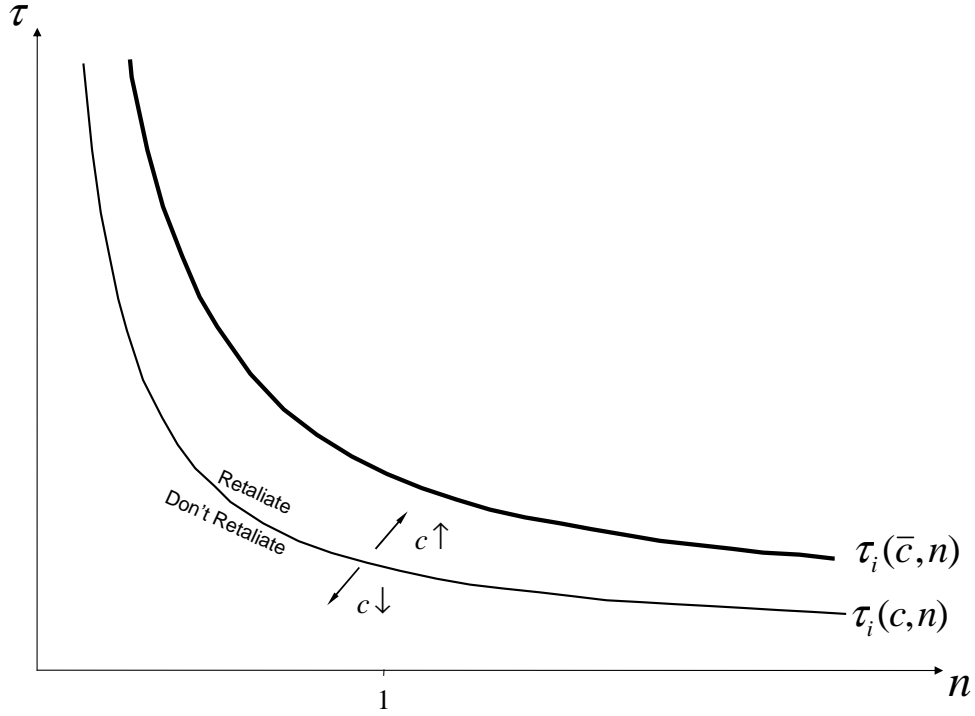
$$\tau_i(c, n) = \frac{12 + 18n - \sqrt{18(4 + n(20 + 17n)) + 18(2 + n)^2\sqrt{1 - 144c} - (2 + n)^2 144c}}{24n}$$

Figure 3.1 displays two alternative indifference curves. The upper curve represents the case of prohibitive costs (i.e. \bar{c}). The lower curve represents a case of $c \in [\underline{c}, \bar{c}]$. Thus, the n - τ -space can be separated into a Northeastern set of locations where Foreign will retaliate (i.e. $\tau > \tau_i(c, n)$) and a Southwestern set of locations, where Foreign will not retaliate (i.e. $\tau \leq \tau_i(c, n)$).

The figure reveals that Foreign’s retaliation threshold is lower, the lower the level of litigation costs is. It also shows that n and τ are “substitutes” from the perspective of Foreign, who is eventually interested in the level of admissible retaliation. In other words, a Home country with a small market, raising its import tariff steeply, could cause the same ΔTV_x (which translates

¹⁹Formally the benefit from retaliating is increasing in the market size of the offender ($\frac{\partial V^*(\tau, \tau_r^*(\tau, n), n)}{\partial n} > 0$) and increasing in the severity of the offense ($\frac{\partial V^*(\tau, \tau_r^*(\tau, n), n)}{\partial \tau} > 0$) for any given non-prohibitive level of litigation costs and as long as $\tau_{eq}^*(\tau, n) < \tau_o^*$ (i.e. the equivalence condition must be binding) holds.

Figure 3.1: Foreign Indifference Inducing Home Tariffs



into the admissible retaliation tariff) as a Home country with a large market which raises its import tariff only slightly.

As a summary, Foreign's best response $\hat{\tau}^*$ for non-prohibitive costs is given by:

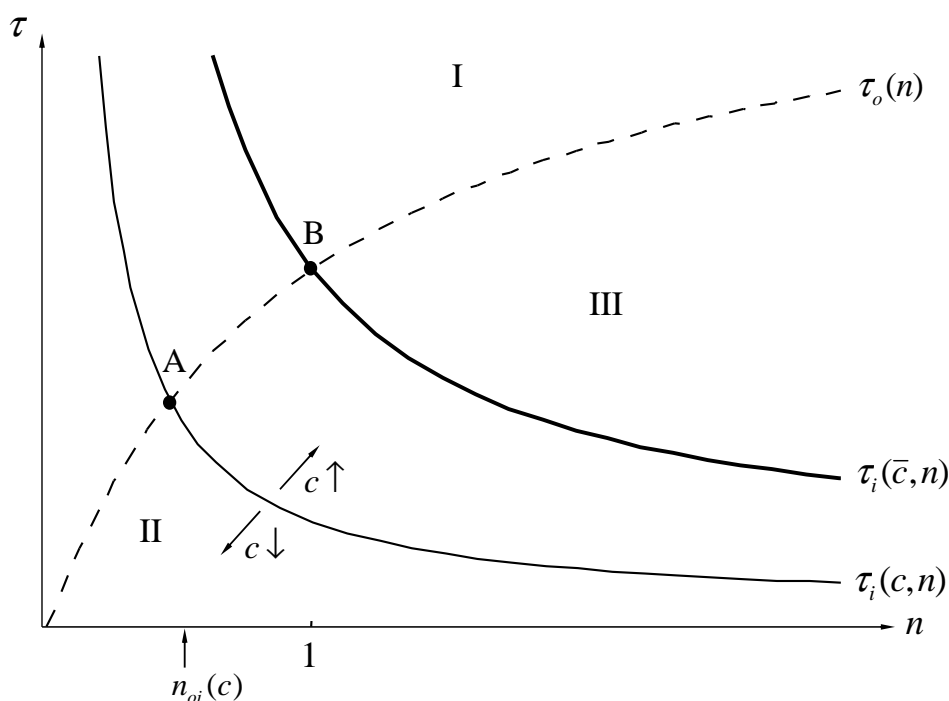
$$\hat{\tau}^* = \begin{cases} 0 & \text{iff } \tau \leq \tau_i(c, n) \\ \tau_r^*(n, \tau) & \text{iff } \tau > \tau_i(c, n) \end{cases} \quad (3.15)$$

3.3.2 The First Mover's Best Response

Home 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 Home's welfare as a function of its import tariff τ is no longer a continuous function, not even for the set of non-prohibitive tariffs. Home's welfare will now have a step at the point where Foreign

switches between retaliating and not retaliating due to an incremental increase in Home's offense. Therefore, one has to distinguish between two cases, depending on whether Foreign retaliates or not. In the following, offenses triggering retaliation (i.e. $\tau > \tau_i(c, n)$) will be referred to as *major offenses*, while smaller levels of violation which do not trigger retaliation (i.e. $0 < \tau \leq \tau_i(c, n)$) will be referred to as *minor offenses*. Consider Figure 3.2 where the bold indifference curve

Figure 3.2: Home's Tariff Levels



represents τ_i for prohibitive costs (i.e. \bar{c}), while the thin indifference curve represents $c \in [\underline{c}, \bar{c})$, and the dashed upward sloping curve depicts Home's optimal tariff. Three sets of dominated strategies can be ruled out right from the start.

Lemma 3.1. *Home never plays a tariff of $\tau > \tau_o(n)$.*

Clearly all combinations of τ and n located above Home's optimal tariff (set I in Figure 3.2) can be excluded from further analysis for the simple reason that the choice of all these locations

is strictly dominated by choosing $\tau_o(n)$.

Lemma 3.2. *Home never plays a tariff of $\tau < \tau_o(n) \wedge \tau < \tau_i(c, n)$.*

For all tariffs located in set II, Home could raise its tariff, thereby getting closer to its optimal tariff, without triggering retaliation since Foreign would only retaliate if the retaliation threshold was exceeded. Hence this set of tariffs is strictly dominated by $\tau_o(n)$ for $n \leq n_{oi}(c)$ and by $\tau_i(c, n)$ for $n > n_{oi}(c)$, where $n_{oi}(c)$ denotes value of n at the intersection of $\tau_o(n)$ and $\tau_i(c, n)$.²⁰

Lemma 3.3. *Home never plays a tariff of $\tau_i(\bar{c}, n) \leq \tau < \tau_o(n)$.*

Consider Set III and recall that $\tau_i(\bar{c}, n)$ is the set of n - τ -combinations that entitles Foreign to retaliate exactly with its optimal tariff $\tau_o^* = \frac{1}{8}$. Hence, any n - τ -combination located above $\tau_i(\bar{c}, n)$ triggers the same amount of retaliation since Foreign's maximum retaliatory capacity is already exhausted. Therefore, all these n - τ -combinations are strictly dominated by playing $\tau_o(n)$.

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

Lemma 3.4. *Given Foreign retaliates elastically, Home prefers to commit a minor offense for all $n \leq 1$.*

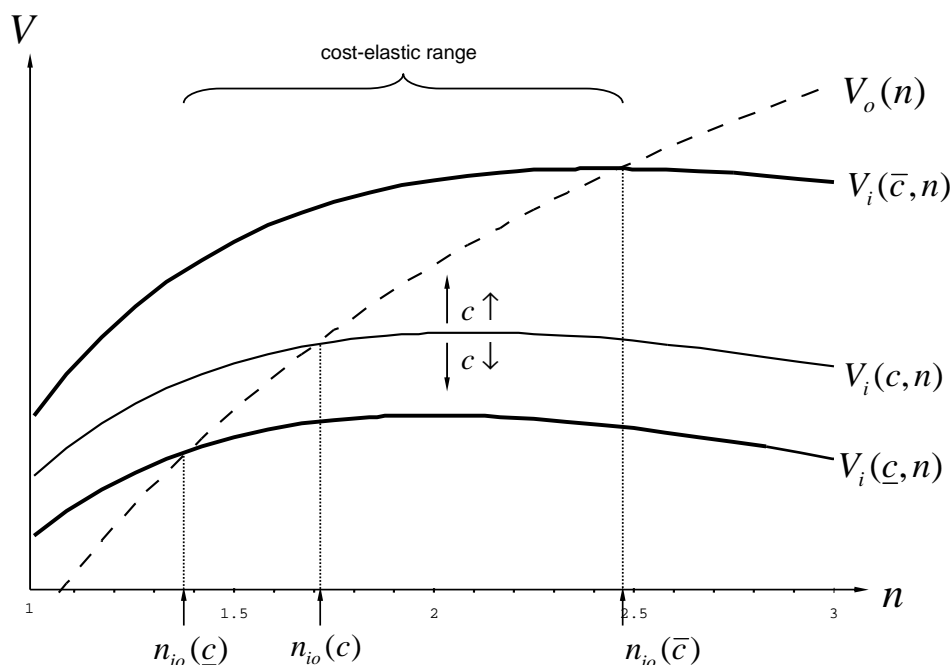
Proof: See Appendix B.3.

Home's remaining options are (i) to play its optimal tariff $\tau_o(n)$, yielding welfare of $V_o(n) := V(\tau_o(n), \tau_o^*, n)$, (ii) to play the current retaliation threshold $\tau_i(c, n)$, yielding welfare of $V_i(c, n) := V(\tau_i(c, n), 0, n)$ and (iii) to play a tariff $\tau_{\S}(n)$ which maximizes Home's welfare given that Foreign retaliates elastically (which can only occur iff $\tau_i(c, n) < \tau < \tau_i(\bar{c}, n)$), yielding welfare of $V_{\S}(n) :=$

²⁰The subscript "oi" should remind the reader of the fact that n_{oi} denotes the critical market size where Home switches from playing $\tau_o(n)$ to playing $\tau_i(c, n)$. The existence and the properties of this lower switching point $n_{oi}(c)$ are examined in the Mathematical Appendix B.2.

$V(\tau_{\S}(n), \tau_{eq}^*(\tau_{\S}(n), n), n)$.²¹ It is possible to show that option (iii) will only be considered by Home for an extremely narrow set of n - c -combinations. A necessary condition for playing $\tau_{\S}(n)$ is $c \leq 0.03086\bar{c}$ and $1 < n \leq 1.40231$. Since the tariff level $\tau_{\S}(n)$ as well as the associated welfare level $V_{\S}(n)$ are extremely close to $\tau_i(c, n)$ and $V_i(c, n)$ in this particular region, further analysis of this option will be omitted.²² Home's welfare under the two relevant strategies is

Figure 3.3: Home's Welfare Levels



depicted in Figure 3.3. The dashed curve represents $V_o(n)$, which is Home's welfare when both Home and Foreign play their optimal tariffs. The three continuous curves represent $V_i(c, n)$ for different cost-levels. The upper bold continuous curve is associated with prohibitive costs. The lower bold continuous curve is associated with zero costs, while the finer continuous curve in

²¹The subscript \S should remind the reader of the fact that this tariff is associated with a major offense that triggers retaliation according to a binding equivalence condition. See Mathematical Appendix B.3 for derivation and properties of $\tau_{\S}(n)$.

²²Formally, one could rule out $\tau_{\S}(n)$ by assuming $c > 0.03086\bar{c}$. See Mathematical Appendix B.4.

the middle represents intermediate costs.²³ $n_{io}(c)$ denotes the value of n where $V_i(c, n)$ crosses $V_o(n)$ from above.²⁴ In other words, $n_{io}(c)$ is the critical country size where Home switches from committing a minor offense to committing a major offense.

Since the case of no costs and the case of prohibitive costs constitute natural boundaries to the shifting range of $V_i(c, n)$, Figure 3.3 already reveals that Home's choice between the two strategies is completely independent of litigation costs for some "exterior" values of n , while it depends upon them for some "interior" values of n . Hence the following proposition distinguishes between three areas of n .

Proposition 3.1. *Home's best response tariff is dependent upon n in the following way:*

- (i) *For all $n \leq 1.38504$, Home commits a minor offense.*
- (ii) *For all $n > 2.46187$, Home commits a major offense.*
- (iii) *For all $1.38504 < n \leq 2.46187$, Home's decision between a major and a minor offense is dependent upon the level of litigation costs. Paradoxically, high litigation costs lead to a minor offense, while low litigation costs lead to a major offense.*

Proof: See *Mathematical Appendix B.5*.

To understand the intuition for the first part of Proposition 3.1, recall that Lemma 3.1 and Lemma 3.2 state that the smallest countries (i.e. $n \leq n_{oi}(c)$) can play their optimal tariff without harming their trading partners enough to trigger a complaint. Moreover, countries of size $n_{oi}(c) < n \leq 1.38504$ prefer to restrict their tariff to $\tau_i(c, n)$ in order not to trigger retaliation since $V_o(n) < V_i(c, n)$ holds in this interval of n .

The second part of Proposition 3.1 basically states that very large Home countries which exceed a particular size, find it more beneficial to commit a major offense by playing $\tau_o(n)$ and taking Foreign's retaliation into account, than to restrict their offense to the maximum tolerated

²³Note that costs are a shift parameter of $V_i(c, n)$, while $V_o(n)$ is independent of costs.

²⁴The subscript "io" should remind the reader of the fact that n_{io} denotes the critical country size where Home switches from playing $\tau_i(\gamma, n)$ to playing $\tau_o(n)$.

offense level of $\tau_i(c, n)$. This result follows from the finding that $V_o(n) > V_i(c, n)$ holds in this interval of n .

The third part of Proposition 3.1 refers to Home countries whose n lies between the two just described boundaries. In this interval of n , the location of the switching point $n_{io}(c)$ is dependent upon the pertinent level of litigation costs. Figure 3.3 shows that $n_{io}(c)$ lies the more to the left (right) of the bounded interval, the lower (higher) litigation costs are. This means that lowering litigation costs will lead even smaller countries than before to committing a major offense, while increasing litigation costs will deter even larger countries than before from committing a major offense. The economic reason for this behavior can be explained by considering Figure 3.2 again. Note that the gap between $\tau_i(c, n)$ and $\tau_o(n)$ widens with increasing market size. This means that the opportunity cost of playing the threshold tariff $\tau_i(c, n)$ is increasing in n since $\tau_i(c, n)$ is decreasing in n while $\tau_o(n)$ is increasing in n .²⁵ Consequently, there is a switching point in terms of n where Home's opportunity costs of avoiding retaliation will equal Home's costs from taking retaliation into account. At this point Home will switch from playing $\tau_i(c, n)$ to playing $\tau_o(n)$.

To summarize, Home's best response $\hat{\tau}$ is given by:

$$\hat{\tau} = \begin{cases} \tau_o(n) & \text{if } n \leq n_{oi}(c) \\ \tau_i(c, n) & \text{iff } n_{oi}(c) < n \leq n_{io}(c) \\ \tau_o(n) & \text{if } n > n_{io}(c) \end{cases} \quad (3.16)$$

Stated verbally:

1. The smallest Home countries will play their optimal tariff because they do not cause enough damage to trigger retaliation.
2. Home countries of intermediate market size will restrict their tariff to a level below their optimal tariff in order to avoid retaliation by bothering Foreign no more than the latter's

²⁵For $V_o(n)$, it can be shown that $\frac{\partial V_o(n)}{\partial n} > 0$ and $\frac{\partial^2 V_o(n)}{\partial n^2} < 0$. See Mathematical Appendix B.6.

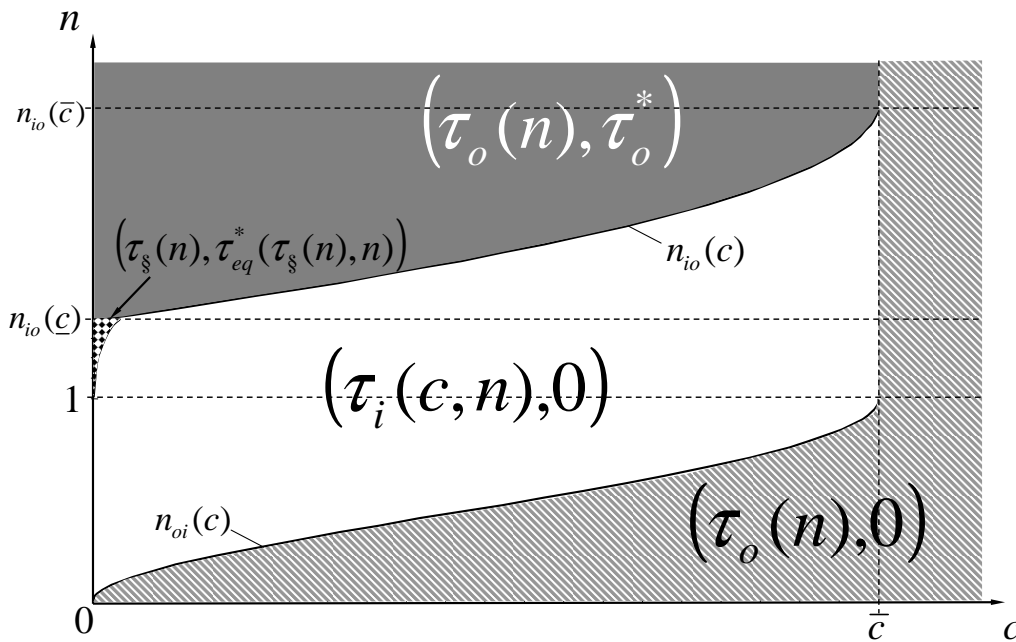
tolerance level.

3. The biggest Home countries will play their optimal tariffs and take Foreign's retaliation into account.

3.3.3 Equilibria

Combining Home's and Foreign's best responses, Nash equilibrium behavior may be expressed just as a function of c and n . Let the pair of Nash equilibrium tariffs be denoted by (τ_N, τ_N^*) . Figure 3.4 shows that the c - n -space is divided into four areas of different equilibria. The grey

Figure 3.4: Equilibria



area to the northwest of Figure 3.4 represents a trade war between the two countries, where each country is playing its optimal tariff. This type of equilibrium occurs if Home is large enough to be willing to put up with Foreign's retaliation.

The white area in the center of Figure 3.4 represents the equilibria in which Home bothers Foreign just so much that retaliation is avoided. The economic intuition for the existence of this type of equilibrium is that either Home is not large enough to be willing to put up with retaliation, or Home's opportunity costs of a minor offense are relatively low, which is the case if litigation costs are relatively high.²⁶ Note that both afore-mentioned types of equilibria only exist for non-prohibitive costs.

The striped area, which stretches to the south and along the eastern edge of Figure 3.4 represents the set of equilibria where Home plays its optimal tariff while Foreign does not retaliate. This type of equilibrium occurs if either Home is not large enough in order to harm Foreign sufficiently (the cases at the southern edge), or costs are prohibitive (the cases at the eastern edge where $c \geq \bar{c}$ holds).

The small checkered area to the west of Figure 3.4 depicts those rare cases where Home commits a major offense by playing $\tau_{\bar{s}}(n)$ while Foreign retaliates according to the binding equivalence condition.

3.3.4 Comparative Statics in Litigation Costs

Finally, the comparative static effects of a reduction of litigation costs can be analyzed by consulting Figure 3.4 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.

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 $(\tau_o(n), 0)$. 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 n .

²⁶The opportunity costs of a minor offense are Home's forgone benefits from a tariff increase to $\tau_o(n)$, constituting a major offense.

For high values of n (i.e. $n \geq n_{io}(\bar{c})$), Home's tariff is left unchanged, although Foreign implements retaliation of τ_o^* .

In the case of an intermediate level of n (i.e. $1 \leq n < n_{io}(\bar{c})$), Home's compliance is improved since the post reduction tariff pair is $(\tau_i(c, n), 0)$.

In the case of a small level of n (i.e. $n < 1$) both countries' tariffs and welfare levels are left unchanged.

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 n , where the initial set of equilibrium tariffs is $(\tau_o(n), \tau_o^*)$, 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 $(\tau_i(c, n), 0)$, which corresponds to any location inside the white area in the center of Figure 3.4. In this case the effects depend even further on n . If $n \leq 1$, the reduction in litigation costs does not change the equilibrium strategies as such since the post reduction equilibrium strategies are again $(\tau_i(c, n), 0)$. Nevertheless, Home will set a lower tariff because the absolute level of $\tau_i(c, n)$ has been reduced in the course of the cost reduction. If, to the contrary $n > 1$, the cost reduction may cause more severe offenses. Either Home commits a more severe offense by switching to its optimal tariff $\tau_o(n)$ or to $\tau_{\S}(n)$, thereby triggering Foreign's retaliation. Note that this paradoxical effect can only occur if the offender is sufficiently large (i.e. $n > 1$).

Suppose the initial equilibrium set of tariffs was $(\tau_o(n), 0)$, which corresponds to the striped area at the southern edge of Figure 3.4. In this case a reduction of costs unambiguously improves Home's compliance, who switches from playing $\tau_o(n)$ to playing $\tau_i(c, n)$ while Foreign's tariff remains 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 in the case of sufficiently small offenders (i.e. $n \leq 1$).

3.4 Extension

3.4.1 Rationale and Model Adaptations

In order to analyze if the results of the first model are robust to variations, this subsection models the asymmetry of the two countries in a different way while the structure of the analysis remains unchanged. Throughout this section the emphasis is put on highlighting the crucial differences that result from the changed specifications.

Suppose the representative consumers' quasilinear utility functions were identical in both countries.²⁷ Suppose further that Foreign has one consumer while Home has n identical consumers. Consequently, demand at Home is now n times foreign demand in both sectors. Demand at Home is then given by:

$$D_x(p_x) := (1 - p_x)n, \quad (3.17)$$

$$D_y(p_y) := (1 - p_y)n. \quad (3.18)$$

Foreign's demand is given by:

$$D_x^*(p_x) := 1 - p_x, \quad (3.19)$$

$$D_y^*(p_y) := 1 - p_y. \quad (3.20)$$

Again Foreign supplies only good x while Home supplies only good y :

$$S_x^*(p_x) := p_x, \quad (3.21)$$

$$S_y(p_y) := p_y. \quad (3.22)$$

Equilibrium prices, quantities, welfare levels and optimal tariffs are obtained in an analogous manner to the calculations conducted in the first model. However, unlike before, Foreign's

²⁷Let utility for a representative consumer be given by: $U(x, y, z) = U^*(x, y, z) = x - \frac{x^2}{2} + y - \frac{y^2}{2} + z$. Again trade is balanced via the numeraire good z .

optimal tariff $\tau_o^*(n)$ is now a function of n . It is given by: $\tau_o^*(n) = \frac{1}{3+4n+n^2}$. Note that Foreign's optimal tariff now clearly decreases in n since Foreign's ability to influence world market prices and hence its ability to generate terms of trade gains deteriorates with increasing n .

The rules of the tariff setting game and the modeling of the WTO's Equivalence Condition remain unchanged.

3.4.2 The Second Mover's Best Response

Again Foreign's welfare is a continuous function of its import tariff τ^* , which is positive and strictly increasing in the interval between zero and $\tau_o^*(n)$. Thus, Foreign's retaliatory tariff τ_r^* is given by $\tau_r^*(\tau, n) = \min\{\tau_o^*(n), \tau_{eq}^*(\tau, n)\}$.

Necessary Condition for Retaliation

Litigation costs c are prohibitive if $c \geq V^*(\tau, \tau_o^*(n), n) - V^*(\tau, 0, n)$ is satisfied. Substituting explicit values yields prohibitive costs \bar{c} as a function of n :

$$\bar{c}(n_p) = \frac{1}{2(2 + n_p)^2(3 + 4n_p + n_p^2)}. \quad (3.23)$$

The subscript p is appended to the country size parameter n in order to be able to identify the cases where costs are prohibitive in terms of country size.²⁸ Equation 3.23 reveals that an increase in litigation costs leads to a decrease of the threshold where costs have a prohibitive effect in terms of country size (i.e. $\frac{\partial \bar{c}(n_p)}{\partial n_p} < 0$). Since $\bar{c}(n_p)$ is a continuous and monotonically decreasing function, it holds that $n < n_p$ is a necessary condition for retaliation.²⁹

²⁸If e.g. $n_p = 2$, Foreign would not complain against offenses committed by countries of size $n \geq 2$, no matter how severe the offenses may be.

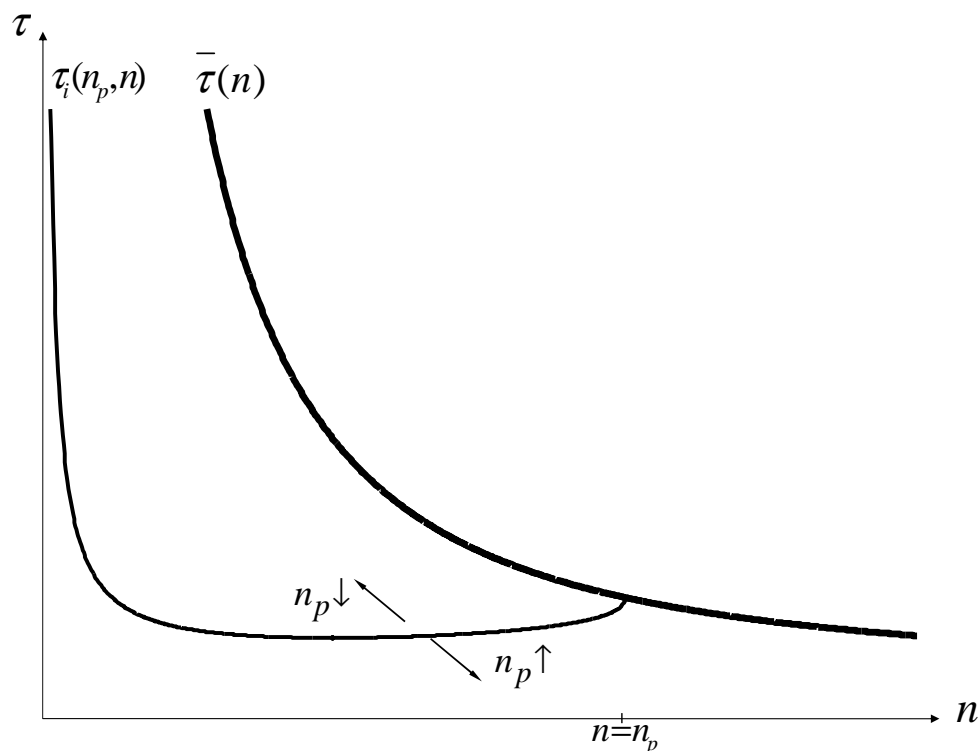
²⁹For $\bar{c}(n_p)$ the following properties can be shown to hold:

$$\bar{c}(n_p) \begin{cases} < \bar{c}(n) & \text{iff } n_p > n \\ = \bar{c}(n) & \text{iff } n_p = n \\ > \bar{c}(n) & \text{iff } n_p < n \end{cases}$$

Sufficient Condition for Retaliation

Foreign will only retaliate if the welfare gain associated with the implementation of its retaliatory tariff $\tau_r^*(\tau, n)$ exceeds litigation costs. Thus there will be a set of combinations of τ , n , and n_p which leads Foreign to be indifferent between retaliating and not retaliating. The set of these indifference inducing combinations can be expressed in terms of Home's tariff $\tau_i(n_p, n)$, which is again a function of costs (already expressed in terms of the prohibitive country size ratio n_p) and country size. Figure 3.5 illustrates that the thin hook-shaped $\tau_i(n_p, n)$ -curve only runs up to the

Figure 3.5: Foreign Indifference Inducing Home Tariffs in the Extended Model



level of n where $n = n_p$ since $\tau_i(n_p, n)$ does not exist for prohibitive costs (i.e. $n \geq n_p$). This indifference curve separates the n - τ -space into two different strategic sections. Combinations of τ and n lying to the Southwest (i.e. low τ and low n) or to the East (i.e. $n \geq n_p$) of the curve will not trigger foreign retaliation, whereas combinations of τ and n lying above the curve will

trigger foreign retaliation.

The bold downward sloping curve labeled $\bar{\tau}(n)$ represents all combinations in the n - τ -space where the authorized retaliatory tariff $\tau_{eq}^*(\tau, n)$ equals Foreign's optimal tariff $\tau_o^*(n)$.³⁰ Economically this means that Foreign's retaliation is inelastic in Home's initial violation for combinations of n and τ that lie above the $\bar{\tau}(n)$ -curve since Foreign will never retaliate with a tariff that is higher than its optimal tariff.

3.4.3 The First Mover's Best Response

The perfectly informed Home country decides between committing a minor offense (i.e. $\tau \leq \tau_i(n_p, n)$), which does not trigger retaliation, and a major offense (i.e. $\tau > \tau_i(n_p, n)$), which does trigger retaliation.³¹ Lemma 3.1, Lemma 3.2, Lemma 3.3, and Lemma 3.4 can be shown to hold analogously in this model specification. Consequently the sets labeled I, II and III in Figure 3.6 constitute strictly dominated strategies for the same reasons as in the previous model.

Once more Home's remaining options are (i) to play its optimal tariff $\tau_o(n)$, (ii) to play the retaliation threshold tariff $\tau_i(n_p, n)$ and (iii) to play a tariff $\tau_{\S}(n)$, which maximizes Home's welfare given that Foreign retaliates elastically. Again the third option will be dominated by playing one of the other two tariffs except for the occurrence of a very narrow range of country size ratios and costs. Consequently further analysis of this option is omitted for the same reasons as in the previous model. For the sake of completeness it can be shown that the Home will only play $\tau_{\S}(n)$ if costs are extremely low (i.e. $n_p \geq 3.7480$) and if $1 < n \leq 1.2128$.

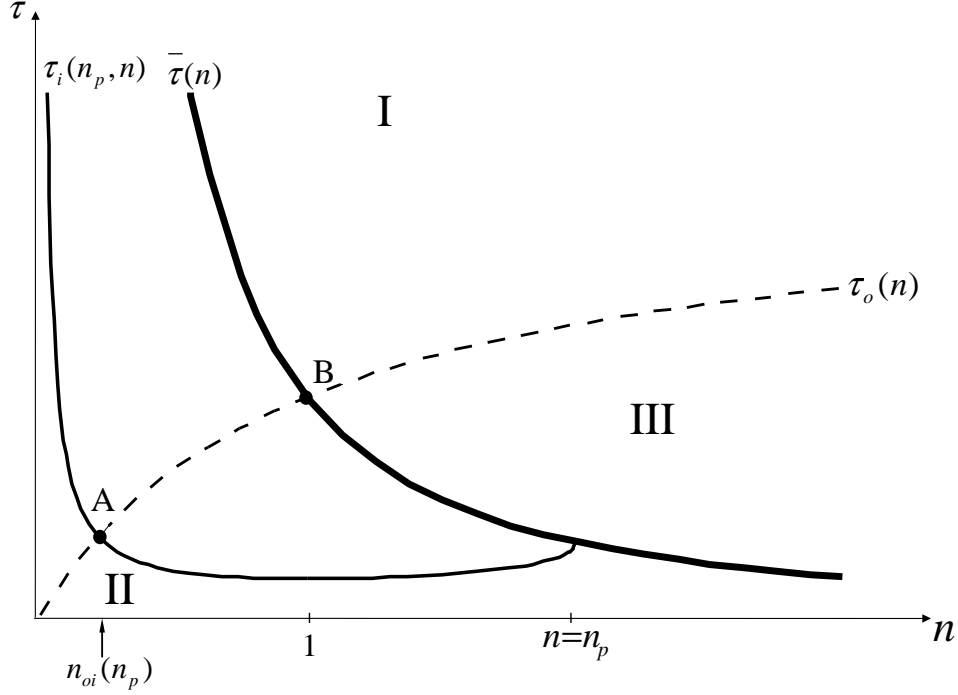
The critical country size ratio $n_{io}(n_p)$ where Home switches from committing a minor offense to committing a major offense can be derived along the lines of the calculations in the previous model.³²

³⁰ Analytically $\bar{\tau}(n)$ is obtained by setting $\tau_{eq}^*(\tau, n)$ equal to $\tau_o^*(n)$ and solving for τ .

³¹ Note that now $\tau_i(n_p, n)$ does not exist for $n > n_p$, since costs are prohibitive in these cases. Therefore it seems reasonable to count as well those violative tariffs as major offenses where Home plays its optimal tariff because costs are prohibitive.

³² Again the switching points between the three sections of Home's best response function are obtained by substituting Home's possible offensive tariffs and Foreign's associated retaliatory tariffs pairwise into Home's welfare function. The two resulting welfare functions of Home are given by:

Figure 3.6: Home's Tariff Levels in the Extended Model



Proposition 3.2. *Home's best response tariff is dependent upon n in the following way:*

- (i) *For all $n \leq 1.21280$, Home commits a minor offense.*
- (ii) *For all $n > 1.60254$, Home commits a major offense.*
- (iii) *For all $1.21280 < n \leq 1.60254$, Home's decision between a major and a minor offense is dependent upon the level of litigation costs. Paradoxically, high litigation costs lead to a minor offense, while low litigation costs lead to a major offense.*

Proof: See Mathematical Appendix B.7.

The paradoxical result that a reduction of litigation costs may lead even smaller countries than before to committing a major offense holds as well in this model. Just like before the shifting

-
1. $V_o(n) = V(\tau_o(n), \tau_o^*(n), n)$ and
 2. $V_i(n_p, n) = V(\tau_i(n_p, n), 0, n)$.

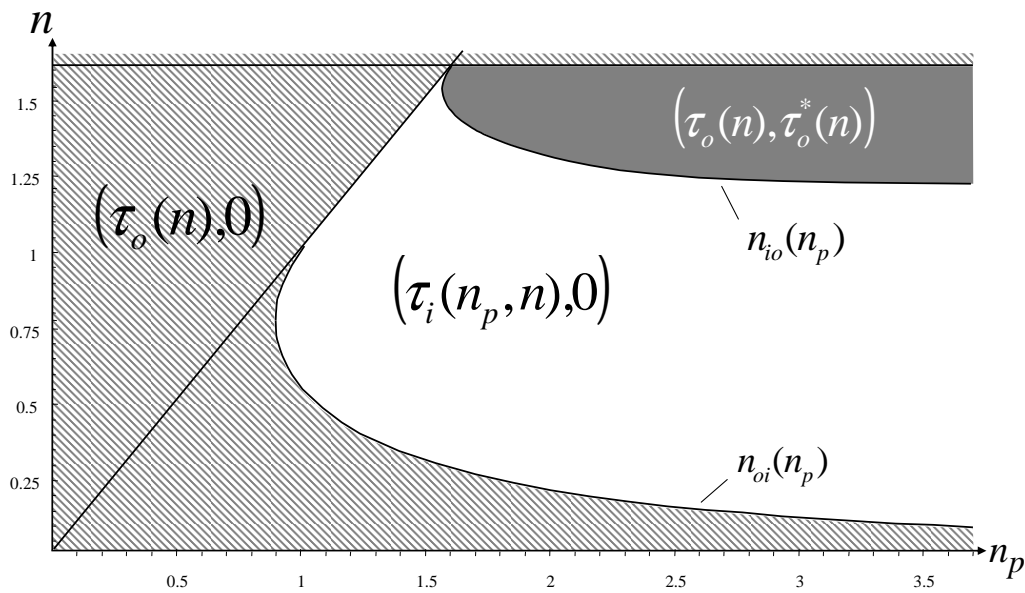
These welfare functions are set equal to each other and solved for n in order to obtain the switching point $n_{io}(n_p)$.

range of $n_{io}(n_p)$ has a boundary above (at $n = 1.60254$) and below (at $n = 1.21280$) at absolute levels of country size, while it is cost-elastic only between these boundaries. Consequently, countries of size $n \leq 1.21280$ will never play $\tau_o(n)$, countries of size $n > 1.60254$ will always play $\tau_o(n)$, while countries of size $1.21280 < n \leq 1.60254$ will play either $\tau_o(n)$ or $\tau_i(n_p, n)$ depending upon the pertinent level of litigation costs.

3.4.4 Equilibria

Figure 3.7 shows the occurrence of three different subgame perfect Nash equilibrium strategy pairs (τ_N, τ_N^*) in the n_p - n -space.³³ The diagonal line starting at the origin, has a slope of one. It

Figure 3.7: Equilibria in the Extended Model



divides the n_p - n -space into one northwestern triangular shaped set, where $n > n_p$ holds and one southeastern triangular shaped set, where $n < n_p$ holds. Clearly all n_p - n -combinations in the

³³Recall that a high (low) level of n_p corresponds to a low (high) level of litigation costs.

northwestern set exhibit prohibitive costs, such that the equilibrium in this triangular is given by $(\tau_o(n), 0)$. This tariff pair constitutes as well an equilibrium in the striped area lying to the southeast of the 45-degree line and to the south of the $n_{oi}(n_p)$ -curve. Although costs are not prohibitive in this area, the offense and therefore the permitted level of retaliation is not large enough to let Foreign break even with litigation costs.

The white area represents all combinations of n_p and n leading to an equilibrium tariff pair of $(\tau_i(n_p, n), 0)$. This area is bordered to the southwest by $n_{oi}(n_p)$, to the southeast by $n_{io}(n_p)$ and to the west by the condition of non-prohibitive costs (i.e. the 45-degree line).

The northeastern grey area represents a trade war equilibrium with both countries playing their optimal tariffs. It is bordered to the south by $n_{io}(n_p)$ and to the west by the condition of non-prohibitive costs.

3.5 Generalization

Let V^M be any country's welfare from setting its best 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 3.5. *A reduction in litigation costs weakly decreases V^m while it does not affect V^M .*

Note that Lemma 3.5 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 3.1. *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 3.1 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 3.5, consider the consequences of a reduction in litigation costs, as stated by the next proposition.

Proposition 3.3. *In every model that satisfies Assumption 3.1, 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 if 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 a minor offense for any reduction in c . Thereby it sets a strictly lower tariff.*

Proof: See Appendix B.8.

Proposition 3.3 shows that asking for the practical relevance of this model's paradoxical finding is equivalent to asking for the practical relevance of Assumption 3.1. Recall that Assumption 3.1 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 models, the country-size and market-size parameter n has been shown to satisfy Assumption 3.1. However, there are various modeling approaches that may satisfy Assumption 3.1 as the literature review in section 1.3 already revealed. 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 its 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 in case of a lower endowment share. Thus their approach is in agreement with Assumption 3.1.

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 3.1.

Melatos et al. (2007) show that Assumption 3.1 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 a modified conference paper version of this chapter, Wilckens (2008) uses a two country setting, that is similar to the setting of Bown (2002), where countries exhibit different political economy parameters in their welfare functions. Wilckens (2008) shows that a country with a sufficiently strong preference for protecting its import-competing industry prefers a tariff war, while a less protectionist country prefers to avoid a tariff war.

3.6 Discussion

The outcomes of the models suggest that the DSS is unable to level out existing imbalances in countries' incentives to impose violative 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. So far, this result parallels the result of Bown (2002) who uses a similar constraint on the victim's admissible level of retaliation, but allows for the possibility of compensation between the countries to avoid a dispute.³⁴ Further-

³⁴Note that Bown (2002) does neither consider any litigation costs nor does he allow the offender to optimize its illegal tariff given the restriction on the victim's level of retaliation.

more, litigation costs have been found to be a key determinant of a violated country's decision whether or not to file a complaint. The central results have been found to be of importance for a broad class of models, as argued in the section on the generalization of the results. In particular, with respect to the decision whether or not to violate a trade agreement, asymmetry in countries' re-distributional motivation is equivalent to asymmetry in countries' ability to influence the terms of trade in their favor.³⁵

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 small countries. However, large countries may be led to commit more severe offenses.³⁶

Besides, a reduction of litigation costs is supposed to lead to more trade disputes surfacing in the dispute settlement record and to 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 large or 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 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

³⁵In 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.

³⁶This result parallels findings of the Economics of Crime literature. See for example Becker (1968), who shows that an intensified punishment may lead some offenders to switch to more severe offenses, while it may reduce the offensive level of others.

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 to developing countries.

Chapter 4

Tradable Retaliation in the WTO

Abstract

Under the WTO's current DSS, the utmost threat to an offender of a trade agreement is posed by the authorization of the successful complainant to implement retaliatory measures against him. This enforcement threat may be less effective when the complaining victim is a small or a developing country that lacks the ability to retaliate. In order to overcome this supposed enforcement flaw of smaller and poorer countries, the Permanent Mission of Mexico to the WTO proposed to allow the retaliatory right to be traded. In this chapter, which is joint work with Mathis Klepper,¹ we analyze the effects of this proposal on the World Trading System in an asymmetric three country model. In different scenarios we distinguish whether or not the initial offender is allowed to buy the retaliatory right. We show that, irrespective of the inclusion of the offender, compliance with the rules of the WTO is unambiguously improved, and that this improvement is strongest in the case of small country victims.

¹Neither one of us did focus exclusively on certain aspects of this study. We worked jointly on each part.

4.1 Introduction

As discussed in the previous chapters, a panel's sole possibility to exert pressure on a non-complying country is to authorize a victorious complainant to impose retaliatory measures against the offender. Thus, the magnitude of the ultimate enforcement threat depends upon the victorious complainant's ability to impose countermeasures against the non-complying offender. As already highlighted in previous chapters, there is clear evidence in the literature suggesting that this ability varies considerably between large and small countries.²

In November 2002 the Permanent Mission of Mexico to the WTO (2002) proposed to make retaliatory rights tradable in order to address the problem that smaller countries may face difficulties in retaliating. With respect to this proposal, the Mexicans conjecture that *“[f]acing a more realistic possibility of being the subject of suspended concessions, the infringing Member will be more inclined to bring its measure into conformity.”*

There is some recent research on this proposal by Bagwell et al. (2007). The authors assume that an offense against a country has already occurred. The victim of this initial offense is unable to use the retaliatory right and thus seeks to sell it. There are at least two potentially buying countries. Each of these countries maximizes its welfare function where producers' surplus is weighted by a political economy parameter, which is drawn from a random distribution. While each country knows the realization of its own parameter, it does not observe the realization of the other countries' parameters. In this particular setting of imperfect information, the authors find that if the initial offender is not allowed to buy the right, it may happen that none of the

²First of all, the optimal tariff of many developing countries is likely to be close to zero since most of these countries cannot influence their terms of trade. Hence, scholars denote this as a “shooting oneself in the foot” effect. Secondly, even if a small and poor country imposed retaliatory tariffs, these are most likely to constitute a threat that is insufficient to enforce an offender's compliance if the offender is large. Recall that on the theoretical side, Johnson (1953), Kennan and Riezman (1988) and Syropoulos (2002) have shown that a country may gain from a tariff war if it is powerful enough compared to its opponent, where “powerful” may refer to the level of population, endowments or the price elasticities of import demand and export supply. On the empirical side there are some studies that come up with evidence in support of these theoretical findings. Broda et al. (2006) show that countries actually do tend to take their market power into account when setting import tariffs. Recall that Bown (2005) and the study in chapter 2 show by means of a probit regression analysis that smaller and poorer countries are less likely to file a complaint against an offender. Furthermore, both studies find that the size of the offender is detrimental to a victim's incentive to file a complaint.

potentially retaliating countries buys and uses the retaliatory right.³ This result is driven by the existence of a positive externality. In particular, when political economy parameters are low, countries may prefer not to impose retaliation themselves. Then countries may prefer to get a free ride on another country's retaliation which drives down the world market price of their imports. However, when Bagwell et al. (2007) allow as well the initial offender to buy the retaliatory right, the latter will always buy and retire the right.

Their setting involves several particular features which are crucial for their findings that (i) the retaliatory right may be misallocated between the bidders and the victim and (ii) no retaliation at all may occur as a special case of misallocation.

First of all, the assumption that the initial owner of the retaliatory right is completely unable to use it, is crucial for the the finding that no retaliation at all may occur. If, to the contrary, the initial owner was able to reap at least a minimum welfare gain from the implementation of the right, retaliation would always be executed, even if no other country submitted a bid. Since the DSU⁴ even allows for cross-retaliation (i.e. retaliation may be implemented in a sector other than the sector of the initial violation), we contribute a setting in which a violated country is not completely unable to utilize a retaliatory right.

The finding of Bagwell et al. (2007) that the retaliatory right may be misallocated in the *basic auction*, which is the auction where the offender is not allowed to bid, builds on the existence of a non-negative reserve price. Restricting the reserve price, and therefore as well the winning bid, to the set of non-negative numbers implies that, unlike the other countries, the victim does not benefit from the positive terms of trade externality. We could rather imagine that the victim, who obviously is a trading partner of the offending country, would benefit from the positive externality that emerges from the implementation of retaliation via a lower world market price

³Bagwell et al. (2007) consider a sealed bid first price auction. In this particular setting a country's optimal strategy may be not to bid when its political economy parameter is sufficiently low. As a result, the retaliatory right remains with the victim and no retaliation occurs. This special case of misallocation of the retaliatory right is denoted as *auction failure* in Bagwell et al. (2007).

⁴Article 22,3 of the DSU states: "In considering what concessions or other obligations to suspend, the complaining party shall apply the following principles and procedures:[...] (b) if that party considers that it is not practicable or effective to suspend concessions or other obligations with respect to the same sector(s), it may seek to suspend concessions or other obligations in other sectors under the same agreement;"

of the offender's export goods. Thus, the victim would be likely to have a positive willingness to pay in order to ensure that retaliation will actually be implemented.⁵

What strikes us is that the Mexican proposal rather addresses the type of North-South trade disputes, where the Southern country finds it difficult to retaliate, than the type of trade disputes between two developed countries which both could implement retaliation easily. As Bagwell et al. (2007) put it on page 310: *"One prominent problem is the practical difficulty faced by small and developing countries in finding the capacity to retaliate effectively against trading partners that are in violation of their WTO commitments."*⁶ Of course in reality both, redistributive considerations as well as terms of trade considerations are likely to influence a country's tariff-setting incentive. While Bagwell et al. (2007) emphasize the redistributive considerations by using a model with asymmetric political economy parameters, we contribute a model where countries differ in their size in order to focus on terms of trade considerations and hence more on typical North-South issues.

The imperfect information setting in Bagwell et al. (2007) prevents bidders from communicating their valuations and thus from internalizing the positive externality between bidders. In our model of perfect information the potential retaliators agree that the larger country should execute the right since the larger country can influence the world market price of the retaliatory good more effectively, thus creating a larger terms of trade gain for all importers of the retaliation good. Hence, even in the presence of a positive externality, the allocation of the retaliatory right turns out to be efficient in our model.

Apart from that, we respond to the suggestion of Bagwell et al. (2007) by offering a first analysis of how a restriction on the maximum admissible level of retaliation would change the results.

The remainder of this chapter starts with the setup of the underlying trade model and our

⁵So what does this victim country in Bagwell et al. (2007) look like? It is either a country that is so small that it cannot influence world market prices or it has a rather low political economy parameter in order to be completely unable to retaliate. In addition it does neither import any good that is exported by the initial offender nor any close substitutes in order to justify that the victim is not affected by the positive externality.

⁶In their Introduction Bagwell et al. (2007) predominantly refer to the terms of small and large countries in order to motivate the analysis of the problem.

assumptions on the sequential game. In section 4.3 we first derive each country's valuation of the retaliatory right. Subsequently, we derive the offender's best response function and analyze equilibrium behavior with respect to (i) country size, (ii) whether or not the offender may buy the right, and (iii) the bargaining power distribution. Concluding remarks are offered in section 4.4.

4.2 Model

4.2.1 Trading Environment

Our model includes three countries: A , B , and C . Let α denote the population of country A , while β denotes the population of country B , and γ denotes the population of country C .

The representative consumer in country i derives utility from consumption of the goods a , b , c , and z according to the quasilinear utility function

$$u_i(a, b, c, z) := a - \frac{a^2}{2} + b - \frac{b^2}{2} + c - \frac{c^2}{2} + z, \quad (4.1)$$

where $i \in \{A, B, C\}$ and z is a freely traded numeraire good with price equal to one. The representative consumer maximizes $u(a, b, c, z)$ subject to its budget constraint. Since consumption of good z features a constant ratio of marginal utility to price that is equal to unity, demand for each non-numeraire good has to satisfy

$$\frac{\partial u_i}{\partial j} \geq p_{ij}, \quad (4.2)$$

where $j \in \{a, b, c\}$ and p_{ij} denotes the price of good j in country i . Consequently, the representative consumer's demand for a non-numeraire good in each country is

$$d_{ij}(p_{ij}) = 1 - p_{ij}. \quad (4.3)$$

Aggregated demand in country A , B and C is then given by

$$Q_{Aj}(p_{Aj}) = \alpha(1 - p_{Aj}), \quad (4.4)$$

$$Q_{Bj}(p_{Bj}) = \beta(1 - p_{Bj}), \quad (4.5)$$

$$Q_{Cj}(p_{Cj}) = \gamma(1 - p_{Cj}) \quad (4.6)$$

for each good j . Demand for the numeraire good z is determined residually.⁷

Assume that each consumer in each country is endowed with one unit of good z . Moreover, let there be one unit of the country specific good in each country. Then supply in each country can be characterized by a vector $S_i = (S_{ia}, S_{ib}, S_{ic}, S_{iz})$. Accordingly, country A 's supply vector is given by

$$S_A := (1, 0, 0, \alpha), \quad (4.7)$$

country B 's supply vector is given by

$$S_B := (0, 1, 0, \beta), \quad (4.8)$$

and country C 's supply vector is given by

$$S_C := (0, 0, 1, \gamma). \quad (4.9)$$

Focusing our analysis on import tariffs, let τ_{ij} denote country i 's per unit import tariff on foreign good j . Furthermore let p_j denote the world market price of good j . Then, market clearing

⁷Demand for the numeraire good in country i , Q_{iz} , is obtained from the budget constraint: $Q_{iz} := I_i - \sum_{j \in \{a, b, c\}} Q_{ij} p_{ij}$, where I_i denotes the income of country i .

conditions are given by

$$S_{Aa} = Q_{Aa}(p_a) + Q_{Ba}(p_a + \tau_{Ba}) + Q_{Ca}(p_a + \tau_{Ca}), \quad (4.10)$$

$$S_{Bb} = Q_{Ab}(p_b + \tau_{Ab}) + Q_{Bb}(p_b) + Q_{Cb}(p_b + \tau_{Cb}), \quad (4.11)$$

$$S_{Cc} = Q_{Ac}(p_c + \tau_{Ac}) + Q_{Bc}(p_c + \tau_{Bc}) + Q_{Cc}(p_c) \quad (4.12)$$

for good a , b , and c respectively. Solving for prices yields the equilibrium world market price \hat{p}_j for each good:⁸

$$\hat{p}_a = \frac{\alpha + \beta + \gamma - 1 - \beta\tau_{Ba} - \gamma\tau_{Ca}}{\alpha + \beta + \gamma}, \quad (4.13)$$

$$\hat{p}_b = \frac{\alpha + \beta + \gamma - 1 - \alpha\tau_{Ab} - \gamma\tau_{Cb}}{\alpha + \beta + \gamma}, \quad (4.14)$$

$$\hat{p}_c = \frac{\alpha + \beta + \gamma - 1 - \alpha\tau_{Ac} - \beta\tau_{Bc}}{\alpha + \beta + \gamma}. \quad (4.15)$$

Aggregated equilibrium demand D_{ij} in country i for good j is obtained by substituting equilibrium prices \hat{p}_j (plus τ_{ij} for imported goods) into aggregated demand functions Q_{ij} .

Figure 4.1 shows the described trading pattern between the three countries. Country i 's gross equilibrium income I_i constitutes of (i) the sales revenues of its initial endowments and (ii) its tariff revenues on the other two imported non-numeraire goods:

$$I_A = S_{Aa}\hat{p}_a + S_{Az} + D_{Ab}\tau_{Ab} + D_{Ac}\tau_{Ac}, \quad (4.16)$$

$$I_B = S_{Bb}\hat{p}_b + S_{Bz} + D_{Ba}\tau_{Ba} + D_{Bc}\tau_{Bc}, \quad (4.17)$$

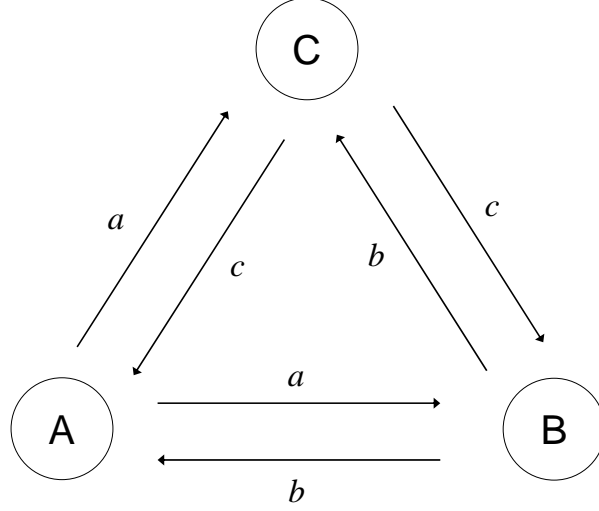
$$I_C = S_{Cc}\hat{p}_c + S_{Cz} + D_{Ca}\tau_{Ca} + D_{Cb}\tau_{Cb}. \quad (4.18)$$

Now we can determine country i 's equilibrium demand for the numeraire good D_{iz} as the residual income after expenditures for all non-numeraire goods.

We use a country's indirect utility function V_i as a measure of welfare. Hence, equilibrium

⁸Due to fix supplies in our model, we require that $\alpha + \beta + \gamma > 1$ in order to obtain positive prices in equilibrium.

Figure 4.1: Trading Pattern in the Three Country Model



welfare of each country is a function of all three country size parameters and all six import tariffs. Note that aggregated equilibrium demand for each good (i.e. D_{ij}) has to be divided by the country's population parameter when it is substituted into the representative consumer's utility function u_i . Multiplying this expression by the population parameter yields the aggregate indirect utility functions in equilibrium:

$$V_A(\alpha, \beta, \gamma, \tau_{Ab}, \tau_{Ac}, \tau_{Ba}, \tau_{Bc}, \tau_{Ca}, \tau_{Cb}) := \alpha u_A(D_{Aa}/\alpha, D_{Ab}/\alpha, D_{Ac}/\alpha, D_{Az}/\alpha), \quad (4.19)$$

$$V_B(\alpha, \beta, \gamma, \tau_{Ab}, \tau_{Ac}, \tau_{Ba}, \tau_{Bc}, \tau_{Ca}, \tau_{Cb}) := \beta u_B(D_{Ba}/\beta, D_{Bb}/\beta, D_{Bc}/\beta, D_{Bz}/\beta), \quad (4.20)$$

$$V_C(\alpha, \beta, \gamma, \tau_{Ab}, \tau_{Ac}, \tau_{Ba}, \tau_{Bc}, \tau_{Ca}, \tau_{Cb}) := \gamma u_C(D_{Ca}/\gamma, D_{Cb}/\gamma, D_{Cc}/\gamma, D_{Cz}/\gamma). \quad (4.21)$$

4.2.2 Properties of the Model

In the following, we analyze country A 's welfare function and the welfare maximizing tariffs. For the other two countries' welfare functions the properties hold analogously.

An increase in τ_{Ab} increases the domestic price $p_{Ab} + \tau_{Ab}$ of good b in country A , which results in a reduced demand for good b . This demand reduction is accompanied by a decrease

in the world market price of good b .⁹ Thus, only a part of the increased import tariff on good b is passed through to country A 's consumers. The other part is paid by country B , which now receives a lower price for its exports. Despite this positive terms of trade effect, consumers' surplus in country A decreases in the course of the higher domestic price for good b . Marginal gains from the terms of trade effect are balanced against marginal losses of consumer surplus at τ_{Ab}^* , which denotes country A 's welfare maximizing import tariff on good b . τ_{Ab}^* is a function of country C 's import tariff on good b , τ_{Cb} , and it is a function of the country size parameters α , β , and γ , which determine the market share of country A . The explicit form is

$$\tau_{Ab}^* = \tau_{Ab}^*(\alpha, \beta, \gamma, \tau_{Cb}) = \frac{\alpha(1 + \gamma\tau_{Cb})}{(\beta + \gamma)(2\alpha + \beta + \gamma)}. \quad (4.22)$$

Consider that the impact of τ_{Ab} on the equilibrium world market price \hat{p}_b is determined by Country A 's market share $\alpha/(\alpha + \beta + \gamma)$. The larger country A 's market share, the higher is its welfare maximizing import tariff. Therefore,

$$\frac{\partial \tau_{Ab}^*}{\partial \alpha} > 0, \quad \frac{\partial \tau_{Ab}^*}{\partial \beta} < 0, \quad \frac{\partial \tau_{Ab}^*}{\partial \gamma} < 0. \quad (4.23)$$

Throughout this chapter we will only consider the tariffs $\tau_{Ab} \in [0, \tau_{Ab}^*]$, $\tau_{Ba} \in [0, \tau_{Ba}^*]$, and $\tau_{Cb} \in [0, \tau_{Cb}^*]$. All other import tariffs are assumed to be zero and will be omitted in the notation.

Thus, country A 's welfare is (i) increasing in A 's import tariff (positive terms of trade effect), (ii) decreasing in any other country's tariff on A 's exports (negative terms of trade externality), and (iii) increasing in any other country's tariff on A 's imports (positive terms of trade externality):

$$\frac{\partial V_A}{\partial \tau_{Ab}} > 0, \quad \frac{\partial V_A}{\partial \tau_{Ba}} < 0, \quad \frac{\partial V_A}{\partial \tau_{Cb}} > 0. \quad (4.24)$$

⁹Since the world market price is determined by aggregate demand, the decrease in the world market price is lower than the increase of τ_{Ab} so that the domestic price for good b is unambiguously increased.

4.2.3 Order of Moves

We start from an initial free trade agreement, which is efficient in the sense that it maximizes the countries' joint welfare. Consider that in other settings where redistributive motivations play a role, free trade does not necessarily have to be efficient. Moreover, we are aware that those scholars who have the literature of Bagwell and Staiger (1999, 2001, and 2002) in mind would probably dislike the assumption of a symmetric initial (free) trade agreement between countries of asymmetric size. To the concerned reader we may suggest to imagine a symmetric trade agreement with payments from smaller to larger countries. Consequently, what we label as an initial offense of B against A would not turn out to become a realized offense. It would rather constitute B 's threat point to extract payments from A . Hence, our analysis of the comparative static transition from the status quo to a system of tradable retaliation could be seen as an analysis of how threat points and the associated payments would change.¹⁰

We assume that countries set tariffs sequentially and under perfect information. First, we allow country B , our "bad guy", to choose whether or not he would like to violate the free trade agreement by imposing an import tariff on good a . Subsequently, the injured country A receives a (tradable) retaliatory right, which entitles its owner to impose an import tariff against country B . Country A may now implement retaliation by itself or it may sell the right either to country C , who then could impose an import tariff against country B , or it may sell the right to country B .

Let us clarify that we only consider one initial offense by country B in the market for good a and retaliatory action in the market for good b . Hence, the remainder of this chapter exclusively

¹⁰To see this more clearly, consider the following case. Let B be larger than A (i.e. $\beta > \alpha$) and suppose both countries have committed themselves to free trade. Furthermore let B 's net welfare gain from an offense against A , which is B 's welfare gain from the offense minus its welfare loss due to A 's retaliation, be denoted as ΔV_B^A . Thus, if $\Delta V_B^A > 0$, A would have to pay an amount of ΔV_B^A to B in order to prevent B from committing the offense. Due to the existence of a deadweight loss in our model, we already know that A would be willing to pay this amount to B since the welfare loss that A would have to incur under the offense would be even larger. Now consider what would happen if, due to introduction of tradable retaliation, the threat of retaliation against B emerged from some other country C that is larger than A (i.e. $\gamma > \alpha$). Clearly B 's net welfare gain from an offense would deteriorate and so would the amount of money that A would have to pay to B in order to prevent the latter from committing an offense.

deals with the initially offensive tariff τ_{Ba} and the retaliatory tariffs τ_{Ab} and τ_{Cb} . All other tariffs may be assumed to equal zero.

Furthermore, we do not assume that the extent of authorized retaliation depends upon the magnitude of the initial offense. We rather assume that the owner of the retaliatory right may straight away set its welfare maximizing tariff τ_{Ab}^* or τ_{Cb}^* respectively. Although this assumption may be at odds with reality in some cases, we find that our central results remain qualitatively unchanged when we use simulations to calculate the authorized extent of retaliation according to a counterfactual trade value model.¹¹

4.3 Strategic Behavior

In this section we first derive all countries' valuations for the retaliatory right before we turn to the analysis of the offender's best response.

4.3.1 Valuations

A natural property of our model is that any positive import tariff causes a deadweight loss. That is, while the tariff setting country's welfare may increase as well as the welfare of the third country, which benefits from a lower world market price, global welfare decreases unambiguously. Hence, speaking in absolute terms, the welfare loss of the country whose exports have been subject to the tariff is always larger than the sum of both the tariff setting and the freeriding country's welfare gains. Thus we obtain the first lemma.

¹¹Jordan (2005) discusses the various approaches that have been employed by WTO panelists to calculate the extent of authorized retaliation. A popular approach has been the counterfactual trade value model. This model first assesses the decrease in the trade value of the affected commodity due to the imposition of the illegal trade measure. Subsequently, the panel would allow the victorious complainant to impose a retaliatory tariff up to a level that would cause an equal reduction in the trade value of imports from the initial offender. However, the interpretation of the Dispute Settlement Understanding's Article 22, which constitutes the legal basis for this equivalence condition, is quite controversial. Experts in the field of international trade law, such as John Jackson, argue that if a country fails to comply with a ruling, retaliation may exceed the magnitude of the initial offense in order to restore compliance from a legal point of view. In his paper titled "*The Myth of 'Rebalancing' Retaliation in WTO Dispute Settlement Practice*", Spamann (2006) shows that indeed panels often do not apply the equivalence condition. Consider Appendix C.3 for a discussion of the changes that go along with the inclusion of this feature in our model.

Lemma 4.1. *Country B's valuation for the retaliatory right is higher than the sum of all other countries' valuations.*

Proof of Lemma 4.1: Let $V := V_A + V_B + V_C$. The deadweight loss ensures that

$$0 > \frac{dV}{d\tau_{ij}} = \frac{dV_A}{d\tau_{ij}} + \frac{dV_B}{d\tau_{ij}} + \frac{dV_C}{d\tau_{ij}} \quad (4.25)$$

For $i \in \{A, C\}$, we get $\frac{dV_A}{d\tau_{ib}} > 0$, $\frac{dV_C}{d\tau_{ib}} > 0$ and $\frac{dV_B}{d\tau_{ib}} < 0$, hence $\frac{dV_A}{d\tau_{ib}} + \frac{dV_C}{d\tau_{ib}} < |\frac{dV_B}{d\tau_{ib}}|$. \square

Since the offender has the highest valuation of the right, he will be able to pay the highest price for it, so that he will finally buy the right whenever he is allowed to do so.

Now let us analyze those cases where the offender is excluded from the negotiation process. Suppose country A received a retaliatory right from the WTO which authorizes the owner to target country B 's exports with an import tariff. In order to answer the question whether country A or country C or no one will execute the retaliatory right, it is useful to assess a country's welfare in each of the three possible negotiation outcomes.

Let V_A^0 denote country A 's welfare when no retaliation occurs. That is,

$$V_A^0 := V_A|_0. \quad (4.26)$$

Let V_A^r denote country A 's welfare when country A carries out retaliation against country B . That is,

$$V_A^r := V_A|_{\tau_{Ab}^*}. \quad (4.27)$$

Finally, let V_A^f denote country A 's welfare, freeriding on country C 's retaliation against country B :

$$V_A^f := V_A|_{\tau_{Cb}^*}. \quad (4.28)$$

Comparing the three different states of welfare, we find the next lemma.

Lemma 4.2. *Country A and country C each prefer to execute retaliation themselves to no retaliation. That is, $V_A^r > V_A^0$ and $V_C^r > V_C^0$.*

Proof of Lemma 4.2: We have $\tau_{ib}^* > 0$ and $\frac{\partial V_i}{\partial \tau_{ib}} > 0$ for $i \in \{A, C\}$. □

Still maintaining the current assumption that the offender is excluded from negotiations, we know from Lemma 4.2 that the final owner of the retaliatory right will use it. As a consequence, the initial owner of the right, country A, has to choose whether he would like to execute the right by himself, yielding V_A^r or if he prefers to have country C execute the right, yielding V_A^f . Note that country C faces an analogous decision between its two states of welfare, V_C^r and V_C^f . Given this binary decision, we define country A's and country C's willingness to pay for the retaliatory right as

$$wp_A := V_A^r - V_A^f, \tag{4.29}$$

$$wp_C := V_C^r - V_C^f. \tag{4.30}$$

Furthermore let the difference between the willingness to pay of country A and country C be denoted by

$$\Delta wp := wp_A - wp_C. \tag{4.31}$$

For Δwp we find the properties stated by the next lemma.

Lemma 4.3. *The difference between country A's and country C's willingness to pay for the retaliatory right, Δwp ,*

(i) *equals zero if $\alpha = \gamma$ and*

(ii) *is increasing in α .*

Proof: See Appendix C.1.

A noteworthy property of our model is that the willingness to pay for the retaliatory right may be negative, both for country A and country C when the offender is not allowed to buy the right and α and γ have about the same size. In those situations each country prefers the other one to execute retaliation since the gain from freeriding is larger than the gain from carrying out retaliation by oneself. However this does not affect the validity of Lemma 4.3 because unlike Bagwell et al. (2007) we do not restrict the price of the retaliatory right to the set of non-negative numbers. Note that a negative price is equivalent to offering the right at a price of zero and attaching an envelope with a positive amount of money to the right. Consider that there is always an amount of money, m , which the initial owner of the right, country A , would be willing to attach to the offered right if $wp_A < 0$. From Lemma 4.3 we know that for $\alpha < \gamma$, country C would always be willing to accept a package consisting of the retaliatory right and a payment that is larger than $|wp_C|$. Since $wp_A < wp_C$ implies $|wp_A| > |wp_C|$ in case of negative valuations, A would always be willing to attach a sufficient amount of money $|wp_C| < m < |wp_A|$ that leads C to buy the right. In other words, even if both countries do not want to retaliate by themselves, the smaller country has a higher willingness to pay for a free ride than the larger country.¹² This result can be explained by considering that the larger country can influence the world market price of good b more effectively than the smaller country. Hence, the positive terms of trade effect that benefits both A and C is larger when the larger country retaliates.

Corollary 4.1. *Between country A and country C the retaliatory right is always allocated to the larger one.*

¹²To see this more clearly, consider the following case: Suppose A is smaller than C (i.e. $\alpha < \gamma$) and both countries prefer the other one to carry out retaliation (i.e. $wp_A < 0$ and $wp_C < 0$). According to our model, the victim A is the initial owner of the retaliatory right. Since wp_A is negative, A 's willingness to pay for carrying out retaliation is negative. Note that this is equivalent to saying that A 's willingness to pay for a free ride on C 's retaliation is $-wp_A$, which is positive. Now consider that Lemma 4.3 states that $\alpha < \gamma$ implies $wp_A < wp_C$. This is equivalent to $-wp_A > -wp_C$, which states that A 's willingness to pay for a free ride on C 's retaliation is larger than C 's willingness to pay for a free ride on A 's retaliation. Hence A would be willing to offer a negative price for the right of wp_A (or to attach an amount of money $m = -wp_A$ to the right), while C would only be willing to offer the higher negative price of wp_C (or to attach a smaller amount of money $m = -wp_C$). Alternatively, one could view this process as two countries making bids for the public good "free ride on my neighbor's retaliation". Since the smaller country has the higher willingness to pay, it will receive the good. The larger country receives the price for the good and carries out retaliation.

4.3.2 The Initial Offense

In this section we assess the best response of the potentially offending country B . We start with the analysis of a regime where B is not allowed to buy the retaliatory right. Subsequently, we relax this assumption and allow B to join negotiations on the retaliatory right. Within the latter setup we further distinguish between cases of high and low bargaining power of the offender and between cases with and without side payments between A and C .

Excluding the Offender

Following the insight from Corollary 4.1, that the larger of country A and C will execute the retaliatory right, we first examine B 's behavior for $\alpha > \gamma$. Due to the symmetry of our model we obtain analogous results for $\alpha < \gamma$. Let $\alpha > \gamma$ and let country B 's net welfare gain from an offense against country A , given country A retaliates by itself, be denoted by

$$\Delta V_B^A := V_B|_{\tau_{Ab}^*, \tau_{Ba}^*} - V_B|_0. \quad (4.32)$$

For ΔV_B^A we find the properties stated by the next lemma.

Lemma 4.4. *Country B 's net welfare gain from an offense against country A , given country A retaliates by itself*

- (i) *is decreasing in α and*
- (ii) *is increasing in β .*

Proof: See Appendix C.2.

Since the damage from retaliation does not depend on the initial offense and because utility functions are separable in goods, we can state Lemma 4.5 which is the symmetric counterpart to Lemma 4.4.

Lemma 4.5. *For $\alpha < \gamma$, country B 's net welfare gain from an offense against country A*

(i) is increasing in β and

(ii) is decreasing in γ .

Given the properties of Lemma 4.4, we may identify a set of country size parameters which exactly balances country B 's gross welfare gain from the initial offense against its loss from the execution of retaliation, so that its net gain equals zero. Formally, we set ΔV_B^A equal to zero and solve for α , yielding

$$\alpha_{IA}(\beta, \gamma), \tag{4.33}$$

which is country B 's indifference curve with respect to the decision of whether or not to commit an offense against country A , given A retaliates by itself. Note that $\frac{d\alpha_{IA}}{d\beta} > 0$ follows from Lemma 4.4, meaning that if the size of the offender increases, the victim country's size has to increase as well in order to restore the offender's indifference.¹³

Elaborating on Lemma 4.5, we may set up an analogous indifference curve for country B , which describes the set of country size parameters that renders country B indifferent between whether or not to commit an offense against country A , given country C retaliates. This curve is denoted by $\gamma_{IC}(\alpha, \beta)$, which exhibits analogous properties to α_{IA} .

Finally, we can assemble the results from Lemma 4.4 and Lemma 4.5 to characterize the offender's decision whether or not to offend in the next proposition.

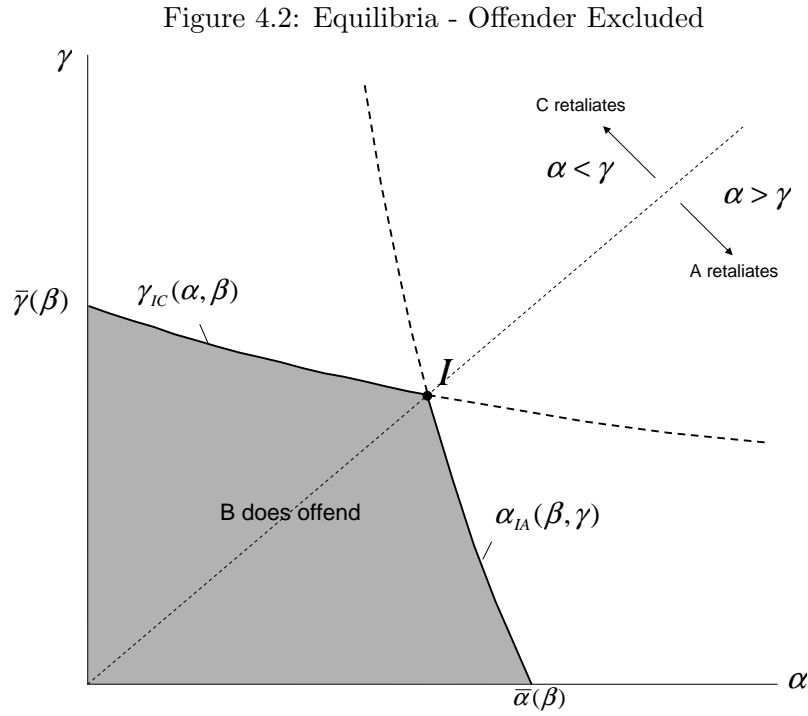
Proposition 4.1. *Country B will commit an offense against country A if and only if one of the following conditions is fulfilled:*

(i) $\gamma \leq \alpha < \alpha_{IA}(\beta, \gamma)$,

(ii) $\alpha < \gamma < \gamma_{IC}(\alpha, \beta)$.

¹³Moreover, using simulation techniques, we find that $\frac{d\alpha_{IA}}{d\gamma} < 0$. This implies that while γ increases, the increase of $V_B|_{\tau_{Ab}^*} - V_B|_0$ is less strong than the decrease of $V_B|_{\tau_{Ba}^*} - V_B|_0$. In other words, as the size of the third country C increases, B 's gross gain from offending erodes more than B 's damage from A 's retaliation does.

Figure 4.2 visualizes the findings of Proposition 4.1 in the α - γ -space, holding β constant. The dashed line with a slope of positive one separates the α - γ -space into a southeastern area



where A executes retaliation and a northwestern area where C executes retaliation. Consider first the area in which $\alpha > \gamma$, where $\alpha_{IA}(\beta, \gamma)$ separates the offensive regions from the non-offensive regions. In line with the intuition of our earlier results, a potential offender of a given size β would switch from not offending to offending as $\alpha_{IA}(\beta, \gamma)$ is crossed from east to west, that is as the victim's size α is reduced.¹⁴

Now consider the northwestern area of Figure 4.2, in which $\alpha < \gamma$ and where $\gamma_{IC}(\alpha, \beta)$ separates the offensive from the non-offensive regions. This area is just the mirror image of the afore described southeastern area, which has been mirrored at the dashed line with slope one.

Furthermore, Figure 4.2 serves well to illustrate the comparative static effect of an intro-

¹⁴Our model exhibits a linear relationship between α and β as well as between γ and β . Particularly, $\bar{\alpha} = 0.867688\beta$ and $\bar{\gamma} = 0.867688\beta$. Hence, the coordinates of the intersection of the two indifference curves at I are linear in β as well. In particular, at I we find $\alpha = \gamma = 0.663037\beta$.

duction of tradable retaliatory rights. As of today, tradable retaliation is fiction. So suppose for a moment, our model was set up in today's dispute settlement reality, that is, $\alpha_{IA}(\beta, \gamma)$ would solely determine whether B offended or not if we do not allow for the possibility of side payments between A and B . In terms of Figure 4.2 this would mean that the whole parameter space that stretches out to the west of $\alpha_{IA}(\beta, \gamma)$ contained offensive equilibria. Returning to fiction, we observe that this set of offensive equilibria is considerably reduced as the retaliatory right is allocated to the most powerful country and $\gamma_{IC}(\alpha, \beta)$ comes into operation. Note that the ability of tradable retaliation to improve a potential offender's compliance is most powerful when the victim is a small country. To see this, consider that the comparative static improvement of compliance works whenever $\alpha < \gamma$ and that even within this area the set of offensive equilibria, which disappears due to the introduction of tradable retaliation, is largest for small α .

Including the Offender

In this subsection we show how equilibrium behavior changes when the offending country B is allowed to buy the retaliatory right. We distinguish between two scenarios, the first one uses the assumption that A and C cannot influence each other's decision by side payments. In the second scenario we relax this assumption.

The Case without Side Payments between Country A and C

If there are no side payments between country A and C , country B 's successful bid will have to be higher than the larger country's welfare gain from retaliation. Hence, B has to decide whether or not it is profitable to reap the gain from its initial offense in sector a at the price of paying another country at least the welfare gain forgone from retaliation in sector b . Another way of asking the same question would be whether or not B 's welfare gain from playing τ_{Ba}^* is at least larger than the maximum of A 's and C 's welfare gain from playing τ_{Ab}^* or τ_{Cb}^* respectively. Since markets for good a and good b are symmetric but separated from each other, the larger

country always has the larger welfare gain from playing its welfare maximizing tariff. Thus, under the additional assumption that B has maximum bargaining power, we obtain the next proposition.

Proposition 4.2. *If country B is allowed to bid, has maximum bargaining power and side payments between country A and C are not allowed, country B will commit an offense against country A if and only if $\beta > \max(\alpha, \gamma)$.*

However, while $\beta > \max(\alpha, \gamma)$ constitutes a necessary condition for observing an offense of B for any assumption on the distribution of bargaining powers, it only constitutes a sufficient condition if B has maximum bargaining power. To understand this, consider that, due to the deadweight loss, B 's valuation of the right is strictly higher than A 's or C 's valuation. Hence, the price π_{nsp} for which B buys the right must lie between the high price

$$\bar{\pi}_{nsp} := V_B|_{\tau_{Ba}^*} - \min\{V_B|_{\tau_{Ab}^*, \tau_{Ba}^*}, V_B|_{\tau_{Ba}^*, \tau_{Cb}^*}\}, \quad (4.34)$$

which extracts B 's valuations completely and the low price

$$\underline{\pi}_{nsp} := \max\{V_A|_{\tau_{Ab}^*, \tau_{Ba}^*} - V_A|_{\tau_{Ba}^*}, V_C|_{\tau_{Ba}^*, \tau_{Cb}^*} - V_C|_{\tau_{Ba}^*}\}, \quad (4.35)$$

which falls short of B 's valuation. Note that $\bar{\pi}_{nsp}$ is just the welfare loss that B would suffer, if retaliation was actually carried out. So if B 's bargaining power is at its minimum such that $\bar{\pi}_{nsp}$ is realized, B 's indifference curves $\alpha_{IA}^{nsp}(\beta, \gamma, \bar{\pi}_{nsp})$ and $\gamma_{IC}^{nsp}(\alpha, \beta, \bar{\pi}_{nsp})$ coincide with the ones of the former regime where B is excluded from the negotiations, i.e. with $\alpha_{IA}(\beta, \gamma)$ and $\gamma_{IC}(\alpha, \beta)$.

Finally, note that Proposition 4.2 implies that B 's indifference curves are independent of α for all $\alpha < \gamma$ and independent of γ for all $\alpha > \gamma$ if and only if B has high bargaining power such that $\bar{\pi}_{nsp}$ is realized. If, to the contrary, B has lower bargaining power, a convex combination of $\bar{\pi}_{nsp}$ and $\underline{\pi}_{nsp}$ is realized, so that the indifference curves are dependent upon all three country size parameters, just as under the regime where B is excluded.

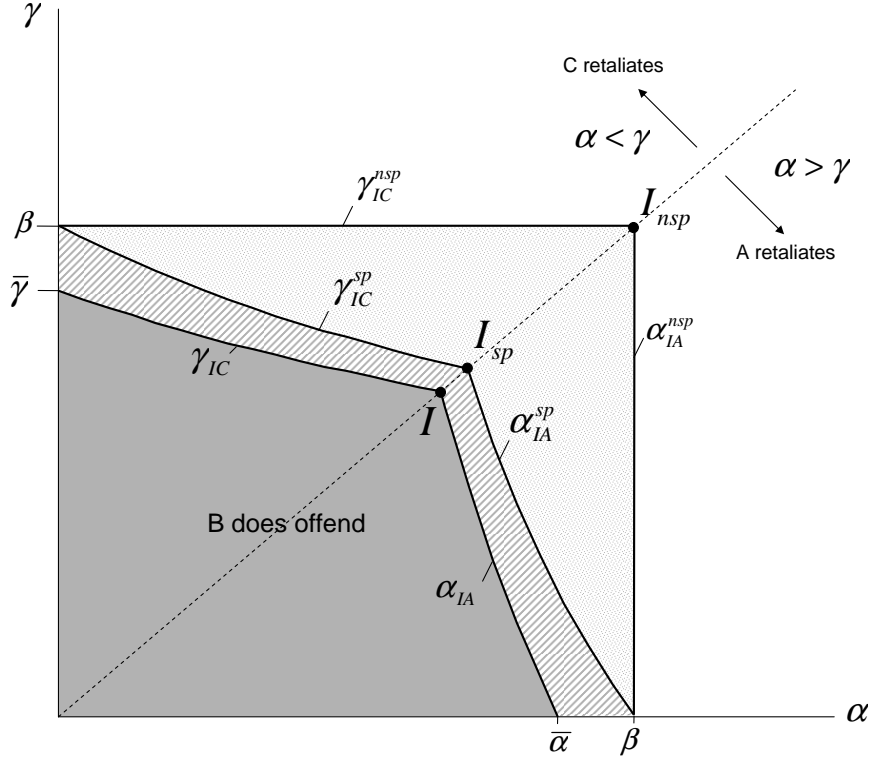
Allowing for Side Payments between Country A and C

If we include the possibility of side payments between A and C , then, even for high bargaining power of B , the price π_{sp} is dependent on the size of both country A and country C . To see this, suppose for the moment that α was larger than γ , so that A and C agree that A should execute retaliation rather than C . Then country C has a positive valuation for its gain from the reduced world market price of good b . In other words, C would want to bribe A in order to prevent A from selling the retaliatory right to B . As a consequence, B will have to afford a price that is higher than the price in the previous scenario without side payments. Thus, the successful bid of B has to be at least as high as the sum of both A 's welfare gain from retaliation and C 's welfare gain from freeriding on the lower world market price of good b . From Lemma 4.1 we know that there exists a range of prices that are smaller than B 's valuation and larger than the sum of A 's and C 's valuation. Which price in this range will actually be realized depends again upon the parties' bargaining power. In the following, we just show the two extremes being (i) a high price, $\bar{\pi}_{sp}$, equal to B 's valuation and (ii) a low price, $\underline{\pi}_{sp}$, equal to the sum of A 's and C 's valuation.

First, assume for the moment, B had minimum bargaining power such that $\bar{\pi}_{sp}$ is in place. Then, the price that B would have to pay for its initial offense would be its full valuation of the retaliatory right. But that is exactly as much as B would lose if it would not buy the retaliatory right but rather suffer from executed retaliation. Hence, B 's indifference curves in the high price scenario, $\alpha_{IA}^{sp}(\beta, \gamma, \bar{\pi}_{sp})$ and $\gamma_{IC}^{sp}(\alpha, \beta, \bar{\pi}_{sp})$, coincide with its indifference curves when B is foreclosed from bidding, i.e. with $\alpha_{IA}(\beta, \gamma)$ and $\gamma_{IC}(\alpha, \beta)$ respectively.

Now assume to the contrary that B had maximum bargaining power, so that the low price, $\underline{\pi}_{sp}$, was in place. Then B , would realize a welfare gain as compared to the afore analyzed high price scenario. Consequently, B 's indifference curves $\alpha_{IA}^{sp}(\beta, \gamma, \underline{\pi}_{sp})$ and $\gamma_{IC}^{sp}(\alpha, \beta, \underline{\pi}_{sp})$ would be shifted outwards such that offending became profitable for even larger values of α and γ as compared to the high price scenario. It may be summarized that for any given bargaining power distribution, A and C are able to extract more of B 's valuation, thus rendering offenses less

Figure 4.3: Comparison of Equilibria



profitable for B , if they coordinate their interests by means of side payments as compared to the case without side payments.

Comparison of Equilibria

The different assumptions on whether or not the offender may buy the right, whether or not side payments between A and C may occur, and whether the offender has high or low bargaining power entail different enforcement levels of the trade agreement. Consider Figure 4.3, which displays the offensive regions under each of these regimes. The dark grey area, which is bordered by $\alpha_{IA}(\beta, \gamma)$ and $\gamma_{IC}(\alpha, \beta)$, displays the offensive regions under the regime where the offender is excluded. Moreover, this region coincides with the offensive region under any regime with the offender included, when the latter's bargaining power is at its minimum. That is, $\alpha_{IA}(\beta, \gamma) = \alpha_{IA}^{sp}(\beta, \gamma, \bar{\pi}_{sp}) = \alpha_{IA}^{nsp}(\beta, \gamma, \bar{\pi}_{nsp})$ and $\gamma_{IC}(\alpha, \beta) = \gamma_{IC}^{sp}(\alpha, \beta, \bar{\pi}_{sp}) = \gamma_{IC}^{nsp}(\alpha, \beta, \bar{\pi}_{nsp})$.

However, this coincidence disappears as soon as we depart from the assumption of minimum bargaining power for the offender. In line with intuition, compliance worsens and the offensive region expands as the offender's bargaining power becomes greater. This expansion is largest under the assumption that A and C may not contract on side payments among each other. Under this assumption an offense is profitable as soon as the offender is just an increment larger than the retaliating country. Hence, we observe that the whole rectangular area to the southwest of γ_{IC}^{nsp} and α_{IA}^{nsp} constitutes an offensive equilibrium for $\pi_{nsp} = \underline{\pi}_{nsp}$. If we allow A and C to contract on side payments, B will have to afford a higher price, even when its bargaining power is at its maximum. As a consequence, the offensive area has to be smaller than in the case without side payments but larger than in the case where B is excluded (or has minimum bargaining power). Thus we observe that the region to the southwest of γ_{IC}^{sp} and α_{IA}^{sp} constitutes an offensive equilibrium for $\pi_{sp} = \underline{\pi}_{sp}$.

4.4 Discussion

The analysis of our model unambiguously suggests that compliance with the rules of the WTO will be improved by the introduction of tradable retaliation when the offender is not allowed to buy the retaliatory right. In line with intuition, we find that the compliance improvement comes to play whenever a third country, C , is larger than the victim of the initial offense. Furthermore, we find that the compliance improvement in this regime coincides with the one under any regime in which the offender is allowed to buy the right but has minimum bargaining power.

However, the assumption that the country which is targeted by the retaliatory right is unable to influence the decision of the owner of the right seems somewhat artificial. Even if it were formally prohibited that the right was bought by the targeted country, the latter would still be able to embark on private negotiations with the owner of the right. Thus, due to the deadweight loss in our model, retaliation would never be carried out, but the targeted country would rather pay the owner of the right to annul it, both in a world with and without tradable retaliation. In light of these considerations we would be talking about a reallocation of threat points due to

the introduction of tradable retaliation.

If one adopted this view, then even in those regimes where the offender is allowed to buy and has high bargaining power, we still would observe an improvement of compliance as compared to a status quo situation without tradable retaliation rights but with the possibility of transfer payments between the offender and the owner of the right.

Moreover, maintaining the threat point view, we are able to state that global welfare would improve under any regime of tradable retaliation since we would observe less initial offenses while retaliation simply would not occur.

Chapter 5

Conclusion

5.1 Summary of Results

In Chapter 2 a new approach, based on a statistical selection criterion and a comprehensive data set, has been employed to investigate whether the usage of the DSS exhibits a bias against smaller and poorer countries. Indeed, this method is able to detect such a bias. This result parallels the empirical finding of Bown (2005) while it is contradictory to the conclusions that are drawn by Horn et al. (1999) and Guzman and Simmons (2005) from their empirical results.

In Chapter 3 the comparative static analysis of a reduction in litigation costs has highlighted a potential disadvantage of this measure. While less powerful countries' compliance is improved, some more powerful countries commit even more severe offenses than before. In particular, it has been shown that if and only if the threat of the victim's retaliation is greater than the offender's gain from an offense, a reduction in litigation costs can render the implementation of retaliation profitable for the victim, and henceforth compliance can be improved. If, on the other hand, the threat of the victim's retaliation is sufficiently small in comparison to the offender's gain from an offense, then a reduction in litigation costs may lead countries to switch from minor offenses to major offenses. This result underpins the insight that if one takes the rules of the DSS at face value and leaves aside goodwill or reputational concerns, the WTO is a system of bilateral trade

relations, where - in each of these pairings - each trading partner's individual economic power determines its threat point towards the other one. While the reduction of litigation costs does improve a country's incentive to file a complaint, it does not change the threat that emerges from a particular country's retaliation. Hence, the measure is unable to level out existing power imbalances.

This insight is at the heart of the Mexican proposal of tradable retaliation, which has been explored in Chapter 4. Once retaliation is allowed to be traded, the threat that is posed to the offender is no longer solely dependent upon the victim's retaliatory capacity. The model shows that whenever there is a country that can utilize the retaliatory right more effectively against the offender than the victim could, the threat of retaliation is improved as compared to the status quo. Moreover, due to the deadweight loss property of the model, the offender has the highest valuation of the right so that he will obtain and retire the right whenever he is allowed to buy it.

5.2 Policy Implications

Given that there is evidence of a power-induced bias in the usage of the DSS,¹ it remains to be questioned whether this observation alone gives cause for concern.

From a normative perspective and in the light of the one-member-one-vote representational concept of the WTO, one may be concerned by the insight that the current system favors economically more powerful countries. However, as compared to a status of anarchy, where each country sets its optimal tariff, the current system of costly and regulated retaliation actually protects less powerful countries from more severe offenses of their more powerful trading partners. At the same time, costly and regulated retaliation creates leeway for less powerful countries to reap some gains from committing minor offenses against their more powerful trading partners without facing the latter's retaliation. That is, from a normative perspective, a reduction of

¹Empirical evidence in support of a power-induced bias is provided by Bown (2005), Allee (2008), and Chapter 2 of this dissertation.

litigation costs would be an undesirable measure since it would bring the system closer to the status of anarchy, thus it would even amplify the WTO members' potential to exploit existing power imbalances.

As modeled in Chapter 3, a reduction of litigation costs has an ambiguous effect on global welfare. That is while a cost reduction triggers more major offenses and more retaliation, it reduces the magnitude of the remaining minor offenses. The first two effects reduce global welfare while the latter effect increases global welfare. Whether the increasing or the decreasing effects dominate, depends upon the distribution of the country specific parameter (e.g. the political economy parameter or the population size parameter). If the vast majority of countries exhibited a sufficiently similar country specific parameter, such that most bilateral parameter ratios were close to unity, major offenses would never be profitable for these countries. Hence, a reduction in litigation costs would mitigate the intensity of many minor offenses, while it would lead only those few countries that exhibit a sufficiently higher parameter to committing major offenses. Thus, global welfare would be improved. On the other hand, if the parameter was distributed rather unevenly across countries, the welfare reducing increase in major offenses and associated retaliation would be the dominating effect.

To conclude, the proposal of a reduction of litigation costs reveals serious flaws, regardless of whether it is evaluated from a normative perspective or a perspective of global efficiency, although the question of how to accomplish the cost reduction in the first place has not been addressed at all.

As modeled in Chapter 4, the Mexican proposal of tradable retaliation has been found to mitigate power imbalances whenever a third country values retaliation more than the victim of the offense does. Thus, from a normative perspective, the introduction of tradable retaliation succeeds in improving compliance with trade agreements that have been made with less powerful countries. Even in those cases where the threat of retaliation is not sufficiently high in order to induce compliance, the victim is able to extract a greater monetary compensation by selling the retaliatory right. Moreover, even if the offender buys the right from the victim, the sales

revenue that accrues to the victim is higher, the higher is any third country's valuation of the right. Hence, whether or not an increase in the retaliatory threat succeeds in deterring an offense, the victim is strictly better off as compared to a system without tradable retaliation whenever there is any other country that can use the retaliatory right more effectively.

Furthermore, global efficiency is unambiguously increased if the offender is allowed to buy the retaliatory right because retaliation would never be carried out while less offenses, as compared to the status quo, would occur.

Another merit of allowing the offender to buy the retaliatory right is that some countries tend to restrict or discriminate against certain imports not because of an optimal tariff or political economy incentive, but rather because of certain domestic legal provisions or customers' preferences. Examples of such cases are the import restrictions of particular EC member states targeting genetically modified food and agricultural products from the US and Canada, that surfaced in the records of the WTO (2008) as DS291, DS292, and DS293. In another dispute (DS26) the EC imposed import restrictions on meat from cattle, originating from the US, that has been treated with hormones.² Both of these import restrictions have been found to constitute an infringement of the WTO's rules. From an efficiency oriented perspective it would be desirable to implement a system of tradable retaliation that allowed countries with special (offending) preferences to live up to these without automatically triggering (welfare reducing) retaliation. Allowing the offender to take the retaliatory right against him from the market, is nothing else than asking him to pay for his preference.

All in all, the system of tradable retaliation in which the offender is allowed to buy the retaliatory right leads to an increase in global welfare while it gives leeway for certain domestic preferences and provisions.

However, when asking for the perspective that this proposal will ever be implemented, one has to keep in mind that the introduction of tradable retaliation does not lead to a pareto welfare improvement. While the less powerful countries benefit from higher compensation revenues and

²The files of the dispute DS26 are available in WTO (2008a).

less offenses, the more powerful countries lose part of their ability to cash in on their power.

5.3 Future Research

Two avenues for further research come to mind.

First, the analysis of trade agreements and various policy proposals by experimental techniques may help to verify the validity of the assumptions that are employed in theory. Usually there is an array of assumptions, typically including rational behavior and perfect information, that is at the heart of each theoretical study that seeks to explore the economics of tariff wars and the enforcement of trade agreements. However, in reality it may as well be the case that e.g. informational asymmetry has created a dispute that surfaced in the record of the WTO, which would not have turned out to become a dispute under perfect information. Even a country's costly strategy to build a reputation as a tough complainant may be a best response under asymmetric information in a repeated game framework. As of today, each "plausible" assumption is equally justifiable since it is not possible to verify how well an assumption captures the real environment. If data on test persons' behavior were generated, economic theory may learn about the performance of its models and consequently about the plausibility of the underlying assumptions.

Second, in order to provide any political decision maker with a ready-to-use policy suggestion, implementation issues have to be included in the analysis. That is, theoretical research has to go one step further and address the question of how those desirable policy measures that increase global welfare but do not lead to a pareto welfare improvement can be implemented.

Appendix A

Appendix to Chapter 2

A.1 Proof of Proposition 2.1

Proof of Proposition 2.1: Potential Nash equilibria (PNE) including “complain” are:

$$\text{PNE1} = \{(\text{complain}|\text{don't retaliate}), (\text{don't comply})\}$$

$$\text{PNE2} = \{(\text{complain}|\text{don't retaliate}), (\text{comply})\}$$

$$\text{PNE3} = \{(\text{complain}|\text{retaliate}), (\text{don't comply})\}$$

$$\text{PNE4} = \{(\text{complain}|\text{retaliate}), (\text{comply})\}$$

PNE1 does not constitute an equilibrium since complaining and not retaliating is strictly worse than not complaining when the offender plays “don’t comply”.

PNE2 does not constitute an equilibrium since “comply” is not a best response to “don’t retaliate”.

PNE3 constitutes a Nash equilibrium iff $\Pi > R_O \wedge R_V > C$.

PNE4 constitutes a Nash equilibrium iff $\Pi \leq R_O \wedge D > C$. □

A.2 Included Disputes

The following list of numbers refers to the numbers of the disputes as filed in the records of the WTO.

1, 2, 3, 4, 6, 7, 8, 10, 11, 12, 13, 14, 16, 17, 18, 19, 21, 23, 24, 25, 26, 27, 29, 31, 34, 41, 44, 48, 49, 52, 54, 55, 56, 58, 60, 62, 63, 64, 65, 66, 67, 68, 72, 74, 75, 76, 77, 78, 81, 84, 85, 87, 89, 97, 98, 99, 101, 102, 105, 109, 110, 112, 119, 121, 122, 123, 132, 134, 137, 138, 140, 141, 142, 143, 144, 145, 146, 147, 148, 151, 154, 155, 156, 157, 158, 159, 161, 164, 165, 166, 167, 169, 175, 177, 178, 179, 180, 181, 182, 184, 185, 187, 189, 191, 195, 202, 203, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 218, 219, 223, 225, 226, 227, 229, 230, 231, 233, 235, 236, 238, 240, 241, 243, 244, 245, 247, 250, 255, 256, 257, 260, 262, 263, 264, 269, 270, 271, 272, 276, 277, 278, 280, 281, 286, 287, 288, 295, 296, 297, 299, 300, 302, 303, 305, 306, 308, 309, 310, 311, 312, 313, 314, 319, 323, 326, 327, 328, 329, 330, 332, 333, 334, 335

A.3 Consequences of Erroneous Selection of Victims

The decision rule on the selection of injured countries, which is stated in Assumption 2 focusses on maintaining a low alpha error, i.e. on maintaining a low probability for the erroneous judgement of an injured country as being a non-injured country. Clearly this is done at the cost of a high beta error, which is the probability of erroneously judging a non-injured country as being injured. Hence, the population of victims used for the regression is likely to contain a significant share of countries that did not suffer from the disputable trade measure although these WTO members shipped the particular commodity to the offender. In order to get an idea about the consequences for the regression, it is useful to consider the distributional properties of the regressors that are used in the probit model (i.e. DTV , GDP_O , GDP_V , $GDPPC_V$, X_{OV}). The following Table A.1 shows that these variables do not differ much between the subsample of injured non-complaining countries on the one hand and the subsample of non-injured non-

complaining countries on the other hand. Tests for common means of these variables accept

Subsample Variable \ Variate	injured countries		non-injured countries	
	mean	std. dev.	mean	std. dev.
<i>DTV</i>	726,412,476	2,435,306,156	281,106,763	1,307,548,531
<i>GDP_O</i>	6.61624E+12	3.49599E+12	6.36563E+12	3.89354E+12
<i>GDP_V</i>	1.78587E+12	3.05519E+12	6.08896E+11	1.74028E+12
<i>GDP_{PCV}</i>	11,600	11,922	11,782	11,505
<i>X_{OV}</i>	26,907,460,940	46,921,528,954	11,811,431,088	28,543,606,898

Table A.1: Consequences of Erroneous Selection of Victims

the null hypothesis of a common mean on a 1% level. So it may be conjectured that there is no systematic difference between injured and non-injured countries in the regressors, given a country does not complain. Consequently, favoring a low alpha error while taking into account a higher beta error, does not provoke a significant selection bias.

A.4 Robustness to Specification in Logarithms

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
<i>C</i>	-3.159760***	-2.0897*	1.1998	-3.3650	-3.3622
$\log(GDP_O)$	-0.1590***	-0.2005***	-0.2220***	-0.2188***	-0.2193***
$\log(GDP_V)$	0.1687***	0.1302***	0.1296***	0.1841***	0.1841***
$\log(DTV)$	0.1127***	0.1056***	0.1063***	0.1053***	0.1053***
$\log(X_{OV})$		0.0568*	0.0792**	0.0840***	0.0839***
$\log(EF_V)$			-0.7554***	0.3798	0.3798
$\log(GDP_{PCV})$				-0.2054***	-0.2054***
$\log(GDP_{PCO})$					0.0010
McFadden R^2	0.1813	0.1836	0.1887	0.1965	0.1965
Akaike	0.4635	0.4631	0.4610	0.4575	0.4583
Schwarz	0.4731	0.4751	0.4755	0.4743	0.4775
Hannan-Quinn	0.4670	0.4675	0.4663	0.4636	0.4653

Table A.2: Probit Results for the Augmented Model in Logs with Constant under $\Phi_4^{cut}(0.05)$

A.5 Robustness to Sample Selection Criteria

Variable\Criterion	$\Phi_4^{cut}(0.05)$	$\Phi_4^{cut}(0.1)$	$\Phi_3^{cut}(0.05)$	$\Phi_3^{cut}(0.1)$
$\log(GDP_O)$	-0.2553***	-0.2545***	-0.2596***	-0.2587***
$\log(GDP_V)$	0.0804***	0.0802***	0.0790***	0.0803***
$\log(DTV)$	0.1078***	0.1071***	0.1090***	0.1087***
$\log(X_{OV})$	0.0910***	0.0913***	0.0962***	0.0945***
Akaike	0.4638	0.4743	0.4353	0.4465
Schwarz	0.4734	0.4841	0.4443	0.4558
Hannan-Quinn	0.4673	0.4779	0.4386	0.4499
Observations	2,409	2,338	2,599	2,506

Table A.3: Probit Results for Logarithmic Data under Various Sample Selection Criteria

Appendix B

Appendix to Chapter 3

B.1 Properties of the Aggregated Welfare Functions

To show that a country's welfare is concave in its own tariff it has to hold that:

(i)

$$\frac{\partial V(\tau, \tau^*, n)}{\partial \tau} > 0 \Leftrightarrow \frac{n(n - 4\tau - 4n\tau)}{(2 + n)^2} > 0$$

This condition is satisfied if the numerator is positive (i.e. if $n(n - 4\tau - 4n\tau) > 0$ holds). Solving this expression for τ yields $\tau < \frac{n}{4+4n}$, which is Home's optimal tariff τ_o .

(ii)

$$\frac{\partial^2 V(\tau, \tau^*, n)}{\partial^2 \tau} < 0 \Leftrightarrow -\frac{4n(1 + n)}{(2 + n)^2} < 0$$

This condition is always satisfied.

A country's welfare is decreasing in the other country's tariff if it holds that:

$$\frac{\partial V(\tau, \tau^*, n)}{\partial \tau^*} < 0 \Leftrightarrow \frac{2\tau^* - 1}{9} < 0$$

This condition is satisfied if it holds that $\tau^* < \frac{1}{2}$, where $\frac{1}{2}$ is the prohibitive level of τ^* , meaning that the traded amount of good y would equal zero under such a high tariff.

B.2 Properties of the Lower Switching Point $n_{oi}(c)$

$n_{oi}(c)$ is the country size ratio where the first mover switches from playing $\tau_o(n)$ to playing $\tau_i(c, n)$. It is found by setting them equal to each other and solving for n . The polynomial has only one positive real root. It takes on the value 1 for $c = \bar{c}$ and the value 0 for $c = \underline{c}$. The local Taylor approximation of $n_{oi}(c)$ at a particular value of c , with $c \in [\underline{c}, \bar{c})$, is strictly increasing in c . In other words, locally (for $n \in [0, 1)$ and $c \in [\underline{c}, \bar{c})$) it holds that $\frac{\partial n_{oi}(c)}{\partial c} > 0$.

B.3 Properties of $\tau_{\S}(n)$ and Proof of Lemma 3.4

Proof of Lemma 3.4: Aggregated welfare at Home in case of a major offense is given by:

$$V(\tau, n) = V(\tau, \min\{\tau_{eq}^*(\tau, n), \tau_o^*\}, n)$$

For the cases where the level of authorized retaliation has already reached τ_o^* , the maximization of $V(\tau, n)$ yields again Home's optimal tariff $\tau_o(n)$ since τ_o^* is independent of τ . Therefore the optimal tariff remains unchanged, while welfare at Home is reduced by a fixed amount.

For the case of flexible retaliation (i.e. $\tau_{eq}^*(\tau, n) \leq \tau_o^*$) Home's welfare from a major offense is:

$$V(\tau, n) = \frac{140 + 176n + 35n^2}{72(2+n)^2} - \frac{72n(2+n)\tau^2 - 3(2+n)(12n\tau + \sqrt{25(2+n)^2 - 72n(2+3n)\tau + 144n^2\tau^2})}{72(2+n)^2}$$

Taking the first derivative of $V(\tau, n)$ w.r.t. τ yields:

$$\frac{\partial V(\tau, n)}{\partial \tau} = \frac{3n((2+3n) - 4n\tau)}{2(2+n)\sqrt{25(2+n)^2 - 72n(2+3n)\tau + 144n^2\tau^2}} - \frac{n(1+4\tau)\sqrt{25(2+n)^2 - 72n(2+3n)\tau + 144n^2\tau^2}}{2(2+n)\sqrt{25(2+n)^2 - 72n(2+3n)\tau + 144n^2\tau^2}}$$

Setting this expression equal to zero and solving for τ yields a polynomial of degree eight in n . After having applied a Taylor Series expansion of degree four around the value $n = 1$, the approximation of $\tau_{\S}(n)$ is given by $\tau_{\S}(n) = \frac{(n-1)}{15} - \frac{17(n-1)^2}{1125} + \frac{817(n-1)^3}{84375} - \frac{1679(n-1)^4}{421875}$. The positive real roots of the polynomial are $n_1 = 1$ and $n_2 = 4.01578$. Obviously it holds that $\tau_{\S}(n) = 0$ at $n = 1$.

$\frac{\partial \tau_{\S}(n)}{\partial n}$ is positive at $n_1 = 1$ and negative at $n_2 = 4.01578$. This means that $\tau_{\S}(n)$ is crossing the zero line from below at $n_1 = 1$ and from above at $n_2 = 4.01578$. Hence $\tau_{\S}(n)$ must be positive between unity and n_2 and negative for values of n which are either smaller than unity or larger than n_2 . Thus, Home prefers not to commit any major offense for all $n \leq 1$. \square

B.4 Identifying the Area where $V_{\S}(n)$ is preferred

First note that it has been shown in Appendix B.3 that $\tau_{\S}(n)$ will never be played if $n \leq 1$. Consequently the following proof can be restricted to the set of $n \in (1, 4.01578)$.

The country size at the intersection of $V_{\S}(n)$ and $V_o(n)$ is found by subtracting $V_{\S}(n)$ from $V_o(n)$, setting this difference equal to zero and solving for n . Since $V_{\S}(n)$, and consequently the difference between the two welfare functions, is a polynomial of degree eight, the regula falsi method is employed to find the real and positive root of this expression.

At the fixed point of $n = 1.40231$, $V_{\S}(n)$ and $V_o(n)$ intersect. Since $\frac{\partial V_o(n)}{\partial n} > \frac{\partial V_{\S}(n)}{\partial n}$ holds locally at $n = 1.40231$, welfare from $V_{\S}(n)$ will be higher (lower) than welfare from $V_o(n)$ iff $n < 1.40231$ ($n > 1.40231$) holds. Therefore, a necessary and sufficient condition for the first

mover to prefer playing $\tau_{\S}(n)$ over $\tau_o(n)$ is that $1 < n < 1.40231$ holds.

Given this necessary and sufficient condition holds, it still depends on the actual level of costs whether Home prefers to play $\tau_{\S}(n)$ or $\tau_i(c, n)$ in this interval. The intersection of $V_{\S}(n)$ and $V_i(c, n)$ at the point where $n = 1.40231$ can be solved for a cost level of $c = 0.03086\bar{c}$. Speaking graphically with regard to Figure 3.3, litigation costs have to be lower than $0.03086\bar{c}$ to shift the $V_i(c, n)$ -curve so much downward that its intercept with the $V_{\S}(n)$ -curve lies in the interval of $1 < n < 1.40231$. Therefore, a necessary condition for the first mover to prefer playing $\tau_{\S}(n)$ over $\tau_i(c, n)$ is $c \in [\underline{c}, 0.03086\bar{c})$.

B.5 Proof of Proposition 3.1

Proof of Proposition 3.1: Let $n_{io}(c)$ denote the market size ratio where the first mover switches from playing $\tau_i(c, n)$ to playing $\tau_o(n)$. Hence it is the intersection of $V_o(n)$ and $V_i(c, n)$ in the n - V -space, where $V_i(c, n)$ crosses $V_o(n)$ from above (You may want to consider Figure 3.3.). It is found by setting the two corresponding welfare functions equal to each other and solving for n :¹

$$V_o(n) = V_i(c, n)$$

\Leftrightarrow

$$\frac{(17+25n)}{64(1+n)} = \frac{1}{18} \left(5 + \frac{1}{4(2+n)^2} (3(-12 - 6n + \sqrt{\alpha})(1 + \frac{1}{12n}((1+n)(12 + 18n - \sqrt{\alpha})))) \right)$$

The resulting polynomial has eight roots in n , meaning that there are eight intersections of $V_o(n)$ and $V_i(c, n)$. Four of them are complex, and four are real. The only root that is positive and real for $n > 1$ (Two other real roots are globally negative. Another real root is positive, but globally smaller than unity.²) is therefore $n_{io}(c)$. It takes on the value 2.46187 at \bar{c} and the value 1.38504 at \underline{c} . The local Taylor approximation of $n_{io}(c)$ at a particular value of c , with $c \in [\underline{c}, \bar{c})$, is strictly increasing in c . In other words, locally (for $n \in (1.38504, 2.46187)$ and $c \in [\underline{c}, \bar{c})$) it

¹Where $\alpha = 18(4 + n(20 + 17n)) + 18(2 + n)^2\sqrt{1 - 144c} - (2 + n)^2144c$.

²This positive real root, being smaller than unity, coincides with the lower switching point $n_{oi}(c)$. This is due to the fact that welfare from both playing $\tau_o(n)$ and playing $\tau_i(c, n)$ always has to coincide in $n_{oi}(c)$ because the associated tariffs themselves are identical, and both do not trigger any retaliation at $n_{oi}(c)$.

holds that $\frac{\partial n_{io}(c)}{\partial c} > 0$. □

B.6 Properties of $V_o(n)$

Substituting Home's optimal tariff into its welfare function yields:

$$V_o(n) := V(\tau_o(n), \tau_o^*, n)$$

In explicit terms the function reads:

$$V_o(n) = \frac{17 + 25n}{64 + 64n}$$

The first and second derivatives w.r.t. n are given by:

$$\frac{\partial V_o(n)}{\partial n} = \frac{1}{8(1+n)^2}, \quad \frac{\partial^2 V_o(n)}{\partial^2 n} = -\frac{1}{4(1+n)^2}$$

B.7 Proof of Proposition 3.2

Proof of Proposition 3.2: Let $n_{io}(n_p)$ denote the country size ratio, where the first mover switches from playing $\tau_i(n_p, n)$ to playing $\tau_o(n)$. Hence $n_{io}(n_p)$ is the equation for the value of n at the intersection of $V_o(n) := V(\tau_o(n), \tau_o^*(n), n)$ and $V_i(n_p, n) := V(\tau_i(n_p, n), 0, n)$ as a function of n_p .

This function is found by setting $V_o(n)$ equal to $V_i(n_p, n)$ and solving for n :³

$$V_o(n) = V_i(n_p, n)$$

⇔

$$\frac{4+45n+30n^2+5n^3}{8(1+n)(3+n)^2} = \frac{1}{2(2+n)^2} \left(1 + 4n + n^2 + \frac{n((3+n)(2+3n)-\beta)}{2(3+n)} - \frac{(1+n)((3+n)(2+3n)-\beta)^2}{4n(3+n)^2} \right)$$

For the case of prohibitive costs (i.e. $n_p = n$), it holds that $n_{io}(n_p) = 1.60254$. Hence any Home country of larger size than 1.60254 would play $\tau_o(n)$. In the other extreme case of no litigation

³Where $\beta = \sqrt{4 + n(100 + n(149 + 66n + 9n^2)) - \frac{8(2+n)^2(3+n)}{(2+n_p)^2(3+4n_p+n_p^2)} + 8(2+n)^2 \sqrt{1 - \frac{(1+n)(2+n)^2(3+n)}{(2+n_p)^2(3+4n_p+n_p^2)}}$.

costs (i.e. $n_p \rightarrow \infty$), $n_{io}(n_p)$ converges to 1.21280. Between these boundaries, the local Taylor approximation of $n_{io}(n_p)$ exhibits the following properties:

1. $\frac{\partial n_{io}(n_p)}{\partial n_p} > 0$ for all $n > 1.52790$
2. $\frac{\partial n_{io}(n_p)}{\partial n_p} = 0$ for all $n = 1.52790$
3. $\frac{\partial n_{io}(n_p)}{\partial n_p} < 0$ for all $n < 1.52790$

□

B.8 Proof of Proposition 3.3

Proof of Proposition 3.3: (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 3.5, 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 .

□

Appendix C

Appendix to Chapter 4

C.1 Proof of Lemma 4.3

Proof of Lemma 4.3: (i) Utility is separable in goods. Therefore the gain from retaliating and freeriding can be analyzed without considering the initial offence, that is

$$V_A|_{\tau_{Ab}^*, \tau_{Ba}^*} - V_A|_{\tau_{Ba}^*} = V_A|_{\tau_{Ab}^*} - V_A|_0 \quad (\text{C.1})$$

and

$$V_A|_{\tau_{Ba}^*, \tau_{Cb}^*} - V_A|_{\tau_{Ba}^*} = V_A|_{\tau_{Cb}^*} - V_A|_0. \quad (\text{C.2})$$

Hence

$$wp_A = V_A|_{\tau_{Ab}^*, \tau_{Ba}^*} - V_A|_{\tau_{Ba}^*, \tau_{Cb}^*} = V_A|_{\tau_{Ab}^*} - V_A|_{\tau_{Cb}^*}, \quad (\text{C.3})$$

which equals wp_C if $\alpha = \gamma$.

(ii) Let $\alpha > \gamma$. We have

$$\Delta wp = V_A|_{\tau_{Ab}^*} - V_A|_{\tau_{Cb}^*} - (V_C|_{\tau_{Cb}^*} - V_C|_{\tau_{Ab}^*}) \quad (\text{C.4})$$

$$= V_A|_{\tau_{Ab}^*} - V_C|_{\tau_{Cb}^*} - (V_A|_{\tau_{Cb}^*} - V_C|_{\tau_{Ab}^*}) \quad (\text{C.5})$$

$$= V_A|_{\tau_{Ab}^*} - V_A|_0 - (V_C|_{\tau_{Cb}^*} - V_C|_0) - (V_A|_{\tau_{Cb}^*} - V_A|_0 - (V_C|_{\tau_{Ab}^*} - V_C|_0)). \quad (\text{C.6})$$

Since $\alpha > \gamma$, A 's demand for good b is more price elastic than C 's demand for good b . Hence A 's welfare gain from setting τ_{Ab}^* is larger than C 's welfare from setting τ_{Cb}^* . Thus, we have $V_A|_{\tau_{Ab}^*} - V_A|_0 - (V_C|_{\tau_{Cb}^*} - V_C|_0) > 0$. From $\alpha > \gamma$ we have $\tau_{Ab}^* > \tau_{Cb}^*$. So the world market price for good b is lower under τ_{Ab}^* than under τ_{Cb}^* . Thus, $V_A|_{\tau_{Cb}^*} - V_A|_0 - (V_C|_{\tau_{Ab}^*} - V_C|_0) < 0$. Consequently, for $\alpha > \gamma$ we get $\Delta wp > 0$ and vice versa. □

C.2 Proof of Lemma 4.4

Proof of Lemma 4.4: Since the utility function is separable in goods we may write

$$\Delta V_B^A = V_B|_{\tau_{Ab}^*, \tau_{Ba}^*} - V_B|_0 \quad (\text{C.7})$$

$$= V_B|_{\tau_{Ab}^*} - V_B|_0 + V_B|_{\tau_{Ba}^*} - V_B|_0. \quad (\text{C.8})$$

(i) Consider $V_B|_{\tau_{Ab}^*} - V_B|_0$, which is B 's welfare loss when A imposes a tariff against B . As α increases, A 's import demand for good b is getting more price elastic. Hence, the share of the deadweight loss, which is associated with the setting of a tariff τ_{Ab} , that A has to bear, decreases while B 's share of the deadweight loss increases. Consequently, we find that $V_B|_{\tau_{Ab}^*} - V_B|_0$ is decreasing in α .

Consider $V_B|_{\tau_{Ba}^*} - V_B|_0$, which is B 's welfare gain from setting a tariff against A . As α increases, A 's export supply of a , which is just the fixed supply S_{Aa} minus domestic demand, is getting more price elastic. This in turn renders worldmarket supply of good a

more price elastic. Hence, the share of the deadweight loss, due to the setting of a tariff τ_{Ba} , that accrues to B increases. Consequently, we find that $V_B|_{\tau_{Ba}^*} - V_B|_0$ is decreasing in α , so ΔV_B^A is decreasing in α .

- (ii) Consider $V_B|_{\tau_{Ab}^*} - V_B|_0$, which is B 's welfare loss when A imposes a tariff against B . As β increases, B 's export supply of good b , which is just the fixed supply S_{Bb} minus domestic demand, is getting more price elastic. This in turn renders worldmarket supply of good b more price elastic. Hence, the share of the deadweight loss, which is associated with the setting of a tariff τ_{Ab} , that B has to bear decreases. Consequently we find that $V_B|_{\tau_{Ab}^*} - V_B|_0$ is increasing in β .

Consider $V_B|_{\tau_{Ba}^*} - V_B|_0$, which is B 's welfare gain from setting a tariff against A . As β increases, B 's import demand for good a is getting more price elastic. Hence, the share of the deadweight loss, due to the setting of a tariff τ_{Ba} , that accrues to B decreases. Consequently we find that $V_B|_{\tau_{Ba}^*} - V_B|_0$ is increasing in β , so ΔV_B^A is increasing in β .

□

C.3 Consequences of Including the WTO's Equivalence Condition

Let the trade value of good b that is imported into country A be denoted by $TV_{Ab} := D_{Ab}\hat{p}_b$, and let the trade value of good a that is imported into country B be denoted by $TV_{Ba} := D_{Ba}\hat{p}_a$. Given an initial free trade agreement let the change in TV_{Ba} due to the setting of a positive import tariff τ_{Ba} be denoted by $\Delta TV_{Ba} := TV_{Ba}|_0 - TV_{Ba}|\tau_{Ba}>0$. The change in TV_{Ab} due to the setting of a positive tariff τ_{Ab} is defined analogously as $\Delta TV_{Ab} := TV_{Ab}|_0 - TV_{Ab}|\tau_{Ab}>0$.

With B as our initial offender, the interpretation of the WTO's equivalence condition by means of a counterfactual trade value model would require that A 's retaliation against B caused a trade value distortion in sector b that must not exceed the initial trade value distortion in

sector a . That is

$$\Delta TV_{Ab} \leq \Delta TV_{Ba}. \quad (\text{C.9})$$

Solving this condition for τ_{Ab} yields τ_{Ab}^{eq} which is A 's tariff that exactly re-balances the trade value distortion according to this interpretation of the equivalence condition.¹

Up to now, B 's best response tariff has been either a tariff of zero or its optimal tariff τ_{Ba}^* . With the introduction of τ_{Ab}^{eq} and τ_{Cb}^{eq} as a restriction on A 's and C 's retaliation, B will take this endogenous reaction into account when choosing its best response. For certain parameter values we find that a third tariff τ_{Ba}^{\S} maximizes B 's welfare.

Let $V_B^{eq} := V_B|_{\tau_{Ab}^{eq}, \tau_{Ba}}$ denote B 's welfare when A 's retaliation is a function of B 's initial offense according WTO's equivalence condition. Then τ_{Ba}^{\S} is the tariff that maximizes V_B^{eq} . Economically, τ_{Ba}^{\S} balances B 's marginal gain from an incremental tariff increase of τ_{Ba} against the marginal loss that is caused via the associated increase of τ_{Ab}^{eq} . Substituting τ_{Ba}^{\S} into V_B^{eq} yields $V_B^{\S} := V_B|_{\tau_{Ab}^{eq}, \tau_{Ba}^{\S}}$, which is B 's maximized welfare from an offense against A , given A retaliates elastically according to the WTO's equivalence condition. In line with economic intuition, we find that the marginal gain from offending is only larger than the marginal loss from retaliation if and only if the offender is larger than the retaliating country. So $\alpha/\beta = 1^2$ constitutes an upper bound to the size ratio between retaliator and offender where τ_{Ba}^{\S} can be a best response. For larger values of α/β , offending is strictly dominated by playing a tariff of zero. Furthermore, for small values of α/β there exists a critical lower bound $\kappa > 0$, which is a function of γ , at which B is indifferent between playing τ_{Ba}^* and τ_{Ba}^{\S} .³

Hence, the inclusion of the equivalence condition affects our results as follows.

- (i) For $\alpha \geq \beta$ the inclusion of the equivalence condition has no effect since playing τ_{Ba}^{\S} is

¹Note that C 's maximum admissible retaliatory tariff τ_{Cb}^{eq} is obtained by similar means.

²In case C retaliates the condition is $\gamma/\beta = 1$

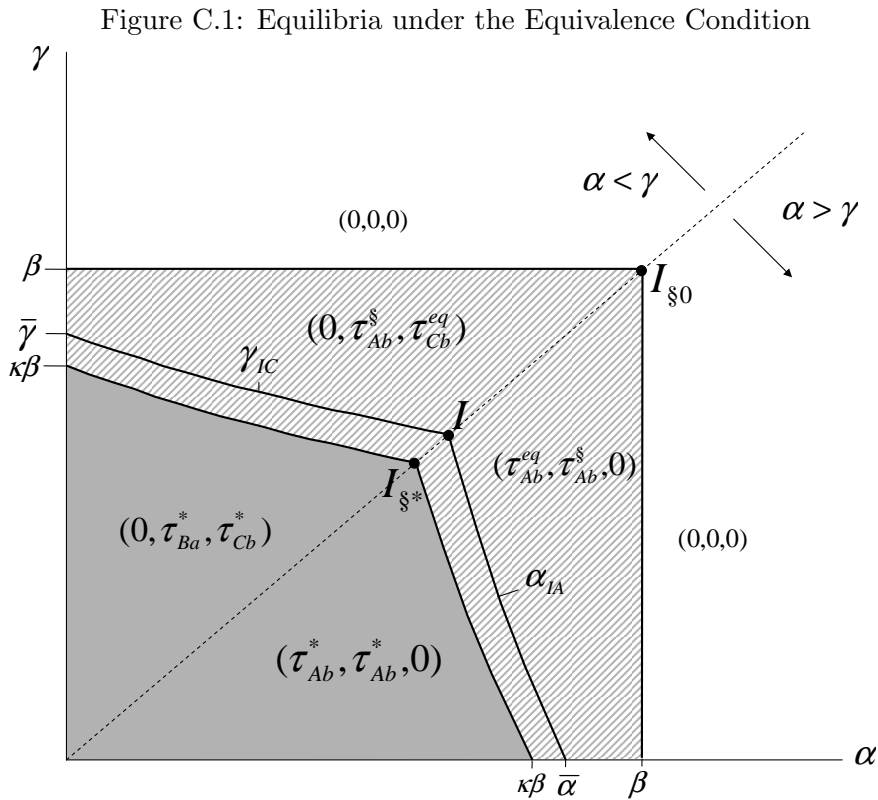
³Of course it holds that κ as the lower bound is smaller than the upper bound of $\alpha/\beta = 1$. For the two country case (i.e. $\gamma = 0$) we find that $\kappa = 0.86147\beta$ is slightly smaller than $\bar{\alpha} = 0.867688\beta$. In case C is the one who retaliates, we find a critical γ/β ratio.

dominated by setting a tariff of zero when the offender is smaller than the retaliating country.

(ii) For $\alpha < \kappa\beta$, the inclusion of the equivalence condition has no effect since for B playing τ_{Ba}^{\S} is dominated by setting its optimal tariff τ_{Ba}^* when the retaliator is sufficiently smaller than the offender (i.e. $\alpha/\beta < \kappa$).

(iii) For $\kappa\beta \leq \alpha < \beta$ the inclusion of the equivalence condition renders τ_{Ba}^{\S} a best response for B .

Consider Figure C.1 to see the effects of an introduction of the equivalence condition into the scenario, where the offender is not allowed to buy the right.



The white outer areas, where no offense occurs, are not affected. The dark grey inner area, where offender and retaliator both play their optimal tariff, remains unchanged as well. However,

the striped area, which depicts those cases where B now plays τ_{Ba}^{\S} while A or C retaliate with τ_{Ab}^{eq} or τ_{Cb}^{eq} respectively, stretches from just below $\alpha = \beta$ and $\gamma = \beta$ down to $\alpha = \kappa\beta$ and $\gamma = \kappa\beta$. Note that $\kappa\beta < \bar{\alpha}$ and $\kappa\beta < \bar{\gamma}$, such that even some of the former $\tau^*-\tau^*$ -equilibria turn into $\tau^{eq}-\tau^{\S}$ -equilibria.

This new area of equilibria basically represents an intermediate case between peace and the trade war with the $\tau^*-\tau^*$ -equilibria. In line with intuition, this new area shows up when the opponents are of similar size, but the offender still has a small size advantage making it profitable for him to commit a small offense.

Appendix D

Eidesstattliche Versicherung

Ich versichere hiermit an Eides Statt, dass ich die Dissertation, “An Economic Analysis of the WTO’s Dispute Settlement System”, selbständig angefertigt habe, alle von anderen Autoren eng anlehenden Ausführungen besonders gekennzeichnet und keine anderen als die in der Dissertationsschrift angegebenen Hilfsmittel benutzt habe.

Ich versichere an Eides Statt, dass ich mich an keiner anderen Fakultät einer Doktorprüfung oder Staatsprüfung unterzogen habe. Meine Prüfung zum Diplom-Volkswirt habe ich an der Christian-Albrechts-Universität zu Kiel abgeschlossen.

Kiel, September 29, 2008

(Sebastian Wilckens)

Appendix E

Hilfsmittel

Die Aufbereitung der Daten in Kapitel 2 ist mithilfe der Software “Microsoft Excel” erfolgt. Die Regressionen in Kapitel 2 sind mit der Software “EViews 5.0” durchgeführt worden. Die Schaubilder in Kapitel 2 sind mit der Software “Microsoft Powerpoint” erstellt worden. Alle Tabellen sind mit der Software “Microsoft Excel” erstellt worden. Die Schaubilder in Kapitel 3, Kapitel 4 und im Appendix sind mit der Software “Mathematica 5” erstellt und mit der Software “Microsoft Powerpoint” eingefärbt und beschriftet worden. Dieses Dokument ist mit der Software “MiKTeX 2.7” und der Software “WinEdt 5.4” erstellt worden.

Kiel, September 29, 2008

(Sebastian Wilckens)

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