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The Rules of the Game

A Game Theoretic Analysis of the WTO Dispute Settlement Mechanism

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Abstract

The aim of this master thesis is to investigate if WTO members' shifting behaviour in the Dispute Settlement Mechanism may be explained using a game theoretic approach.
To do this, the author uses a three step process: First, a thorough quantitative analysis of how the DSM works and how the members behave in it is carried out. Second, with the result from the first part in mind, a game theoretic model pointing out different possible strategies that may be pursued in the DSM is constructed. And third, the implications of the model are compared with the findings in the first part in order to evaluate whether the model could be used to explain the members' different behaviour in the DSM or not.

The main result is that many aspects of the member states' strategies could be explained whit the constructed model but as a few commonly used strategies seem completely irrational from the model's perspective it is far from a perfect explanation.

Keywords: Dispute Settlement Mechanism, game theory, quantitative method, trade disputes, WTO

Number of words: 9291

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List of abbreviations and denotations

Abbreviations

DSB	Dispute Settlement Body
DSM	Dispute Settlement Mechanism
DSU	Dispute Settlement Understanding
GATT	General Agreements on Tariffs and Trade
GDP	Gross Domestic Product
GNP	Gross National Product
H	High income countries
L	Low income countries
LM	Lower Middle income countries
UM	Upper Middle income countries
WTO	World Trade Organisation

Denotations

A	Appellate Body
C	Complainant
c	The economic value that the complainant loses because of the respondent's measure (and accordingly the amount that the complainant demand of the respondent)
d	The dispute cost, namely the economic value of what the dispute costs (wages, flights, material etc) for each party in each turn of the dispute process
n	The discount off the complainant's losses that may be negotiated during the consultations
P	Panel
p	The probability that a case is a "good case"
R	Respondent
r	The economic value that the respondent gains because of his measure (does not need to be the same as as the illicit measure may invoke additional gains or losses for the respondent or may be used against more than the complainant country)
x	The number of turns in the dispute process

1 Introduction

In 1995 the World Trade Organisation (WTO) replaced the General Agreement on Tariffs and Trade (GATT) which had been in place since 1948 with the mission to ease world trade. Both institutions stipulate (or stipulated) how international trade should be conducted by the member states. When any member believes that these agreements are violated in any sense by another member, it is useful to have an institution that takes care of the upcoming disputes. Therefore there has always existed a Dispute Settlement Mechanism (DSM)[1] which the members are supposed to use when such a dispute occur. With the birth of the WTO, a new such mechanism replaced the old one and has to this day received 373 formal complaints (WTO, 2008a). However, members' use of, and behaviour in, this institution differs in many ways. These differences are the focus of the thesis.

1.1 Statement of purpose

To find out how and why these differences occur, the thesis turns to game theory:
Could a game theoretic approach be used to explain WTO members' shifting behaviour in the Dispute Settlement Mechanism?
The thesis tries to answer this question.

1.2 Method

In order to answer the research question, a method consisting of three different parts is used:

First, a thorough quantitative analysis of how the DSM works and how the members behave in it is carried out.

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[1] The label *Dispute Settlement Mechanism* is not used by the WTO itself but indeed by many scholars studying this phenomenon (see for example Srinivasan 2007: p1034).

Second, with the result from the first part in mind, a game theoretic model lining out different possible strategies that may be pursued in the DSM is constructed

And third, the implications of the model are compared with the findings in the first part in order to evaluate whether the model is able to explain the members' different behaviour in the DSM.

1.3 Delimitations

Since the object of the study is to find patterns in the member states' behaviour it is of importance to find similarities and dissimilarities among the disputes. Unfortunately, it is impossible to account for all such aspects. Partly, the theoretical framework used denies the involvement of a lot of aspects as it counteract with its notion of simplicity and predictability. And partly, it was not possible to find as much detailed information about the disputes as had been desired. Hence, the study only treats the most obvious aspects of the DSM**.**

Therefore, the thesis has no generalising ambitions concerning the use of game theory in DSM studies. The results may of course point in one or the other direction but to reach conclusions, more studies using those aspects of the DSM, as well as game theory that was not used in this thesis, have to be conducted.

1.4 Previous research

Many scholars have studied the DSM since its birth in 1995 in one or the other way.[2] It is however difficult to get an overview of all different aspects that have been treated but – at least in political science – generally all studies falls in one of two categories: Either you have a top-bottom approach and examine what effects the DSM have on the political scene (domestically and internationally) or you have a bottom-top approach and examine how different actors relate to the DSM. This thesis treats the latter. More

[2] Some scholars actually seem to have done nothing else since then, for example Leitner – Lester have published one statistical review of the DSM each year since its founding. See for example the last one: Leitner – Simon, 2007.

specifically, it only treats the member states' behaviour in the DSM and how and why this may differ.

Nevertheless, quite a few studies with partly the same object have been made. Most of those try to explain different behaviour from economical factors. For example, it has been found that the value of the contested measure influences a country's choice to complain or not (Bown 2005). In fact it has been proven that countries with smaller GDP file fewer complaints than those with bigger, probably because the values of the disputes are lower (Busch – Reinhardt 2003). Bown – Hoekman (2005) made a similar statement when they showed that small importers complain more seldom because they know that an import restricting retaliation would not affect a rich country. Also, it seems that a country files most of its complaints concerning the industries where they have the domestically most powerful lobbyists (Davis – Shirato 2007).

The few studies also concerning non economic sides of the process have proposed that developing countries not file against developed because they are reliant on the latter for development assistance (Zejan – Bartels 2006: p1022). Conti (2008) tried in a recent study to show that motives for filing may be political or symbolic as well as economical. And not least, Busch – Reinhardt (2006) have shown that if a third party exist in a dispute, this lower the prospects for early settlement.

From the example above we can conclude that the existing literature in the field has a bias toward a discussion of why a country file a complaint in the first place, while very few discuss how countries behave inside the DSM.

When the scope is reduced to game theoretic studies of the DSM the number of studies decreases drastically. This fact may have several explanations but two of the most important should be:

- Game theory is regarded with great suspicion in big parts of the field of political science. Hence, many scholars refuse to concern themselves with game theoretic analysis at all (Ordeshook 1986: px).
- If game theory is used in political science, it is most commonly applied to domestic politics like voting or elections. When applied to international politics, most studies have concerned the prospects for peace and war as most realist scholars for a long time were much more interested in "real" political conflicts than economical ones (Morrow 1994: p3).

There does not seem to be any study – concerning the participants' behaviour – made using a completely game theoretic framework. Rosendorff (2005) has used a game theoretic model to investigate how the existence of a DSM in a trade agreement (such as the one in WTO) affect the trade agreement itself and Grinols – Perrelli (2006) conducted a similar study in order to investigate

how the design of DSMs affects the frequency and number of trade disputes. As these studies concern the same kind of institution, some of the assumptions and intuitions may apply to this study but the appliance and the implications differ.

1.5 Disposition

The thesis is divided into seven main chapters. Next chapter describes the methods and material used in the study in more detail, as well as important definitions and operationalizations. Chapter 3 concludes the theoretical framework while chapter 4 gives a more thorough explanation of how the DSM works and is being used. The game theoretic model is then constructed and analysed in chapter 5 and compared with the findings from chapter 4 in chapter 6. Conclusions are made in chapter 7.

2 Methods and material

2.1 Methods

2.1.1 Quantitative analysis

Even though the main object of this study is to construct and use a game theoretic model, a minor quantitative analysis of the complaints brought to the DSM have been conducted. The reason for this procedure was twofold:

First, in order to develop a model of an existent phenomenon – and even more important: to know what to use this model for – you have to have some basic knowledge about what characteristics this phenomenon has. Only then it is possible to build a model that at least has the potential to correspond with reality.

Second, to be able to judge whether the implications of the constructed model correspond with the reality – and thus determine if the WTO member states act in a way consistent with what the game theoretic model implies – it needs to be compared with the reality. And once again the result of the quantitative analysis can be used to tell if it holds for such a comparison.

The 324 disputes that were taken by the member states to the DSM between 1 January 1995 and 31 December 2004 were individually examined and categorised using WTO:s own dispute summaries. The data was compiled and analyzed using the SPSS (Statistical Package for the Social Sciences), a computer program designed for statistical analysis.

However, no really technical feature that should need any extra explanation was used. The analysis only involves simple measures like means, distributions and percents. The relevant results are presented in part 4.2.

2.1.2 Game theoretic analysis

In game theory, different possibilities and what they may entail in each situation are of main importance. Therefore a simplified model of all possible moves and outcomes of the DSM process was constructed as a first step. Next, an assessment of what each move and outcome could imply for the involved players (that is to say member states) was carried out.

With all basic parts and assumptions in place, the model could then be analysed and expanded: Possible outcomes were evaluated, the expected best moves for each player were revealed, and theoretic assumptions were added and removed. All of these may be found in chapter 5 while the implications of the model and how those correspond with reality are presented in chapter 6.

2.2 Material

As mentioned above many studies investigating the WTO Dispute Settlement Mechanism have been done and not a few of them have had a statistical approach. Thus the disputes have been heavily analyzed and extensive sets of statistical data should exist in many scientists' computers all over the world. However, the interest of sharing these datasets freely seems to be much more modest. It has been impossible to find an existing set of data concerning the issues treated in this thesis.

The sole option was therefore to turn to the WTO itself and from the information supplied on the website (WTO 2008a) complete a new dataset. The WTO provides a complete list of cases where the characteristics and the events of each dispute are more or less extensively summarized. This list was used to collect a few interesting features of every dispute set off during the first ten years of the DSM. Additional information about the states in question that could not be found on the WTO website was collected from the World Bank website (World Bank 2008a).

As data collecting was not the main purpose of the thesis, only a limited amount of time could be spent on this task and therefore the data collected could not be as extensive as desired. For a study of this magnitude it has nevertheless been satisfactory.

2.3 Definitions and operationalizations

2.3.1 Time period

As mentioned above, this thesis studies all disputes taken to the DSM between 1995 and 2004. This period of time has been chosen for two main reasons. Firstly, as WTO (and at the same time the DSM) was launched 1 January 1995 it consists of a neat period of the first ten years of the DSM in action. And secondly, virtually all cases filed during this period have, up to this date, in one or the other way been settled or dismissed. This means that the statistical analysis is not flawed with a big number of cases where the outcome is still uncertain, which then would have jeopardised the final result.

2.3.2 Member states

All states that were or became a member in the WTO during the examined period have been included in the study, this counts for all of the now 151 member states except three (Saudi Arabia, Viet Nam and Tonga). As members of the European Union participate in the WTO as the European Communities (even if they also are individual members), all members accessed before the enlargement in May 2004 are excluded from the study. Hence, in total, 133 members are represented (WTO 2008b).

The fact that countries that only have been members for a few years still are included may produce a little bias towards inactive countries: There could be rational explanations to why a state proceeds more cautiously during its first years of membership than mature members do which implies that those countries should be removed from the study. But then there would be an even more delicate problem to point out which countries to remove and which to keep. If only countries that have been members since the start would qualify, the study would end up with a too small case population. On the whole, it therefore seems better to include all members.

2.3.3 Country categories

To test whether a country's development status affects its behaviour in the DSM each of the WTO member countries must be classified as either developed or developing. To do this, the World Bank's classification, based on GNP/capita, is used. This is partly because it is the most commonly used classification (Todaro – Smith 2003: p34) and partly because it seems most appropriate to use an economic classification as the study mostly treats economic costs and gains.

The Bank presents yearly the GNP/capita for almost every economy of the world (including all of the 133 WTO members used in this study) and classifies them, using these figures, into four different categories. The wealthiest rank as High income countries (H), the next group as Upper middle income countries (UM), the second poorest group as Lower middle income countries (LM) and the poorest as Low income countries (L) (Todaro – Smith 2003: p34). In this study, all countries are considered developing countries except those ranked as High income countries. Some times, in order to get an even more detailed comparison all the four subgroups are also used.

As the study covers a time period of ten years and the World Bank presents a new ranking every year it is possible for a country to shift between several different country classes. To be able to summarize all disputes in an effective way each country however need to be grouped into only one class. For that reason, the countries that have been shifting between categories have been grouped into the category they have belonged to most of the ten years.

2.3.4 Issue categories

To be able to find some common feature for the different disputes they where categorized by what issue each dispute concerned. Five different – mutually exclusive – categories were used:

- Natural resources
- Agricultural products
- Manufactures
- Services
- Horizontal issues

All of them are quite straightforward and should not need any further explanation except the Horizontal issues. Those are issues that can not be referred to a particular industry but concerns more general policy issues like tax codes or general domestic law (Davis – Shirato 2007: p285).

Of course all of these categories could have been divided in more specific subcategories but it has to be questioned what use a general and simplifying study would have of ten or more specialized categories. The big picture and possible existing tendencies would risk vanishing in a multitude of details. The reliability with such a large amount of categories would also diminish as the uncertainty about to what category a specific dispute belongs would increase.

2.3.5 Disputes and cases

During the ten years observed in this study a total of 324 disputes were taken to the DSM by the members. It is however not unusual that several member states start one dispute each concerning one country's specific measure. In such a case, when several disputes concern the same question, further negotiations and eventual panel establishments are done collectively. Thus several disputes may be treated as only one case. In the same way it is possible for involved countries to treat a number of disputes closely related as only one, also resulting in several disputes becoming only one case.

To not blur the analysis these unnatural disputes must all be adjusted. Partly because some disputes otherwise may seem to end abruptly without any form of settlement when in fact the dispute was solved together with another one. And partly because if one or more countries have started multiple disputes concerning one other country's measure it would create an unnatural bias if those would count as more than one case. When the data set were corrected for all these kind of anomalies the 324 disputes decreased to 261 cases.

3 Theory

3.1 Game theory

The field of game theory was more or less invented by Neumann – Morgenstern when they released their book *Theory of Games and Economic Behavior* in 1944. Only a few years later the literature flourished and it did not take long before the use of game theory was extended to other social sciences, including political science (Brams 1975: pxi). Most of the theory described below dates from its heydays in the 50s and 60s as its formal usage in political science has declined ever since. However, many important theories developed in recent years have their roots in game theory (e.g. Putnam's two-level game model) (Morrow 1994: p2-3, p187).

Game theory could be seen as a subcategory to rational choice theory as they share the key beliefs of the state of the world, such as a rather positivistic epistemology and the assumption of rational actors (Brams 1975:pxii; Hay 2002: p8). The primary advantage of these theories is that they reduce real world phenomena to simple models that then could be thoroughly analysed. Even if the real world looks a lot more complex than a simple game theoretic model, game theory may nevertheless contribute to the understanding of political events because it forces the researcher to focus on a few aspects that are believed to be the most relevant, while neglecting the rest (Morrow 1994: p6-7). This is exactly what has been done in this study and below, the relevant parts of the approach are briefly explained.

3.2 Theoretical assumptions and models

3.2.1 Rational actors

As the theory have clear predictive objectives the actors – whose actions we want to predict – must behave rationally (Hay 2002, p8-9). The concept of rationality is quite contested (Brams 1975, pxv) but it all boils down to a rather simple assumption. For example, Morrow puts it as "rational behaviour means choosing the best means to gain a predetermined set of ends" (1994: p17). This does thus mean that rational actors have specified goals and always choose the action that they believe will best attain those goals. Prolonged, this implies that they can rank all the possible outcomes according to their preferences (*complete preferences*) and that they always act in consistence with that ranking (if $a > b$ and $b > c$, then $a > c$) (*transitive preferences*). Preferences that are both complete and transitive are called *ordinal* as all of the outcomes then are possible to order (Morrow 1994, p17-18).

To use these conceptions of rationality practically the players' preferences are assumed to be fixed. That is to say that each time the actors are given the same options (resulting in the same outcomes) they always choose the same action (Morrow 1994, p17).

3.2.2 Simplicity

It is often impossible to predict all possible outcomes in a specific situation and even if they all were predicted, a model with all these possible outcomes spelled out would be extremely complicated. Hence, to be able to use game theory at all on real world phenomena, another feature is important, and that is simplification. To make a model fruitful and cogent the essence of a real world situation must be captured while everything else is ignored. The simplifications used to do this can then be judged by the accuracy of the implications of the model. If the model's implications correspond with the behaviour in the real world the simplifications are probably justified, if not they are either false or have missed out some important aspects (Morrow 1994: p6-7).

3.2.3 Utility

As ordinal preferences can be ordered they may also be assigned values that are consistent with that order, such a value is called a utility. A function that shows what utility each choice has (or is expected to have) is called a utility function (Morrow 1994, p18).

If it is not known that an action certainly may produce an outcome the player must take the probabilities of the different possible outcomes to account (Morrow 1994, p24). The expected utility for an action (a) can be said to be the product of the utility of each outcome (o) times the probability of that outcome (p) given the action summed across all outcomes. Algebraically this is written

$u(a) = p_1 \times o_1 + p_2 \times o_2 ... + p_n \times o_n$.

3.2.4 Different types of games

If – for each possible outcome in a game – one player's gain equals the other player's loss, the game is denoted a *zero-sum game*. It is impossible for one player to win more than the other loses. Alternatively, if a game is played without such a common stake it is denoted a *non-zero-sum game*. In such a game one player's utility does not need to have anything to do with the others', this also means that a game may result in either gains or losses for all players. As zero-sum games relate badly to most real world situations all games in the thesis are assumed to be non-zero-sum games (Morrow 1994: p74-75).

A non-zero-sum game could also be divided into two subgroups: either they are *cooperative* or they are *noncooperative*. In a cooperative game, players are allowed to make binding agreements during the play. The players' choices thus depend on their utility functions and on potential agreement. In noncooperative games, agreements are not an option, each player is always free to choose whatever they believe will produce the best outcome (Morrow 1994: p75-76).

As the outcomes of cooperative games depend on the agreements negotiated between the players it is impossible to say anything about the outcomes of such a game without knowing these agreements (and the other way around every single strategy played by a player could be explained by assuming some sort of agreement) (Morrow 1994: p111). Because of these limitations of cooperative games, all games in the thesis are assumed to be noncooperative.

3.2.5 Extensive and strategic forms of games

When modelling a game, usually one of two (or both) different forms is used. The most basic form is the extensive form which has the shape of a game tree where the whole procedure with all choices and alternatives are sketched out (Morrow 1994: p65-66). A simple example of an extensive-form game is shown in figure 1.

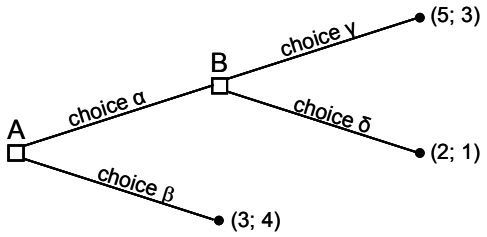

Figure 1.

Each box is a *node* where a player can make a choice. At the first node player A may choose between *choice* α and *choice* β. If A chooses β the game ends, illustrated by the dot, and the utility for A will then be 3 and for B it will be 4, often denoted *payoffs*. If A chooses α player B will have to make a choice. The game will then end irrespective of $B's$ choice, only the payoffs will differ.

With a game in extensive form, every aspect of the game is shown, but it may easily become quite complicated when the number of nodes and choices increase (Morrow 1994: p70). Instead, a game can be summarized by the possible strategies the players may follow. The game outlined in its extensive form in figure 1 is summarized in its strategic form in table 1.

		B	
		choice γ	*choice* δ
A	*choice* α	$(5; 3)$	$(2; 1)$
	choice β	$(3; 4)$	$(3; 4)$

Table 1.

The players' possible strategies are given in the table's rows and columns respectively. As one player's payoff is assumed to depend on the other player's strategy the payoffs of different strategies are shown where one of player $A's$ and one of player $B's$ strategies intersect. In the example this is true as long as player A chooses α but if A chooses β, $B's$ strategy no longer matter. However, the payoffs are spelled out anyway because even if B is not given the option to choose he still may have decided for a strategy (Morrow 1994: p66).

3.2.6 Backwards induction

When a game is written in extensive form the players' strategies may be predicted using backwards induction. By beginning with the end nodes of the game and constantly define each players optimal move until the first node is reached the preferred (and thus used) strategies are revealed (Morrow 1994: p124-125).

3.2.7 Best replies and Nash equilibriums

Modelled in its strategic form, a game's best strategies for the different players are easy to find. If we for example assume that A chooses α in table 1 we easily conclude that $B's$ best reply is γ. That one player's strategy is the best reply for another player's is generally expressed as $P(S_i; s_j) \geq P(S; s_j)$ where P denotes a payoff; S first player's strategies; and s second player's strategies (see table 2). The above expression thus means that there is no strategy that gives a better payoff for player 1 than S_i given that player 2 plays s_j.

First player (1)	*Second player* (2)		
		s_i	s_j
	S_i	$P(S_i; s_i)$	$P(S_i; s_j)$
	S_j	$P(S_j; s_i)$	$P(S_j; s_j)$

Table 2.

When the whole game is examined in a similar manner, we find every strategy's best reply. If (and only if) it turns out that a pair of strategies are best replies to each other they form a *Nash equilibrium*. To show this algebraically, the following two equations must be fulfilled:

$P_1(S_i; s_j) \geq P_1(S; s_j)$ *for all* $S \neq S_i$,

$P_2(S_i; s_j) \geq P_2(S_i; s)$ *for all* $s \neq s_j$.

For the game in table 2, there exist two such Nash equilibriums: $P(\alpha; \gamma)$ and $P(\beta; \delta)$.

As each player's strategy is the best reply to the other's no player would ever choose to change his strategy once in a Nash equilibrium. This also means that, if we assume complete information (that all players know all payoffs), rational players would only play strategies resulting in Nash equilibriums (Morrow 1994: p98). If a game contains several Nash equilibriums the first player will choose the strategy that leads to his most preferred Nash equilibrium. In table 1 player A knows that the game will end

in one of the two equilibriums and as he prefers the Nash equilibrium $P(\alpha;\gamma)$ he will choose α .

3.2.8 Different kinds of information

In the example in figure 1 above the players have *perfect* information about the game. This means that all players know exactly how the game looks and on which node they are when it is their turn to choose. However, if B has to choose without knowing where in the game tree he is (even if it is easy to guess in the example as B only have one node) the information is *imperfect* (Morrow 1994: p63-64). Imperfect information usually implies that a player needs to estimate probability distributions concerning which node it may be on and for the possible outcomes of its choices (figure 4 in chapter 5 represent this type of game) (Morrow 1994: p56).

But even if a game is played under imperfect information, it is assumed that all players in a game know all the possible payoffs. This means that B still knows all the payoffs shown in table 1. As long as this is true, the information is *complete*. If this is not true (and, for example, B does not know what payoffs A may get from choices γ and δ) the information in the game is *incomplete* (Morrow 1994: p63-64).

3.2.9 The Rubinstein Bargaining Model

Game theory is often applied to bargaining situations (and this thesis is no exception) where the players try to reach a mutual acceptable solution. If this bargaining is held under complete information all players' utilities are supposed to be known from the start, implying that everybody knows which outcome one player prefers over another. And if this is the case, there is no need for bargaining at all as it is possible to trace the optimal mutual acceptable solution at once.

Hence, if there exists an agreement acceptable to everybody we may say directly what the agreement will be, and this agreement will be offered by the first player in the first round of the negotiation. The intuition behind this reasoning is called the *Rubinstein Bargaining Model* (Morrow 1994: p145-149).

4 Background

4.1 How does the DSM work?

When a WTO member state believes that it is deprived of benefits because another member violates any of the WTO agreements it has three choices. Either it does nothing; either it contacts the violating country and try to solve the problem bilaterally; or it complains to the WTO. It is when a country chooses the third option that the case lands up in the Dispute Settlement Mechanism.

How the DSM functions/works is spelled out in the Dispute Settlement Understanding (DSU) – a treaty negotiated during the Uruguay round – and covers all disputes arising in the WTO. The rules and the proceedings are described rather strictly with a clear framework that each dispute need to follow. This procedure may be summarized in the steps below:

1. When a complaint is made to the WTO the disputing parties first have to try to solve the conflict through consultations. During this stage the WTO offers the parties mediation to ease the negotiations.
2. After at least 60 days of consultation, the complainant may request the establishment of a panel if no solution has been found. The Dispute Settlement Body (DSB) – a part of the WTO council – then appoints a panel consisting of three individuals. These three are chosen from an existing list of trade policy experts (WTO diplomats, civil servants and academics) suggested by all the member states. The panel then have six months to hear the disputing parties, examine the facts and to come to a conclusion. The conclusions are released in a report which specifies if and in what way the respondent has violated the WTO agreements or not.
3. Both parties have the right to appeal the panel report if they think that the panel has interpreted the relevant agreements incorrectly. If either party does this, three of the seven permanent members of the Appellate Body have 90 days to examine the case and verify if

the panel report is correct. The Appellate Body's decision is then released in a new report.

4. If, after the three steps above, the respondent is found guilty, he is recommended to correct his measures in "a reasonable period of time" which may be determined by the DSB. If the complainant is not pleased with the implementation of the corrections, he has two choices. Either he reports the disobedience to the DSB, which means that the question of implementation is treated in the same way as the original complaint was in step 2-4. Or he asks the Appellate Body of permission to start retaliation measures against the respondent which are supposed to neutralize the effects of the illicit measures. Thus, if the complaint is approved, the complainant is supposed to always be compensated whether the respondent complies or not.
   (Hoekman – Kostecki 2001: p76-77; Seth 2004: p81-105)

4.2 How do the countries act? A quantitative analysis

To be able to construct an accurate model – and later to investigate how well the model correspond with reality – we need a little more information about the disputes, these are compiled below.

First of all, most members have not had to care about these rules at all, as they have never participated in a dispute as either complainant or respondent (see table 3). It is also obvious that the extent of countries that participate decreases in line with their GNP/capita. This result is line with the fact that developed countries only account for one third of the total complaints.

From table 3 we can also tell that it is more common to participate as complainant than as respondent which indicate that there are more countries that voluntarily start a case than there are countries that involuntarily end up in one.

	All countries	Developed countries	All developing countries	Developing countries classified as LM or L	Developing countries classified as L
	133 member states	23 member states	110 member states	82 member states	46 member states
Participated in at least one dispute	35%	52%	32%	22%	9%
Participated as both complainant and respondent	21%	26%	20%	15%	7%
Participated as complainant	30%	52%	26%	18%	9%
Participated as respondent	26%	26%	26%	18%	7%

Table 3. Participation

When it comes to what kind of issues that are most disputed the distribution follows in table 4. This corresponds reasonably well to the different sectors of world trade (even if the horizontal issues are non-measurable) except for natural resources and services, those account for much more than one respectively two percent of the world trade today (World Bank 2008b).

	Frequency	Percent
Agricultural products	78	30
Horizontal issues	67	26
Manufactures	106	41
Natural resources	4	1
Services	6	2
Total	261	100

Table 4. Issue categories

When it concerns the countries that have taken part in at least one case, the result looks like in table 5. It is a little discouraging that only less than a quarter of the cases reach an end during the consultations but what is most surprising is that more than one third of the cases end without any form of agreement. It seems logical that when someone files a complaint he wants to reach a solution, thus if no settlement is reached the complainant should demand the establishment of a panel. But apparently, this is not the case.

	Frequency	Percent
Settlement	59	23
No settlement, no panel	100	38
Panel established	102	39
Total	261	100

Table 5. Case proceedings

May the proceedings of a case differ depending on what kind of issue that is at stake? The answer may be found in the two following tables. In table 6 it is shown that most issues have fairly equal case proceedings except the two last categories. We should however not pay too much attention to the outstanding figures of these two issues as they consist of very small populations. Excluding those two, the most interesting findings are that in cases concerning manufactures 45% are taken to a panel, and concerning agricultural products almost half of them end in nowhere.

In table 7 it is possible to see if countries of one kind act differently depending on which kind of country it is disputing against. This could be said to be the most interesting table with several interesting implications: It shows clearly that it is much harder to find a settlement when a developing country has filed a developed than otherwise. Furthermore, when a developed country files a developing there is much less chance that the complainant will desert it than usual. Finally, it seems more likely that cases are deserted when both parties are of the same kind than if not.

Category	Case proceedings			Total
	Settlement	No settlement, no panel	Panel established	
Agricultural products (78 cases)	21%	47%	32%	100%
Horizontal issues (67 cases)	27%	37%	36%	100%
Manufactures (106 cases)	21%	34%	45%	100%
Natural resources (4 cases)	50%	25%	25%	100%
Services (6 cases)	17%	17%	66%	100%
Total	23%	38%	39%	100%

Table 6. Case proceedings for different issues

Case conditions	Case proceedings			Total
	Settlement	No settlement, no panel	Panel established	
Complainant = developed Respondent = developed (112 cases)	22%	47%	31%	100%
Complainant = developed Respondent = developing (45 cases)	29%	29%	42%	100%
Complainant = developing Respondent = developed (44 cases)	11%	46%	43%	100%
Complainant = developing Respondent = developing (49 cases)	29%	51%	20%	100%
Complainant = both Respondent = developed (8 cases)	12%	63%	25%	100%
Complainant = both Respondent = developing (3 cases)	33%	67%	0%	100%

Table 7. Case proceedings for different case conditions

Of those cases where a panel is established, most of them seem to be well-founded. If the cases without a report yet are separated from table 8, more than 79% are approved. Seemingly, either the world is full of trade violations; or the members choose when to complain about a measure with great prudence.

From table 9 we can also see that most of the panel reports are upheld by the Appellate Body when appealed (when the results of table 8 and 9 are put together we find that – in total – the complainant is right in 78% of the cases). Only 7% of the approved complaints and 27% of the dismissed are rejected by the Appellate Body. This indicates that the panel reports are right in a large majority of the cases. The obvious question is then why 65 of 102 cases nevertheless are appealed. There is no answer to find in the statistics but table 10 at least gives a detailed picture of the situation. It may seem a little odd that complainants have appealed even when the complaint was approved but in such a case the appeal concerns some minor part of the complaint that was disliked.

	Frequency	Percent
Approved	76	74
Dismissed	20	20
No report yet	6	6
Total	102	100

Table 8. Panel's judgement

		Appelate Body's decision		
		Judgement upheld	Judgement rejected	Total
Panel's judgement	Approved	50	4	54
	Dismissed	8	3	11
Total		58	7	65

Table 9. Appellate Body's opinion on Panel's judgement

		Appeal to Appellate Body				
		No appeal	Complainant's appeal	Respondent's appeal	Appeal by both	Total
Panel's judgement	Approved	22	3	50	1	76
	Dismissed	9	11	0	0	20
Total		31	14	50	1	96

Table 10. When do the parties appeal and when do they not?

If the respondent is found guilty, the DSU stipulates that he has to comply with the judgement. However, only three quarters do this, the others refuse (see table 11). When this has been the case, all complainants except one have used one of their two possibilities to force the respondent to compliance (table 12).

	Frequency	Percent
Comply	57	76
Not comply	18	24
Total	75	100

Table 11. Respondent's compliance

	Frequency	Percent
Nothing	1	6
Implementation appeal	8	44
Retaliation	7	39
Both	2	11
Total	18	100

Table 12. Complainants response to no compliance

5 The model

5.1 The outline

Knowing how the DSM is supposed to function according to the DSU as well as how all of the 261 cases looked like in reality, it is now time to construct an extensive-form game theoretic model, valid for all known possibilities. The result of this attempt can be seen in figure 2.

Each step of this model may of course be contested as the main ambition has been to make it as simple as possible, not as accurate as possible. Nevertheless it is rather realistic: The procedure of any case may be sketched according to this model.

Each node, and the possible choices an actor can make at each node, is reasonably straightforward but a few steps may nonetheless need a little more explanation:

- At the second node, where R may choose whether to settle the case or not, it is of course not only up to R. This node represents the whole consultation process where R and C are supposed to reach a settlement on their own. However, as this is bargaining process it can according to the Rubinstein Bargaining Model be replaced by one single choice. And this choice is R's as he is to choose whether to give C an acceptable offer or not (see part 5.3.2 for a more thorough discussion of what the Rubinstein Bargaining Model implies for this game).
- When a panel report is appealed, the Appellate Body's decision is always denoted *approved* if the decision approves the initial complaint – even if the appeal itself really is dismissed – and vice versa. This denotation makes the different choices more comparable and intuitive.
- The three "end nodes" of the game also look somewhat odd as all of the choices do not seem to end the game. And this is entirely true, the option *implementation appeal* is marked with an arrow instead of a dot because if C chooses this option the procedure continues with a new panel and maybe also an appeal of that panel's report. Exactly what may happen can be seen in figure 3. The reasons to why the rest of the game not is outlined in figure 2 are however ridiculously simple:

First, the *implementation appeal* option involves a whole range of new possibilities which together with the rest of the model would not fit on one single page.

Second, according to the basic interpretation of the model it is never rational for C to play the *implementation appeal* option. It seems a bit unnecessary to include possibilities that are not plausible in the model.

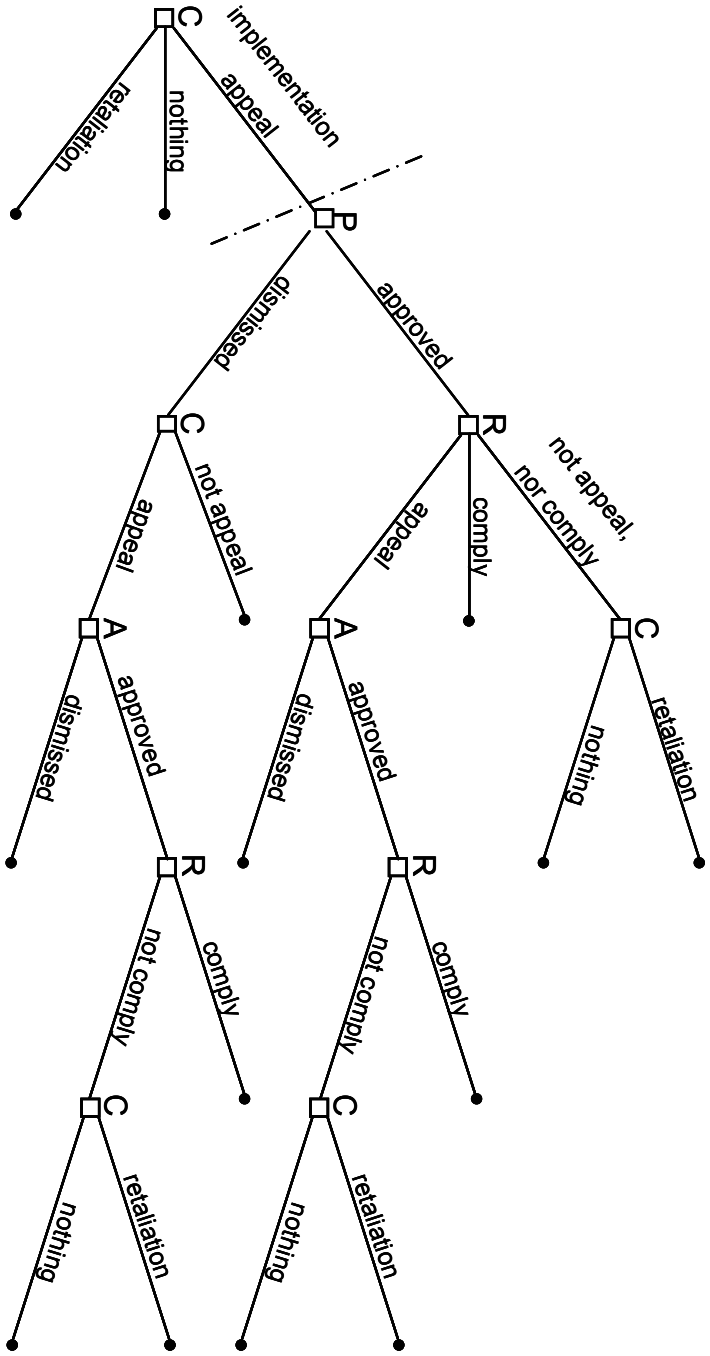

Figure 3.

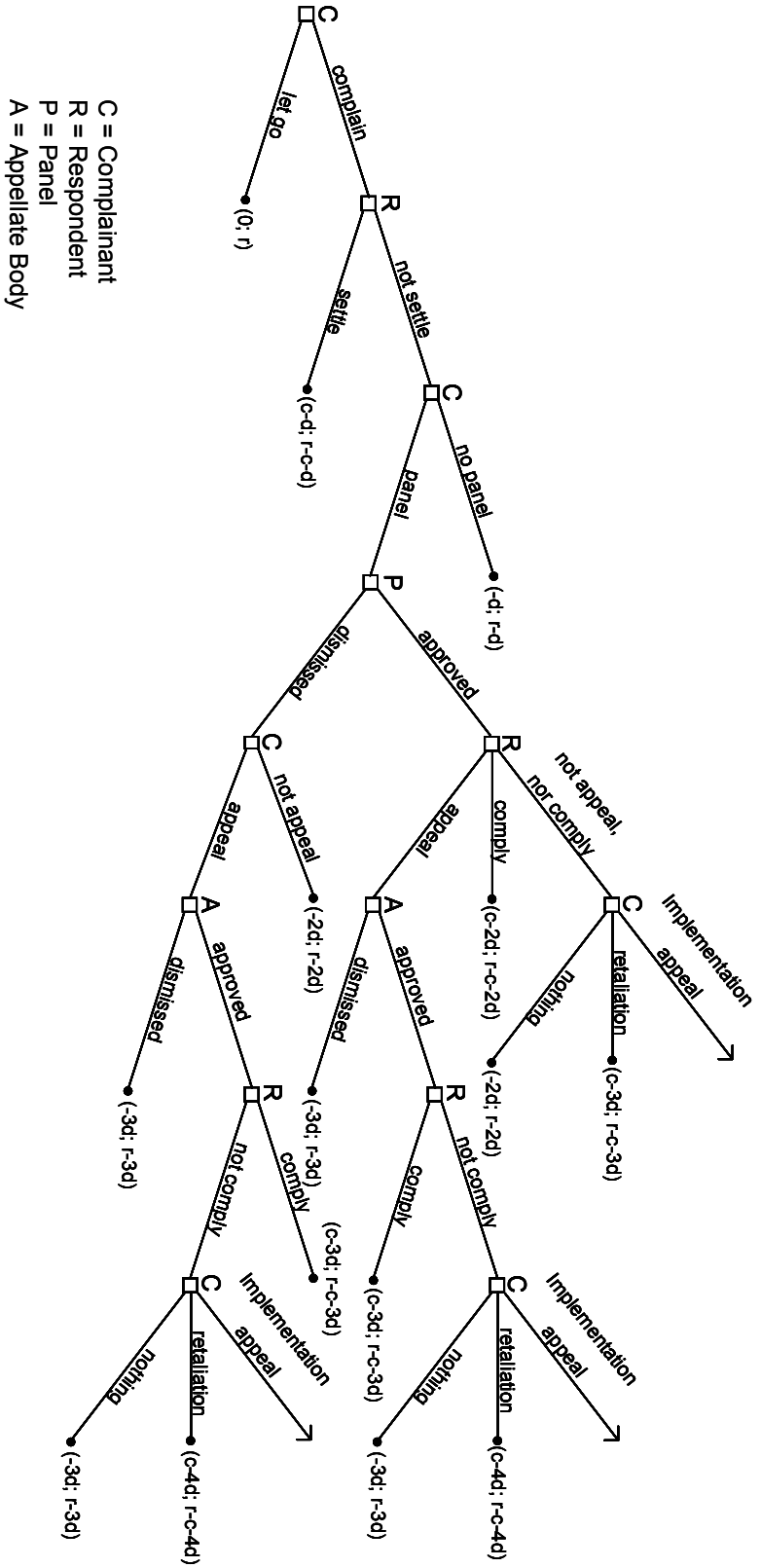
C = Complainant
R = Respondent
P = Panel
A = Appellate Body
C
let go
complain
(0; r)
R
settle
not settle
(c-d; r-c-d)
C
panel
no panel
(-d; r-d)
P
dismissed
approved
C
appeal
not appeal
(-2d; r-2d)
A
dismissed
approved
(-3d; r-3d)
R
not comply
comply
(c-3d; r-c-3d)
C
retaliation
nothing
implementation
appeal
(c-4d; r-c-4d)
(-3d; r-3d)
R
appeal
comply
not appeal, nor comply
(c-2d; r-c-2d)
A
dismissed
approved
(-3d; r-3d)
R
not comply
comply
(c-3d; r-c-3d)
C
retaliation
nothing
implementation
appeal
(c-4d; r-c-4d)
(-3d; r-3d)
(-2d; r-2d)
C
retaliation
nothing
implementation
appeal
(c-3d; r-c-3d)

Figure 2.

5.2 Variables and payoffs

The possible payoffs from this game model (between brackets after each outcome) are assumed to consist of the following variables:

$c =$ the economic value that the complainant loses because of the respondent's measure (and accordingly the amount that the complainant demand of the respondent)

$r =$ the economic value that the respondent gains because of his measure (does not need to be the same as c as the illicit measure may invoke additional gains or losses for the respondent or may be used against more than the complainant country)

$n =$ the discount off the complainant's losses (c) that may be negotiated during the consultations ($0 \leq n \leq c$)

$d =$ the dispute cost, namely the economic value of what the dispute costs (wages, flights, material etc) for each party in each turn of the dispute process

$x =$ the number of turns in the dispute process ($1 \leq x \leq 6$ but if the implementation appellation possibility is left out (as it does not seem economically rational)$1 \leq x \leq 4$)

$p =$ the probability that a case is a "good case" ($0 \leq p \leq 1$)

For each outcome C's payoff is given before R's.At the start, C is thought to have nothing, while R is thought to have r, thereof the payoffs for the strategy *let go*. If C chooses to proceed in the game, the dispute costs will start to accumulate and are never possible to get rid off. As they rise for every part of the game that demands new efforts from the disputing parties d's coefficient will rise as well.

If the parties are able to reach a settlement in the second node, C receives the amount he demands minus R's negotiated discount while R of course loses the same amount. If a case instead reaches at least a panel, the player's payoffs depend on the panels' and the Appelate Body's reports and R's eventual compliance. If R does not comply, C may take one of two actions, either he asks for permission to start countermeasures against R (which are supposed to equal C's loss) or he makes an *implementation appeal*. He may also choose to do nothing. If C chooses the appeal option, he will for certain have higher dispute costs than if he had not appealed and it is not certain that his appeal will be approved at all. Thus, the strategy to make an *implementation appeal* seems to always be worse than to retaliate.

5.3 Interpretation

It is more or less impossible to draw any conclusions from the model in figure 2 as the most important choices are made by P and A, two players that are not part of the study. Hence, we need to reduce the game from a four-player to a two-player game.

Luckily, this is easily done by introducing a *chance node* (Ch). If we start by letting *chance* decide whether the filed complaint is a good or a bad case A and P are no longer needed.[3] As a matter of fact, *chance* also decides all utilities after a panel has been established except for the total dispute cost. This means that the model may be reduced to figure 4 if we denote the unknown dispute cost xd. The broken lines in this figure means that the player in a node linked with another one cannot determine which of these two nodes it is at when it must choose, but all possible payoffs are still known to both players. Hence, the game is played under imperfect but complete information.

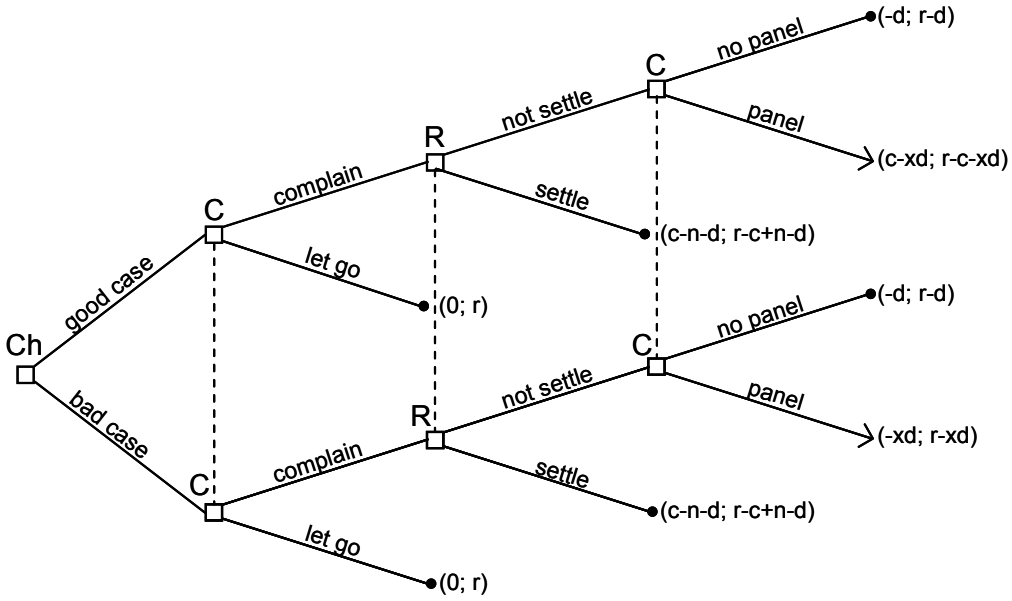

Figure 4.

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[3] Of course there exist no such things as hundred percent good or bad cases in the real world. First of all, most panel reports are not completely approving or dismissing but instead they approve some parts of the complaint and dismiss other. Nevertheless, when looking at the whole picture it is still possible to say which party that won or lost the case. Secondly, no panel report could be said to have access to any eternal truths. A report could always be rejected by the Appellate Body or any other expert in the field. But yet it is a rather good estimate and the only possible simplification tool at hand.

To use this model for predictive purpose the players' choices must be evaluated. This is done below, using the method of backwards induction.

5.3.1 Node 3

When C is in position to choose to either demand the establishment of a panel or not he notice that the choice to not establish a panel always will result in the utility function

$u(no\ panel) = -d$

but the choice to establish a panel may result in either

$u(panel_g) = p(c - xd)$ or $u(panel_b) = (1-p)\times(-xd)$.

Thus the complete utility function for C is

$u(panel) = p(c - xd) + (1-p)\times(-xd) = pc - pxd - xd + pxd = pc - xd$

As C knows that he should establish a panel if the estimated utility function for establishing a panel exceeds the utility function for not doing so he will demand a panel if $pc - xd > -d$.

However it seems not rational that C would ever choose the option to not demand a panel when the game is played with complete information. Because with complete information all utility functions are known in advance and C should not start a dispute at all if he knew that $-d$ would be his best expected outcome when could do nothing and get 0.

5.3.2 Node 2

Before $C's$ choice, the consultations take place. This bargaining process will only treat the size of n (as it is the only variable that the parties may affect) where C would prefer $n = 0$ and R $n = c$. If we assume that R makes the offers, he will start by offering C nothing ($n = c$). However, C will accept no offer resulting in a payoff ($c - n - d$) that gives him less than the not settle option ($pc - xd$). This means that C only accepts offers where $n < c - pc + xd - d$.

When the bargaining process is reaching the end, R then has the option to give C an offer that he will accept ($n < c - pc + xd - d$) or not. As all facts presented above will be known to R when the bargaining process starts, the Rubinstein model implies that there will be no real bargaining. At the start, R will choose whether to offer an acceptable size of n to C or not. And then it will be over.

$R's$ decision will depend on if he prefers the payoff that the settlement will produce or the one he will get when C establish a panel. The latter will result in either

$u(panel_g) = p(r - c - xd)$ or $u(panel_b) = (1-p) \times (r - xd)$.
The complete utility function for R if he chooses not to settle is consequently:

$$u(not\ settle) = u(panel_g) + u(panel_b) = p(r - c - xd) + (1-p) \times (r - xd) =$$

$$= pr - pc - pxd + r - xd - pr + pxd = r - pc - xd$$

As we can read from the figure that $R's$ utility function for settling with C is $u(settle) = r - c + n - d$
the decision equation for R at this point is to settle if
$r - c + n - d > r - pc - xd$ (that is to say if $pc + xd > c - n + d$);
otherwise not.

5.3.3 Node 1

When C chooses whether to complain to the WTO or not he can expect two different utility functions:
If R wants to settle: $u(settle) = c - n - d$
and if R or not want to settle: $u(panel) = pc - xd$.

As complete information is assumed, C already knows what $R's$ strategy is and hence his choice is simple: if the relevant function exceeds 0 (which will be the outcome if he not complains at all) he should complain, otherwise not.

Summarized, this game consists of three simple steps:

1. C complains if the relevant $u(complain)$ ($pc - xd$ or $c - n - d$) exceeds 0 .
2. R chooses to settle if $u(settle) > u(not\ settle)$ ($pc + xd > c - n + d$).
3. C demands a panel if $u(panel) > u(no\ panel)$ ($pc - xd > -d$).

5.3.4 Strategic form

Of course, the game may also be summarized in its strategic form; this is done in table x.x. The model then boils down to six different strategies, with four different payoffs.

		R	
C	*Strategies*	*Settle* (S)	*Not settle* (N)
	Complain, no panel $(C-N)$	$(c-n-d;\ r-c+n-d)$	$(-d;\ r-d)$
	Complain, panel $(C-P)$	$(c-n-d;\ r-c+n-d)$	$(pc-xd;\ r-pc-xd)$
	Let go (L)	$(0;\ r)$	$(0;\ r)$

5.3.5 Nash equilibriums

But which of these strategies may be rational? Even if the values of the payoffs are not known, those choices that possibly could be Nash equilibria may be solved algebraically. It turns out that four of the six possible outcomes are potential Nash equilibria (to see how this was calculated, see Appendix A). These are:

- $C-P;\ S$
- $C-P;\ N$
- $L;\ S$
- $L;\ N$

Thus, rational players with complete information should end up in one of these four outcomes, which one depends on the specific values of the variables for each case. However, from the algebraic solution it seems that $C-P;\ S$ and $C-P;\ N$ are more likely to occur than the other two.

No matter what, the strategic form could be reduced to figure x.x where each player could choose between two rational strategies.

		R	
C	*Strategies*	*Settle* (S)	*Not settle* (N)
	Complain, panel $(C-P)$	$(c-n-d;\ r-c+n-d)$	$(pc-xd;\ r-pc-xd)$
	Let go (L)	$(0;\ r)$	$(0;\ r)$

5.3.6 What if incomplete information?

Is it realistic to believe that this kind of game really has complete information? Does the model alter – and if so how – if we relax this assumption?

It actually does not seem completely unreasonable that C and R would have exactly the same information (on the assumption that they make the same estimates for p and x) but if something should not be known by all parties at the start of the game it should be the values of r and c. It could be difficult to estimate exactly how a certain measure affects another country (and it is not sure that they would tell you if you asked). However, according to the decisions summary above, r does not influence any choice, only c does. Hence, it does not matter whether C knows r or not but the value of c is important for every decision. But even if c is $C's$ private information at the start of the game, he cannot pass the consultation phase (where C accepts any offer where $n < c - pc + xd - d$) without revealing it to R. Thus, after the second node, all information will be shared, and as the first node only

concerns C (who has complete information), the unknown c does not matter either.

Hence, if p and x are assumed to be accurately estimated, complete or incomplete information would not matter. However, if the parties would make diverging estimates of p and x, it would have implications for the decision-making process. Then, the outcome abolished above of neither a settlement nor a panel would become rationally possible. Because the implications of the Rubinstein Bargaining Model would no longer apply, R could refuse a settlement that C had expected R to accept. Then C could – unexpectedly – end up at the panel choice node where it now seems more rational to let it all go than to continue with the case.

5.4 What happens when a panel report is released?

When a panel report is released the disputing parties finally find out if the case is good or bad. As mentioned above, a case cannot be denoted good or bad only by looking at the panel's report but it is nevertheless a much better indication than the estimated probability that the players use until then. But how do the parties use this new information to adjust their strategies? These strategies are until then built on estimated utility functions which now could be updated and diversified, and as rational players who want to maximize their utility R and C should do this.

If, as is mostly the case, the complaint is approved R finds himself in an uncomfortable situation. He has apparently chosen not to settle because he believed he had a good chance to win but now the opposite seems more likely. The chance that the Appellate Body would reject the panel's judgement is p_r which give a rational R two utility functions to rank (see figure 1). Either he prefers

$$u(appeal) = p_r \times (r - 3d) + (1 - p_r) \times (r - c - 3d) = rp_r - 3dp_r + r - c - 3d - rp_r + cp_r + 3dp_r =$$
$$= r + cp_r - c - 3d$$

or $u(comply) = r - c - 2d$ (to not comply is not a rational option).
As p_r statistically is very small (7%) R must either have very good reasons to believe it to be bigger in his situation or, the value of c must be very big in order to make R take the risk to appeal.

As seen in figure 1, C can only wait while first R and then maybe the Appellate Body make the decisions. Depending on the outcome, he could then either enjoy $R's$ compliance, accept a defeat or start retaliating, neither action demanding any difficult decision-making.

If, on the other hand, the complaint is dismissed by the panel the tables are turned. C can then choose between
$u(appeal) = p_r \times (c - 3d) + (1 - p_r) \times (-3d) = cp_r - 3dp_r - 3d + 3dp_r = cp_r - 3d$
and $u(not\_appeal) = -2d$.
Even if p_r statistically tends to be bigger for C (27%) than for R , C still needs good reason if he should appeal.

Apparently, according to the model there is not much to do after a panel report is released, most of the time the parties should only accept the judgement. The most important decisions are undeniably made before the establishment of a panel.

6 Implications of the model

First of all, the costs that are associated with starting a dispute seem crucial. If it would not be for these costs (d) there would exist no rational economic reason for not starting a dispute as every complainant always could walk out with at least as much as he walked in with. As the DSM works now, C needs to expect that at least his dispute costs will be covered before he makes a formal complain. And these costs are not trivial, Bown – Hoekman (2005) have estimated these to be at least 500 000 USD per turn. Every time the economic losses of R's illicit measure are much higher than the dispute costs it should nonetheless be fruitful to complain.

These findings imply that disputes concerning large amounts of money are more valuable to complain about. As the sums at stake generally are bigger in the developed world than in the developing, this implies that there should be started more disputes in the former than the latter. This implication actually corresponds with the findings of table 3.

Even if a developing country could afford a shorter process, the risk that it may last several rounds could deter it from filing. Thus, it would be in the interest of a developed country to act as hard as possible against developing complainants as it would deter potential future developing complainants to file at all. According to table 7, the number of settled conflicts is the lowest when C is a developing country and R a developed, thus it confirms the model's implication.

The above findings also imply that (according to table 4) the most valuable cases for the member states concern manufactures, agricultural products and horizontal issues while natural resources and services are of less value. This does not seem to correspond as good with reality and the disparity probably need other explanations.

The next crucial variable in the model is p as pc always affects $C's$ initial choice to file or not (either directly in $pc - xd > 0$, or indirectly as $R's$ choice whether to settle or not depends on pc). This means that most filed measures should be very probable to be illicit as the higher risk to lose otherwise would make it unattractive. According to table 8, almost 80% of the complaints were approved, thus confirming the model's implication.

But what about the possible outcome of neither a settlement nor a panel? With the assumptions made (including complete information), this outcome seems completely irrational but nonetheless more than one third of the cases end up here according to table 5. The complete information model fails to

explain this behaviour, if it was only cases where C was developing and R developed it could be explained by the deterrence factor described above but according to table 7 it is a common outcome irrespective of parties. With incomplete information one other explanation is added: if C and R has different conceptions of the two estimated variables, x and p, C may have misjudged $R's$ interest in reaching a settlement. But it seems to be much more common in reality than in the model.

It is neither possible to explain the behaviour of some complainants in when choosing between retaliation and implementation appeal, those who have chosen the latter in table 12 seem to have acted irrational.

7 Conclusions

The game theoretic model for WTO member states' behaviour in the DSM outlined in this thesis is in many ways a very unrealistic one. For example, it only treats the direct costs and benefits of a perceived illicit measure while there exists an infinite number of different indirect utilities in the real world. Furthermore, it has a bias towards economical factors as the utilities used more or less corresponds to economic values (of course, for example c could signify both the strictly economical loss for C as well as other experienced, non economical, costs but to the biggest part it is the economical reasons that have been evaluated). Nevertheless, there exist a rather good correlation between what the model implies and what the reality looks like. Except a few drawbacks concerning the heavy use of a strategy that results in neither a settlement nor a panel and the choice of implementation appeal instead of retaliation. However possible explanations to these seemingly irrational strategies may be found in related or future research. If the model were expanded to include more features those strategies could become rational. However, too many aspects added reduce the predictive capacity of game theory as each case then will have a whole lot of variables that must be estimated. One single mistake during that procedure would ruin the predictability. What is gained in accuracy is consequently lost in predictability. Hence it is uncertain that a more thorough elaborated model would have generated any better results.

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Appendix A

Nash equilibriums

1. Complain, no panel; Settle (C-N; S) - **False**

$P_C(C-N;\,S) \geq P_C(C-P;\,S) \Rightarrow c-n-d \geq c-n-d$ (true)
$P_C(C-N;\,S) \geq P_C(L;\,S) \Rightarrow c-n-d \geq 0$ (true)
$P_R(C-N;\,S) \geq P_R(C-N;\,N) \Rightarrow r-c+n-d \geq r-d$ (true)

Each equation is true on its own but all three equations cannot exist at the same time as we then would get the expression:
$(0 \geq d)$
which is false as $d > 0$. Thus, this outcome cannot be a Nash Equilibrium.

2. Complain, no panel; Not Settle (C-N; N) - **False**

$P_C(C-N;\,N) \geq P_C(C-P;\,N) \Rightarrow -d \geq pc-xd$ (true)
$P_C(C-N;\,N) \geq P_C(L;\,N) \Rightarrow -d \geq 0$ (false)
$P_R(C-N;\,N) \geq P_R(C-N;\,S) \Rightarrow r-d \geq r-c+n-d$ (true)

As equation number two is false in itself (as $d > 0$) this outcome cannot be a Nash Equilibrium.

3. Complain, panel; Settle (C-P; S) - **True**

$P_C(C-P;\,S) \geq P_C(C-N;\,S) \Rightarrow c-n-d \geq c-n-d$ (true)
$P_C(C-P;\,S) \geq P_C(L;\,S) \Rightarrow c-n-d \geq 0$ (true)
$P_R(C-P;\,S) \geq P_R(C-P;\,N) \Rightarrow r-c+n-d \geq r-pc-xd$ (true)

Each equation is true on its own and all three can exist at the same time. Thus, this outcome can be a Nash Equilibrium.

4. Complain, panel; Not settle (C-P; N) - **True**

$P_C(C-P;\,N) \geq P_C(C-N;\,N) \Rightarrow pc-xd \geq -d$ (true)
$P_C(C-P;\,N) \geq P_C(L;\,N) \Rightarrow pc-xd \geq 0$ (true)
$P_R(C-P;\,N) \geq P_R(C-P;\,S) \Rightarrow r-pc-xd \geq r-c+n-d$ (true)

Each equation is true on its own and all three can exist at the same time. Thus, this outcome can be a Nash Equilibrium.

5. Let go; Settle (L; S) - **True**

$P_C(L; S) \geq P_C(C - N; S) \Rightarrow 0 \geq c - n - d$ (true)
$P_C(L; S) \geq P_C(C - P; S) \Rightarrow 0 \geq c - n - d$ (true)
$P_R(L; S) \geq P_R(L; N) \Rightarrow r \geq r$ (true)

Each equation is true on its own and all three can exist at the same time. Thus, this outcome can be a Nash Equilibrium.

6. Let go; Not settle (L; N) - **True**

$P_C(L; N) \geq P_C(C - N; N) \Rightarrow 0 \geq -d$ (true)
$P_C(L; N) \geq P_C(C - P; N) \Rightarrow 0 \geq pc - xd$ (true)
$P_R(L; N) \geq P_R(L; S) \Rightarrow r \geq r$ (true)

Each equation is true on its own and all three can exist at the same time. Thus, this outcome can be a Nash Equilibrium.