Essays on Institutional and Macroeconomic Aspects of International Trade

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Abstract

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The overarching theme of this dissertation is the analysis of institutional and macroeconomic factors that shape and interact with international trade. Chapters 1, 2 and 4 of this dissertation examine how institutional arrangements impact trade policy decisions and bilateral trade flows, while chapter 3 analyzes how the structural composition of trade affects macroeconomic development.

Chapters 1 and 2 focus on the emergence of trade disputes in the World Trade Organization (WTO). Starting out in chapter 1 with a thorough stylized facts analysis of the usage pattern of the WTO dispute settlement mechanism, chapter 2 develops and empirically tests a model of members' selection into WTO disputes which can account for a number of key discoveries in the data. In particular, I extend the standard WTO theory by incorporating a link between endogenous trade policy formation and agreement violation and dispute filing decisions. I show that countries are more likely to engage in trade disputes as complainants or defendants when they have a small "tariff overhang", which represents the difference between bound tariffs (by WTO negotiations) and the actually applied tariffs.

Chapter 3 considers the question whether the structure of a nation's trade flows has a clear-cut effect on economic growth. In the growth determinants literature, numerous alternative candidate regressors have been motivated by alternative theories but not one trade regressor has been robustly related to growth. Instead of relying on aggregate trade

measures as previous studies, chapter 3 proposes a structured approach and examines the diversity of sectoral exports as a potential growth determinant. Controlling for model uncertainty and endogeneity, chapter 3 shows that export diversity serves as a crucial growth determinant for low income countries, an effect that weakens with the level of development.

Chapter 4 examines to what extent underlying differences in the design of preferential trade agreements (PTAs) are responsible for the observed heterogeneity in PTA effects on bilateral trade flows. Controlling in the estimation framework for multilateral resistance terms and bilateral heterogeneity to reduce omitted variable and endogeneity biases, chapter 4 shows that PTAs focusing on goods trade liberalization and the legal enforceability of agreement provisions are most successful in raising trade flows. Moreover, countries' efforts to harmonize product standards and other regulations decrease bilateral trade flows, at least initially. The results also show that the underlying agreement dimension effects mostly operate through the intensive margin of trade.

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DEDICATION

To my parents.

Chapter 1

WTO DISPUTE SETTLEMENT PARTICIPATION: A STYLIZED FACTS ANALYSIS

1.1 Introduction

Since its inception in 1995 the World Trade Organization has been described by most commentators as being one of the more successful multilateral organizations that were created after the Second World War. Although recent progress has been slow – with the first elements of the Doha Round having finally been passed after 12 years in December 2013 – impediments to trade have declined significantly since the creation of the GATT in 1947 and under its successor, the WTO. The major European economies and the United States, for instance, reduced their average applied tariff levels from high double-digit rates in the early 1930s to 5.2 percent and 3.5 percent in 2007, respectively (Bown, 2009). Besides reducing tariff levels and limiting the use of non-tariff measures, the WTO has been particularly praised for the introduction of a legal-based trade dispute settlement mechanism. This chapter of the dissertation provides an overview of the key statistics and potential determinants of the trade dispute pattern that has emerged in the WTO since 1995.

While it was already possible for member states to address trade policy issues in an official setting under the GATT, the dispute mechanism prior to 1995 suffered from its reliance on the positive consensus principle. That is, prior to 1995 individual member states of the GATT could veto dispute settlement decisions or even the adoption of a dispute settlement panel. The WTO Dispute Settlement Body (DSB from now on), on the other hand, has a legal basis and relies on the concept of negative consensus, that is, a ruling of the DSB stands unless there is a consensus of all WTO members against it. In addition to abolishing the positive consensus requirement, the WTO dispute procedure has been also equipped with a more stringent timeline during which disputes need to be resolved. Overall, the WTO DSB is potentially a major stepping stone towards trade liberalization

due to at least three reasons. First, the DSB's new legal foundation has reduced member states' uncertainty regarding the enforcement of previously negotiated trade policies. As shown by Handley (2011), reducing uncertainty could be one of the WTO's major roles in stimulating companies' export decisions. Second, as argued by Maggi and Staiger (2011), the DSB is better equipped to fill gaps in the WTO agreement. This role seems to be even more important given the fact of how long it takes member countries to conclude new trade rounds altering the nature of the WTO agreement. And third, compared to the old GATT system, the DSB could function as a better signaling device to third countries (read as non-participants in disputes), leading in turn to a higher compliance rate of WTO members with existing agreement provisions (Maggi, 1999).

Although the potential benefits of the WTO dispute settlement mechanism seem to be substantial, there is no comprehensive study in the economic literature that explicitly tries to evaluate the potential economic impact of the WTO DSB. That is, to what extent does the presence of the DSB have a trade liberalizing effect, either measured directly in form of protection measures, or indirectly by its impact on trade volumes?[1] A major difficulty in answering this question is the potential presence of a selection bias in the choice of trade disputes which are brought to the attention of the DSB. If the current institutional design of the WTO's dispute mechanism favors a particular group of countries, any of the potential benefits listed above could be reduced or even reversed. It is therefore crucial to understand in a first step countries' incentives to select into trade disputes.

Existing studies on the subject often argue that country size and trade volumes between countries are mainly responsible for the emerged dispute filing pattern between WTO members. Bown (2002, 2004b) shows that countries with more power over their terms of trade are more likely to deviate illegally from the GATT/WTO agreements. Horn et al. (2005) argue that the emerged sample of WTO disputes can be explained by the existing structure of sectoral trade flows between countries. Bown (2005) provides empirical evidence that the probability of being a complainant in a WTO dispute increases both in sectoral exports to and total imports from the defendant, the latter being a measure of the complainant's

[1] Bown (2004a) evaluates empirically which factors determine GATT/WTO dispute defendants' trade liberalization efforts, as measured by changes in sectoral trade volumes after a dispute is concluded. However, possible selection issues in dispute filings are not addressed in Bown's study.

retaliation capacity. He also provides evidence that political economy aspects, such as preferential trade agreements, can impact the dispute filing decision. And Sattler and Bernauer (2011) show empirically that trade volumes and economic size, as measured by GDP, are positively related to the total number of WTO disputes between country pairs. Overall, these studies indicate that no group of WTO members is disadvantaged by the current dispute settlement mechanism, since WTO dispute participation seems to just mirror world trade patterns. This chapter re-visits the issue and investigates whether there are factors beyond gravity variables which matter for WTO agreement violations and dispute initiations. In doing so, I proceed in two steps. I first present a number of stylized usage facts with regard to the usage of the DSB by WTO members. The main focus will lie on identifying patterns which cannot be entirely explained by the gravity argument. Two stylized facts stand out in particular. First, trade volumes and GDPs of most member countries have increased significantly since the inception of the WTO in 1995 while simultaneously trade disputes steeply declined after the late 1990s. And second, there is a disproportionate number of disputes in certain sectors relative to their actual economic importance. Why, for instance, do we observe so many disputes dealing with agriculture and textiles although these sectors' actual share in world trade is relatively low?

In section 1.3, this chapter then considers several potential causes of the emerged dispute pattern presented in the first part. In doing so, I examine both potential micro- and macroeconomic explanations for the emerged dispute pattern between WTO member countries. Two results emerge that deserve particular attention. First, sectoral trading activities clearly matter. Countries with more active import and export sectors are more likely to participate in trade disputes. Furthermore, countries tend to file disputes against their most important sectoral trading partners. And second, the sectoral structure of bound and applied tariff rates is an important determinant for a complainant country's choice who to target in a trade dispute. I show that the sectoral distribution of tariff overhangs, that is, the difference between negotiated tariff bindings and effectively applied tariffs, is crucial in understanding the structure of dispute filings in the WTO.[2] In particular, a WTO member

[2] The fact that WTO member countries negotiate tariff bindings and not applied tariff rates has not been considered in the commercial policy literature until fairly recently. Bagwell and Staiger (2005), Handley

country is more likely to be named as defendant in a WTO dispute if it has a tighter tariff overhang compared to other trading partners of the complaining country in the sector(s) at issue.

In focusing on dispute characteristics which have not received much attention up to now, this chapter also provides a novel view on the question whether the WTO DSB has indeed been a contributor to trade liberalization. Although the focus on the emerged WTO dispute pattern allows only for a preliminary test of this hypothesis, the results are crucial for future research aiming at reliably estimating the true economic impact of the DSB. Besides allowing for a more accurate assessment of the economic success of the WTO DSB, the selection pattern into WTO disputes is of interest for at least two other reasons. First, knowing more about countries' selection into WTO disputes allows us to judge to what extent the observed structure of trade disputes is representative of the underlying disagreement over trade policies among WTO members. And second, the Dispute Settlement Understanding (DSU), the legal agreement behind the WTO DSB, is one of the main areas of negotiation in the Doha Development Agenda (DDA). If selection issues inhibit the use of the WTO DSB, the selection pattern could serve as a guideline for the renegotiation of the DSU in order to make the system more accessible for countries (and sectors) that so far have rather shied away from engaging in trade disputes.

The remainder of the chapter is structured as follows. Section 1.2 identifies a number of stylized facts with regard to the usage of the WTO's Dispute Settlement Body by its member countries. While some of these facts might be already known by readers who are familiar with the WTO dispute literature, they nevertheless provide an important benchmark to which I return when addressing potential causes of the observed pattern in the data. Section 1.3 provides a detailed analysis of why countries decide to file disputes in certain sectors against specific member countries while abstaining in other instances. In doing so, I focus on factors commonly considered in the literature and, which is the most novel feature of this chapter, tariff overhangs. Section 1.4 concludes. Appendix A contains all tables and

(2011), Beshkar et al. (2012), Beshkar and Bond (2012) and Handley and Limão (2012), among others, have started to correct this apparent disconnect between theory and practice. Their results indicate that tariff overhangs are an important trade policy instrument which is crucial in evaluating the economic impact of the WTO.

graphs to which this chapter refers.

1.2 Stylized Facts on the Usage of the WTO Dispute Settlement Body

1.2.1 Basic Definitions

In the remainder of this chapter, I follow the convention in the literature and define the emergence of a WTO trade dispute when a member country alerts the DSB that it has filed an official request for consultations with another member country with regard to a specific trade policy issue. In case multiple member countries file a request for consultations with another member country, each country pair is counted as having a separate dispute. Several statistics below will also be presented by the industry sectors cited in the requests for consultations. Unless otherwise noted, each dispute sectors will be treated as a separate entity. If one dispute, for instance, cites three industry sectors and a second dispute cites one industry sector, the data from all four industry sectors will be considered separately instead of taking averages over the three sectors in the first case and just presenting two data points. Statistics for the individual member states of the European Union will not be reported, since the EU forms a customs union with a unified external trade policy. Additional definitions and data sources are provided in passing below.

1.2.2 Complainants and Defendants in WTO Disputes

Let us first take a look at the time series of cases brought to the attention of the WTO DSB. Table A.1 depicts the total number of disputes filed between 1995 and 2011, as well as a breakdown by the complaining countries' income classification. The income group definitions are taken from the official World Bank classification for each respective year.[3] In 2011, the income categories for countries in per-capita terms were: low income ($1,005 or less), lower middle income ($1,006 to $3,975), upper middle income ($3,976 to $12,275) and high income ($12,276 or more). As of the end of 2011, 27 of the 153 WTO member countries (not counting Vanuatu, Russia, Montenegro and Samoa who had been admitted, but whose

[3] The World Bank uses for its classification gross national income per capita, the historical thresholds are available at http://data.worldbank.org/about/country-classifications/a-short-history.

memberships were still subject to those countries' ratification) are classified as low income, 38 are lower middle income, 39 are upper middle income and 49 are high income economies.

Table A.1 and Figure A.1 indicate two trends in the filing of official WTO disputes. First, the overall number of cases reached its peak with 51 in 1996, shortly after the new dispute settlement system was introduced.[4] The left panel in Figure A.1 shows a steady downward trend in requests for consultations thereafter. In 2011, an all-time low was reached with only eight filed cases. And second, the decrease in the total number of complaints since the late 1990s is mainly due to fewer complaints by high income countries. This fact is also supported by the right panel in Figure A.1, which focuses on the number of complaints by non-high income countries and shows no clear trend over time for any other income group. Overall, around 80 percent of all WTO disputes over time have been either filed by high-income or upper middle-income countries. Whether this disproportional participation of richer countries is due to unfavorable conditions in the dispute settlement mechanism for poorer WTO members is an important question which I will address below.

Table A.2 disentangles filings by complainants on the country level. Three observations are particularly noteworthy. First, the United States and the European Union are the most frequent users of the WTO DSB. Their dominance is particularly striking during the first few years after the new dispute settlement mechanism was introduced. And while we can observe for most countries a clear downward trend in the number of filed complaints over time (except for Argentina, Korea and China), the reduction in American and European complaints has been remarkably higher than for all other countries. Second, the economic size of a country and trade volumes do not seem to be the only determinants of the number of dispute filings. Japan, for instance, has filed relatively few disputes compared to other countries which are smaller in economic size and trade less in absolute terms, such as Mexico, India or Argentina. And third, similar trends also hold for the income aggregates of those countries that are not separately included in Table A.2. For instance, there is a substantial drop in filed cases since 1995 for high income countries other than the US, the EU, Canada, Korea and Japan. Interestingly, lower middle income economies other than India, China

[4] Note that the total number of disputes in Table A.1 exceeds the official count of 427 disputes. This is due to the fact that in case multiple countries filed a dispute, each country's filing is treated as an individual filing.

and Thailand are the only country group which filed a roughly constant number of cases during all time periods.

After having discussed the patterns among the filers of complaints in the WTO dispute settlement mechanism, let us turn our attention to the defendant side. Table A.3 repeats the analysis from Table A.1, but this time the number of disputes is disentangled by the income status of the defendant country. The general income pattern of defendant countries is similar to the one for dispute initiators presented in Table A.1. The clear majority of cases was also filed against high income countries. However, over time the share of disputes with high income defendants has decreased from over 80 percent in 1995 to below 60 percent after 2005. Nonetheless, Figure A.2 illustrates that the decrease in dispute filings is mainly due to a decrease in the number of filings against high income countries. The right panel also shows that no clear trends can be detected for defendants in other income groups.

Table A.4 presents an overview of the individual countries which have received the most requests for consultations since 1995. The table indicates that the recent drop in the share of high income country defendants is mainly due to the increased number of official complaints against China. While the number of received complaints has decreased over time for most countries (except for Mexico and Chile during 2001-2006), China stands out as the only country that has received an increasing number of complaints since it joined the WTO in 2001.

Looking at Table A.4, we can also observe that either the United States or the European Union were defendants in nearly every second dispute, implying that these two members dominate the defendant side of disputes even more than the complainant side. It is noteworthy that in the most recent period considered in Table A.4, 2007-2011, the United States, the European Union and China accounted together for over 70% (50 out of 71) of the defending parties. In addition, upper and lower middle income economies seem to constitute the most diverse defendant groups in the sense that many countries in these two groups were defendants in disputes over time but not in enough cases to be listed individually as one of the most frequent defendants.

In the next step, let us turn our attention to country pairs which have been most frequently involved in WTO disputes. Table A.5 depicts the country dyads which so far

fought the most disputes in the WTO. The statistics are disentangled by the same three time periods which were already used in Tables A.2 and A.4. The initiation pattern of disputes in each period is shown in parentheses, with the first number indicating the number of disputes initiated by the country listed first. Table A.5 only depicts the time pattern of dispute filings for country pairs which in total had four or more trade disputes. Not surprisingly, the European Union and the United States had the most disputes among all member countries of the WTO. In addition, either country shows up in most dispute pairs in Table A.5. Interestingly, for most country pairs, except for US – China and EU – India, it was not the United States or the European Union which filed the majority of disputes but the respective dispute partner. It is also noteworthy that trends in the overall dispute initiation patterns do not necessarily translate to similar trends across different time periods. Extreme examples include the country pairs Mexico – United States, Brazil – United States and European Union - Argentina. For all three pairs, there are sub-periods during which dispute initiation patterns deviate, in part considerably, from the overall picture. This fact indicates that countries tend to bundle cases against certain countries during some periods while they might decide to abstain from filing against specific countries during other times.

1.2.3 Disputes by Stages and Agreements

So far, all disputes have been treated as equivalent observations. That is, a dispute was counted when a WTO member requested official consultations with another country with regard to certain measure imposed by the latter. However, not all WTO disputes go to the same stage of the dispute settlement process. Table A.6 breaks down all cases by the reached dispute stages.[5] Before discussing in detail the statistics on the current state of disputes in Table A.6, it should be noted that cases which are counted by the WTO as *still in consultations* also include many disputes that have not been active for many years. For 1995, for instance, there are five cases which are still counted as being in consultations. However, it seems more likely that these cases have been concluded a long time ago without official notification to the dispute settlement body. The count of 140 disputes as still being in consultations is therefore likely to be an exaggeration.

[5] Source: http://www.wto.org/english/tratop_e/dispu_e/dispu_current_status_e.htm, as of September 2012.

Of the 455 initiated disputes, 97 ended with a mutual agreement to terminate them (or were withdrawn by the complainant). 52 disputes ended with the respective respondent's acceptance of the panel verdict while another 109 cases ended after the acceptance of the ruling issued by the appellate body panel. In another 32 cases compliance proceedings were necessary after a panel or appellate body ruling, such as the establishment of a panel to evaluate the implementation of a previous ruling. Overall, 193 panel reports (not counting cases where a mutually agreed solution was found) were issued by the DSB in so far 290 concluded cases. Of the 193 disputes for which a panel report was issued, 136 disputes were appealed by either one or both parties to the dispute. Thus, while only every second dispute went to the panel stage, 70 percent of all panel rulings were also appealed by at least one party to the dispute. This high share of appeals hints at the possibility that only very controversial cases reach the panel stage. That is, the panel stage of the DSB seems to rather fulfill the function of a court instead of an arbitration device.

Having provided statistics on the current state of disputes, it is also interesting to take a closer look on the question which WTO agreements give rise to the most disputes among member countries. Table A.7 lists the number of disputes filed per WTO agreement. Note that many disputes involve more than one WTO agreement, resulting in a sum of disputes greater than 455 in Table A.7.[6] Table A.7 shows that nearly all requests for consultations within the WTO's dispute settlement mechanism cite one or more articles of the most fundamental WTO agreement, the General Agreement on Tariffs and Trade (GATT). Disputes involving intellectual property (TRIPS) and services (GATS), on the other hand, seem to be considerably less frequent than common perception would suggest. Furthermore, Table A.7 indicates that disputes involving agricultural products take up a disproportionate share compared to other goods. At the same time, anti-dumping measures and export subsidies are in the center of nearly half of all disputes.

[6] The data in Table A.7 was compiled using the dispute settlement database provided by Henrik Horn and Petros C. Mavroidis, which is available at http://go.worldbank.org/X5EZPHXJY0 .

1.2.4 The Timing of Disputes

Having provided evidence that certain country pairs meet much more frequently in the WTO disputes than others, it is of particular interest whether disputes follow a certain time pattern. For instance, does the initiation of a dispute by country A against country B lead frequently to a prompt initiation of a counter-dispute by country B against country A out of purely retaliatory motives? Although not an ultimate proof for the importance of retaliatory concerns in the filing of disputes, we can look at the timing of requests for consultations between country pairs for some preliminary evidence. Allowing for different time frames between the initiations of disputes (3 months, 6 months, 12 months, 2 years, 3 years and more than 3 years), Table A.8 lists the number of cases which could fit this retaliation pattern. Before discussing the evidence on potentially retaliatory dispute filings in detail, a few words of caution are warranted. Although retaliatory motives might foster dispute filings, they can be at best interpreted as a catalyst for trade quarrels but not their underlying cause. Filing a case without any valid claim would be a pointless exercise for any WTO member, since it could jeopardize its international reputation. I therefore take up the timing of dispute filings here and not in section 1.3 which analyzes in detail potential determinants of dispute filings.

Table A.8 shows that more than half of all 455 disputes were filed after the respective defendant country had previously filed a dispute against the current complainant country. In 217 disputes, retaliatory motives can be ruled out from the outset due to fact that previously no cases were filed by the opposing country. This number includes country pairs between which only one dispute occurred, country pairs in which only one side filed cases, and country pairs which started their confrontations with filing stretches by one party that were not interrupted by counter-filings by the opposing country.

If disputes are randomly filed between country pairs, we would expect that the timing of country B's dispute filings should be independent of country A's dispute filings. That is, roughly the same number of disputes should be filed by country B during each period after country A's initial request for consultations. Column (2) of Table A.8, however, does not take into account that countries will also file cases independently of any retaliation

concerns. In column (4), I account for this fact by calculating the expected number of cases that all countries which actually filed a case during the respective time period should have filed based on their general filing behavior.

Let me illustrate the calculation of the number of expected complaints in column (4) via a simple example. Suppose the United States filed a potential counter-complaint against the Philippines 158 days after the last dispute filing of the Philippines against the US. During the 17 years of the DSB's existence, the US filed 98 cases, or on average 0.0158 cases per day. Thus, within a given 158 day window, the US should file on average 2.496 cases. Since this case would be counted towards the 3-6 months window in Table 8 below, we have to subtract from this number the average number of cases the US would file in the first 90 days, 1.422 cases, to obtain the average (or expected) number of cases the US would file during a given 91–158 day window. Repeating this sort of calculation for every potential counter-complaint and summing over all cases we obtain the expected number of complaints in column (4) of Table A.8. By subtracting the expected number of complaints in column (4) from the actual number of potential complaints in column (2), I successfully control for the fact that some countries file cases with a very high frequency while others are not very active users of the WTO's dispute settlement mechanism.

Table A.8 indicates that retaliation concerns could be indeed a driving force behind countries motivations to initiate a dispute. Around 50 percent of all potential counter-complaints are filed within one year after the filing of the initial complaint by the other country, with most potential counter-complaints actually occurring within the first three months. 70 percent of all potential counter-complaints are filed within the first two years of the initial complaint, and the share of complaints continues to decrease with the time passed since the initial dispute was filed by the other country. However, as already noted above, we should not put too much weight on the raw number of potential counter-complaints in column (2). It is more meaningful to look at the divergence between the actual and expected number of filed cases in column (5). The numbers clearly indicate that within the first 12 months after the filing of a case it is much more likely for the initial complainant to be the receiver of a complaint than predicted by the average filing behavior of the original defendant country. Overall, 60 (or over 100 (!) percent) more requests for consultations

were submitted than expected within the first 12 months. Note that the expected and actual case numbers converge between years 2 and 6 while the number of expected cases is much larger than the actual number of filed after year 6.

The tilted distribution in the timing of potential counter-complaint filings is also illustrated by Figure A.3. The left panel depicts the histogram of the unadjusted number of filed disputes using 90-day bin intervals. The right panel adjusts the raw numbers in the left panel using a similar procedure as outlined for Table A.8, the only difference being that the expected case numbers are calculated over regularly spaced 90-day intervals. In contrast to Table A.8 we do not observe any negative values in the right panel. This difference is due to the fact that I have applied a regular spacing of 90 days in plotting Figure A.3 instead of the yearly adjustments partially used in Table A.8. Both panels in Figure A.3 indicate that retaliation motives could matter in countries' decision to file a dispute, although the adjusted complaints data shows a reduced right skewness compared to the raw data.

One drawback of Table A.8 and Figure A.3 is that they mix the timing of potential counter-complaints for different country pairs. In other words, they neglect the fact that the potential for counter-complaints could differ across country pairs. I therefore also check whether a similar pattern holds for individual country pairs. Figure A.4 shows the histogram for the timing of potential counter-complaints between the European Union and the United States. Similar to Figure A.3 the left panel depicts the raw number of potential counter-complaints while the right panel accounts for the expected number of cases in the absence of potential retaliation motives. It is evident from Figure A.4 that the right skewness in the timing distribution of potential counter-complaints is also observable for cases that only involve the country pair United States/European Union. However, the pattern is much less distinct when controlling for the number of expected case filings. Due to the limited number of observations, repeating an analogous analysis with other country pairs is not likely to offer much additional insights. In general, the timing of WTO disputes suggests that a number of past filings have been induced by retaliatory motives of dispute defendants. However, the evidence on the individual country pair level is much weaker than when aggregating potential counter-complaints across country pairs.

1.2.5 Outcomes of Disputes

A complainant's expectation about the chance to succeed in a trade dispute is a potentially important determinant of dispute filing decisions. I therefore analyze in the next step the pattern of WTO dispute outcomes. In particular, do complainants tend to prevail frequently when WTO disputes advance to a panel, or do defendants stand good chances to go through disputes without having to fear a disadvantageous ruling? Similarly, it is also of interest to know more about countries' chances to succeed with appealing a panel ruling.

Table A.9 depicts the number of claims in disputes by complaining countries against defending countries and how many times the panel ruled in favor of the complainant for those disputes in which panel reports were circulated. A claim is defined in this context as a provision or paragraph of an agreement which has been allegedly violated by the defendant country and has been specified by the complainant country. The same is done for cases that went to the appellate stage and for which an appellate report was circulated by the appellate body of the WTO DSB. The claims data was compiled using the earlier mentioned dispute settlement database by Henrik Horn and Petros C. Mavroidis (last updated in November 2011). The statistics for the appellate body rulings are also broken down by defendant/complainant status of the claimant in the original dispute.

Note that in both the panel and appellate stages most claims also received a ruling. The remaining claims can be suspected, at least for the most part, to have not received rulings by the panel or appellate body due to "judicial economy", that is, the decision on another claim which made a ruling on the claim at issue unnecessary. Two thirds of the claims which received a ruling during the panel stage were in favor of the complaining country, indicating that the initiation of most disputes which went to the panel stage was justified. In fact, when taking a closer look at the more disaggregated data, there are only seven disputes in which all claims were ruled in favor of the defending country.

The picture looks a little different for the appellate stage of the dispute settlement procedure. Interestingly, the clear majority of claims made by parties in the appeal of a panel ruling are rejected by the appellate body of the WTO. Overall, when combining both claims of the original defendant and complainant in a dispute, only around one quarter

of all claims put forward in the WTO appeals process are ruled in favor of the claimant. This finding indicates that only a minority of panel rulings are reversed by the WTO Appellate Body. Table A.9 also shows that it is important to differentiate between claims made by the original dispute complainant and defendant when considering the rulings at the appellate stage. The clear majority of claims during the appellate stage is brought forward by defendant countries, indicating that defendant countries are indeed losing cases more frequently during the panel stage. At the same time, even if a defending country knows that it is in the wrong, it might be inclined to appeal a panel ruling in order to gain time until it has to implement a DSB ruling. This point could also explain why defending countries win a much lower percentage of claims during the appellate stage than original complainants do.

In order to detect potential time dynamics in claims won by WTO members, it is worthwhile to disentangle the claims data by years. Table A.10 shows the annual average of claims per claimant, the annual average of victories per claimant per year and the annual average likelihood of a claimant to win its claim. The two latter statistics are insofar of interest that a potential drop-off in both measures could offer a potential explanation for the declining number of observed disputes over time. Note that a claimant in Table A.10 is defined as a country which files claims during the panel or the appellate stage. Since both the initial defendant and complainant can file claims during the appellate process, it is possible to have up to three claimants in one single dispute (initial complainant at panel stage, initial complainant at appellate stage, and initial defendant at appellate stage).

There are at least two interesting observations which we can draw from Table A.10. First, while the number of filed disputes has decreased over the years, it is not true that the average number of claims that countries filed during the panel or the appellate stage has systematically fallen. The number of filed cases therefore does not seem to be directly related to the number of claims countries fight over in a given case. And second, the average likelihood of winning a claim per claimant seems to follow a specific pattern. Between 1996 and 1999 the average likelihood for a given claimant to win a claim was over 60 percent which, at least in part, is considerably higher than in most years thereafter. Only in 2009 and 2010, the average likelihood reached again higher levels. However, in both these years

the number of claimants on which the averages are based is rather low. The last column depicts in parentheses the respective victory shares for claims solely in the panel stage. A similar pattern holds there; between 1996 and 1999 the probability to win a claim was at least 80 percent, which was never reached again in the years thereafter. One possible explanation is that in the first few years after the new dispute settlement mechanism was introduced countries tended to file disputes in which they were relatively confident to receive a beneficial ruling. In the following years, especially between 2000 and 2006, the success of submitted claims dropped significantly which could be one of the explanations why the number of filed disputes decreased so much in the 2000s compared to the late 1990s.

Another interesting feature of the data is that many all-or-nothing rulings can be observed. That is, a claimant is likely to either win or lose all of her claims when a panel or the appellate body issues a ruling. This conclusion is backed by Figure A.5 which presents a histogram of the victory shares (or likelihood to win a given claim) per claimant for all 355 claimants in the dataset. In fact, 188 of all 355 claimants in the panel and appellate stages of the WTO DSB either win or lose all their claims. This feature of the data indicates that many WTO disputes are actually not as controversial as one would think, at least in the view of the DSB.

1.2.6 Disputes by Products

Having provided statistics on the outcomes of disputes and which agreements are most frequently cited in official requests for consultations, it also proves fruitful to determine those product groups which are most frequently in complaints. Given the fact that the HS classification of products is used by complainants in official requests for consultations in the WTB DSB, I disentangle dispute filings on this basis.[7] Data on HS product citations in consultation requests is provided in the dispute settlement database by Henrik Horn and Petros C. Mavroidis. For the analysis of disputes by product categories, I aggregated all HS citations in consultation requests to the 2-digit HS level.[8] The 2-digit HS sectors are

[7] HS is the acronym for the Harmonized Commodity Description and Coding System which is a multipurpose international product nomenclature developed by the World Customs Organization (WCO).

[8] Most consultation requests specify the product category at a finer level than 2 digits. If for a given case multiple product categories within a 2-digit level are specified, all cases are counted as a single complaint

then grouped into 22 different industries using the official HS schedule definition. Figure A.6 depicts a bar chart of product categories cited in WTO disputes (sorted by industries). Table A.11 describes in detail the exact matching of all 2-digit HS categories into the different HS industry sections. Note that due to the possibility of multiple category listings in a dispute, the total number of cited 2-digit HS categories exceeds the total number of filed cases.

Three observations in Figure A.6 are particularly noteworthy. First, the biggest share of product categories cited in disputes falls on agricultural goods or other products manufactured thereof, which can be found in sections I to IV in Figure A.6. Second, this observation is not solely driven by the high number of 24 2-digit HS sectors in sections I-IV. Looking at more disaggregated data (not shown), it is also the case that 8 out of the 10 most cited 2-digit HS categories in WTO disputes are agricultural or food products. These two observations together indicate that the agricultural sector, although having only a share in total world merchandise trade of 9.8 percent (according to the WTO's International Trade Statistics 2010), is the subject of disproportionately many WTO disputes. The same observation also applies to the textile industry (sector XI) which, according to the same source, makes up only 1.7 percent of world merchandise trade. And third, except for clothing and steel, manufacturing industries in general tend to be much less frequently the topic of trade disputes than their total share of 68.8 percent in world merchandise trade would suggest. These numbers indicate that trade volumes might not be the sole motivator for trade disputes. This point is also confirmed by Figure A.7 which depicts for all industry sections their respective shares in all WTO dispute citations and their corresponding shares in trade among WTO members. The latter measure is calculated using annual trade data from Comtrade for the years 1995-2011. In particular, the annual trade share of each industry is averaged over all years to obtain the trade share measure in Figure A.7.

For a non-negligible number of complaints (151 out of 455), however, no HS categories are specified in the above mentioned dispute settlement database. Where possible, the affected product categories were hand-matched at the 2-digit level using the product descriptions

in this particular 2-digit HS category. Suppose, for instance, a complaint refers to categories HS 030310 (Pacific salmon) and HS 030322 (Atlantic and Danube Salmon). Then both categories are summarized and counted as one complaint in the 2-digit HS category 03 (fish and crustaceans, mollusks and other aquatic invertebrates).

in the request document.[9] Figure A.8 below repeats the analysis from Figure A.6 but this time also includes the hand-matched product categories for 92 of the 151 disputes with missing HS classifications. The remaining 59 disputes could not be assigned to HS categories due to their general nature. These disputes cover, for instance, issues related to patent protection, financial services or provisions in antidumping and subsidy legislation. When comparing Figures A.6 and A.8, we can observe that the general sorting pattern of disputes into industries does not change much when adding the hand matched dispute data to the sample. Agricultural and food industries are still the subject in a substantial portion of disputes. 699 out of all 1582 cited HS2 categories in disputes belong to these sectors. Furthermore, the textile, agriculture and food sectors are still disproportionately cited in WTO disputes compared to their actual importance in world trade. A figure (not shown) along the lines of Figure A.7 that includes also hand-matched dispute citations produces very similar results to Figure A.6. Note that when including hand-matched categories, the sample size of industry sections cited in WTO disputes increases from 848 to 1582. The inclusion of hand-matched cases could therefore alter the pattern in the data substantially. Thus, the fact that Figures A.6 and A.8 lead to similar conclusions suggests that classification errors are not a first order issue.

1.3 Potential Determinants of WTO Dispute Filings

After having provided an overview of the most important stylized facts on the usage and outcomes of the WTO dispute settlement mechanism, this section provides a detailed analysis of potential determinants of WTO dispute filings. The focus will lie in particular on measures of economic power and political economy parameters which have been shown in the literature to be important trade policy determinants. This section addresses the key question whether it is indeed simply the size of economies, as measured by trade volumes and GDP, which determines the likelihood of WTO members to be involved in trade disputes. Or is it rather the case that there are underlying determinants of WTO disputes which are simply correlated with the economic size of a country? This section provides evidence that this question should be answered in the affirmative. Large WTO members are

[9] A matching at a finer level would be desirable but also more prone to classification errors.

not only involved in more cases because they trade more with each other but due to their tight trade policy flexibility. In particular, dispute filings are much more frequent in sectors where the difference between negotiated WTO bound and actually applied tariff rates are, on average, negative or close to zero. Smaller WTO members, usually face less restrictive tariff bindings under the WTO agreement which makes the use of illegal trade policy instruments unnecessary and thus an involvement in trade dispute less likely. Before I provide evidence for the importance of WTO members' trade policy structure for the emergence of WTO disputes, the next subsection discusses potential macroeconomic determinants of trade disputes between WTO members.

1.3.1 Macroeconomic Determinants of Dispute Filings

It is a common perception in the literature on the WTO DSB that macroeconomic variables are the main cause for the observed pattern of WTO trade disputes (e.g. Horn et al., 2005, and Sattler and Bernauer, 2011). The natural first step to understand countries' dispute filing behavior is therefore to focus on potential macroeconomic factors such as GDP, trade volumes, the number of industries involved in international trade, and other trade diversification measures.

Before proceeding with the analysis of dispute determinants, a brief discussion of the relevant control group of non-complainant countries, that is, the WTO member countries which are not filing disputes, is in order. This choice is important, since we need a sensible set of non-complainants that allows us to determine in which sense dispute-filing WTO members are different from filing members. Choosing the appropriate group of non-complainants is much less of an issue on the macro-level than on the micro-level, the latter issue will be discussed in more detail below. In our case, the macro-level is defined as the country-pair or dyad level. In particular, I divide the population of WTO members as follows. In a given year, there are $n(n-1)$ possible combinations of WTO member pairs that could face each other in a trade dispute, where n is the number of WTO members at any given time. In addition, a time dimension is introduced, implying that the dispute activity between countries is counted separately by years. On the macroeconomic level, a country will be

counted as complainant in a given country dyad and year when it has filed one or more disputes against the respective partner country during said year. It follows naturally that non-complainant countries are defined as those countries who did not file a dispute in a given year against their respective partner country in a dyad. We can further restrict the set of non-complainants to those dyads which also had positive trade flows. Thus, all country pairs for which no trade data is recorded in a given year are dropped from the sample. In a second step, the sample of non-complainants is further reduced by including only those countries in the control group that participated in at least one dispute in WTO history, either as complainant or defendant. These non-participant countries are likely to face prohibitive costs which render the appearance of them in a dispute impossible. All results presented in this subsection include all non-complainants left in the dataset after the first step. The results for non-complainants left after the second step are only reported in case of a substantial deviation.

To detect potential linkages with dispute filings, I have considered a substantial number of macroeconomic determinants in the analysis: the Hirschman-Herfindahl index of a country's export portfolio, the trade intensity index for each country pair, each country's Trade Freedom Index published by the Heritage Foundation, each country pairs' Grubel-Lloyd index (as measure for intra-industry trade intensity), the sum of trade partners' GDPs, each country's GDP growth, each country's change in the unemployment rate, countries' bilateral and multilateral trade volumes, each country pair's trade balance, preferential trade agreement membership, bilateral distance, the number of sectors with positive trade flows between countries (at the 4-digit HS level), changes in the real exchange rate between countries, countries' labor union density and power asymmetries between countries (in terms of GDP and active import and export sectors). While this collection of potential determinants of dispute filings is not exhaustive, the list above is a good starting point. In order to save space, only information on those indicators will be reported for which certain systematic differences emerged across the sets of complainants and non-complainants. In particular, the following indicators did not show any substantial differences between non-complainants and complainants and are therefore not discussed any further: the Trade Freedom Index, GDP growth, unemployment rate dynamics, bilateral distance, real exchange rate dynamics,

and countries' labor union density.

Let us first look at the macroeconomic variable which is the most widely cited determinant of WTO disputes: countries' economic size. In particular, let us consider the sum of GDPs in each country dyad. Using nominal GDP data from the IMF's World Economic Outlook database (in logs), the left upper panel in Figure A.9 depicts a histogram of the sums of the complainant's and the respondent's GDPs (in logs) in each WTO dispute. The right upper panel of Figure A.9 depicts the corresponding measure for the above described set of non-complainants. The upper two panels in Figure A.9 impressively illustrate that economically more powerful countries are more likely to be involved in a WTO dispute. The lower two panels in Figure A.9 repeat the same analysis with bilateral trade volumes (in logs, data from Comtrade database) for both groups of country dyads. The conclusion is identical to the case of GDPs, which is not surprising given the fact that the gravity equation links GDPs one-to-one to trade volumes.

Using this gravity argument to explain the emerged pattern of WTO disputes suffers, however, from several major weaknesses. If it is solely the economic size of countries which explains the observed dispute pattern in the WTO, why has the number of WTO disputes been steadily dropping since the late 1990s? And why have disputes been mainly emerging in industries such as agriculture, textiles or steel products? While the shares in world trade of these industries are certainly not negligible, the emergence of disputes in these sectors is disproportionately high.

Going beyond aggregate trade flows as potential macroeconomic determinant of WTO disputes, it turns out that the diversification of trade flows between countries (or the extensive margin) drives to a large extent the positive correlation between dispute initiations and trade flows. The left panel in Figure A.10 shows a histogram of the number of active trade sectors for country pairs involved in a dispute during a given year. The right panel depicts a histogram of the same kind for country pairs not involved in a dispute during a given year. Using trade flow data at the 4-digit HS level from the Comtrade database, the number of active trade sectors for a given country pair is simply constructed by summing up a country's number of sectors with positive export and import flows with the other country in a given year. There are in total 1,258 4-digit HS categories, implying that the maximum

number of active trade sectors for a given country pair is 2516.

The differences between both panels are striking. Figure A.10 indicates that countries overwhelmingly tend to file cases against countries with which they have well diversified trading relationships. Note that the skew of the histograms in the left panel is solely driven by the fact that most complainants and defendants in WTO disputes are high-income economies who tend to have more diversified trade portfolios. A similar picture is obtained when only high-income complainants and respondents are considered in the analysis.

In order to check whether variations in active trade sectors are also related to dispute filing variations within a country dyad, let us take a closer look at the WTO member dyad most frequently involved in trade disputes, United States/European Union. Figure A.11 depicts a scatter plot and the associated linear prediction between the number of active trade sectors between the EU/US in a given year and the number of actually filed WTO disputes by either the United States or the European Union. Figure A.11 shows for the case of the US and the EU that more active trade sectors in a given year are associated with more dispute filings. The results are similar when focusing separately on export and import sectors (not shown). Thus, there is strong evidence that the extensive margin of trade plays an important role in explaining the connection between trade flows and WTO disputes.

The data presented in Figures A.10 and A.11 indicates that the WTO dispute settlement mechanism might suffer from selection issues due to the lack of trade diversification of many WTO members. That is, it seems as if countries mainly tend to file disputes against trading partners if their trade is sufficiently diversified in order to minimize the possible adverse impact on the overall trading relationship. The diversity of a trading relationship could in fact favor dispute filings in two ways. First, trade diversity lowers the potentially adverse impact of a dispute in one sector on the overall trading relationship between two countries. And second, with a well-diversified trading relationship, the defendant is more likely to comply with a ruling of the DSB, since the complainant has more retaliation power, that is, the ability to withdraw concessions on its own that might hurt the defendant.

Having seen that bilateral trade diversity, as measured by the number of active trading sectors within a country dyad, is positively correlated with the emergence of trade disputes, let us also look at three other indicators which measure trade diversity along different

dimensions. The first measure is the Hirschman-Herfindahl index (HHI) of complainants' and non-complainants' export portfolios. The HHI is the sum of squared shares of each product in total exports of a country (calculated at the 2-digit HS level). A country with a perfectly diversified export portfolio will have an index close to zero, whereas a country which exports only one good (or in one 2-digit HS sector to be precise) will have an HHI of one (least diversified). The left panel in Figure A.12 shows a histogram of WTO dispute complainants' HHIs while the right panel is a compilation of the same measure for non-complainant WTO members. It is evident from both panels that complainant countries seem to have in general a much more diversified portfolio of export products than non-complainants. In fact, two thirds of all complainant countries have an HHI of 0.1 or lower while the same is only true for a third of non-complainant countries. The difference in means of the HHI is around 0.13. While this result is not surprising on the first glimpse, since exports in more sectors should naturally imply more potential causes for disputes, there is also a second effect that might work in the opposite direction. If a country has less diversified exports, it might be more willing to file a dispute when it faces export hurdles in a sector, since potentially more benefits are at stake.

The second measure for trade diversity is the complainants' and non-complainants' Trade Intensity Index (TII), which is compiled by the World Bank and measures whether the value of trade between two countries is greater or smaller than what would be expected on the basis of their importance in world trade. It is defined as the share of one country's exports going to a partner divided by the share of world exports going to the partner. A TII higher (less) than one indicates a bilateral trade flow larger (smaller) than expected given the partner country's importance in world trade. Figure A.13 provides histograms of the TIIs for both complainant and non-complainant country pairs. Figure A.13 shows that around 50 percent of complainants export less to their respective opponents in a dispute than both partners' importance in world trade would suggest, which is implied by a TII$<$1. This share is much higher with 80 percent when we look instead at non-complainants' exports to their respective partners. Thus, Figure A.13 offers some additional evidence that disputes seem to be rather filed between countries that trade more intensively with each other than their importance in world trade suggests. This result is interesting in the sense that conventional

wisdom might suggest that countries shy away from filing disputes against important trading partners in order to avoid a strain on important bilateral relationships.

The third alternative measure for trade diversity that I consider is the Grubel-Lloyd (GL) index. The GL index measures the degree of intra-industry trade between two countries in sector j and is formally defined as: $GL_j = 1 - |EX_j - IM_j|/(EX_j + IM_j)$. The GL index allows us to determine whether sectors in which countries tend to file disputes are intra- or inter-industry dominated. That is, if trade disputes occur predominantly in sectors with inter-industry trade, the diversification argument put forward above would be further strengthened. Note that if the Grubel-Lloyd index in a given sector takes the value one, there is only intra-industry trade. If, on the other hand, the Grubel-Lloyd index takes the value zero, there is only inter-industry trade. I calculate the GL index at the 2-digit HS level using annual sectoral trade data between WTO members. For dispute country pairs, I compute the GL index for each 2-digit HS sector which is cited in the official request for consultations. A histogram of the GL indices from WTO disputes is shown in the left panel of Figure A.14. The right panel depicts the same measure for the non-dispute country pairs for each 2-digit HS dispute sector. In order to keep the analysis tractable on the sectoral level, the set of non-dispute country pairs consists now of the respective complainant in the dispute and all trading partners in the dispute sector which the complainant did not target in a dispute filing.

Figure A.14 indicates that there is no substantial difference in intra-industry trade between dispute dyads and non-dispute dyads at the 2-digit HS level. Thus, intra-industry trade intensity does not seem to be an important determinant for dispute filing decisions. Note that in generating the histograms in Figure A.14 all country dyads with zero export or import values were excluded. Including these observations skews both histograms further towards zero. The share of GL indices with a value of zero or close to zero increases, however, more in the right panel which is due to the fact that more one-way trading relationships are observed among non-dispute dyads (most likely due to a higher number of large-small country pairs). The results also do not change significantly if an alternative set of non-dispute country pairs is chosen. In the alternative set, non-dispute dyads consist of the respective defendants in disputes and those countries which did not file a complaint

in the same 2-digit HS sector against the dispute defendant. The results in Figure A.14 are also robust to a further disaggregation of the data. When choosing the finest sectoral disaggregation possible for all disputes (e.g. GL index at 4-digit HS level when a 4-digit HS sector was cited in a dispute), the results remain stable.

There are also a number of results which are worth mentioning although no detailed figures are reported here. First, complainants tend to have a more positive trade balance with defendants (as share of their GDP) than non-complainants with non-defendants. Second, asymmetries in GDPs do not seem to be systematically linked to dispute filings, which could indicate that countries in general do not shy away from filing disputes just because their counterpart is much larger in economic terms. And third, asymmetries in the number of active import and export sectors between countries (in absolute terms) are positively correlated with dispute initiation but weaker than asymmetries in the trade balance with dispute initiation. Finally, the data also shows a slightly positive correlation between the membership in a preferential trade agreement and the initiation of a dispute. This seems counterintuitive on the first glimpse but might result from the fact that both the number of active trading sectors and bilateral trade volumes are positively correlated with PTA membership as well. Furthermore, when comparing the importance of bilateral relative to multilateral trade volumes of both complainants and non-complainants, it is evident that bilateral trading relationship with defendants are relatively more important for complainants than for non-complainants.

1.3.2 Market Power and the Filing Pattern of Disputes

After having emphasized trade diversity as potential explanation for the observed pattern of dispute filings in the previous section, this part considers the relationship between countries' market power and the observed dispute pattern among WTO members. One interesting feature of the data presented above is that the share of many product categories in overall disputes filings is much higher than their overall share in world trade. Thus, the question arises whether there is something special about these sectors which results in a disproportionately high numbers of dispute filings. One natural suspect to cause trade disputes is

the potential market power of countries in the aforementioned sectors. Intuitively, countries with high market power have potentially more to gain when filing a dispute compared to countries with less market power due to greater trade volumes at stake. When looking at trade relations between countries, market power in product markets can be measured in various dimensions. A good proxy for a country's overall market power in an industry is its share in world imports and world exports, respectively. The former measure would be a good indicator for dispute filings if countries are first and foremost concerned to protect their domestic producers from foreign competitors. The latter measure would be more adequate if countries rather intend to open foreign markets through dispute filings.

Figure A.15 depicts the histograms of both measures over all dispute pairs for which individual and world trade data is available. All trade data has been obtained at the 2-digit HS level from the UN Comtrade database. Using the 2-digit HS aggregation, there are 719 distinct sectors cited in WTO disputes (disputes without specific citations are dropped from the sample). Hand-matched cases are excluded in the compilation of Figure A.15 and 33 dispute sectors are dropped due to lack of data in Comtrade, leaving us with 686 observations. Each bin in the histograms in Figure A.15 spans 2.5 percentage points of world import and world export shares, respectively. The y-axis measures the share of complainants (in percentage points) within each bin. Both variables are distributed in a similar fashion. Nevertheless, dispute filings tend to occur slightly more frequently in sectors in which complainants have higher sectoral world export shares. As expected, the correlation between sectoral world import and export shares is quite high with 0.86, which indicates that complainants who have a high world export share are also likely to have a high world import share in the same sector, and vice versa. At the same time, the concentration of observations close to zero percent in both histograms indicates that neither world import nor world export shares of complainants in dispute sectors would be an accurate predictor for dispute filings. That is, market power is not countries' main motivation when filing a case with the WTO DSB. The shapes of the histograms in Figure A.15 are also robust to the inclusion of hand-matched sectors, that is, those 2-digit HS sectors which were determined based on their verbal description in the consultation requests when no sector number was specified. The histograms in Figure A.15 also look similar when choosing a more disaggregated level of

dispute sectors.

While a country might not be a heavyweight in the global market for a certain product, it is still possible that the good is important for a country in terms of its contribution to GDP. I therefore also checked (not shown) how complainant countries' imports and exports in dispute sectors compare to their respective GDP. For the overwhelming majority of complainants (around 90 percent in both cases) neither imports nor exports in a dispute sector do exceed one percent of their respective GDP in the dispute year, even when measured at the 2-digit HS level. Most shares are in fact closer to zero than to one percent. Thus, dispute sectors are most of the time not of major economic importance for complainant countries.

Nevertheless, in every sector, trade relationships with some countries are likely to be much more important than with others. Figure A.16 depicts histograms of complainants' export and import dependence with regard to defendants in dispute sectors (again at the 2-digit HS level). Import dependence is defined as the complaining country's imports from the defending country in sector x over the complaining country's overall imports in sector x. Similarly, export dependence is defined as the complaining country's exports to the defending country in sector x over the complaining country's overall exports in sector x. The bin width in both histograms spans 2.5 percentage points of import and export dependence, respectively. Figure A.16 confirms the evidence from Figure A.15 that the opening of export markets seems to play a relatively more important role for the filing of WTO disputes than the protection of domestic markets.[10] However, in nearly 50 percent of all cases, the defending country actually receives less than 2.5 percent of the complainant's total exports in the 2-digit sector at issue. That is, neither import nor export dependence at the 2-digit HS level seems to be a good predictor for the incidence of WTO disputes, which could indicate that WTO members frequently shy away from dispute filings due to the fear of

[10] In the compilation of Figure A.16, I exclude all observations with zero trade flows at the sectoral level. In Comtrade, sectoral import and export data is not available for 139 and 111 of the 719 product categories associated with the non-hand-matched disputes, respectively. In either case, 33 of the missing observations are due to the non-reporting of data in Comtrade for certain countries/sectors. Replacing the remaining missing cases with zero trade flows tilts both histograms further to the left, since these cases would be counted as having zero import and export dependence, respectively. However, the overall patterns remain unchanged.

retaliatory actions by the defendant.

It turns out, however, that this conclusion could be driven to a large extent by considering aggregated trade volumes at the 2-digit HS level. Figure A.17 revisits the question whether WTO members tend to file trade disputes against important or unimportant trading partners by considering complainants' exports to defendants at the most detailed level possible, for instance at the 6-digit HS level when a consultation requests specifies a dispute sector at this level. To facilitate the comparison of export volumes across different aggregation levels, Figure A.17 collects the percentile position of the complainants' export volumes to defendants in dispute sectors when considering the complete set of complainants' bilateral export partners in those sectors.[11] I compile the data in Figure A.17 by ordering for each dispute the complainant's export destinations in the dispute sector in ascending order by the respective bilateral export volume. I then divide the respective defendant's rank by the total number of ranked countries in the respective dispute sector. The results for all disputes and complainants is then presented in the form of the percentile distribution in Figure A.17. In general, a higher percentile indicates a larger dependence of the complainant on the defendant as an export destination. The accumulation of percentile values to the right end in Figure A.17 therefore indicates that countries tend to file disputes against countries which are an important export partners for the complainant in dispute sectors relative to other countries. Thus, countries who are willing to engage in trade disputes in the WTO will file them against important sectoral trading partners.

Nonetheless, it should be kept in mind that the complainant's imports from and exports to the defendant country are likely to be imperfect measures of the importance of both countries' trading relationship. In particular, the domestic government's expectations on future trade developments with the defendant country might be the key to understand the filing pattern of disputes. I therefore check next whether determinants which have been shown by leading political economy models of trade policy, see Grossman and Helpman

[11] Given the sector citation practice in disputes, data on sectoral export volumes alone would be an insufficient measure of complainants' export dependence on certain countries. In general, WTO trade disputes differ substantially by the aggregation level of the cited sectors. Complainants in WTO disputes usually cite sectors at either the 2-,4- or 6-digit level, which naturally differ in their respective distribution of trade volumes. In addition, the percentile distribution has the advantage of implicitly capturing the extent to which a complainant can choose between alternative destinations for his products in dispute sectors.

(1994, 1995), can explain why governments might seek the opening of certain product markets but oppose liberalization in others. In particular, I will focus on sectoral import and export penetration.

Following the literature, import penetration is defined as a complainant's (or defendant's) gross imports in the dispute sector from the defendant (or complainant) over domestic consumption in the dispute sector (domestic production + net imports). Export penetration is defined as the complainant's (or defendant's) exports in the dispute sector to the defendant (or complainant) over domestic production. I obtain sectoral production data from the UN Industry Commodity Statistics for the years 1995 to 2006. The UN production data is reported in the CPC 1.1 format (in US Dollars) and was converted to the 6-digit-HS2002 format using correspondence tables provided by the UN. Production data for each country was then aggregated up to the 2-digit-HS level. Note, however, that the production data is limited in several ways. First, for a significant number of sectors and countries, data is not available in the UN Industry Commodity Statistics database (at least not in US Dollars or national currency values).[12] Second, due to missing sectoral data, the aggregated data at the 2-digit-HS level might understate the domestic production values of certain countries for which some but not all data is available. And third, the UN Industry Commodity Statistics does not provide comprehensive data for the European Union. I therefore construct EU production data by summing the data across sectors from all available EU member countries. On the bright side, production data is only systematically missing for five smaller EU members: Belgium, The Netherlands, Luxembourg, Austria and Malta. Nevertheless, the sectoral EU production data could be somewhat inaccurate.

Due to the aforementioned data limitations, only 246 of the original 719 dispute 2-digit-HS sectors could be matched with production data. The upper two panels of A.18 report histograms of the two import penetration measures for dispute defendants and dispute complainants, while the lower two panels show histograms of the two export penetration measures for both groups of countries. The left two panels report import and export penetration for complainants and the right two panels report import and export penetration

[12] The UN commodity statistics database does not provide any data on the production of raw materials and for a number of countries there is no data available at all.

for defendants. Note that in the construction off all histograms outliers were disregarded for expository purposes. All import and export penetration measures are expressed in percentages. It is evident from Figure A.18 that the import and export penetration measures of complainants and defendants in dispute sectors are close to zero with regard to their respective opponents. A slight deviation in that pattern can be observed for complainants' export penetration which tends to be positive in most cases and is in line with the micro-level evidence in Figure A.17. However, neither on the complainant nor the defendant side aggregate level import and export penetration seem to be closely associated with dispute filings. Note that the histograms in Figure A.17 do also not change significantly when the hand-matched dispute sectors (at the 2-digit HS level) are included in the analysis.

Lastly, Trefler (1993) argues that instead of the actual level of import or export penetration, one should rather look at the change in these variables when trying to explain the choice of trade policies. Unfortunately, due the scattered availability of production data, the change in these variables could only be calculated for a small number of disputes. Any attempt in interpreting these indicators would therefore likely to be meaningless.

1.3.3 Industry Characteristics and Dispute Filings

Since most of the sector-specific market power variables in the previous section could not be closely linked to WTO dispute filings, this section extends the analysis to another array of industry characteristics which could be of importance for governments' filing decisions. In particular, this part will use industry-specific data made available by the CEPII Trade, Production and Bilateral Protection Database.[13] The production data and related variables in this dataset draw upon information originally published by the United Nations Industrial Development Organization (UNIDO); the coverage period is 1980 to 2004.

All variables in the CEPII dataset are recorded at the 3-digit level of the ISIC2 revised industry classification system. In order to match the industry data to the dispute filing sectors, which are at the 2-digit HS level, I apply conversion tables. In particular, I first match the HS sectors to the 4-digit ISIC3 revised industry classification system and then to

[13] The CEPII database, available at http://www.cepii.com/, is in part based on the Trade, Production and Protection database by Alessandro Nicita and Marcelo Olarreaga (World Bank).

the 3-digit ISIC2 revised classification system. In the process, it is necessary to make two simplifying assumptions to deal with a number of issues related to the usage of the product conversion tables. First, there are typically multiple 2-digit HS sectors matched to each 4-digit ISIC3 sector. In what follows, I therefore weight the importance of each 2-digit HS sector in a given ISIC3 sector according to the number of sectors at the 6-digit HS level which can be found in the ISIC3 sector in question. Second, multiple 4-digit ISIC3 sectors also comprise each 3-digit ISIC2 sector. The importance of each 4-digit ISIC3 sector is again weighted by the respective count of 4-digit ISIC3 sectors in each 3-digit ISIC2 sector. Using these two assumptions, I calculate the importance weight of an individual 2-digit HS sector k in a given 3-digit ISIC2 sector m as:

$$weight_{HS_k,ISIC2_m} = \sum_j \left(\frac{\#HS_k \; in \; ISIC3_j}{\sum_i \#HS_i \; in \; ISIC3_j} \right) \left(\frac{1}{\#ISIC3 \; in \; ISIC2_m} \right) I_{jm}$$

where the first term in the sum is the share of subsectors attributed to the 2-digit HS sector k of all subsectors in the j-th 4-digit ISIC3 industry. Note that $\#HS_k$ is the number of 6-digit HS sectors in the 2-digit HS sector k while $\sum_i \#HS_i \; in \; ISIC3_j$ is the number of all 6-digit HS sectors in the 4-digit ISIC3 industry j. The second term is the inverse of the count of all 4-digit ISIC3 sectors in the 3-digit sector ISIC2 m. And the third term is an indicator variable taking the value one if the j-th 4-digit ISIC3 industry is part of the m-th 3-digit ISIC2 sector. I then obtain an estimate of the relevant 2-digit HS industry specific characteristics (production value, value added, employment, number of firms) as follows. I compute for each 2-digit HS sector k the following sum: $\sum_m weight_{HS_k,ISIC2_m} X_{ISIC2_m}$, where X_{ISIC2_m} is the value of the variable of interest (e.g. number of firms) in the ISIC2 sector m and $weight_{HS_k,ISIC2_m}$ is the previously computed importance weight of 6-digit HS sector k in each 3-digit ISIC2 sector m. Note that while the weights are identical across years and countries (they only differ by 2-digit HS and 3-digit ISIC2 sectors), the values of the variables of interest will differ by country, year, and 3-digit ISIC2 sectors. Each of the industry characteristics in the CEPII data (domestic production, value added, number of firms, and number of employees) could impact countries' decisions to file WTO disputes by well-known political economy channels. For instance, we should expect that industries

with greater value added lobby the domestic government for more trade policy support and dispute filings, or labor unions could pressure the government into trade disputes in employment-heavy industries that are adversely affected by foreign imports.

Figure A.19 shows in the left panel the complainant countries' distribution of active firms in dispute sectors; the bar width in the histogram is 500 firms. The right panel in Figure A.19 shows the dispute sectors' shares in total manufacturing employment in the complainant country. We can draw several interesting conclusions from Figure A.19. First, in most disputes the number of potentially affected firms in the complainant countries seems to be rather low. In nearly one third of all 2-digit HS sectors at issue, less than 500 firms have been affected in the complainant country. Note that this number includes both exporters and purely domestically active firms. The low number of active firms in the complainant country could imply that domestic market power is quite concentrated which could favor the formation of industry lobbies due to less sectoral free-riding issues. The right panel in Figure A.19 indicates that disputes usually affect less than five percent of total manufacturing employment in complainant countries. However, in a substantial number of cases the affected share of domestic employment is far from negligible. This fact suggests that manufacturing employment considerations could indeed play a significant role in dispute filing decisions.

In addition to the number of active firms and employment information, the CEPII database also provides data on production by industries. The left panel in Figure A.20 depicts complainants' production values in dispute sectors as share of GDP (in percentage points). The right panel illustrates the change in production over GDP compared to the previous year (in percentage points). The latter is of interest, since it might provide us with a sense whether disputes tend to be filed in sectors which are on the rise or in decline. Figure A.20 illustrates two facts. First, most dispute sectors are fairly unimportant compared to a country's total GDP, which is in line with the previously shown low trade shares of dispute sectors in GDP. And second, more disputes tend to be filed in declining rather than in growing sectors, which could indicate that governments of complainant countries act particularly in sectors where domestic production and employment are adversely affected by foreign competition.

For most complainants, the share of domestic value added (not shown) in dispute sectors is between 20 and 60 percent, which indicates that the domestic contribution to final output is non-negligible in the sectors at issue. As expected, governments do not tend to file disputes in sectors in which the domestic industry is a fairly unimportant part of the global value chain. Note that when considering the change in value added in production compared to the year prior to the dispute (not shown), no distinct pattern is obvious. Thus, while the overall sectoral production as share of GDP seems to decline in the majority of cases prior to a dispute, the domestic share in value added remains relatively constant.

1.3.4 Bilateral and Multilateral Trade Dependence and Dispute Filings

Since trade disputes can be categorized in a broader sense as a conflict between countries, it is also worthwhile to take a closer look at variables in the analysis of WTO disputes which have been suggested in the economic literature on conflicts. Martin et al. (2008) formulate a model which results in two determinants related to trade that can explain countries' sorting patterns into conflicts. On the one hand, a country should be more willing to enter into a conflict with another country if its bilateral trade dependence on the other country is low. That is, if the potential amount of welfare at risk through an interruption of trade is low, the probability of the initiation of a conflict is higher, ceteris paribus. Following the same logic, a high multilateral trade dependence of a country should, on the other hand, increase the likelihood to enter into a conflict with any given country, since higher multilateral trade dependence minimizes any likely welfare loss from a dispute with an individual country. The analysis by Martin et al. (2008) suggests that the key tradeoff we should be looking at when explaining given conflict patterns between countries is the relative size of countries' bilateral to multilateral trade dependence. Even if bilateral dependence is high between two given countries, there could still be a non-negligible probability for them to enter into conflict if multilateral trade dependence of either of those countries would be high at the same time. That is, we should expect those countries to be involved in more conflicts which have not put all of their eggs into one basket.

Although the logic outlined above has been originally applied to military conflicts, one

should expect that it also translates to trade disputes (even though the expected welfare loss from a military conflict is likely to be much higher than the expected welfare loss from a trade dispute). In the following, I therefore look at several indicators measuring complaining countries' bilateral trade dependence and relate it to the equivalent multilateral measure. In our case, I define bilateral dependence as the complainant's trade dependence on the defendant country while multilateral dependence is defined as the aggregated trade dependence of the complaining country on all countries other than the defendant. One complication compared to the military conflict literature is, however, that it is not entirely clear in which way a WTO dispute would impact a complaining country's overall trade with the defendant country. It is possible that a trade conflict will only impact the sector at issue but it could also have some impact on the whole industry, or, if the dispute is of a very controversial nature, even on the entire trade relations between the parties. In order to control for this possibility, I will consider bilateral and multilateral dependence measures at both the HS2-digit and the overall trade level.

Figure A.21 shows a histogram measuring the complainant countries' bilateral trade dependence on the defendant countries relative to the complainants' multilateral trade dependence at the 2-digit HS level. To obtain the histogram, each complainant's bilateral trade volume with a defendant country in the 2-digit HS dispute sectors is divided by the complainant's trade volume with all other countries in the same sector. Values close to zero indicate a low sectoral dependence on the defendant while larger values indicate a high sectoral dependence on the defendant. Note that for the sake of clarity a few large outliers were disregarded in the compilation of Figure A.21. Figure A.21 indicates that in most disputes bilateral trade with the defendant is only a negligible share of the complainant's overall trade in the sector at issue. For around 50 percent of all complainants, the ratio takes a value of less than 0.025, implying that these countries have a bilateral trade volume with the defendant in the dispute sector which is less than 2.5 percent of the trade volume with all other countries.

Let us repeat the same analysis when the trade data between countries is aggregated across all sectors, Figure A.22 depicts the results; note that for the sake of clarity a few large

outliers were again disregarded.[14] The histogram delivers a similar result as in Figure A.21, which focuses on trade in dispute sectors. Overall, both histograms in Figures A.21 and A.22 indicate that the relative importance of complainants' bilateral trading relationship with defendants is similar across different aggregation levels and strongly skewed towards zero. It therefore seems as if complainants will shy away from filing a case against a country when the bilateral trading relationship is important relative to the complainants' other trading relationships. Thus the degree of trade integration with other countries seems to play an important role for WTO members' dispute filing decisions.

1.3.5 Tariff Overhangs and Dispute Filings

This section considers the potential relationship between WTO dispute filings and countries' tariff policy choices and constraints. One possible explanation for dispute filings could be an increased likelihood of tight tariff bindings in dispute sectors which causes countries to consider an illegal deviation from WTO agreements, resulting eventually in trade disputes. A basis for this theory is provided by the work of Beshkar et al. (2012) who develop a model and also provide empirical evidence that tariff overhangs, that is, the difference between the negotiated bound MFN tariff rate and the effectively applied rate, are lower for larger WTO members. The second chapter of this dissertation develops a theory that links tariff overhangs to the merged WTO dispute pattern.

Figure A.23 depicts in the left panel a histogram of the average tariff overhang faced by complainants when trading with a dispute defendant one year prior to a dispute. The data was compiled using the WITS database by the World Bank which contains country- and sector-specific country pair data on applied tariffs and WTO most favored nation (MFN) bound tariffs. For each year and country pair, I first compute the simple average of applied and bound tariff rates (based on 6-digit HS tariff line data). In a second step, I then subtract the average applied tariff rate from the average bound tariff rate to obtain the simple average of the tariff overhang for each country pair and year. As can be seen from the left panel in Figure A.23, approximately two thirds of all complainants faced an average

[14] In both Figures A.21 and A.22, only data of non-hand-matched disputes were used, the results with hand-matched cases are similar though.

tariff overhang of less than 5 percentage points (in absolute terms) with respect to their respective dispute defendants. Thus, low (or even negative) tariff overhangs seem to be an important underlying cause of dispute filings.

The right panel in Figure A.23 depicts the average tariff overhang that complainants faced in countries they did not target in a dispute filing (during a year in which the complainant filed at least one complaint against another country). The right panel shows that only 20 percent of all complainants faced an average tariff overhang of less than 5 percentage points (in absolute terms) in countries which they did not target in dispute failings. In fact, in most cases the tariff overhang is considerably larger than that. The results in Figure A.23 are also similar when import-weighted averages of tariffs are computed instead of simple averages of tariffs. Note that all duplicate dispute country pairs were dropped in the compilation of Figure A.23. For example, if the United States files two cases against Thailand in a given year, Thailand's average tariff overhang towards the United States is only included once. In addition, due to the lack of data in WITS for certain countries and years, another 85 dispute pairs had to be dropped, leaving us in the end with 268 dispute pairs (out of the original 455) for the compilation of the left panel in Figure A.23.

There are at least two reasons why larger tariff overhangs could lead to less disputes. First, countries with a large tariff overhang can simply increase their applied tariff rates without violating a WTO agreement when additional protection is desired, giving their trading partners no legal grounds for a dispute filing. And second, filing a case against another WTO member is less attractive when the potential complainant country has a large tariff overhang due to WTO's existing reward structure for winners of trade disputes. The WTO can at most grant the complainant country the right to set a retaliatory tariff if the defendant country does not comply with the DSB's ruling. This retaliatory tariff is not very attractive to the complainant country when it already possesses a lot of trade policy flexibility, as indicated by a large tariff overhang. While the first channel is the focus of this chapter, the second point will be discussed in more depth in the second chapter of this dissertation.

Interestingly, the average tariff overhang in Figure A.23 is negative for a substantial number of cases. This fact might seem surprising on a first glance, since WTO rules specify

that members are only allowed to set applied tariff rates up to the negotiated bound rates. Digging a little deeper, it turns out that the average tariff overhang can still be negative for several reasons: 1. no bound rates are set for certain sectors (which could bias the average bound rate), 2. specific bound and applied tariff rates might distort the calculation of tariff averages due to the necessary conversion into ad-valorem equivalents (more on this below), 3. after new bound rates have been negotiated, WTO members are usually granted a phase-in period during which they can still apply a tariff above the negotiated tariff commitment, and 4. WTO members can, under certain conditions, temporarily apply antidumping and safeguard duties which exceed the previously negotiated tariff bounds.

In order to minimize the first bias, all sectors for which no bound rates are available in a given year are dropped from the analysis. To address the second bias, a few remarks concerning ad-valorem equivalents (AVEs) are warranted. There is a significant share of non-ad-valorem (NAV) tariffs, such as specific tariffs or mixed duties, in the tariff schedules submitted by members to the WTO secretariat. Up to 2003, which is close to the middle of the sample period considered here, the share of NAV tariff lines in all tariff lines submitted to the WTO was around 6.6 percent (WTO, 2003). NAV tariffs are most frequently encountered in tariff lines for agricultural products. When calculating tariff overhangs for all figures presented in this section, I employed estimated ad-valorem equivalents of NAV tariffs in case they were available in WITS (based on the UNCTAD 1 method).[15] In order to rule out that the results are partly driven by the inclusion of AVEs, all calculations were repeated leaving out tariff lines which contained AVEs (not shown). As it turns out, there are, in general, no substantial differences in the results between both cases. The third potential bias resulting from phase-in-periods is harder to tackle. However, since most countries who are frequently involved in disputes joined the WTO simultaneously in 1995 (except for China), a potential bias in tariff overhangs due to phase-in-periods might work in similar directions for both defendants and non-defendants in disputes.

[15] WITS offers four options to calculate ad-valorem equivalents of NAV tariffs: UNCTAD 1, UNCTAD 2, WTO Agricultural negotiation method, and the WTO non-Agricultural Market Access negotiation method. The differences are outlined in the WITS handbook. UNCTAD 1 is the most conservative choice, since it includes UNCTAD 2 as a subcase, and the latter two methods require a differentiation between agricultural and non-agricultural goods.

One drawback of the approach in Figure A.23 is the aggregation of tariff overhangs in each given country pair over all active trade sectors. In a next step, I therefore analyze the tariff overhang data between countries at the HS level specified in the respective WTO disputes (either at the 2-, 4-, or 6-digit HS level). Figure A.24 below depicts the equivalent of Figure A.23 at the most disaggregated level possible. That is, when a dispute sector is specified at the 2-digit HS level, all bound and applied tariff rates within said 2-digit HS category are averaged (both simple and weighted averages were considered) by country pair. A similar approach is taken for 4-digit HS categories[16] As noted above, when calculating tariff overhangs for the respective HS categories, all observations are dropped from the sample in case no bound rates were available. Disputes with missing HS sector citations in the official requests for consultations (151 out of the 455 WTO disputes) are also dropped from the sector-based tariff overhang analysis. Although not explicitly reported here, the results presented in this section are similar when hand-matched sectors are included, which reduces the number of initially dropped disputes from the analysis to 59. Overall, the 304 WTO disputes left in the non-hand-matched sample contain 2,298 cited HS sectors at the 2-, 4-, and 6-digit level. WITS provides both applied and bound rates for 1,144 of those sectors (from 194 of the 304 disputes), the remaining sectors are excluded from the analysis. In case hand-matched cases are included, this number increases to 1,498 out of 3182 dispute sectors (from 274 of 396 possible disputes).

The set of non-complainants/non-defendants considered in the right panel is chosen in line with the procedure outlined above for Figure A.23. That is, the relevant country pairs in the right panel consist of the complainant country in a dispute sector in a given year and all countries which were not targeted in a dispute in the said sector. Suppose the United States filed a dispute in HS category 72 against the European Union in 1999, the relevant set of country pairs in the right panel would then consist of the United States (as non-complainant) and all countries (as non-defendants) which did not receive an official complaint from the US that involved HS category 72 in 1999.

The results in Figure A.24 are quite striking and allow for an even stronger conclusion

[16] Note that tariff bounds are negotiated in the WTO at the 6-digit HS level, disaggregated bound tariff rates are therefore not available beyond this level.

than with the aggregated data in Figure A.23. The left panel in Figure A.24 indicates that tariff overhangs faced by complainants in dispute sectors are even more frequently close to zero than at the aggregated level. In nearly 80 percent of all dispute sectors, complainants faced an average tariff overhang of less than 5 percentage points (in absolute terms). This contrasts with a little over thirty percent for the complainant/non-defendant country pairs in the same sectors in the right panel. In about 60 percent of all cited dispute sectors, the tariff overhang is in fact negative, indicating a violation of WTO tariff bounds by the dispute defendant. While requests for consultations most of the time specify certain non-tariff measures as being at the heart of the dispute, the data indicates that WTO disputes could also be proxy wars for deeper lying issues.

The inverse relationship between tariff overhangs and WTO dispute filings also holds when the data presented in Figure A.24 is analyzed separately by different income groups, time periods and the aggregation level of HS sectors cited in disputes (not shown). In order to rule out that the pattern presented in Figure A.24 is mainly due to the dominating impact of a few disputes with disproportionately many sector citations, Figure A.25 presents the same histograms using averages of defendants' and non-defendants' tariff overhangs, respectively. In particular, Figure A.25 averages the tariff overhang faced by complainants over all cited HS sectors in each given dispute. Suppose, for instance, the United States has filed a dispute against the European Union in HS sectors 50, 51 and 52. Instead of considering each sector separately, as done in Figure A.24 when compiling the tariff overhang histograms, Figure A.25 averages the tariff overhang faced by the United States over the three sectors. In this way, Figure A.25 addresses the point that the previous results could be driven by disputes with disproportionately many sector citations, since each dispute enters only once independent of how many HS sectors are cited initially by the complainant. As a result, the left panel in Figure A.25 now only contains 194 data points, one for each dispute with at least one HS sector citation in the official request for consultations. A similar approach is chosen when compiling the histogram for the tariff overhangs faced by complainants in countries that are not involved in WTO disputes in the right panel.

Figure A.25 indicates that the general pattern from Figure A.24 still holds but the share of disputes with an average negative tariff overhang in dispute sectors is lower. While around

66 percent of all cited dispute sector have a negative tariff overhang in Figure A.24, the number drops to around 43 percent when we average over all cited sectors in each dispute. However, it is remarkable that complainants now face in almost every non-defendant country a positive tariff overhang, see the right panel in Figure A.25. Comparing the left to the right panel in Figure A.25, we find that for two thirds of all complainants the average tariff overhang faced in disputes is less than 5 percentage points (in absolute terms) while the same is true for less than three percent of complainants when dealing with tariff overhangs in dispute sectors in non-defendant countries.

To further shine light on the relationship between dispute incidence and tariff overhangs, I check in the next step whether the observed pattern in Figure A.24 is driven by certain types of agreement violations. This point is of particular interest, since negative tariff overhangs could be simply the result of implemented anti-dumping or safeguard measures, resulting in turn in complaints by adversely impacted exporters. In particular, I distinguish between citations of the agreements on antidumping (AD), safeguards (SG), and subsidies and countervailing measures (SCM) and the citations of all other agreements. This distinction is made, since these three agreements contain provisions which allow countries to temporarily violate their tariff bindings under certain conditions. The upper two panels in Figure A.26 show histograms of tariff overhangs faced by complainants in defendant/non-defendant countries when either of these agreements was cited in a dispute. The lower two panels depict the corresponding histograms for all other agreements.

Of the 1144 cited dispute sectors for which tariff overhang data is available in WITS, 771 are from disputes in which either the antidumping, safeguard, or subsidy and countervailing measures agreements were cited (or any combination of them). 371 of the dispute sectors do in turn not cite any of these three agreements. Although the ratio of dispute sectors citing at least one of the AD, SG and SCM agreement to all other agreements seems large, it should be noted that disputes of the former kind, in general, cite more dispute sectors, which is most likely due to the required precision of allegations in these kinds of disputes. This point is further supported by the fact that of the 1,154 dispute sectors for which tariff overhang data is missing in WITS, 702 cite the AD, SG, or SCM agreements while only 452 cite a different WTO agreement.

Figure A.26 allows for two important conclusions. First, the tendency to lower tariff overhangs is greater in disputes in which complainants challenge temporary protection implemented under the provisions of the AD, SG and SCM agreements. And second, although the pattern is not as pronounced, tight tariff overhangs can also be observed in the majority of sectors in disputes which do not cite the AD, SG, or SCM agreements. The lower left panel of Figure A.26 shows that complainants face a negative tariff overhang in around 40 percent of dispute sectors which are cited outside of these three agreements, and there is another 30 percent who face a tariff overhang of less than 5 percent. Nonetheless, the high share of dispute sectors citing the AD, SG, or SCM agreement implies that the results in Figure A.24 are driven to a large part by disputes over temporary protectionist measures implemented by defendants.

1.4 Concluding Remarks

This chapter has served two main purposes. First, I presented in great detail various stylized facts regarding the usage of the WTO's Dispute Settlement Body. In doing so, I made a number of observations which are inconsistent with a pure gravity-based explanation of the emerged WTO dispute pattern. In particular, (i) the number of WTO disputes has declined significantly since the late 1990s, and (ii) there is an apparent disconnect between the importance of certain sectors, measured by their share in WTO trade, and their respective fraction in total dispute citations.

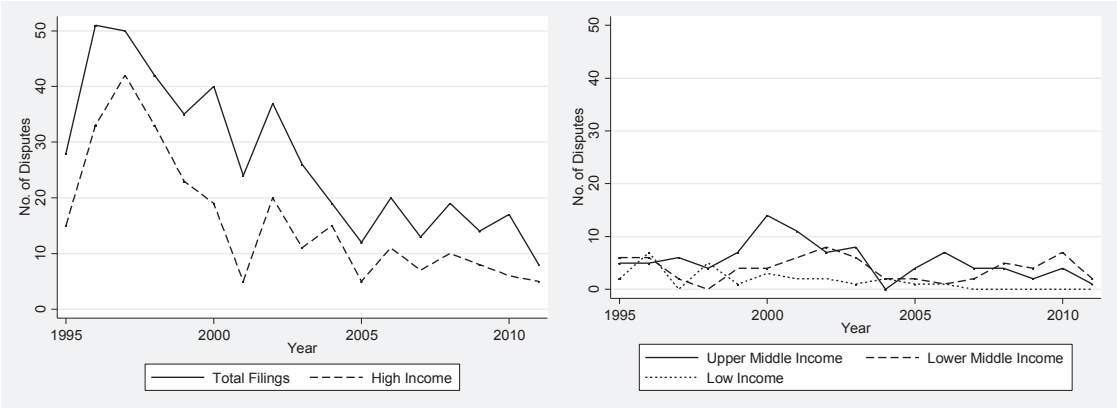
I then examined potential determinants of WTO disputes. I detected two variables which seem to be strongly linked to the sorting of WTO members into trade disputes. First, countries are more likely to be named as a dispute defendant if they possess less flexibility in setting their trade policy in the cited dispute sector. I measured trade policy flexibility in this context by a country's tariff overhang, which is the sectoral difference between a country's negotiated WTO bound and the actually applied tariff rate. And second, countries mostly tend to file trade disputes against their most important trading partners in the respective dispute sectors. The next chapter of this dissertation develops a model which can explain why these two determinants of WTO disputes have emerged.

Appendix 1

APPENDIX TO CHAPTER 1

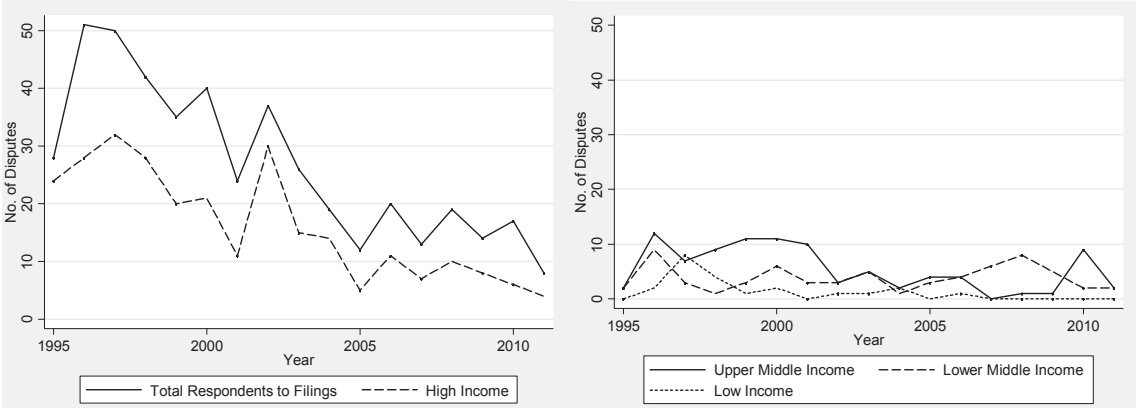
A.1 Figures and Tables

Figure A.1: WTO Disputes (Total and by Income Group of Complainants), 1995-2011



Source: Author's own calculations based on information available on www.wto.org. A trade dispute is initiated when a WTO member sends an official request for consultations to another member country citing the sector and the measure at issue. Figure A.1 counts cases with multiple complainants separately, resulting in a total of 455 trade disputes between 1995 and 2011. Income categories follow from the World Bank definition, see text for details.

Figure A.2: WTO Disputes (Total and by Income Group of Defendants), 1995-2011



Source: Author's own calculations based on information available on www.wto.org. A trade dispute is initiated when a WTO member sends an official request for consultations to another member country citing the sector and the measure at issue. Figure A.2 counts cases with multiple complainants separately, resulting in a total of 455 trade disputes between 1995 and 2011. Income categories follow from the World Bank definition, see text for details.

Figure A.3: Timing of Potential Counter-complaints, 1995-2011

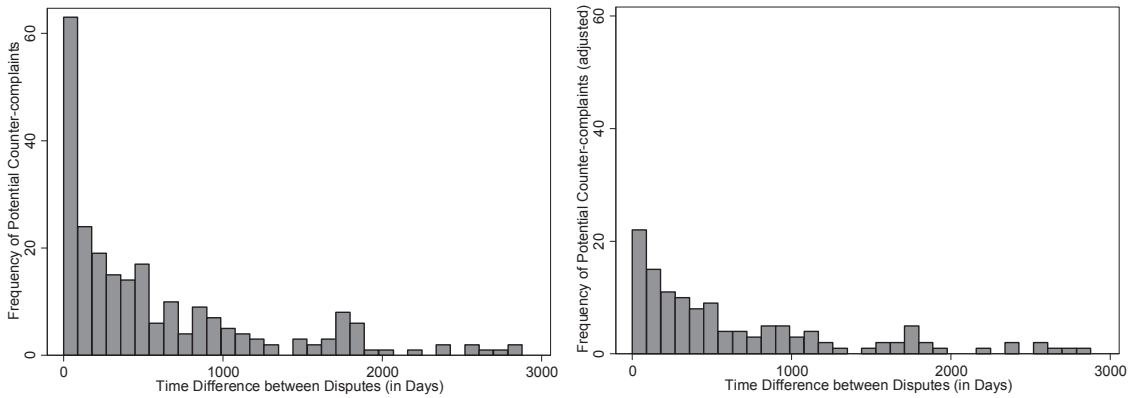


Figure A.4: Timing of Potential Counter-complaints between EU/US

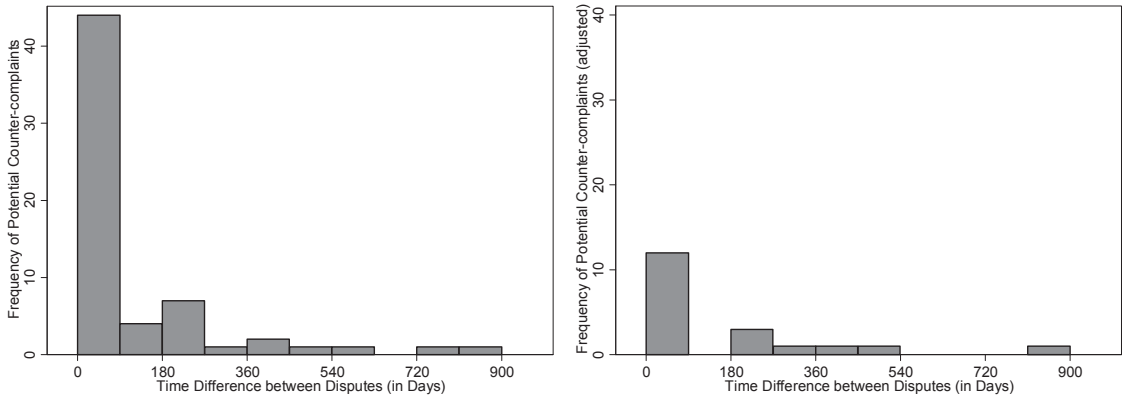


Figure A.5: Victory Share per Claimant

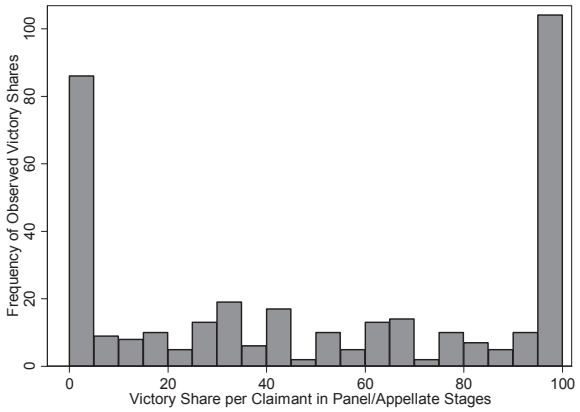


Figure A.6: Product Categories Cited in WTO Disputes (by HS Industry Sections)

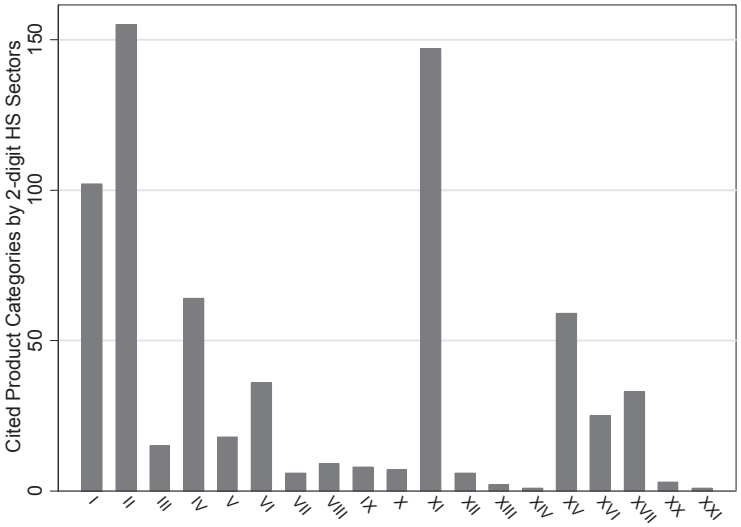


Figure A.7: Share in WTO Dispute Citations and WTO Trade (by HS Industry Sections)

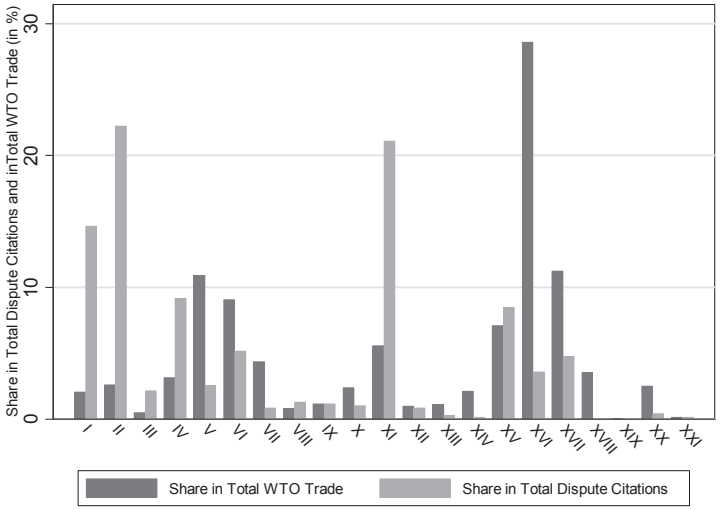


Figure A.8: Product Categories Cited in WTO Disputes (by HS Industry Sections) – Including Hand-Matched Cases

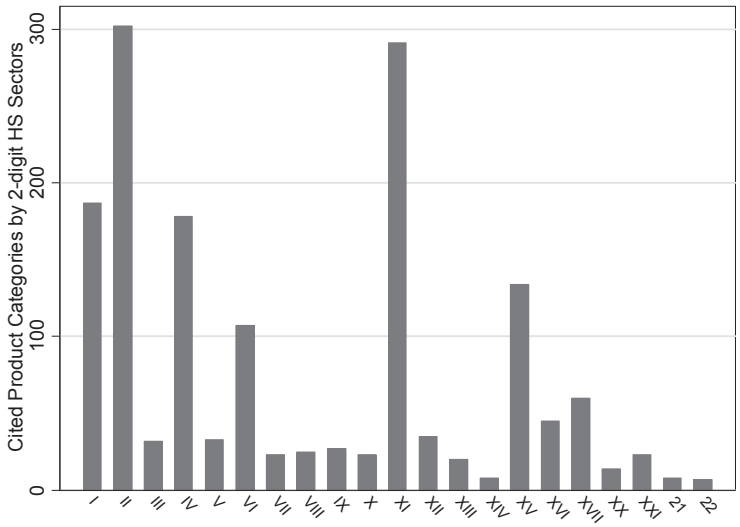


Figure A.9: Sum of GDPs (in logs) and Trade Volume (in logs) in Dispute and Non-dispute Country Dyads

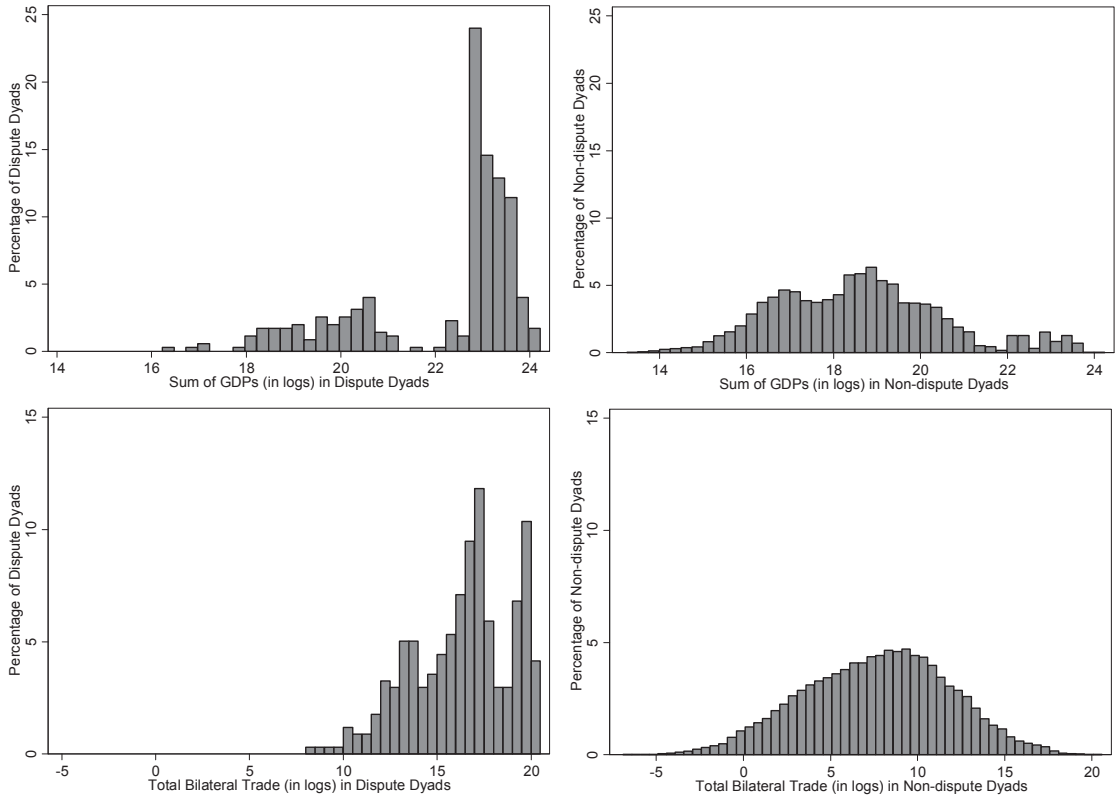


Figure A.10: Active Trading Sectors in Dispute and Non-dispute Dyads (at 4-digit HS level)

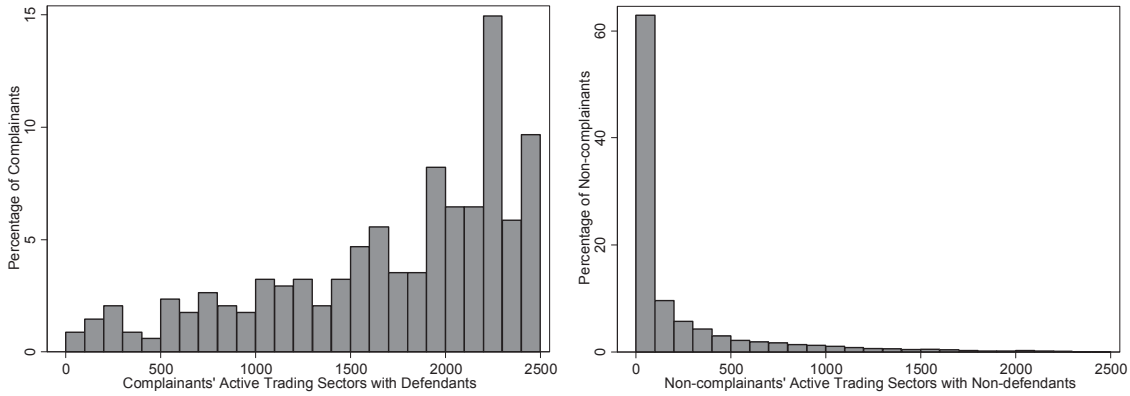


Figure A.11: Scatter Plot of EU-US Active Trade Sectors and Associated Annual Dispute Counts (Including Linear Prediction)

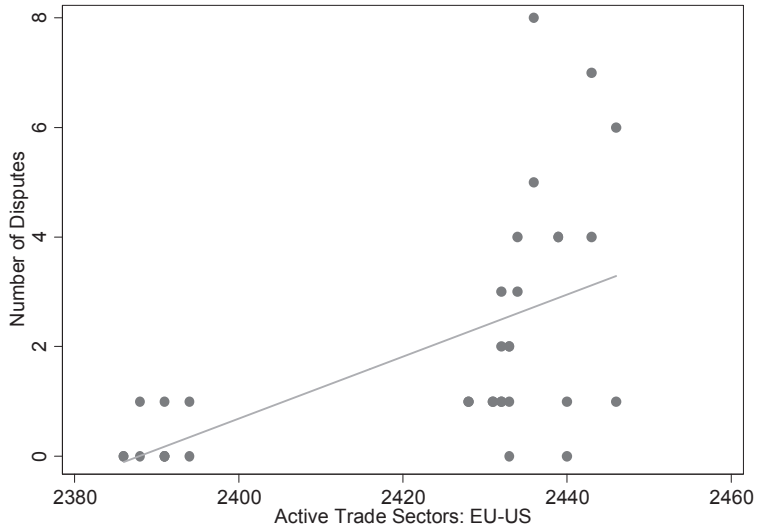


Figure A.12: Hirschman-Herfindahl Index of Export Portfolios

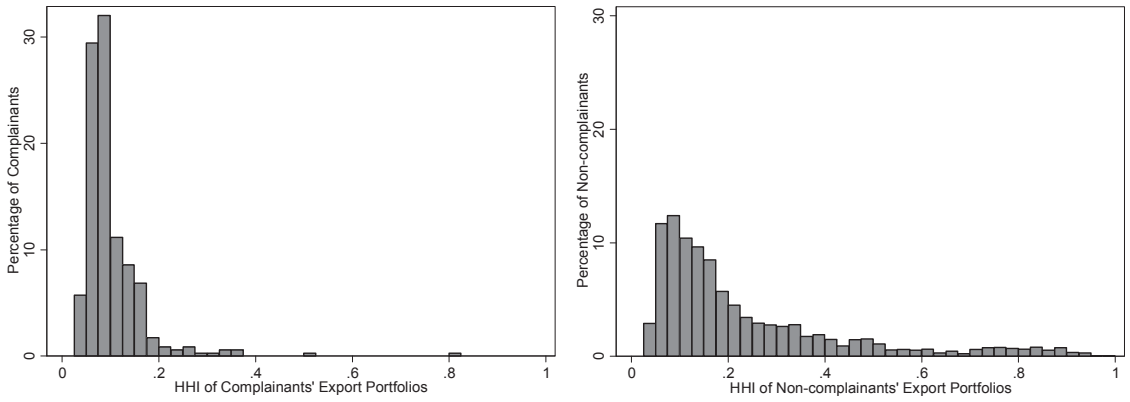


Figure A.13: Trade Intensity Index in Dispute and Non-dispute Country Pairs

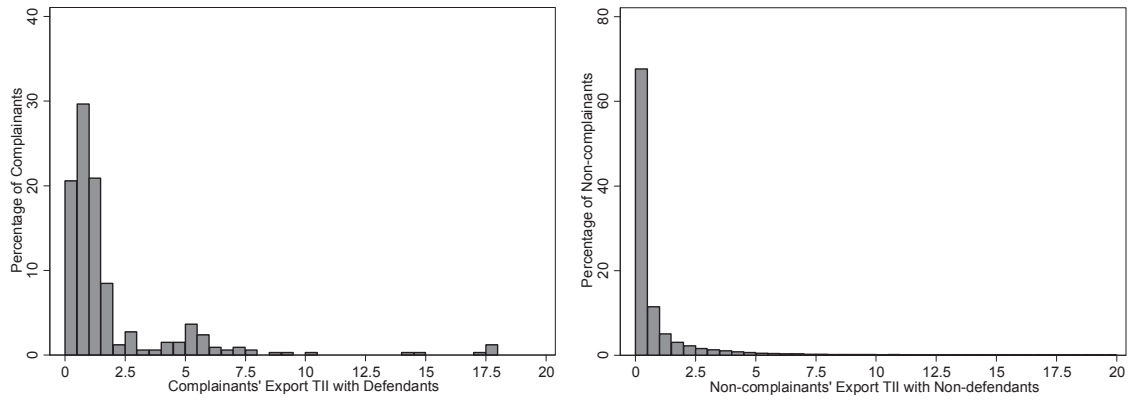


Figure A.14: Grubel-Lloyd Index in Dispute and Non-dispute Country Dyads

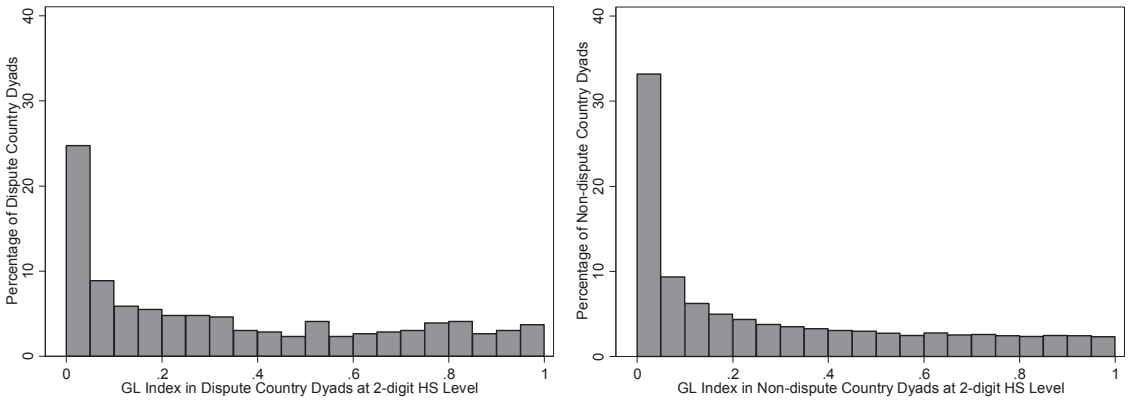


Figure A.15: Complainants' World Import and Export Shares in Dispute Sectors

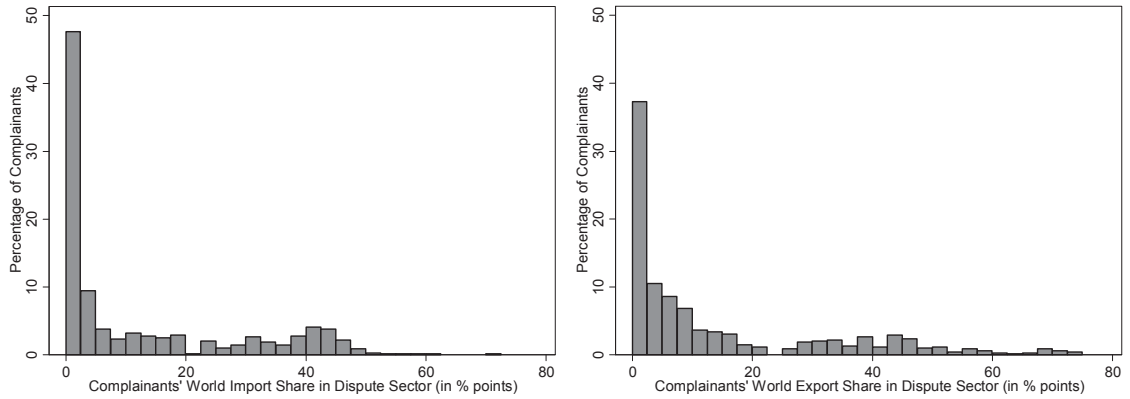


Figure A.16: Complainants' Import and Export Dependence on Defendants in Dispute Sectors

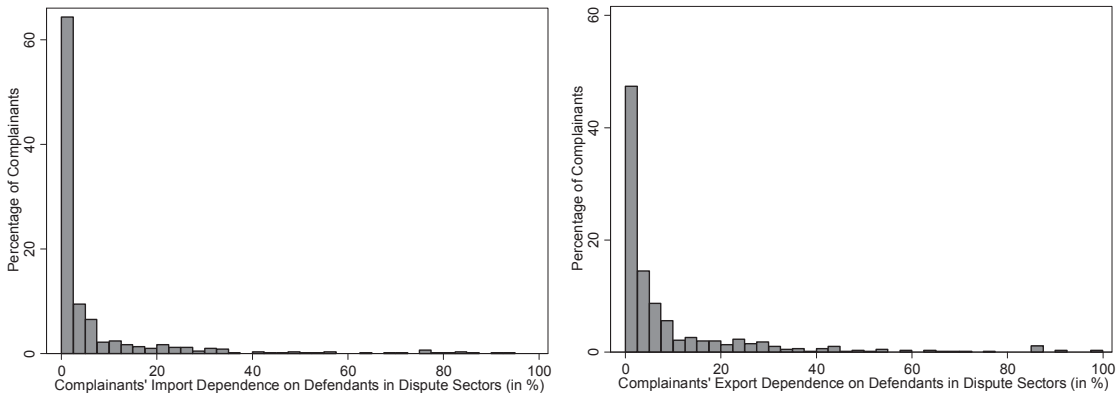


Figure A.17: Percentile Ranks of Complainants' Exports to Defendants in Dispute Sectors

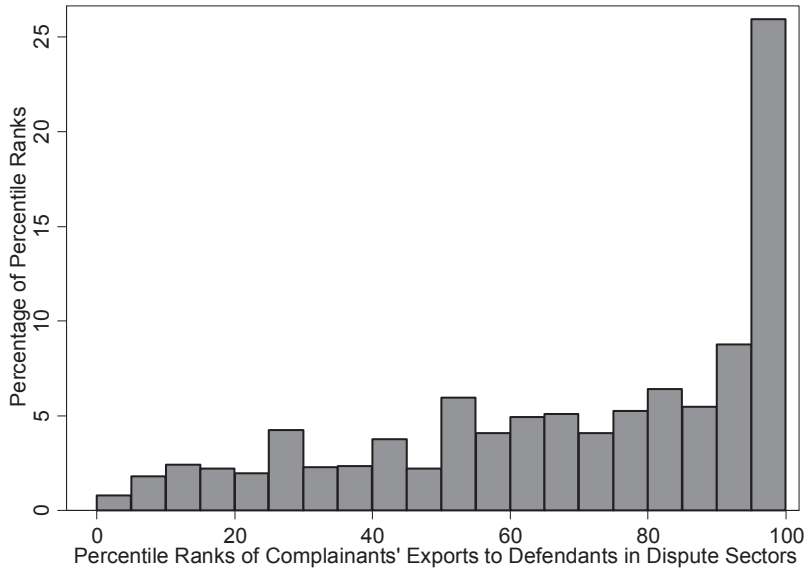


Figure A.18: Sectoral Import and Export Penetration by Dispute Opponents in Complainant and Defendant Countries

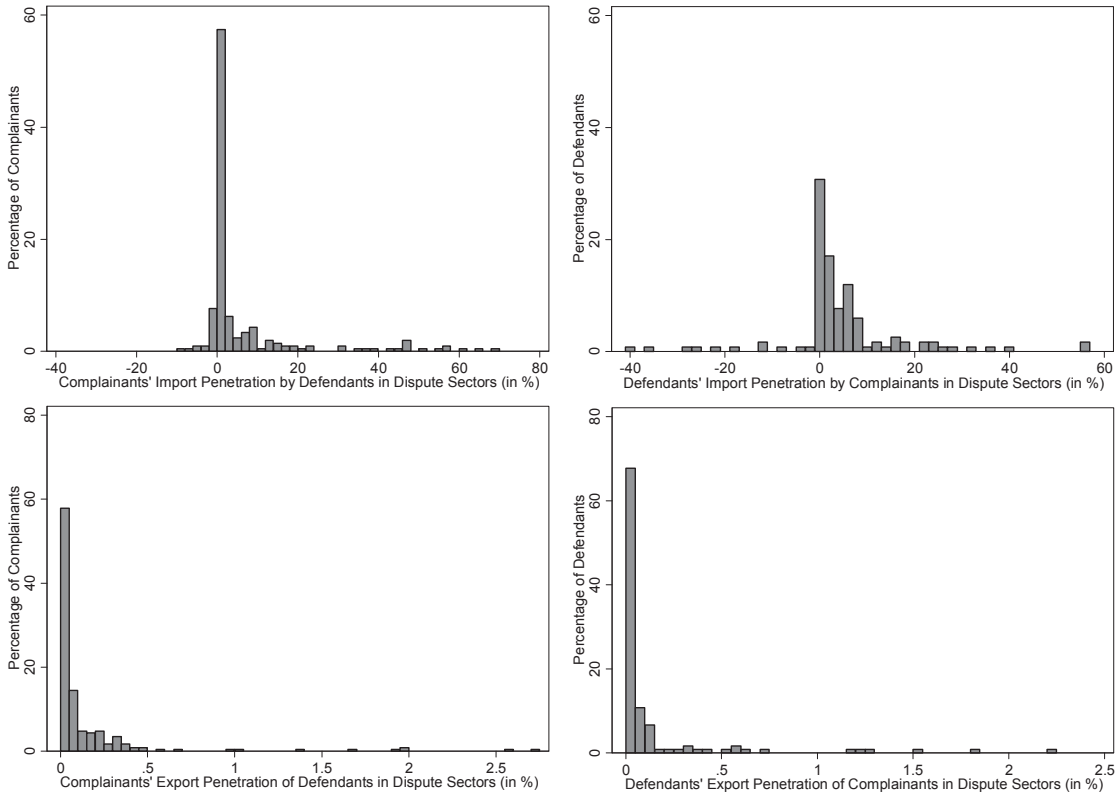


Figure A.19: Complainants' Firm Count in Dispute Sectors and Share of Manufacturing Employment at Stake

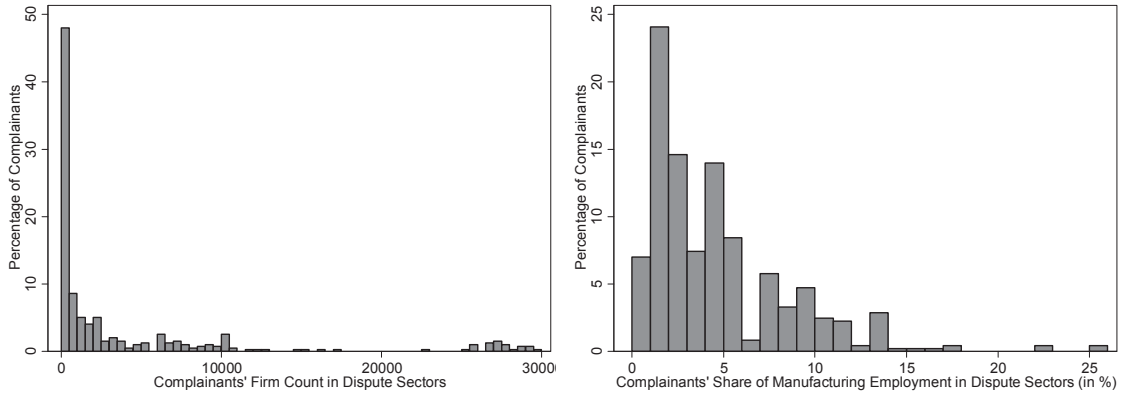


Figure A.20: Complainants' Production in Dispute Sectors as Share of GDP and the Percentage Change Thereof

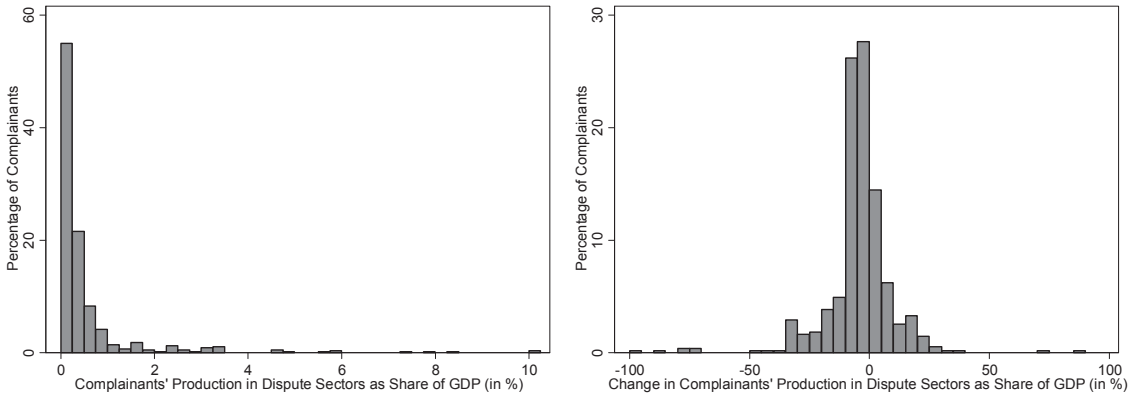


Figure A.21: Complainants' Bilateral Trade Dependence on Defendants in Dispute Sectors

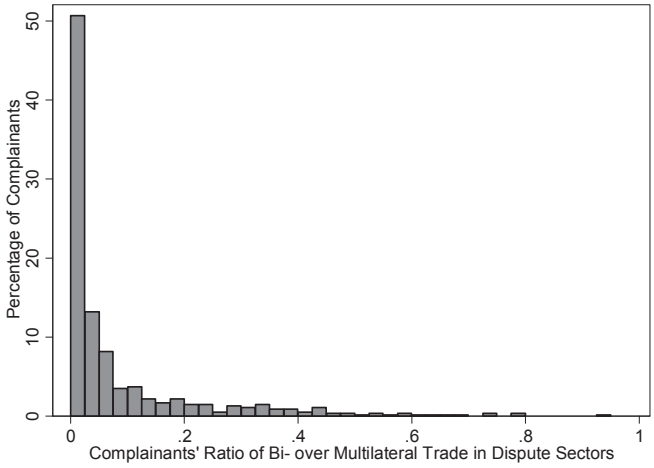


Figure A.22: Complainants' Total Bilateral Trade Dependence on Defendants

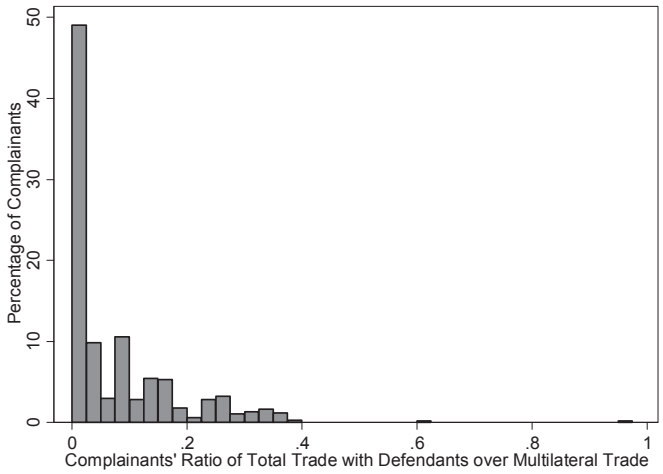


Figure A.23: Tariff Overhang Faced by Complainants in Defendant/Non-defendant Countries

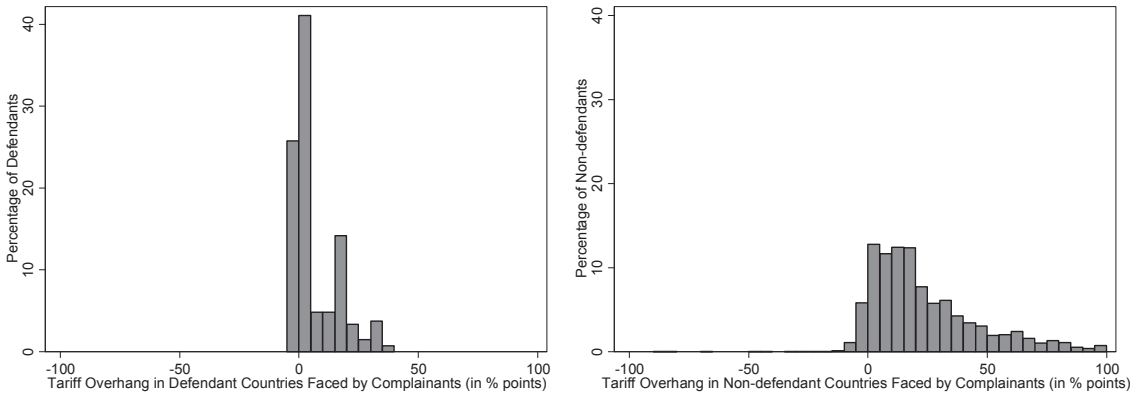


Figure A.24: Tariff Overhang Faced by Complainants in Dispute Sectors in Defendant and Non-defendant Countries (Most Disaggregated Sector Level)

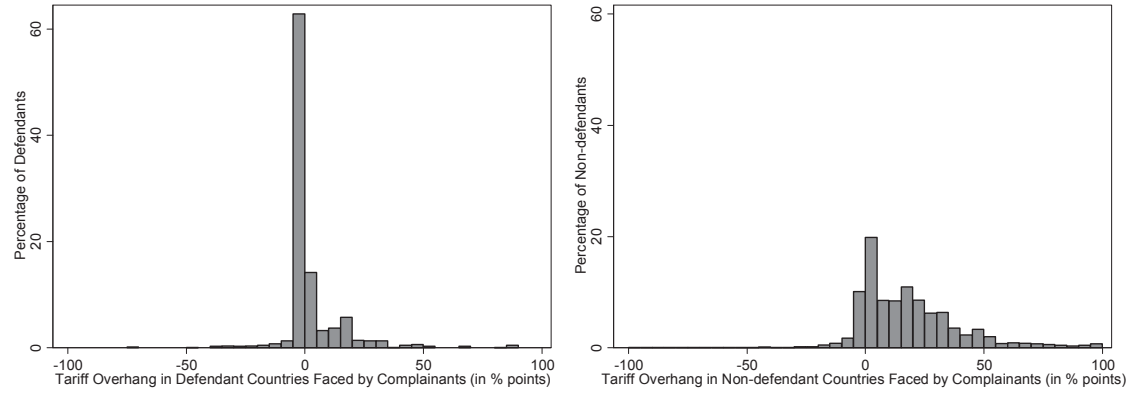


Figure A.25: Tariff Overhang Faced by Complainants in Dispute Sectors in Defendant and Non-defendant Countries (Averaged over all HS Sector Citations in each Dispute)

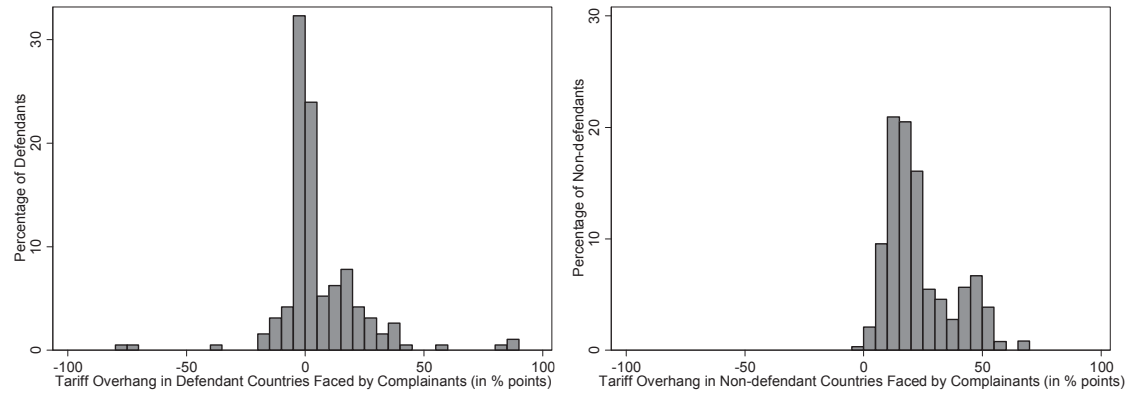


Figure A.26: Tariff Overhang Faced by Complainants in Dispute Sectors in Defendant and Non-defendant Countries (Disaggregated by Cited Agreements)

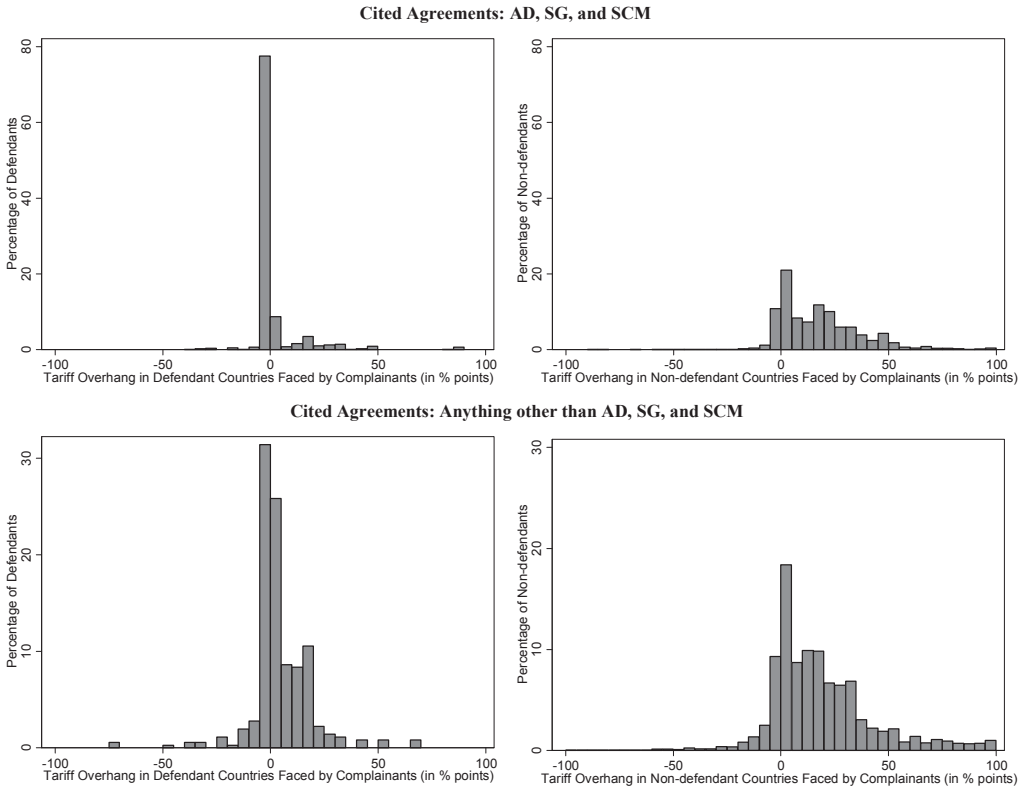


Table A.1: Number of Disputes (Total and by Income Group of Complainants)

Year	No. of disputes	High income	Upper middle income	Lower middle income	Low income
1995	28	15	5	6	2
1996	51	33	5	6	7
1997	50	42	6	2	0
1998	42	33	4	0	5
1999	35	23	7	4	1
2000	40	19	14	4	3
2001	24	5	11	6	2
2002	37	20	7	8	2
2003	26	11	8	6	1
2004	19	15	0	2	2
2005	12	5	4	2	1
2006	20	11	7	1	1
2007	13	7	4	2	0
2008	19	10	4	5	0
2009	14	8	2	4	0
2010	17	6	4	7	0
2011	8	5	1	2	0
Total	**455**	**268**	**93**	**67**	**27**

Table A.2: Complainant Countries in WTO Disputes

Complainant	1995-2000	2001-2006	2007-2011	Total
United States	68	16	14	98
European Union	55	21	9	85
Canada	16	11	6	33
Brazil	13	9	3	25
Mexico	9	7	5	21
India	11	6	2	19
Argentina	3	11	1	15
Korea	6	7	2	15
Japan	9	3	2	14
Thailand	7	5	1	13
China	-	1	7	8
Other high income economies	15	9	3	27
Other upper middle economies	12	15	4	31
Other lower middle economies	15	14	12	41
Other low income economies	7	3	0	10
Total complaints by period	**246**	**138**	**71**	**455**

Table A.3: Number of Disputes (Total and by Income Group of Defendants)

Year	No. of disputes	High income	Upper middle income	Lower middle income	Low income
1995	28	24	2	2	0
1996	51	28	12	9	2
1997	50	32	7	3	8
1998	42	28	9	1	4
1999	35	20	11	3	1
2000	40	21	11	6	2
2001	24	11	10	3	0
2002	37	30	3	3	1
2003	26	15	5	5	1
2004	19	14	2	1	2
2005	12	5	4	3	0
2006	20	11	4	4	1
2007	13	7	0	6	0
2008	19	10	1	8	0
2009	14	8	1	5	0
2010	17	6	9	2	0
2011	8	4	2	2	0
Total	**455**	**274**	**93**	**66**	**22**

Table A.4: Defendant Countries in WTO Disputes

Defendant	1995-2000	2001-2006	2007-2011	Total
United States	61	47	17	125
European Union	52	26	14	92
China	-	4	19	23
India	13	5	2	20
Argentina	12	4	1	17
Canada	10	5	2	17
Japan	12	3	0	15
Brazil	11	3	0	14
Korea	11	2	1	14
Mexico	6	8	0	14
Chile	5	7	1	13
Other high income economies	10	3	1	15
Other upper middle economies	15	7	5	26
Other lower middle economies	24	14	8	46
Other low income economies	4	0	0	4
Total complaints by period	**246**	**138**	**71**	**455**

Table A.5: Country Pairs Involved in Disputes by Time Periods

Country Pair	**1995-2000**	**2001-2006**	**2007-2011**	**Total**
United States – European Union	48 (26-22)	15 (6-9)	3 (1-2)	66 (34-32)
Canada – United States	7 (3-4)	11 (9-2)	2 (2-0)	20 (15-5)
United States – China	-	3 (2-1)	15 (10-5)	18 (12-6)
European Union – India	9 (6-3)	5 (3-2)	3 (1-2)	17 (10-7)
Mexico – United States	5 (1-4)	8 (6-2)	2 (2-0)	15 (9-6)
Korea – United States	11 (5-6)	2 (2-0)	2 (2-0)	15 (9-6)
Canada – European Union	9 (6-3)	3 (1-2)	3 (2-1)	15 (9-6)
Brazil – United States	7 (3-4)	5 (5-0)	2 (2-0)	14 (10-4)
Japan – United States	10 (5-5)	4 (3-1)	-	14 (8-6)
India – United States	8 (5-3)	2 (2-0)	1 (0-1)	11 (7-4)
Brazil – European Union	7 (4-3)	3 (2-1)	1 (1-0)	11 (7-4)
European Union – Argentina	6 (6-0)	4 (1-3)	-	10 (7-3)
European Union – Korea	3 (3-0)	4 (1-3)	-	7 (4-3)
European Union – Japan	6 (6-0)	-	1 (0-1)	7 (6-1)
European Union – China	-	1 (1-0)	6 (4-2)	7 (5-2)
United States – Argentina	5 (4-1)	2 (0-2)		7 (4-3)
Argentina – Chile	1 (1-0)	5 (4-1)	1 (1-0)	7 (6-1)
United States – Australia	6 (4-2)	-	-	6 (4-2)
Mexico – European Union	4 (3-1)	2 (0-2)	-	6 (3-3)
United States – Philippines	4 (3-1)	-	1 (1-0)	5 (4-1)
Thailand – United States	2 (2-0)	2 (2-0)	1 (1-0)	5 (5-0)
Thailand – European Union	1 (1-0)	3 (3-0)	1 (0-1)	5 (4-1)
European Union – Chile	4 (3-1)	1 (0-1)	-	5 (3-2)
Mexico – Guatemala	2 (2-0)	2 (0-2)	-	4 (2-2)
Brazil – Canada	3 (2-1)	1 (1-0)	-	4 (3-1)
Other country pairs	82	50	26	158
Total complaints by period	**246**	**138**	**71**	**455**

Table A.6: Statistics on Current State of Disputes

Stage	**No. of Disputes**
(1.) Mutually agreed to terminate (at any stage)	**97**
(2.) Panel verdict accepted	**52**
(3.) Appeal panel verdict accepted	**109**
(4.) Compliance proceedings required after panel/appeal panel verdict	**32**
◇ After panel verdict	5
◇ After appeal panel verdict	27
(5.) Ongoing disputes	**165**
◇ Still in consultations	140
◇ Beyond consultations	25
(1.) + (2.) + (3.) + (4.) + (5.) = Consultations requested	**455**

Table A.7: Disputes by Agreement

Agreement	**No. of Disputes**
GATT	355
Anti-dumping (Article VI of GATT)	100
Subsidies and countervailing measures	97
Agriculture	74
Agreement establishing the WTO	51
Technical barriers to trade	41
Import licensing	40
Safeguards	39
Sanitary and phytosanitary measures	37
Trade-related investment measures (TRIMs)	31
TRIPs	29
GATS	26
Protocol of accession	20
◇ Chinese protocol of accession	19
Textiles and clothing	16
Dispute settlement understanding	15
Customs valuation (Article VII of GATT)	14
Rules of origin	7
Government procurement	4

Table A.8: Timing of Disputes

(1)	**(2)**	**(3)**	**(4)**	**(5)**
Time since last dispute filed by other country	**Number of potential counter-complaints**	**Percentage (out of 238 cases)**	**Expected number of complaints**	**(2) − (4)**
N/A	217	-	-	-
3 Months	64	24.40%	41	23
3 – 6 Months	24	10.10%	9	15
6 – 9 Months	19	8.40%	8	11
9 – 12 Months	16	6.70%	5	11
1 – 2 Years	47	20.20%	83	37
2 – 3 Years	26	10.90%	33	7
3 – 4 Years	6	2.50%	8	2
4 – 5 Years	16	6.70%	22	6
5 – 6 Years	8	3.40%	6	2
More than 6 Years	16	6.70%	89	-73

Note: numbers in columns (4) and (5) are rounded to nearest integer.

Table A.9: Panel and Appellate Body Rulings

Claims by complainant	Claims ruled on	Rulings in favor of complainant	Percentage of rulings in favor of complainant
3230	2760	1817	65.83%
Appellate Body Rulings:			
Claims by original complainant	Claims ruled on	Rulings in favor of claimant	Percentage of rulings in favor of claimant
498	319	136	42.63%
Claims by original defendant	Claims ruled on	Rulings in favor of claimant	Percentage of rulings in favor of claimant
948	854	173	20.26%
Claims by original complainant and defendant	Claims ruled on	Rulings in favor of claimant	Percentage of rulings in favor of claimant
1446	1173	309	26.34%

Table A.10: Time Structure of Claims, Victories and Winning Probabilities per Claimant

Year	**No. of claimants**	**Average number of claims per claimant**	**Average number of victories per claimant**	**Average probability for claimant to win a claim**
1995	-	-	-	-
1996	11	3	2.45	90.9% (100%)
1997	27	33.96	12.26	66.2% (98.2%)
1998	33	4.91	3.33	70.7% (83.2%)
1999	30	4.33	1.8	60.0% (81.9%)
2000	38	6.89	4.26	47.3% (71.4%)
2001	20	7.75	3.65	52.3% (63.0%)
2002	29	49.79	28.79	48.7% (57.1%)
2003	39	38.64	16.56	41.6% (75.9%)
2004	20	9.3	4	45.7% (70.0%)
2005	33	11.45	3.03	27.6% (49.8%)
2006	11	25.64	12.91	45.0% (43.8%)
2007	11	18.18	9.64	58.1% (65.0%)
2008	23	5.87	3.04	37.3% (68.6%)
2009	7	32	16.86	63.0% (66.5%)
2010	12	17.33	10.92	67.1% (68.9%)
2011	11	11.73	6.36	53.9% (75.4%)

Table A.11: Industry Sections in HS Schedule by 2-digit HS Categories

Section	Title	HS2 Categories
I	Live Animals; Animal Products	01 – 05
II	Vegetable Products	06 – 14
III	Animal or Vegetable Fats and Oils and Their Cleavage Products; Prepared Edible Fats; Animal or Vegetable Waxes	15
IV	Prepared Foodstuffs; Beverages, Spirits, and Vinegar; Tobacco and Manufactured Tobacco Substitutes	16 – 24
V	Mineral Products	25 – 27
VI	Products of the Chemical or Allied Industries	28 – 38
VII	Plastics and Articles Thereof; Rubber and Articles Thereof	39 – 40
VIII	Raw Hides and Skins, Leather, Furskins and Articles Thereof; Saddlery and Harness; Travel Goods, Handbags and Similar Containers; Articles of Animal Gut (Other Than Silkworm Gut)	41 – 43
IX	Wood and Articles of Wood; Wood Charcoal; Cork and Articles of Cork; Manufacturers of Straw, of Esparto or of Other Plaiting Materials; Basketware and Wickerwork	44 – 46
X	Pulp of Wood or of Other Fibrous Cellulosic Material; Waste and Scrap of Paper or Paperboard; Paper and Paperboard and Articles Thereof	47 – 49
XI	Textile and Textile Articles	50 – 63
XII	Footwear, Headgear, Umbrellas, Sun Umbrellas, Walking Sticks, Seatsticks, Whips, Riding-Crops and Parts Thereof; Prepared Feathers and Articles Made Therewith; Artificial Flowers; Articles of Human Hair	64 – 67
XIII	Articles of Stone, Plaster, Cement, Asbestos, Mica or Similar Materials; Ceramic Products; Glass and Glassware	68 – 70
XIV	Natural or Cultured Pearls, Precious or Semiprecious Stones, Precious Metals, Metals Clad With Precious Metal, and Articles Thereof; Imitation Jewelry; Coin	71
XV	Base Metals and Articles of Base Metal	72 – 83
XVI	Machinery and Mechanical Appliances; Electrical Equipment; Parts Thereof; Sound Recorders and Reproducers, Television Image and Sound Recorders and Reproducers, and Parts and Accessories of Such Articles	84 – 85
XVII	Vehicles, Aircraft, Vessels and Associated Transport Equipment	86 – 89
XVIII	Optical, Photographic, Cinematographic, Measuring, Checking, Precision, Medical or Surgical Instruments and Apparatus; Clocks and Watches; Musical Instruments; Parts and Accessories Thereof	90 – 92
XIX	Arms and Ammunition; Parts and Accessories Thereof	93
XX	Miscellaneous Manufactured Articles	94 – 96
XXI	Works of Art, Collectors' Pieces and Antiques	97
XXII	Special Classification Provisions; Temporary Legislation; Temporary Modifications Proclaimed Pursuant to Trade Agreements Legislation; Additional Import Restrictions Proclaimed Pursuant to Section 22 of the Agricultural Adjustment Act, as Amended	98 – 99

Chapter 2

WTO DISPUTE DETERMINANTS

2.1 Introduction

The GATT/WTO has facilitated a remarkable degree of trade liberalization in over 100 countries in the past 60 years, generating intense interest in providing economic underpinnings of the institution as well as in identifying the empirical gains from membership. Of the widely regarded key tenets for the success of the GATT/WTO: reciprocity, nondiscrimination and enforcement (Bagwell and Staiger, 2002), the approach to enforcement experienced the most drastic paradigm shift after integrating the GATT into the WTO in 1995. The WTO established a powerful legal-based dispute settlement mechanism, the Dispute Settlement Body (DSB), which adjudicates agreement infractions and enforces rules with authorized retaliatory measures for harmed countries as punishment.[1] The DSB is essential for guaranteeing members' compliance with their commitments and understanding its usage pattern is crucial for assessing the true value of the WTO's liberalization efforts. Since 1995 the DSB has been extraordinarily active with over 400 cases, mostly with large developed and developing member countries as both dispute complainants and defendants (Tables B.1 and B.2). Earlier empirical studies of the WTO dispute pattern confirm this notion and find that countries with high incomes, substantial retaliatory capacity and diverse exports violate the WTO rules more frequently and simultaneously file more complaints with the DSB.[2] These implications also fit well with the predictions of the canonical WTO terms-of-trade approach (Bagwell and Staiger, 1999).

[1] When a WTO member files a case with the DSB and is unable to resolve its dispute with the defendant country in a consultation stage, a DSB panel will issue a ruling that can be appealed by either country. If the defendant fails to comply with the final verdict, the DSB can allow the harmed country to impose trade sanctions on the violator.

[2] See Horn et al. (2005), Bown (2005) and Sattler and Bernauer (2011) for empirical evidence. Busch and Reinhardt (2003), Guzman and Simmons (2005) and Davis and Bermeo (2009) suggest instead that many developing countries participate less frequently in WTO disputes due to the lack of legal capacities and resources.

Since 2000, however, the WTO DSB pattern has become more nuanced (Figure B.1) as the gap in disputes involving high per capita income countries and other WTO members as complainants has all but disappeared.[3] Even though measures of retaliatory capacity (GDP, trade flows, and diversity of active trading sectors) still correlate with dispute frequency, they fail to account for two key features in the data. First, the total number of WTO disputes has decreased sharply since the early 2000s while the stakes at issue, world trade flows, have increased tremendously. This drop in disputes was driven by a dramatic reduction in high income country participation, although their retaliatory power has certainly not been reduced. Second, WTO disputes are disproportionately concentrated in a few selected industries (Figure B.2). Surprisingly, the industries most frequently cited in disputes do not coincide with those sectors that have high WTO trade shares. Disputes are substantially more frequent in agriculture, food, and textile industries than their share in WTO trade suggests, while exactly the opposite is true for machinery, vehicles, and mineral products.

In this chapter, I extend the WTO theory to account for the above documented dispute pattern by integrating political economy aspects and country asymmetries into the standard terms-of-trade framework. To do so, I leverage the recent literature on "tariff overhangs", which represent the difference between bound tariffs (by WTO negotiations) and the actually applied tariffs. I will show that underlying country parameters, size being one of them, drive disputes and tariff violation decisions in countries through their impact on tariff overhangs. The smaller a country's tariff overhang, the less flexibility policy makers possess in responding to economic shocks, which I motivate in my model by establishing a link between trade liberalization and adjustments in industry productivity. Since the ensuing change in average sectoral productivity and competitiveness is difficult for policy makers to predict ex ante during the WTO tariff negotiations, the rigidity of the agreement eventually leads to post-agreement struggles. Taken together, the model predicts that productivity shocks and subsequent trade disputes emerge at higher frequencies during tariff bound reduction periods. Given that the phase-in periods for the newly negotiated Uruguay Round tariff bounds ended for developed economies in 2000 (later for other members), a natural explanation results for the heyday of WTO disputes during that time and the steep drop-off

[3] A similar pattern holds when instead considering the income groups of defendant countries (not shown).

thereafter.

In the model, tariff overhangs also play a crucial role for countries debating a dispute filing with the DSB after observing a violation. Since the DSB enforcement threat is directly tied to the complainant country's willingness to retaliate, a dispute filing only occurs when a temporary increase of the tariff rate seems desirable. It follows that a harmed WTO member solely considers entering a dispute when the agreement prohibits the application of its individual optimal tariff, as revealed by a tight or zero tariff overhang. Guided by the model's theoretical predictions, I subsequently provide empirical evidence that tariff overhangs are an important factor in dispute violation and filing decisions. My regressions show that WTO members' tariff overhangs are a significant predictor of the incidence of WTO disputes, even when controlling for country size, trade volumes, sectoral diversification and political economy aspects. This paper therefore contains two major contributions. First, I provide the theoretical argument and empirical evidence that tariff overhangs are crucial for countries' agreement violation and dispute filing decisions. Second, I highlight the specific channels through which underlying country parameters, such as country size, productivity and political economy motives, impact dispute participation incentives.

This paper is not the first to address questions regarding the possible interactions between endogenous trade policy and GATT/WTO dispute settlement procedures. Hungerford (1991), Kovenock and Thursby (1992) and Ludema (2001) focus on how the presence of a dispute settlement institution can impact the choice of trade policy tools in an agreement. More recent models of the WTO which incorporate trade disputes and analyze the potential roles of the DSB include Klimenko et al. (2008), Beshkar (2010), Maggi and Staiger (2011) and Park (2011). None of these studies relate, however, their findings to the observed WTO dispute pattern. Maggi and Staiger (2013), on the other hand, model and empirically test the relationship between different contract classes, DSB ruling precision and the outcomes of WTO disputes.

In its search for the underlying causes of the WTO dispute pattern, this paper is closest to Bown (2002, 2004b) who identifies political pressure as the key determinant of countries' willingness to breach the WTO agreement. His approach differs from mine in that he focuses on symmetric countries with fixed productivity parameters and the negotiation of

applied tariff rates. Both points turn out to be crucial. To focus on the importance of tariff overhangs for trade disputes, my framework builds on recent contributions in the bound tariff literature by Bagwell and Staiger (2005) and Beshkar and Bond (2012). Their works as well as Amador and Bagwell (2013) highlight the importance to differentiate between the negotiation of applied and bound tariff rates in trade agreements. In particular, tariff bounds can offer welfare improvements for agreement members when governments face uncertain political pressure from domestic lobbying groups. To motivate the existence of tariff bounds in the WTO, I follow this paradigm and allow for time-varying political pressure on governments which cannot be verified by trading partners.[4]

The remainder of the chapter proceeds as follows. Section 2.2 motivates a trade agreement with tariff bounds and derives the equilibrium trade policies. Section 2.3 extends the model to allow for trade disputes and examines a country's incentive to violate the trade agreement, both in the absence and in the presence of a DSB. Section 2.4 analyzes a country's dispute filing decision after detecting a violation. Section 2.5 provides empirical evidence for the link between tariff overhangs and dispute incidence. Section 2.6 concludes.

2.2 A Trade Agreement with Tariff Bounds

The presentation of the theoretical framework in this section follows Bagwell and Staiger (2005) and its extension by Beshkar and Bond (2012). Their approach is convenient for our purposes due to two reasons. First, it allows for trade agreements between countries of asymmetric size, a feature of potentially major importance for explaining the emerged pattern of WTO disputes. And second, the model is very tractable due to the assumption of specific demand and supply structures across countries. I first present the basic framework and then derive the equilibrium agreement policies.

[4] A second possibility to motivate tariff bounds is the presence of non-negligible negotiation costs. In this case, it is too costly for countries to negotiate trade policies for every possible state of the world, making an incomplete agreement with tariff bounds an appealing alternative, see Horn et al. (2010a).

2.2.1 Basic Structure

There are two countries, Home (no *) and Foreign (*), whose economies produce three goods, $i = 0, 1, 2$. In the domestic and the foreign economy live N and N^* households, respectively. Each household has identical preferences of the form $U = c_0 + \sum_{i=1,2} c_i(1 - .5c_i)$ with c_i describing the amount of consumption of good i. Labor is the only factor of production and every household in each country supplies the quantity of l_i in the respective labor market. Per household production of each good in Home is $x_0 = l_0$ and $x_i = (2\phi_i l_i)^{1/2}$ for $i = 1, 2$, with ϕ_i as measure for domestic labor productivity in sector i. Total domestic production of each good is then $X_i = Nx_i$. Good 0 is the numeraire with a normalized price equal to one and can be freely traded between both countries. While the production technology for good 0 is identical in the foreign country, the production processes for the non-numeraire goods differ, $x_i^* = (2\phi_i^* l_i)^{1/2}$ for $i = 1, 2$. Labor supplies are large enough for production of good 0 to occur in either country, implying a fixed wage rate of one in both economies. Goods markets are competitive.

Given the preferences and production technologies, the demand and supply relationships for non-numeraire goods in Home are $D_i = N(1 - p_i)$ and $S_i = N\phi_i p_i$, respectively. Similar relationships hold for Foreign. Autarky prices for the non-numeraire goods in Home and Foreign are then $p_i^A = 1/(1 + \phi_i)$ and $p_i^{*A} = 1/(1 + \phi_i^*)$, respectively. Without loss of generality, $\phi_2 = \phi_1^* > 1$ and $\phi_1 = \phi_2^* = 1$, implying a comparative advantage for Home (Foreign) in the production of good 2 (1). The only trade policy instruments available to both countries are ad-valorem import tariffs, t and t^*. Allowing for trade, the world prices of goods 1 and 2 are then $p_1 = (1 + t)p_1^*$ and $p_2^* = (1 + t^*)p_2$. Due to the quasi-linear preferences in both countries, only the tariff set by Home can impact domestic and foreign welfare in Home's import sector. The same argument applies to Foreign's tariff in Foreign's import sector. Since the production and demand structure is symmetric across countries, it is sufficient for now to focus the analysis on Home's import sector, good 1.

Home's aggregate import demand and Foreign's export supply function for good 1 are $M_1 = D_1 - S_1 = N(1 - 2p_1)$ and $E_1^* = S_1^* - D_1^* = N^* \left([p_1(1 + \phi_1^*)/(1 + t)] - 1\right)$, respectively. To simplify notation, I drop good subscripts throughout this section. Given the structure

of the import demand and export supply functions, goods prices in Home and Foreign are homogeneous of degree zero in both countries' population sizes, implying that only relative and not absolute population in Home and Foreign have an impact on equilibrium prices. Normalizing the world population to 1, with share λ living in Home and share $1-\lambda$ living in Foreign, the equilibrium price of good 1 in Home is

$$p(t) = \frac{1+t}{2\lambda(1+t)+(1-\lambda)(1+\phi^*)} \quad . \tag{2.1}$$

Welfare of the domestic government in sector 1 is the sum of consumer surplus, producer surplus and tariff revenue, which is reimbursed in equal shares to domestic residents. The domestic government assigns a higher weight, $\gamma \geq 1$, to producer welfare in the import-competing sector.[5] Foreign government welfare in sector 1 is in turn the sum of producer and consumer surplus. In summary, the domestic and foreign government welfare functions in sector 1 are given by

$$W(t,\gamma) = CS(t) + \gamma PS(t) + TR(t) \tag{2.2}$$

$$W^*(t) = CS^*(t) + PS^*(t) \tag{2.3}$$

where $CS(t) = \lambda(1-p(t))^2/2$, $PS(t) = \lambda p(t)^2/2$, $TR(t) = tp^*(t)\lambda(1-2p(t))$, $CS^*(t) = (1-\lambda)(1-p^*(t))^2/2$, and $PS^*(t) = (1-\lambda)\phi^* p^*(t)^2/2$.

Domestic political pressure can vary from period to period. More specifically, γ is distributed uniformly and takes with equal probability any value in the range $\gamma \in [1, \overline{\gamma}]$, with $\overline{\gamma} < (3\phi^* - 1)/(1+\phi^*)$ to ensure positive imports of good 1. Crucially, neither government can observe the exact realization of political pressure in the other country due to the absence of a costless monitoring device. Even if the information is available, it is likely to arrive with time lags in the other country which makes contemporary reviews of Home's tariff choice by the Foreign government an imprecise undertaking. Mutual uncertainty about political pressures has important implications for the negotiation of a trade agreement between Home and Foreign. I outline the optimal agreement policies next.

[5] See Grossman and Helpman (1994) for a microeconomic foundation of this assumption.

2.2.2 Optimal Agreement Policies in the Presence of Uncertainty

In the absence of a trade agreement, Home sets its individually optimal tariff rate in each period, which we find by maximizing $W(t, \gamma)$ with respect to t:

$$t^N(\gamma) = \frac{(\gamma - 1)(1 + \phi^*) + 2\lambda(\phi^* - 1)}{(3 - \gamma)(1 + \phi^*) + 4\lambda} \tag{2.4}$$

where I suppress the dependence of the Nash tariff on ϕ^* and λ on the left hand side because both parameters are fixed for now. Notice that Home's Nash tariff in (2.4) depends positively on domestic political pressure, country size and the domestic productivity disadvantage in Home's import sector.

An incentive compatible trade agreement needs to induce each government to always announce the true political pressure it faces. Home and Foreign can solve this issue by negotiating tariff bounds instead of fixed applied tariff rates.[6] Both countries can then apply their Nash tariff when political pressure is low and a tariff equal to the tariff bound in times of high political pressure. Intuitively, a tariff bound ensures truthfulness because either a country can already set its individually optimal tariff or, if political pressure is too high, the tariff bound binds and announcing a higher γ is not welfare improving. The incentive compatible tariff schedule for Home in the agreement is therefore

$$t = min[t^N(\gamma), t^B] \tag{2.5}$$

where $t^N(\gamma)$ is set according to (2.4) and t^B is the negotiated tariff bound. Using (2.4), we can solve in the next step for the threshold of political pressure, $\gamma^N(t^B)$, above which the domestic government's Nash tariff is greater than the tariff bound:

$$\gamma^N(t^B) = \frac{t^B[3(1 + \phi^*) + 4\lambda] + (1 + \phi^*) - 2\lambda(\phi^* - 1)}{(1 + t^B)(1 + \phi^*)} \tag{2.6}$$

where $t^N(\gamma^N) = t^B$. When transfer payments between governments are feasible and both

[6] If both countries negotiate a state-contingent agreement, the efficient tariff rate which maximizes world welfare in each period, $W + W^*$, is $t^E = (\gamma - 1)/(3 - \gamma)$. But since $\partial t^E/\partial\gamma > 0$ and $t^E < t^N$, Home always has an incentive in this case to announce too high political pressure realizations.

governments are risk-neutral, the optimal agreement in the presence of uncertainty maximizes expected world welfare in each sector.[7] Expected world welfare in sector 1 is

$$\begin{aligned} E[W+W^*] = &\int_1^{\gamma^N(t^B)} \left[W(t^N(\gamma),\gamma) + W^*(t^N(\gamma))\right] f(\gamma) d\gamma \\ &+ \int_{\gamma^N(t^B)}^{\overline{\gamma}} \left[W(t^B,\gamma) + W^*(t^B)\right] f(\gamma) d\gamma \end{aligned} \tag{2.7}$$

where $f(\gamma) = 1/(\overline{\gamma}-1)$ is the probability density function of the uniform distribution. Using (2.1), (2.2) and (2.3), we find the optimal tariff bound in sector 1 by maximizing (2.7) with respect to t^B:[8]

$$t^B = \begin{cases} \frac{\overline{\gamma}-1}{5-\overline{\gamma}} & \text{if} \quad t^B \leq t^N(1) \\ \frac{(\overline{\gamma}-1)(1+\phi^*)-2\lambda(\phi^*-1)}{(3-\overline{\gamma})(1+\phi^*)-4\lambda} & \text{if} \quad t^N(1) < t^B \leq t^N(\overline{\gamma}) \end{cases} \tag{2.8}$$

where Home always has a tariff overhang, $t^B - t$, of zero when the first line applies, which I term case 1 from now on. The second line describes the scenario, case 2 from now on, in which both the realization of a positive and a zero tariff overhang is possible, depending on the exact political pressure draw. The incidence of both cases depends solely on the relation between country size (λ), relative productivity (ϕ^*), and the range of possible political pressure realizations ($\overline{\gamma}$). Case 1 (2) applies if $\lambda \geq (<)\ \tilde{\lambda} \equiv \frac{(\overline{\gamma}-1)(1+\phi^*)}{2(3\phi^*-1)-(1+\phi^*)(1+\overline{\gamma})}$. That is, if a country is sufficiently large, its tariff overhang is always zero. The derivation of Foreign's tariff bound proceeds in similar steps.

Having characterized the properties of the negotiated trade agreement between Home and Foreign, we are now ready to analyze both countries' incentives to violate the agreement.

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[7] In the absence of transfer payments, a trade agreement between asymmetric countries does not maximize world welfare, see Bagwell and Staiger (1999) and Bond and Park (2002). Nonetheless, the resulting agreement is still Pareto-optimal. The next section discusses the enforcement compatibility of the agreement in more detail.

[8] The FOC of (2.7) with respect to the tariff binding is $\frac{\partial E[W+W^*]}{\partial t^B} = \int_{\gamma^N(t^B)}^{\overline{\gamma}} \frac{\partial [W(t^B,\gamma)+W^*(t^B)]}{\partial t^B} f(\gamma) d\gamma = 0$. See Beshkar and Bond (2012) for the proof that (2.8) is indeed a maximum.

2.3 The Emergence of Trade Disputes

In this part, I extend the model to allow for situations in which countries rationally choose to violate the previously negotiated trade agreement. In particular, I presume a link between trade liberalization and productivity, an empirical feature widely documented in the literature (for instance, Amiti and Konings, 2007, and Melitz and Ottaviano, 2008). If the trade agreement leads to relative productivity adjustments over time, a country will consider violating the agreement in certain instances. I first outline the condition under which a trade agreement is incentive compatible between potentially asymmetric countries when international productivity differences remain constant over time. After introducing productivity shocks, I distinguish between (i) an agreement without and (ii) and an agreement with a dispute settlement institution. In either scenario, I analyze how a productivity shock impacts Home's welfare incentive to breach the agreement. In the former case, similar to Bagwell and Staiger (2005), a deviation from the agreement leads to its break-up while in the latter case the dispute settlement institution ensures the survival of the agreement, even if the harmed country is not filing a dispute.

2.3.1 Incentive Compatible Weak Tariff Bounds

A welfare maximizing trade agreement requires transfers between countries in case they are too asymmetric. Syropoulos (2002) illustrates this point by showing under fairly general conditions that the larger country requires a transfer from the smaller country to not set its Nash tariff.[9] While I do not explicitly model the exact bargaining process here, I presume that both Home and Foreign can agree on a constant per period transfer, T, at the outset of the agreement. This transfer does not need to be a monetary reward. Support of the agreement is also possible through cooperation on non-trade issues, see Limão (2007) for a discussion of this point.

I follow the literature and model the incentive compatibility of the trade agreement

[9] Amador and Bagwell (2013) provide the conditions under which an optimal trade agreement takes the form of a tariff bound instead of an exact tariff if no transfers between countries are available. Amador and Bagwell treat tariff bounds as a special case of the delegation problem between a principal and an agent when the latter has superior information on the state of nature.

between Home and Foreign as an infinitely repeated game. Without loss of generality, I focus on Home's perspective; a similar reasoning applies to Foreign. The agreement is self-enforcing for Home if the stream of expected welfare realizations under the agreement is at least as large as the expected welfare stream when deviating. If Home violates the agreement, both countries will set their Nash tariffs forever thereafter.[10] Since both countries are not symmetric, it is not sufficient to focus the analysis on comparing world welfare in one sector under the efficient agreement and under Nash reversion. I define instead Home's expected per period welfare under the trade agreement with a tariff bound as

$$\tilde{W}^E = E\left[W_1(t(\gamma),\gamma) + W_2(t^*(\gamma^*))|t^B, t^{*B}\right] - T$$

where W_i is Home's welfare in sector i. Home makes a positive transfer payment, $T > 0$, if Foreign is large relative to Home, and vice versa. In a given period, the transfer payment is only made if either country applies a tariff consistent with the incentive compatible schedule in (2.5). In order for a trade agreement to be meaningful for Home, the following needs to hold:

$$\tilde{W}^E \geq \tilde{W}^N = E\left[W_1(t^N,\gamma) + W_2(t^{*N})\right]$$

where $\tilde{W}^N$ is the sum of Home's expected welfare in sectors 1 and 2 without a trade agreement, in which case both countries set their respective Nash tariffs in each period.

In order for the trade agreement to be self-enforcing, deviating in the present period should never offer a welfare improvement over cooperation for either country. The following agreement enforcement condition therefore needs to hold for Home:

$$\frac{\delta}{1-\delta}\left(\tilde{W}^E - \tilde{W}^N\right) \geq W_1(t^N,\gamma) - W_1(t^B,\gamma) + T \tag{2.9}$$

where δ is Home's per period discount factor and Home does neither pay nor receive the transfer in the deviation period. The left hand side of (2.9) describes the future benefit of

[10] Under the WTO dispute settlement mechanism a breach of the agreement is unlikely to result in the termination of the violating country's WTO membership and an infinite Nash reversion strategy. The defendant in a WTO dispute faces at most a temporary punishment phase. When allowing for the presence of a dispute settlement institution below, I therefore modify the enforcement condition from this part.

the agreement over the Nash reversion strategy. The right hand side characterizes Home's present period benefit from violating the agreement which is increasing in domestic political pressure, that is, $d[W_1(t^N,\gamma)-W_1(t^B,\gamma)]/d\gamma > 0$. Since the future loss from the agreement break-up depends only on the expected realization of γ, Home is most willing to break the agreement if it faces the highest possible political pressure realization, $\overline{\gamma}$. That is, as long as (2.9) holds for $\gamma = \overline{\gamma}$, the agreement is also always enforceable for any $\gamma < \overline{\gamma}$. A similar condition holds for Foreign.

2.3.2 Breaching the Trade Agreement without Dispute Settlement Institution

Given the outline of the model so far, a breach of the trade agreement between Home and Foreign should never happen. Home and Foreign negotiate a tariff bound as specified in section 2.2.2 and a transfer, T, which induces both countries to always choose cooperation over shortsighted self-interest. Any breach of the trade agreement has to follow in turn from an unexpected happening which is not foreseen when signing the agreement. I motivate agreement breaches by introducing in the model a link between trade liberalization and aggregate productivity shocks.[11] Since post-agreement productivity adjustments are hard to predict ex ante, either country will be bound by the initial constraints of the agreement. To fix ideas, I consider in what follows an unexpected permanent shock, ϵ, to Foreign's productivity parameter, ϕ^*, after the trade agreement enters into force. Foreign's productivity advantage in sector 1 then equals $\phi^{*'} = \phi^* + \epsilon$, where ϕ^* is Foreign's productivity parameter at the time of the agreement signing. Notice that ϕ^* is equivalent to Foreign's relative productivity edge in Home's import sector, that is, the ratio of Foreign's and Home's productivity parameters.

After the productivity shock hits in Home's import sector, when will Home decide to breach the agreement? Violating the agreement requires Home to have an inability to set its preferred tariff rate, t^N, under the agreement's current tariff schedule. The necessary condition for Home to consider a violation is therefore a zero tariff overhang in its import sector after the realization of the productivity shock. Otherwise, an agreement breach is

[11] These shocks, for instance, follow naturally in a world with heterogeneous firms (Melitz, 2003) where changes in trade costs lead to a reshuffling of aggregate industry productivity.

pointless because Home can already set its individually optimal trade policy. Proposition 1 summarizes how Home's tariff overhang structure prior to the productivity shock affects its chances to meet the prerequisite for an agreement breach.

Proposition 1 *A lower tariff overhang increases Home's likelihood to meet the prerequisite for an agreement breach when Foreign experiences a positive shock to its productivity parameter, ϕ^*, and vice versa.*

Proof: See Mathematical Appendix to this chapter.

Intuitively, an increase in Foreign's productivity increases the Nash tariff in (2.4) that Home wishes to set. Having a lower tariff overhang prior to the shock therefore raises the probability to be constrained by the agreement afterwards. On the one hand, a positive shock increases Home's likelihood to always have a zero tariff overhang (incidence of case 1). And second, it increases the share of political pressure realizations which result in a zero tariff overhang in Home in case 2. Proposition 1 also illustrates that after a positive productivity shock, an illegal deviation becomes a potential policy option in more scenarios for Home. This conclusion holds for any realization of Home's other model parameters $(\lambda, \phi^*, \overline{\gamma})$. Notice that this result is independent of the presence of a dispute settlement institution and also applies in the next section when I introduce a DSB.

Figure B.3 offers empirical support for the hypothesis that tariff overhangs are an essential determinant for WTO agreement violations. Prior to WTO dispute filings, complainants face tariff overhangs in dispute sectors which are much more tightly distributed around zero in defendant countries than in non-defendant countries (WTO members not subject to dispute filings). While this finding is not sufficient to directly identify WTO agreement violators –note the non-negligible share of tight bindings in the right panel– Figure B.3 provides evidence that having a zero or tight tariff overhang is a necessary condition to breach a WTO agreement.[12] Table B.3 also provides summary statistics of both samples

[12] The substantial share of negative tariff overhangs in Figure B.3 might seem surprising given that WTO members in general must not set applied tariffs above their bound rates. In practice, however, the average tariff overhang can be negative for several reasons: 1. WTO members can, under specific conditions, apply safeguard and antidumping duties above their bound rates, 2. no bound rates are set for certain sectors (which can bias the average bound rate), 3. specific bound and applied tariff rates might distort the calculation of tariff averages due to the necessary conversion into ad-valorem equivalents, and 4. after

in Figure B.3, showing that the tariff overhang distributions differ significantly between dispute defendants and non-defendants.

Next, I identify how Home's model parameters impact its incentive for an agreement breach when the prerequisite of a zero tariff overhang is met after the productivity shock. In particular, I examine the circumstances under which a positive shock to Foreign's productivity parameter is more likely to result in a violation of the agreement enforcement condition in (2.9). Notice that the productivity shock changes the shape of Home's welfare function in sector 1 in two distinct ways. There is a direct effect through the change in ϕ^* but also an indirect effect through the impact on Home's Nash tariff choice. Let us define the terms on the left and right hand sides in (2.9) as $\Delta\tilde{W} = \tilde{W}^E(t(\gamma), \gamma, \phi^*|t^B, t^{*B}) - \tilde{W}^N(t^N(\gamma), \gamma, \phi^*)$ and $\Delta W_1 = W_1(t^N(\gamma), \gamma, \phi^*) - W_1(t^B, \gamma, \phi^*)$, respectively, where I now write Home's welfare expressions as explicit functions of ϕ^* to indicate that the productivity parameter is not fixed anymore. Using the envelope theorem and the fact that Home cannot adjust its tariff bound retroactively, the change in Home's welfare incentive to breach the agreement after a permanent productivity shock is then

$$\Delta\Omega = \frac{d\Delta W_1}{d\phi^*} - \frac{\delta}{1-\delta}\frac{d\Delta\tilde{W}}{d\phi^*} \quad . \tag{2.10}$$

The Mathematical Appendix to this chapter provides the detailed expression for equation (2.10). The first term is the effect on Home's immediate gain from the breach and the second term describes the change in the future welfare losses after the agreement break-up. As long as (2.9) binds with equality, a positive permanent shock to Foreign's relative productivity edge induces a violation of the agreement by Home if $\Delta\Omega > 0$, and keeps the agreement in place otherwise.

However, even if $\gamma = \overline{\gamma}$, the bargaining power distribution between Home and Foreign in the agreement negotiations will determine the status of the binding in (2.9). I therefore consider the more general scenario when the enforcement condition in (2.9) binds with inequality. In this case, a positive value of $\Delta\Omega$ implies that the welfare incentive to breach the agreement has increased after the productivity shock but it might not be sufficient to

negotiating new bound rates, WTO members are usually granted phase-in periods during which applied tariffs can exceed the new tariff bounds.

trump the value of cooperation in the future. Suppose $\gamma \in [\gamma^N, \overline{\gamma}]$ and $\frac{\delta}{1-\delta}(\tilde{W}^E - \tilde{W}^N) - G = W_1(t^N, \gamma) - W_1(t^B, \gamma) + T$ where G is the gain from remaining in the agreement in future periods relative to the benefit from deviating in the present period. Violating the agreement after the productivity shock is only preferable as long as $\Delta\Omega > G$. The focus on political pressure realizations above γ^N follows from the zero tariff overhang prerequisite for Home to ever consider a deviation after the productivity shock.

The sign of $\Delta\Omega$ in (2.10) is ambiguous and depends on the model's parameters: (i) Home's size, λ, (ii) Foreign's productivity advantage before the shock, ϕ^*, and (iii) the range of political pressure realizations in Home, $\gamma \in [1, \overline{\gamma}]$. Proposition 2 summarizes the conditions under which Home's breaching incentive becomes more attractive after a productivity shock, that is, when $\Delta\Omega$ is ensured to be positive.

Proposition 2 *After a positive shock to Foreign's productivity parameter, ϕ^*, Home's incentive to breach the agreement is guaranteed to increase under the following conditions:*

$$\lambda > \begin{cases} \frac{(1+\phi^*)(5-\overline{\gamma})}{(1+\phi^*)(5-\overline{\gamma})+4} & \text{if} \quad t^B \leq t^N(1) \\ \frac{(1+\phi^*)(3-\overline{\gamma})}{6} & \text{if} \quad t^N(1) < t^B \leq t^N(\overline{\gamma}) \end{cases}$$

for any $0 < \lambda < 1$ and $\gamma \in [\gamma^N, 2)$.

Proof of Proposition 2: see Mathematical Appendix to this chapter.

It follows from inspection of Proposition 2 that a positive shock to Foreign's productivity parameter is more likely to result in a guaranteed increase in Home's breaching incentive when (i) Home is large, (ii) Home's productivity disadvantage in its import sector is low, and (iii) the uncertainty about Home's political pressure is high. Part (i) results, since either condition in Proposition 2 is more easily met when λ increases. Parts (ii) and (iii) follow in turn because the right-hand sides of both inequalities in Proposition 2 are increasing in ϕ^* and decreasing in $\overline{\gamma}$, respectively.

There is one last piece we need to consider to predict which underlying country characteristics raise the likelihood for an agreement violation by Home. The comparative statics of the Nash tariff in (2.4) and the tariff bound in (2.8) imply that larger countries (high

λ) with a substantial productivity disadvantage in their import sector (high ϕ^*) and a narrow range of potential political pressure (low $\overline{\gamma}$) have, in general, lower tariff overhangs. In conjunction with Proposition 1, the same country characteristics also determine when Home is more likely to meet the prerequisite for a violation after a post-agreement productivity shock. Simply considering potential deviation gains as in Proposition 2, without paying attention to the incidence of tight tariff overhangs, can therefore result in misleading conclusions. In fact, of all three country parameters $(\lambda, \phi^*, \overline{\gamma})$, only an increase in country size raises the probability for Home to simultaneously face a tight tariff overhang and to experience a guaranteed increase in the welfare incentive to violate the agreement. A similar clear-cut prediction is not feasible with respect to Foreign's productivity edge in Home's import sector and Home's range of potential political pressure. In order to arrive at this conclusion, it is crucial to emphasize that a country's decision to violate the agreement operates through two channels: a tight tariff overhang and its welfare incentive for a breach when this prerequisite is met.

In summary, the analysis in this section implies that only country size emerges as an unambiguous predictor of a members's tendency to commit a violation of the WTO agreement. Next, I address the question of whether these results carry over to the case when the trade agreement includes a dispute settlement mechanism.

2.3.3 Breaching the Agreement with Dispute Settlement Institution

This section modifies the previous analysis by introducing into the negotiated agreement a dispute settlement institution which can assign countries the right to set a retaliation tariff beyond their agreement schedule if a trading partner commits a violation. In case of an agreement breach by Home, Foreign resorts from now on to the agreement's dispute settlement body instead of reverting forever to its Nash tariff. That is, the parties to the trade agreement always resolve their differences within the institutions of the agreement. The DSB in this part takes on primarily the role of a judge and rules in favor of the complaining country with probability π^{DSB} in case a dispute emerges.[13] The imperfection

[13] Maggi and Staiger (2011) provide a more detailed treatment of a DSB's potential roles in a trade agreement. In particular, they consider three potential tasks: (1) interpreting the agreement, (2) filling gaps in the

in the DSB's ruling pattern can follow from numerous reasons, such as limited information due to monitoring costs or the provision of misleading information.

The timing of events in each period is as follows: (1) each country draws its respective political pressure realization, γ and γ^*, and chooses its applied tariff rate, (2) Home/Foreign makes the pre-specified transfer payment, T, if $t \leq t^B$, (3) in case of a violation by Home, Foreign files, as shown below, with endogenous probability P^F a case with the DSB, (4) after a dispute filing, the DSB grants Foreign with exogenous probability π^{DSB} the right to retaliate, and (5) trade flows are realized. In case of a favorable verdict, the DSB assigns Foreign a retaliation tariff which results in the withdrawal of concessions equivalent to the damage induced by Home.[14] While the WTO does not provide a formal definition of the meaning of *suspension of equivalent concessions*, I follow Bagwell and Staiger (1999) and define the term as the mutual changes in trade policy which lead to equivalent changes in import values in Home and Foreign, as measured at existing world prices. That is, the DSB assigns Foreign a tariff t^{*DSB} which reduces its value of imports from Home in sector 2 by the same amount as its own reduction in exports in sector 1 due to Home's agreement violating application of its Nash tariff:

$$p_1^*(t^B)\left[M_1(t^B) - M_1(t^N)\right] = p_2(t^{*B})\left[M_2^*(t^{*B}) - M_2^*(t^{*DSB})\right] \quad . \tag{2.11}$$

$p_1^*(t^B)$ and $p_2(t^{*B})$ are the world prices of goods 1 and 2, respectively, which would prevail in the absence of Home's agreement breach. World prices and imports are evaluated at both countries' respective tariff bounds, since each Home and Foreign require a zero tariff overhang to enter a dispute. Due to the lack of perfect information when making its decision, the DSB uses the original parameters as specified in the agreement when applying the definition in (2.11). Under these circumstances, a productivity shock does not change the DSB's decision criteria for setting a retaliation tariff.

Foreign, however, only applies the DSB-granted retaliation tariff if it is equal to or below

agreement, and (3) modifying provisions of the agreement. One main distinction to the present paper is, however, that Maggi and Staiger only allow for two distinct trade policies, protectionism and free trade.

[14] Article 22.4 of the WTO's Dispute Settlement Understanding states: "The level of the suspension of concessions or other obligations authorized by the DSB shall be equivalent to the level of the nullification or impairment."

its Nash tariff. Otherwise, Foreign has a welfare incentive to opt for setting its lower Nash tariff rate. Foreign's compensation through retaliation, C, is then

$$C = \begin{cases} W_2^*(t^{*N}(\gamma^*), \gamma^*) - W_2^*(t^{*B}, \gamma^*) & \text{if} \quad t^{*N} < t^{*DSB} \\ W_2^*(t^{*DSB}, \gamma^*) - W_2^*(t^{*B}, \gamma^*) & \text{if} \quad t^{*N} > t^{*DSB} \end{cases}$$

where the upper term applies when Foreign lacks the sufficient retaliatory capacity to cause an equivalent reduction in the value of Home's exports as specified in (2.11). When Foreign has sufficient retaliation power and chooses to apply t^{*DSB}, the lower term determines the welfare gain in its own import sector. The compensation granted by the DSB to Foreign directly translates into the following welfare loss, W_L, and thus threat point for Home:

$$W_L = \begin{cases} W_2(t^{*B}) - W_2(t^{*N}(\gamma^*)) & \text{if} \quad C = W_2^*(t^{*N}(\gamma^*), \gamma^*) - W_2^*(t^{*B}, \gamma^*) \\ W_2(t^{*B}) - W_2(t^{*DSB}) & \text{if} \quad C = W_2^*(t^{*DSB}, \gamma^*) - W_2^*(t^{*B}, \gamma^*) \end{cases} . \tag{2.12}$$

In the upper case, when Foreign lacks sufficient retaliation power, Home's loss in its export sector is equivalent to the damage done by Foreign's Nash tariff, t^{*N}. Otherwise Foreign's DSB-granted retaliation tariff, t^{*DSB}, determines the reduction in Home's welfare.

The presence of the dispute settlement institution changes the rules of the game and therefore also the agreement enforcement condition for Home. The threat point after observing an agreement violation is not infinite Nash reversion anymore but the compensation threat in the present period through the presence of the DSB. Since the agreement now remains in force even after an observed violation, Home and Foreign have to make separate agreement violation and dispute filing decisions in each period after drawing new political pressure realizations. As in the case without DSB, Home and Foreign are only willing to close a trade agreement if both countries expect their respective counterpart to not violate the agreement from the outset, even when being in the most attractive situation to do so. A self-enforcing agreement with a DSB thus requires both Home and Foreign to expect the realization of the efficient agreement policies, $\tilde{W}^E$, for all future periods. The agreement

enforcement condition for Home in the presence of the DSB then changes to:[15]

$$\pi^{DSB} P^F E[W_L|\gamma^* > \gamma^{*N}] - T \geq W_1(t^N, \phi^*, \gamma) - W_1(t^B, \phi^*, \gamma) \tag{2.13}$$

where the left hand side is Home's expected cost from deviating and the right hand side describes the benefit from an agreement violation. The condition in (2.13) has a similar interpretation as the enforcement condition in (2.9). When (2.13) holds, Home does not gain from a violation even when facing that level of political pressure for which a deviation would promise the highest payoff.

In equation (2.13), P^F denotes the dispute filing probability of Foreign, which we can determine endogenously. As long as there are no dispute filing costs, Foreign submits a complaint with the DSB if its own Nash tariff exceeds its tariff binding, $t^{*N} > t^{*B}$, which is true as long as $\gamma^* > \gamma^{*N}$. Otherwise, filing a case with the DSB does not provide the chance of a welfare improvement, because Foreign is already able to set its individually optimal tariff. Following an agreement violation by Home, Foreign's probability to file a complaint with the DSB in a given period is then $P^F = min\left[Pr(\gamma^* > \gamma^{*N}), 1\right] = min\left[\frac{\overline{\gamma}^* - \gamma^{*N}}{\overline{\gamma}^* - 1}, 1\right]$, where P^F always takes a value of one if $\gamma^{*N} < 1$. The second equality follows from the uniform distribution of Foreign's political pressure parameter γ^* with support $[1, \overline{\gamma}^*]$. Since Home is unaware of the exact realization of Foreign's political pressure parameter, the left hand side in (2.13) includes the expected instead of the actually suffered welfare loss. In addition, because Foreign only files a dispute when $\gamma^* > \gamma^{*N}$, we need to condition Home's welfare loss on this range of political pressure realizations, $E[W_L|\gamma^* > \gamma^{*N}]$. The term T on the left hand side in (2.13) arises again from skipping the per-period transfer when Home deviates from the agreement. As in the previous section, Home receives a transfer if it is large relative to Foreign, implying that $T < 0$, and vice versa.

I now examine the parameter conditions under which a permanent shock to Foreign's productivity parameter creates an incentive for Home to deviate from the agreement which includes a DSB. Let us focus again on the general case when (2.13) holds with inequality.

[15] Home's expected future welfare is identical under deviation and cooperation in the present period. Both terms therefore cancel on both sides in (2.13).

In the upper case in (2.12), when Foreign lacks sufficient retaliation power to suspend equivalent concessions, Home's expected welfare loss is $E[W_L|\gamma^* > \gamma^{*N}] = E[W_2(t^{*B}) - W_2(t^{*N}(\gamma^*))|\gamma^* > \gamma^{*N}]$. In the lower case in (2.12), the DSB limits Foreign's retaliation tariff to a level below its Nash tariff, $t^{*DSB} < t^{*N}$. Foreign's compensation then depends positively on the DSB-granted tariff while Home's expected welfare loss from breaking the agreement is $E[W_L|\gamma^* > \gamma^{*N}] = E[W_2(t^{*B}) - W_2(t^{*DSB})|\gamma^* > \gamma^{*N}] = W_2(t^{*B}) - W_2(t^{*DSB})$, with the last equality following from W_2's independence of γ^*. Since Home's welfare function in sector 2, W_2, is independent of ϕ^* and the DSB sets the retaliation tariff based on the original agreement information, the productivity shock does not affect the left hand side in equation (2.13). The change in Home's welfare incentive to implement an agreement violating policy is therefore identical in either case. In particular, taking the total differential of equation (2.13) with respect to ϕ^*, the change in Home's welfare incentive to breach the agreement is

$$\Delta\Omega^{DSB} = \frac{d\Delta W_1}{d\phi^*} = \frac{\partial W_1(t^N, \gamma, \phi^*)}{\partial \phi^*} - \frac{\partial W_1(t^B, \gamma, \phi^*)}{\partial \phi^*} \tag{2.14}$$

which is equivalent to the first term in (2.10), the corresponding expression in the absence of a DSB. Thus, in the presence of the dispute settlement institution, the productivity shock only affects Home's present period gain from setting its Nash tariff. Notice again that $\Delta\Omega^{DSB} > 0$ only implies a greater welfare incentive to breach the agreement but does not guarantee a welfare gain relative to the case in which Home sets an agreement consistent tariff. Like in the case without DSB, this result emerges due to the possibility of the enforcement condition in (2.13) holding with inequality. Proposition 3 summarizes how the presence of the DSB impacts the conditions for Home to experience a guaranteed increase in its welfare incentive to breach the agreement.

Proposition 3 *Consider the same range of political pressure realizations as in Proposition 2:* $\gamma \in [\gamma^N, 2)$. *The conditions which guarantee an increase in Home's welfare incentive to breach the agreement after a positive shock to Foreign's productivity parameter are then identical with and without dispute settlement institution.*

The result in Proposition 3 emerges because $\Delta\Omega^{DSB}$ is identical to the first term of $\Delta\Omega$ in (2.10), which is guaranteed to be positive under the exact same conditions as in

Proposition 2. The conclusions regarding the impact of the underlying country parameters on agreement violations therefore carry over from the previous section. In the presence of a DSB, there is still a greater chance that larger countries (higher λ) violate the agreement because they are more likely to simultaneously face a low tariff overhang and to experience a guaranteed increase in their welfare incentive to breach the agreement. A similar prediction is not feasible for Foreign's productivity edge in Home's import sector (ϕ^*) and the range of Home's political pressure ($\overline{\gamma}$).

The main point to take from this section is that the presence of a dispute settlement institution does not fundamentally change the agreement breach incentives of countries after a productivity shock. With or without a dispute settlement mechanism, tariff overhangs presort agreement members into groups that differ substantially in their aptitude to even consider an agreement violation in the first place. Smaller WTO members, such as many developing economies, are less likely to face a tariff setting constraint and therefore possess the flexibility to react to adverse shocks within the limits of the agreement. Even if they meet the prerequisite of a low tariff overhang, the limited ability of this group of countries to improve their terms-of-trade might not be sufficient to make up for any possible retaliation damage. The next section takes up the other side of the coin and analyzes the dispute filing decision of harmed economies. In particular, I examine the circumstances under which a country is more likely to call upon the DSB to obtain retaliation rights against a violator of a WTO agreement.

2.4 The Likelihood of Dispute Filings

2.4.1 Determinants of the Filing Decision

This section considers Foreign's decision to file a dispute in case it discovers an agreement violation by Home. I first analyze how the model parameters affect the filing decision through the impact on Foreign's tariff overhang. In the second step, I explore which countries are the most likely targets in a dispute filing. In particular, I illustrate how the likelihood of filing a complaint with the DSB varies with the importance of Home as an export destination for Foreign.

As outlined above, Foreign's likelihood to file a dispute after an agreement violation by Home is $P^F = min\left[\frac{\overline{\gamma}^* - \gamma^{*N}}{\overline{\gamma}^* - 1}, 1\right]$. This probability expression follows directly from the assumption that Foreign's political pressure follows a uniform distribution with support $[1, \overline{\gamma}^*]$.[16] Intuitively, the filing probability captures the likelihood of Foreign's Nash tariff to be greater than its tariff bound. That is, a country requires a zero tariff overhang to file a dispute with the DSB. Only then Foreign benefits from receiving a positive verdict to set a retaliation tariff above its tariff bound. Proposition 4 illustrates how the three different parameters in Foreign's own import market $(\lambda, \phi, \overline{\gamma}^*)$ affect its dispute filing probability in case of an agreement violation by Home.

Proposition 4 *After observing an agreement violation committed by Home, Foreign's likelihood to face a zero tariff overhang and to file a dispute with the DSB is higher when:*
(i) Foreign is large relative to Home (low λ),
(ii) the range of potential political pressure realizations in Foreign is narrow (low $\overline{\gamma}^*$), and
(iii) Foreign's productivity disadvantage in its own import sector is large (high ϕ).

Proof of Proposition 4: see Mathematical Appendix to this chapter.

Let us discuss the intuition behind these results. First, if Foreign is large relative to Home, Foreign faces, in general, a lower tariff bound in its own import sector. Since the value of a DSB-granted retaliation tariff is greater for countries with less tariff setting flexibility, a dispute filing must be more appealing for large economies. Second, if the range of political pressure in Foreign increases, the trade agreement negotiations with Home result in a higher tariff bound for Foreign. The intuition for the result in part (ii) is therefore the exact reverse of part (i). A higher tariff bound implies that Foreign can set its Nash tariff more frequently, thereby facing less often a tight tariff overhang, and diminishes the attractiveness for Foreign to file a dispute with the DSB. Similarly for part (iii), a higher comparative disadvantage of Foreign in its own import sector leads to the inflow of more imports and thus raises the Nash tariff Foreign wishes to implement. In addition, if Foreign is small enough, an increase

[16] Notice that if $\gamma^{*N} > 1$, the results below do not hinge on this assumption. The only requirement for the results to hold more generally is then $\partial P^F / \partial \gamma^{*N} < 0$, implying that the likelihood of a dispute filing decreases in the threshold of political pressure above which the applied tariff is always at its bound rate. This requirement is trivially met by any cumulative distribution function unless the applied tariff is always at its bound rate.

in ϕ also lowers the negotiated case 2 tariff bound for Foreign. Otherwise, Foreign can use its trade taxation power too excessively. Both effects imply that a higher productivity disadvantage in its own import sector decreases Foreign's trade policy flexibility in the agreement, which in turn makes a dispute filing more appealing.

2.4.2 Exports and Dispute Filings

An important empirical and theoretical question is which countries are more likely to be targets in WTO dispute filings. In particular, do countries tend to file disputes against relatively important or unimportant trading partners? I argue in this part that the model above predicts a positive correlation between Foreign's exports to Home, E^*, and Foreign's filing probability, P^F, after Foreign detects an agreement violation. I first discuss the theoretical argument and then provide supporting empirical evidence that WTO members tend to file disputes against their most important export destinations.

In case of an agreement violation by Home, Foreign's exports of good 1 to Home are

$$E^* = \frac{\lambda(1-\lambda)[\phi^* - 1 - 2t^N]}{2\lambda(1+t^N) + (1-\lambda)(1+\phi^*)} = \frac{\lambda(1-\lambda)[\phi^*(3-\gamma) - (1+\gamma)]}{8\lambda + (1-\lambda)(1+\phi^*)(3-\gamma)} \tag{2.15}$$

where the Nash tariff indicates that Home chooses to deviate from the agreement. Equation (2.15) shows that Foreign's exports depend on Home's relative size to Foreign (λ), Foreign's productivity edge in Home's import sector (ϕ^*) and the political pressure realization in Home (γ). If $\gamma < (3\phi^* - 1)/(1+\phi^*)$, Foreign's exports to Home are always non-zero in the range $\lambda \in (0,1)$. Since ϕ^* and γ are per se not related to Foreign's filing probability, see Proposition 4, the only connecting link between Foreign's exports to Home and its filing probability is both countries' relative size.

Equation (2.15) indicates that Foreign's exports of good 1 to Home are a bell-shaped function of λ. That is, E^* has a single maximum in the relevant parameter space, $\lambda \in (0,1)$, which we can find via the first-order condition of (2.15) with respect to λ.[17] The value of

[17] The FOC with respect to λ turns out to be a quadratic equation: $\lambda^2[8-(1+\phi^*)(3-\gamma)] + \lambda[2(1+\phi^*)(3-\gamma)] - (1+\phi^*)(3-\gamma) = 0$. To see that exports from Foreign to Home are indeed a bell-shaped function, note that for any $\lambda \in (0,1)$ the second order condition of (2.15) is negative, implying a concave shape of E^* with respect to λ.

Home's relative size which maximizes Foreign's exports, $\hat{\lambda}$, depends on Home's political pressure and Foreign's relative productivity edge in Home's import sector, but in general tends toward $\lambda = 0.5$:

$$\hat{\lambda} = \begin{cases} 0.5 & \text{if} \quad \gamma = \frac{3\phi^* - 5}{1+\phi^*} \\ \sqrt{(1+\phi^*)(3-\gamma)} \left[\frac{\sqrt{8} - \sqrt{(1+\phi^*)(3-\gamma)}}{8-(1+\phi^*)(3-\gamma)} \right] & \text{otherwise} \end{cases} \tag{2.16}$$

where $\hat{\lambda}$ is either increasing or decreasing in ϕ^*, depending on the exact realization of γ. In particular, $\hat{\lambda}$ tends to increase for larger values of political pressure in Home, and vice versa. Thus, the expression in (2.16) predicts that exports from Foreign to Home are highest if both countries are of similar size. This theoretical feature is in line with the empirical evidence from standard gravity regressions, which show that trade flows between countries are proportional to the product of the economic mass of the two trading partners.[18] The left panel in Figure B.4 depicts E^* as function of λ, with $\hat{\lambda}$ indicating the maximum level of Foreign's exports to Home.

The right panel in Figure B.4 shows the dispute filing probability as function of λ, conditional on an observed agreement violation by Home. As Proposition 4 indicates, Foreign always files a dispute as long as its tariff overhang is zero, that is when $\gamma^{*N} \leq 1$. Otherwise Foreign's filing probability is decreasing in Home's size, λ. More specifically, Foreign's filing probability decreases as long as λ exceeds the following value:

$$\dot{\lambda} = \frac{2[(3\phi - 1) - \overline{\gamma}^*(1+\phi)]}{2(3\phi - 1) - (1+\overline{\gamma}^*)(1+\phi)} \quad . \tag{2.17}$$

Notice that (2.17) is identical to the condition for λ above which Foreign has a tariff bound that, for low enough realizations of γ^*, allows for the application of its own Nash tariff.[19]

[18] See Anderson (2010) for the basics of the gravity equation and a review of developments in the literature over time.

[19] In particular, Foreign's tariff bound in the trade agreement is

$$t^{*B} = \begin{cases} \frac{\overline{\gamma}^* - 1}{5 - \overline{\gamma}^*} & \text{if} \quad \lambda \leq \dot{\lambda} \\ \frac{(\overline{\gamma}^* - 1)(1+\phi) - 2(1-\lambda)(\phi - 1)}{(3-\overline{\gamma}^*)(1+\phi) - 4(1-\lambda)} & \text{if} \quad \lambda > \dot{\lambda} \end{cases} ,$$

which we can derive in a similar fashion as Home's tariff bound in (2.8).

Using Figure B.4, we can now establish that a positive association between exports and the likelihood of filing a trade dispute is the logical outcome of the previous analysis. While the model does not allow to solve for the exact probability with which a country deviates, the earlier results show that larger WTO members should violate the agreement more frequently than smaller economies. It follows from this prediction that the right-hand portion of both graphs in Figure B.4 is most relevant for the analysis. More specifically, Proposition 5 summarizes the condition under which a qualitative statement about the relationship between Foreign's filing probability and its exports to Home is feasible.

Proposition 5 *If* $\lambda > max[\hat{\lambda}, \dot{\lambda}]$*, Foreign's exports to Home and Foreign's likelihood to file a dispute after observing a violation are guaranteed to be positively correlated.*

Proposition 5 follows directly from the fact that increases in λ lead to monotonous decreases in both Foreign's filing probability and Foreign's exports to Home when $\lambda > \dot{\lambda}$ and $\lambda > \hat{\lambda}$, respectively. A positive relationship between both variables is thus imperative when λ is greater than both thresholds. Intuitively, the harmed country only files a dispute if the agreement constrains its trade policy flexibility, that is, when $t^{*N} > t^{*B}$. Since the likelihood of a tight tariff overhang increases with country size, dispute filings must rise when Foreign is larger. And as long as Foreign is smaller than Home, an increase in its size also simultaneously boosts Foreign's exports to Home because both countries become more symmetric.

The data confirms the prediction of more dispute filings by WTO members against important export destinations. Figure B.5 presents a histogram of the percentile positions of complainants' export volumes to defendants in dispute sectors. For each dispute sector, I rank the complainants' complete set of export destinations in ascending order by the respective bilateral export volume. I then obtain the percentile distribution in Figure B.5 by dividing the defendants' rank by the total number of ranked countries in the respective dispute sector. A higher percentile indicates a larger dependence of the complainant on the defendant as an export destination. The accumulation of percentile values to the right end in Figure B.5 therefore confirms the hypothesis of more dispute filings against important export partners. Notice that the average number of complainants' export destinations in

dispute sectors is 65 in the data. The results are therefore not driven by complainants with only a few export destinations.

This section has argued that the structure of tariff overhangs are a potentially crucial but previously neglected element for countries dispute filing decisions in the WTO. The next section combines the predictions from the previous analysis and empirically tests the hypothesis that tariff overhangs are an essential element for WTO members' dispute participation decisions.

2.5 Empirical Evidence: Tariff Overhangs and WTO Dispute Incidence

To test the hypothesis that tariff overhangs are a crucial determinant for the incidence of WTO disputes, I use a standard binary choice framework. In order to stick with the model predictions outlined above, I employ the following econometric specification in the empirical analysis:

$$\begin{aligned} DISPUTE_{cd,t} = \beta_0 + \beta_1 OVERHANG_{c,t-1} + \beta_2 OVERHANG_{d,t-1} \\ + \beta_3 RELSIZE_{cd,t-1} + \delta Z_{cd,t-1} + \epsilon_{cd,t} \end{aligned} \tag{2.18}$$

where the unit of observation is a WTO member pair consisting of a potential dispute complainant, c, and a potential dispute defendant, d, in year t. The dependent variable, WTO dispute incidence, takes the value one in case a dispute is observed in a given year, and zero otherwise. $OVERHANG_c$ and $OVERHANG_d$ are the potential complainant's and potential defendant's average tariff overhangs, respectively.[20] In line with Propositions 1 and 4, we should expect that $\beta_1 < 0$ and $\beta_2 < 0$. For dispute defendants, tariff overhangs and agreement violations are negatively linked, since a lower tariff overhang increases the likelihood to meet the prerequisite for an agreement violation after a productivity shock. On the complainant side, the link is more subtle. According to the model, a country only files a case when having a zero tariff overhang. However, with many import goods, this requirement does not have to be met in each individual sector. We can still expect a negative impact of $OVERHANG_c$ on dispute incidence as long as the average tariff overhang is inversely related to the incidence of zero tariff overhangs.

[20] I calculate tariff overhangs using simple averages across sectors; the results are similar with trade-weighted averages.

In accordance with the model, I also include a measure of power asymmetry which I proxy with a country pair's absolute difference in log GDPs, $RELSIZE_{cd}$. While the earlier analysis illustrates that larger economies have a greater incentive to violate the WTO agreement, Proposition 4 also predicts that larger countries are more likely to file a dispute. Combining these predictions, dispute pairs should involve countries of not too different size, implying a negative impact of $RELSIZE_{cd}$ on dispute incidence, $\beta_3 < 0$. Finally, Z_{cd} describes a collection of additional covariates which I discuss in passing below.

I consider in the analysis all potential WTO dispute pairs between 1995 and 2011. Each country pair enters the dataset twice in each year, once with each country as a potential complainant. In accordance with the model, I only consider country pairs with positive two-way trade flows in a given year. Data on tariffs and trade flows come from the TRAINS and COMTRADE databases, respectively. Table B.4 provides definitions, sources and summary statistics for all variables used in the analysis below. As indicated by the specification in (2.18), I include one period lagged values of all independent variables in each regression in order to control for information lags.[21] Overall, the unbalanced panel includes 49,740 observations.

Table B.5 provides results of logit regressions of the WTO dispute incidence variable on tariff overhangs in potential complainant and defendant countries with a varying set of control variables.[22] I first consider the most economical specification by regressing dispute incidence on both the potential complainant's and defendant's average tariff overhangs. Column (1) provides the estimates of this specification. The signs of both terms are negative and significant at the 1 percent level which confirms that lower tariff overhangs increase the likelihood for member countries to participate both as complainants and defendants in WTO disputes. The Pseudo R^2 of .135 also indicates that tariff overhangs alone explain a substantial share of the variation in WTO dispute incidence. Column (2) adds $RELSIZE_{cd}$ as additional covariate. The tariff overhang estimates remain stable and significant while the coefficient of $RELSIZE_{cd}$ is significant at the 1 percent level and has the expected negative sign. Countries of similar size are therefore more likely to meet in a WTO dispute.

[21] Since WTO tariff data is not available in TRAINS for 1994, I use the contemporaneous tariff overhang data for 1995.

[22] The results are similar when using instead a Probit framework or a linear probability model.

In accordance with the model's predictions, the structure of tariff overhangs and WTO members' relative size are inversely linked to WTO dispute incidence.

In section 2.3.2, I argue that country pairs that lower their tariff barriers will face productivity shocks which result in ex post violations of the trade agreement. While we cannot directly observe productivity shocks, I introduce in column (3) a variable that can proxy for aggregate productivity adjustments that were induced by new tariff commitments of WTO members in the wake of the Uruguay Round. When aggregate productivity adjustments are more likely to occur after deeper trade liberalization, countries that implemented larger tariff cuts after the end of the Uruguay Round in 1994 should be more frequently involved in WTO disputes. I therefore add in column (3) the variable UR_LIB_{cd} which measures a country pairs's combined tariff reductions since the conclusion of the Uruguay Round. In particular, using pre-1995 tariff data from the World Development Indicators, I calculate for each country pair the sum of the reduction in the applied mean tariff rates of the potential complainant and defendant until 2000, or the first available year thereafter.[23] The negative and significant coefficient of UR_LIB_{cd} confirms that country pairs which have witnessed deeper trade liberalization (lower UR_LIB_{cd}), and thus have a greater chance to experience productivity adjustments, are more likely to meet in WTO disputes. The conclusions with respect to all other variables remain unchanged. Overall, the structure of tariff overhangs as well as WTO members' relative size and tariff liberalization since the Uruguay Round can account well for the general evolution of the number of WTO disputes since 1995. The correlation between the number of predicted and actual WTO disputes is 0.71 in Figure B.6, which has been compiled using the estimates in column (3) and under the assumptions that disputes occur independently of each other and the number of country pair observations is identical in each year.

Instead of measuring a continuous effect of tariff overhangs on dispute participation, I include tariff overhang bins in column (4). The bins are identical to dummy variables,

[23] Developed WTO members had to phase in their Uruguay Round tariff commitments until that year. Note that due to limited tariff data availability prior to 1995, the sample size in columns (3)-(5) is lowered to 36,738. When estimating these specifications with the extended sample and without UR_LIB_{cd}, the signs and coefficient magnitudes of the remaining variables are very similar to the results in columns (1) and (2).

taking the value one if a country's average tariff overhang lies within a prespecified limit. I consider three bins for both complainants and defendants, with the bin thresholds taking tariff overhang values of 0 and 20 percentage points, respectively. That is, the dummy for the first bin takes the value one if a country's tariff overhang is 0 percentage points or less. The excluded benchmark categories in the logit regression in column (4) are the bins taking a value of one if tariff overhangs are 20 percentage points or higher. Two results emerge. First, the coefficients of the bins containing the lowest tariff overhangs for complainants, $BIN0_c$, and defendants, $BIN0_d$, are both positive and significant at the 1 percent level. The same also holds for the next higher bins, $BIN0\_20_c$ and $BIN0\_20_d$, which capture tariff overhangs between 0 and 20 percentage points for potential complainants and defendants, respectively. And second, the estimated coefficients drop in magnitude from the lower to the higher bins. This result, in accordance with Propositions 1 and 4, implies again that WTO members who fall into lower tariff overhang bins are more likely to actively participate in trade disputes.

The specification in Column (5) introduces the potential complainant's and defendant's respective bilateral imports, export diversity and a preferential trading relationship dummy as additional controls. The respective bilateral import values, $IMPORTS_c$ and $IMPORTS_d$, proxy for the potential stakes in a trade dispute. According to proposition 5, bilateral imports by the defendant are positively linked to dispute filings. In addition, since higher bilateral imports imply a greater retaliatory capacity for the complainant, $IMPORTS_c$ should enter with a positive sign as well. To control for the diversity of each country's exports, column (5) includes for both complainants and defendants the extensive margin measure of their respective exports proposed by Hummels and Klenow (2005), EM_c and EM_d. The sign of both variables is unsure ex ante, since a more diverse export portfolio increases the likelihood to possess low tariff overhangs in a number of sectors but could also diminish the importance of individual sectors as drivers of trade disputes. And finally, to control for political economy aspects, I also consider a dummy variable taking the value one if a country pair has a preferential trading relationship, PTA_{cd}. We should expect that existing PTAs between WTO members lower dispute participation because retaliation threats have a higher deterrent effect in this case and PTA members might also have alternative

forums to resolve their differences. The regression results in column (5) confirm the previous findings. While the tariff overhang estimates have a smaller magnitude, they are both still negative and significant. In addition, $RELSIZE_{cd}$, $IMPORTS_c$ and $IMPORTS_d$ have the expected signs and are significant contributors (at the 1 percent level) to the emergence of WTO disputes. The diversity of exports has a negative effect for complainants and defendants while, as expected, country pairs with an existing preferential trading relationship are less likely to select into a WTO dispute.

2.6 Concluding Remarks

This chapter proposes a new channel that can explain the observed pattern of WTO disputes. I show that the structure of tariff overhangs, the difference between a country's WTO bound and its applied tariffs, is a crucial determinant of WTO agreement violations and dispute filing decisions. WTO members with smaller tariff overhangs are more likely to lack the necessary policy flexibility to react to adverse productivity shocks within the limits of the agreement, which arise as a consequence of decreases in trade costs ensuing from tariff bound reductions in the WTO. In addition, from the harmed country's perspective, economies with tight tariff overhangs are also more likely to gain from dispute filings, since the awarded compensation by the DSB moves their applied tariff closer to the individually optimal level.

This chapter also provides the underlying channels through which power asymmetries operate in the WTO dispute context, the main determinant previously emphasized in the literature. Larger WTO members are both more likely to have a low tariff overhang and to experience an increase in their welfare incentive to breach the agreement after an adverse productivity shock. The lack of participation by most developing countries in the WTO is thus not only due to potentially scarce legal resources, but because they also lack a welfare incentive to commit violations and to file disputes. These predictions also hold empirically. I show in my regression analysis that tariff overhangs are a significant predictor for WTO disputes, even when controlling for countries' size, trade volumes, export diversity and preferential trading relationships. In line with the model's projections, country pairs with larger combined trade liberalization efforts since the beginning of the Uruguay Round are also more likely to face each other in WTO disputes.

Given these predictions about the WTO dispute pattern, how can the WTO induce less economically powerful countries to report more trade violations to its Dispute Settlement Body? This paper suggests that the key to making the WTO dispute settlement system more accessible is to reform the compensation system. In the current form, the retaliation capacity of the harmed country determines the success of enforcing WTO agreements via the DSB, see Bown (2004a) for empirical evidence. The current emphasis of the WTO on providing subsidized legal advice to developing country members through the Advisory Centre on WTO Law certainly helps poorer members to file disputes and increases the likelihood of winning a case. It does not, however, address the main issue: offering access to adequate compensation to countries who lack the willingness to retaliate, as indicated by substantial tariff overhangs. Designing a reform to address this problem is certainly a complex task. Limão and Saggi (2008) show that even if governments can agree on monetary instead of tariff retaliation compensation, the dispute settlement system would still suffer from similar issues due to the lacking enforcement power of smaller countries. A solution could be to allow for auctions of retaliation rights, see Bagwell et al. (2006) for an analysis of this point.

Finally, let me comment on two limitations of the above dispute framework and possible remedies. First, the model restricts the analysis to two countries and two tradeable non-numeraire goods. The empirical evidence suggests, however, that the importance of tariff overhangs as a driver of WTO disputes also carries over to the many-countries/many-goods case.[24] Second, the analysis is silent on how frequent WTO members actually observe violations in practice but decide against filing a dispute. While this is an important and interesting point of analysis, there is currently no data available which would allow to directly address this question. One possible solution could be to employ data on countries who obtain official observer, or third country, status in WTO dispute proceedings.

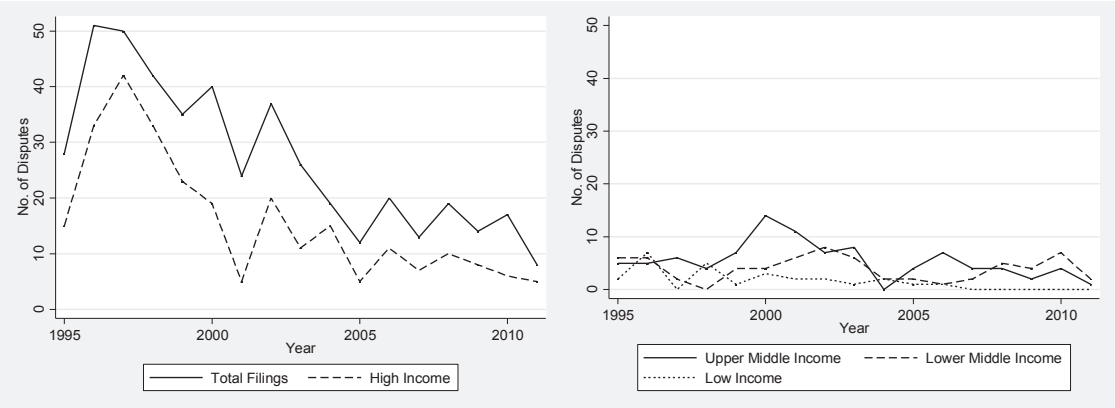
[24] This iresult is in line with Beshkar et al. (2012) who extend the above framework to the many goods case and provide empirical evidence that market power is inversely related to tariff overhangs.

Appendix 2

APPENDIX TO CHAPTER 2

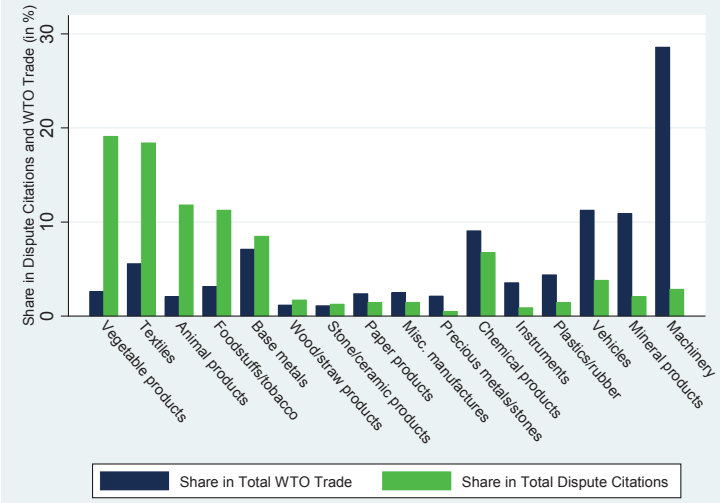
B.1 Figures and Tables

Figure B.1: WTO Disputes (Total and by Income Group of Complainants), 1995-2011



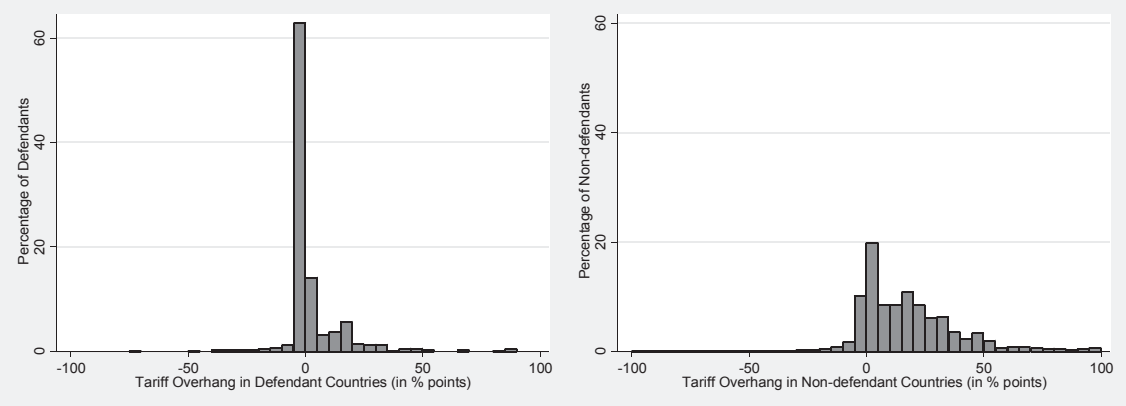
Source: Author's own calculations based on information available on www.wto.org. A trade dispute is initiated when a WTO member sends an official request for consultations to another member country citing the sector and the measure at issue. Figure B.1 counts cases with multiple complainants separately, resulting in a total of 455 trade disputes between 1995 and 2011. The income categories are derived from the World Bank definition, see the Data Appendix of this chapter for details.

Figure B.2: Share in WTO Dispute Citations and WTO Trade (by Industries)



Source: Author's own calculations using data from Comtrade and dispute settlement databases, see the Data Appendix of this chapter for details and data sources. Industries with an average share in WTO trade below one percent have been disregarded in the compilation.

Figure B.3: Tariff Overhang Faced by Complainants in Dispute Sectors in Defendant and Non-defendant Countries



Source: Author's own calculations using data from TRAINS database on sectoral simple averages of applied and bound tariff rates, see Appendix B for details. Tariff overhang outliers of more than 100 and less than −100 percentage points are excluded, leaving us with 98 and 97 percent of the original observations in the defendant and non-defendant samples, respectively.

Figure B.4: The Relation between Exports and Dispute Filing Probability

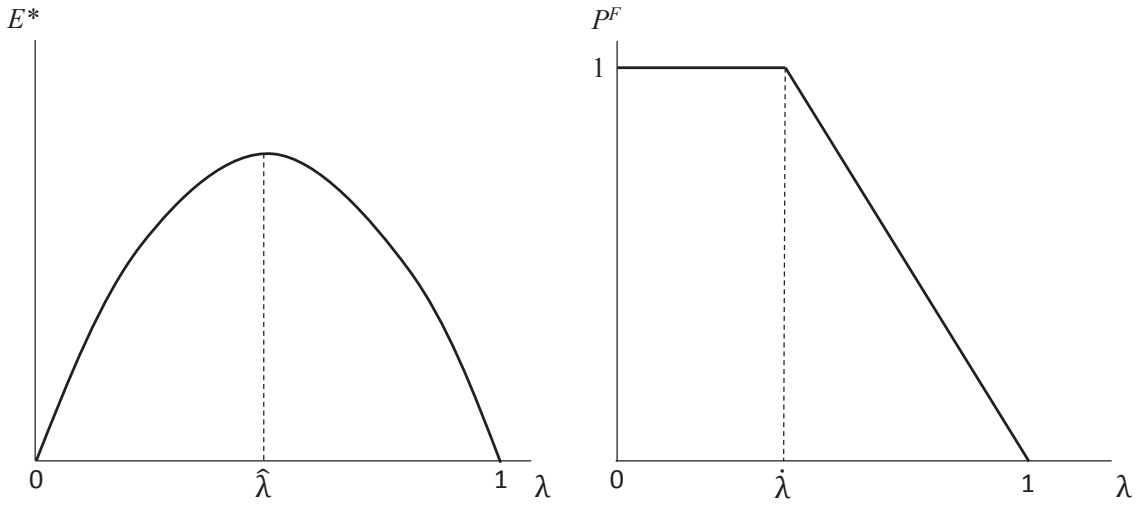
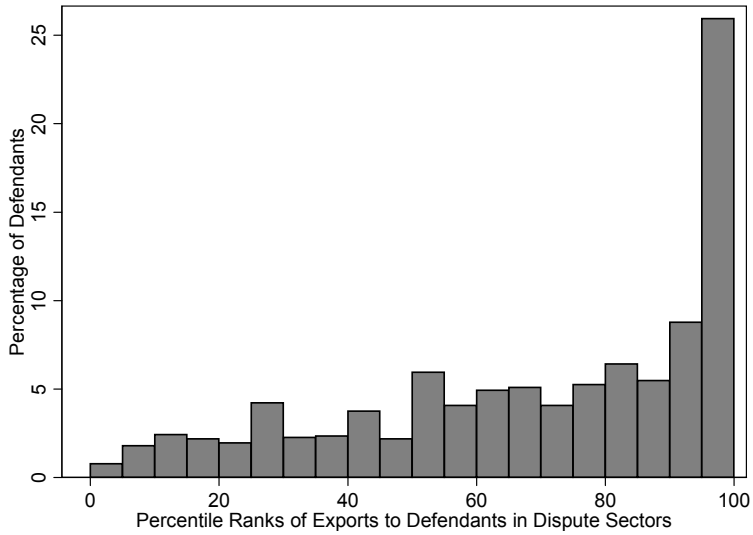
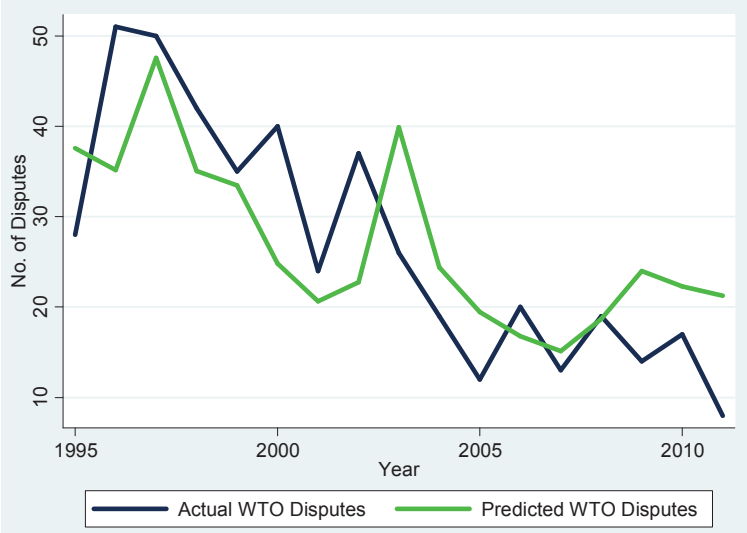


Figure B.5: Percentile Ranks of Complainants' Exports to Defendants in Dispute Sectors



Source: Author's own calculations using data from Comtrade database. Figure B.5 measures the importance of WTO dispute defendants as export destination for complainant countries. A percentile value of 100 (0) implies that the defendant country is the most (least) important export destination for the complainant country in the respective dispute sector.

Figure B.6: Predicted vs. Actual Number of WTO Disputes



The number of predicted disputes has been computed using specification (3) in Table B.5. Two assumptions were made in the computation: 1. disputes occur independently of each other, and 2. to ensure comparable results, dispute predictions were adjusted to include the same number of observations in each year (by scaling up estimates using the ratio to the number of observations from the year with the most country pairs in the sample).

Table B.1: Top Complainants and Defendants in WTO Disputes, 1995-2011

Complainants	No. of Disputes	Defendants	No. of Disputes
United States	98	United States	125
European Union	85	European Union	92
Canada	33	China	23
Brazil	25	India	20
Mexico	21	Canada	17
India	19	Argentina	17
Argentina	15	Japan	15
Korea	15	Brazil	14
Japan	14	Korea	14
Thailand	7	Mexico	14

Table B.2: Top WTO Dispute Pairs, 1995-2011

Country Pair	No. of Disputes (Initiated Complaints)
United States - European Union	66 (34 – 32)
Canada - United States	20 (15 – 5)
United States - China	18 (12 – 6)
European Union - India	17 (10 – 7)
Mexico - United States	15 (9 – 6)
Korea - United States	15 (9 – 6)
Canada - European Union	15 (9 – 6)
Brazil - United States	14 (10 – 4)
Japan - United States	14 (8 – 6)
India - United States	11 (7 – 4)
Brazil - European Union	11 (7 – 4)

Table B.3: Tariff Overhangs in WTO Dispute and Non-dispute Country Pairs

Tariff overhang (in percentage points)	Complainant/ Defendant	Complainant/ Non-defendant	p-value for equality test in both samples
Mean	2.2113	17.1677	0.000^a
Median	-1.23	14.0	0.000^b
Standard deviation	12.5967	21.9164	0.000^c
Sample size	1,131	33,598	N/A

[a] p-value based on Welch's t-test.
[b] p-value based on non-parametric K sample χ^2-test.
[c] p-value based on Levene's robust F-test for the equality of variances between two groups.

Source: Author's own calculations using data from TRAINS database, see Data Appendix of this chapter for details.

Table B.4: Summary Statistics

Variable	Mean	SD	Min	Max	Definition	Source
$DISPUTE_{cd}$	0.01	0.07	0.00	1.00	WTO Dispute(1: Yes, 0: No)	WTO homepage
$OVERHANG_c$	23.79	26.49	-28.27	150.40	Average tariff bound − average applied MFN tariff of complainant (in % points)	TRAINS
$OVERHANG_d$	23.79	26.49	-28.27	150.40	Average tariff bound − average applied MFN tariff of defendant (in % points)	TRAINS
$RELSIZE_{cd}$	2.78	2.06	0.00	10.80	Absolute difference in log GDPs between complainant and defendant	GDPs from World Development Indicators
$IMPORTS_c$	15.65	4.00	0.00	26.74	Complainant's log imports from defendant	COMTRADE
$IMPORTS_d$	15.65	4.00	0.00	26.74	Defendant's log imports from complainant	COMTRADE
EM_c	0.32	0.27	0.00	0.91	Hummels and Klenow (2005) extensive margin measure for complainant	Author's own calculations, data: COMTRADE
EM_d	0.32	0.27	0.00	0.91	Hummels and Klenow (2005) extensive margin measure for defendant	Author's own calculations, data: COMTRADE
PTA_{cd}	0.12	0.32	0.00	1.00	Country pair is member of the same PTA (1: Yes, 0: No)	NSF-Kellogg Institute EIA data base.
$BIN0_c$	0.10	0.30	0.00	1.00	$OVERHANG_c \leq 0$ (1: Yes, 0: No)	Author's own calculations
$BIN0\_20_c$	0.49	0.50	0.00	1.00	$0 < OVERHANG_c \leq 20$ (1: Yes, 0: No)	Author's own calculations
$BIN0_d$	0.10	0.30	0.00	1.00	$OVERHANG_d \leq 0$ (1: Yes, 0: No)	Author's own calculations
$BIN0\_20_d$	0.49	0.50	0.00	1.00	$0 < OVERHANG_d \leq 20$ (1: Yes, 0: No)	Author's own calculations
UR_LIB_{cd}	-24.26	18.88	-126.90	15.10	Reduction in average applied MFN tariff (in % points) between Uruguay Round (1986 or first year with available tariff data before 1994) and year 2000 (or first year after with available tariff data)	Author's own calculations, data: World Development Indicators

Table B.5: Logit Regressions - WTO Dispute Incidence and Tariff Overhangs

Dependent variable: WTO Dispute (1: Yes, 0: No)	(1)	(2)	(3)	(4)	(5)
$OVERHANG_c$	-.058***	-.059***	-.068***		-.018***
	(.006)	(.006)	(.006)		(.005)
$OVERHANG_d$	-.082***	-.083***	-.089***		-.042***
	(.006)	(.006)	(.005)		(.008)
$RELSIZE_{cd}$		-.153***	-.118***	-.216***	-.117***
		(.030)	(.032)	(.030)	(.043)
UR_LIB_{cd}			-.012***	-.012***	-.015***
			(.003)	(.004)	(.004)
$IMPORTS_d$					.490***
					(.079)
$IMPORTS_c$					.317***
					(.076)
EM_c					-1.473***
					(.490)
EM_d					-1.419**
					(.556)
PTA_{cd}					-.497***
					(.170)
$BIN0_c$				2.751***	
				(.196)	
$BIN0\_20_c$				.832***	
				(.189)	
$BIN0_d$				4.033***	
				(.286)	
$BIN0\_20_d$				1.874***	
				(.285)	
$Constant$	-3.531***	-3.110***	-2.958***	-7.842***	-18.546***
	(.088)	(.124)	(.147)	(.353)	(.815)
N (Country pairs)	49740	49740	36738	36738	36738
Pseudo R2	.135	.142	.175	.218	.379

The table presents Logit regression results. Robust standard errors of coefficients are listed in parentheses. ***, ** and * indicate 1 percent, 5 percent and 10 percent statistical significance levels, respectively.

B.2 Mathematical Appendix

B.2.1 Proof of Proposition 1

To prove Proposition 1, it is sufficient to show that a positive productivity shocks increases both the incidence of case 1 and the share of γ realizations which result in a zero tariff overhang in case 2. The first part of this statement is true, since

$$\frac{\partial \tilde{\lambda}}{\partial \phi^*} = -\frac{8(\overline{\gamma}-1)}{[2(3\phi^*-1)-(1+\phi^*)(1+\overline{\gamma})]^2} < 0 \quad ,$$

implying that the size threshold above which a country always faces a zero tariff overhang decreases. In case 2, a zero tariff overhang becomes more likely, since γ^N is decreasing in ϕ^*:

$$\frac{d\gamma^N}{d\phi^*} = \frac{\partial \gamma^N}{\partial \phi^*} + \frac{\partial \gamma^N}{\partial t^B}\frac{dt^B}{d\phi^*} < 0 \quad ,$$

which holds for any $\lambda \in (0,1)$ because the tariff bound cannot be retroactively changed, $\frac{dt^B}{d\phi^*} = 0$, and $\frac{\partial \gamma^N}{\partial \phi^*} = -\frac{4\lambda}{(1+\phi^*)^2}$. ■

B.2.2 Proof of Proposition 2

Noting that $\Delta\Omega$ in (2.10) can be written as

$$\Delta\Omega = \left(\frac{\partial W_1(t,\gamma,\phi^*)}{\partial \phi^*}\Big|_{t=t^N} - \frac{\partial W_1(t,\gamma,\phi^*)}{\partial \phi^*}\Big|_{t=t^B}\right) + \frac{\delta}{1-\delta}\int_{\gamma^N}^{\overline{\gamma}} \left(\frac{\partial W_1(t,\gamma,\phi^*)}{\partial \phi^*}\Big|_{t=t^N} - \frac{\partial W_1(t,\gamma,\phi^*)}{\partial \phi^*}\Big|_{t=t^B}\right) f(\gamma)d\gamma$$

where

$$\frac{\partial W_1(t,\gamma,\phi^*)}{\partial \phi^*} = \lambda(1-\lambda)\frac{[(1+t)[2\lambda-(1+\gamma)+t(3-\gamma)]+(1-\lambda)(1+\phi^*)]}{[2\lambda(1+t)+(1-\lambda)(1+\phi^*)]^3}$$

and $\partial W_1(t,\gamma,\phi^*)/\partial\phi^*|_{t=t^N} > 0$ for $\phi^* > 1$ and $\gamma < \frac{3\phi^*-1}{1+\phi^*}$, it is sufficient for $\Delta\Omega > 0$ to show that $\partial^2 W_1(t,\gamma,\phi^*)/\partial\phi^*\partial t > 0$ for any tariff and political pressure realization in the

ranges $t \in [t^B, t^N]$ and $\gamma \in [\gamma^N, \overline{\gamma}]$. The inequality $\partial^2 W_1(t, \gamma, \phi^*)/\partial\phi^*\partial t > 0$ boils down to

$$\underbrace{\lambda(1+t)}_{l_1}\underbrace{[5+\gamma-4\lambda-t(3-\gamma)]}_{l_2} > \underbrace{(1-\lambda)(1+\phi^*)}_{r_1}\underbrace{[\gamma-1+2\lambda-t(3-\gamma)]}_{r_2} \quad . \tag{B.1}$$

While it is not feasible to derive directly from the above expression the parameter combinations for which (B.1) holds, we can use the individual elements l_1, l_2, r_1, r_2 to derive the conditions under which (B.1) is guaranteed to be met. Noting that all individual elements are positive as long as $0 < \lambda < 1$, (B.1) holds in the following scenarios:

(i) $\underline{l_1 > r_1 \cap l_2 > r_2}$:

As long as $\lambda < 1$, $l_2 > r_2$ is always true. For $l_1 > r_1$ to be met for any $t \in [t^B, t^N]$, it is sufficient to plug into this expression the lowest possible realization of $t = t^B$. In case 1, when $t^B = \frac{\overline{\gamma}-1}{5-\overline{\gamma}}$, this results in the following condition for λ:

$$\lambda > \frac{(1+\phi^*)(5-\overline{\gamma})}{(1+\phi^*)(5-\overline{\gamma})+4}$$

which corresponds to the upper condition stated in Proposition 1. In case 2, when $t^B = \frac{(\overline{\gamma}-1)(1+\phi^*)-2\lambda(\phi^*-1)}{(3-\overline{\gamma})(1+\phi^*)-4\lambda}$, we obtain instead:

$$\lambda > \frac{(1+\phi^*)(3-\overline{\gamma})}{6}$$

which corresponds to the bottom condition stated in Proposition 1.

(ii) $\underline{l_2 > r_1 \cap l_1 > r_2}$:

$l_2 > r_1$ is least likely to hold when $t = t^N$. When inserting t^N, see equation (B.4), this expression can be written as

$$(3-\gamma)(1+\phi^*)(5-\phi^*)(1-\lambda) + 4\lambda[4+(3-\phi^*)(1-\lambda)] > 0$$

which is always met as long as $\phi^* < 5$. The second piece, $l_1 > r_2$, is least likely to hold when $t = t^B$. In case 1, when $t^B = \frac{\overline{\gamma}-1}{5-\overline{\gamma}}$, this condition never holds for all $\gamma \in [\gamma^N, \overline{\gamma}]$. In case 2, when $t^B = \frac{(\overline{\gamma}-1)(1+\phi^*)-2\lambda(\phi^*-1)}{(3-\overline{\gamma})(1+\phi^*)-4\lambda}$, $l_1 > r_2$ will not hold for all $\gamma \in [\gamma^N, \overline{\gamma}]$ as long as

$\overline{\gamma} < 2$. ■

B.2.3 Proof of Proposition 4

Note that Foreign's filing probability in case of an agreement violation by Home is

$$P^F = min\left[Pr(\gamma^* > \gamma^{*N}), 1\right] = min\left[\frac{\overline{\gamma}^* - \gamma^{*N}}{\overline{\gamma}^* - 1}, 1\right]$$

where

$$\gamma^{*N} = \frac{t^{*B}[3(1+\phi) + 4(1-\lambda)] + (1+\phi) - 2(1-\lambda)(\phi - 1)}{(1+t^{*B})(1+\phi)} \quad .$$

If $\gamma^{*N} \leq 1$, $P^F = 1$ and Foreign always has a zero tariff overhang (case 1). If $\gamma^{*N} > 1$, $P^F = \frac{\overline{\gamma}^* - \gamma^{*N}}{\overline{\gamma}^* - 1}$ and both a zero and positive tariff overhang are possible for Foreign (case 2). The proof of Proposition 4 consists of two parts. First, I show that the conditions in Proposition 4 imply a higher likelihood for Home to always have a zero tariff overhang (incidence of case 1). If $\gamma^{*N} \leq 1$, similar to section 2.2.2 for Home, Foreign always has a zero tariff overhang if

$$1 - \lambda \geq 1 - \dot{\lambda} \equiv \frac{(\overline{\gamma}^* - 1)(1+\phi)}{2(3\phi - 1) - (1+\overline{\gamma})(1+\phi)} \quad . \tag{B.2}$$

Part (i) in Proposition 4 follows because (B.2) is more easily met when λ decreases. Parts (ii) and (iii) result because

$$\frac{\partial(1-\dot{\lambda})}{\partial\overline{\gamma}^*} = \frac{2(1+\phi)[(3\phi - 1) - \overline{\gamma}^*(1+\phi)]}{[2(3\phi - 1) - (1+\overline{\gamma}^*)]^2} > 0$$

and

$$\frac{\partial(1-\dot{\lambda})}{\partial\phi} = -\frac{8(\overline{\gamma}^* - 1)}{[2(3\phi - 1) - (1+\overline{\gamma}^*)]^2} < 0 \quad ,$$

from which we can conclude that the incidence of case 1 for Foreign is decreasing in $\overline{\gamma}^*$ and increasing in ϕ, respectively.

The second part of the proof shows that in case 2, when $P^F = \frac{\overline{\gamma}^* - \gamma^{*N}}{\overline{\gamma}^* - 1}$, P^F is decreasing in λ and $\overline{\gamma}^*$, and increasing in ϕ, respectively. Noting that $t^{*B} = \frac{(\overline{\gamma}^* - 1)(1+\phi) - 2(1-\lambda)(\phi - 1)}{(3 - \overline{\gamma}^*)(1+\phi) - 4(1-\lambda)}$ in case 2, the results in Proposition 4 emerge as follows.

Part (i):

$$\frac{dP^F}{d\lambda} = \frac{\partial P^F}{\partial \gamma^{*N}} \left[\frac{\partial \gamma^{*N}}{\partial \lambda} + \frac{\partial \gamma^{*N}}{\partial t^{*B}} \frac{dt^{*B}}{d\lambda} \right]$$

where $\partial P^F / \partial \gamma^{*N} = -1/(\overline{\gamma}^* - 1) < 0$. The signs of the individual terms in the square bracket are

$$\frac{\partial \gamma^{*N}}{\partial \lambda} = \frac{2(\phi - 1) - 4t^{*B}}{(1 + t^{*B})(1 + \phi)} > 0 \tag{B.3}$$

$$\frac{\partial \gamma^{*N}}{\partial t^{*B}} = \frac{2(2 - \lambda)}{(1 + t^{*B})^2} > 0 \tag{B.4}$$

$$\frac{dt^{*B}}{d\lambda} = \frac{(1 + \phi)[\phi(3 - \overline{\gamma}^*) - (1 + \phi)]}{[(3 - \overline{\gamma}^*)(1 + \phi) - 4(1 - \lambda)]^2} > 0 \quad . \tag{B.5}$$

(B.3) is positive if $(3\phi - 1)/(1 + \phi) > \overline{\gamma}^*$, which is identical to the condition for positive exports of good 2 from Home to Foreign. The signs of (B.3), (B.4), (B.5) and $\partial P^F / \partial \gamma^{*N} < 0$ then imply $dP^F/\lambda < 0$.

Part (ii):

$$\frac{dP^F}{d\overline{\gamma}^*} = \frac{\partial P^F}{\partial \overline{\gamma}^*} + \frac{\partial P^F}{\partial \gamma^{*N}} \frac{d\gamma^{*N}}{d\overline{\gamma}^*}$$

where the individual terms other than $\partial P^F / \partial \gamma^{*N}$ equal

$$\frac{\partial P^F}{\partial \overline{\gamma}^*} = \frac{\gamma^{*N} - 1}{(\overline{\gamma}^* - 1)^2} > 0 \tag{B.6}$$

$$\frac{d\gamma^{*N}}{d\overline{\gamma}^*} = \frac{2\lambda(1 + \phi)^2}{[(3 - \overline{\gamma}^*)(1 + \phi) - 4(1 - \lambda)]^2} \geq 0 \quad . \tag{B.7}$$

(B.7) holds with inequality as long as $\lambda > 0$. Noting that $\frac{\partial P^F}{\partial \overline{\gamma}^*} + \frac{\partial P^F}{\partial \gamma^{*N}} \frac{d\gamma^{*N}}{d\overline{\gamma}^*} < 0$ is always true, then implies $dP^F / d\overline{\gamma}^* < 0$.

Part (iii):

$$\frac{dP^F}{d\phi} = \frac{\partial P^F}{\partial \gamma^{*N}} \left[\frac{\partial \gamma^{*N}}{\partial \phi} + \frac{\partial \gamma^{*N}}{\partial t^{*B}} \frac{dt^{*B}}{d\phi} \right]$$

where $\frac{\partial \gamma^{*N}}{\partial \phi}$ and $\frac{dt^{*B}}{d\phi}$ are given by

$$\frac{\partial \gamma^{*N}}{\partial \phi} = \frac{-4(1-\lambda)(1+t^{*B})}{(1+t^{*B})(1+\phi)^2} \leq 0 \tag{B.8}$$

$$\frac{dt^{*B}}{d\phi} = -\frac{8\lambda(1-\lambda)}{[(3-\overline{\gamma}^{*})(1+\phi)-4(1-\lambda)]^2} \leq 0 \quad . \tag{B.9}$$

(B.8) and (B.9) hold with inequality as long as $\lambda \in (0,1)$. $\partial P^F/\partial \gamma^{*N} < 0$, (B.4) , (B.8) and (B.9) then imply $dP^F/d\phi > 0$. Both parts of this proof therefore show that Foreign's likelihood to have a zero tariff overhang rises under the conditions in Proposition 4, which directly results in an increase in the probability to file a dispute. ■

B.3 Data Appendix

Dispute Citations: When filing a trade dispute with the Dispute Settlement Body of the WTO, the complainant country has to name the sector(s) in which the violation of WTO rules occurs. In the request for consultations sent to the defendant country, the complainant country either describes the sector(s) verbally, or more commonly, by naming the corresponding 2-, 4-, or 6-digit HS codes. Henrik Horn and Petros C. Mavroidis provide data on these sector citations in WTO disputes in their dispute settlement database, which is available online at http://go.worldbank.org/X5EZPHXJY0. It is common for WTO members to cite multiple sectors when filing a trade dispute, leaving us in practice with many more dispute sectors than actual trade disputes.

Tariff overhangs: I calculate tariff overhangs using data on sectoral simple averages of applied and bound tariff rates from the TRAINS database, which can be accessed through the WITS system provided by the World Bank: http://wits.worldbank.org/wits/. In particular, I proceed in two steps. I first collect simple averages of bound and applied tariff rates faced by complainants in defendant and non-defendant countries in dispute sectors one year prior to the initiation of a dispute.[1] The simple tariff averages also include estimates of ad-valorem equivalents of non-ad valorem tariffs.[2] In the second step, I subtract the

[1] The results are similar if import-weighted averages are used instead.

[2] For computational details, see the notes in the methodology section on the WITS homepage: http://wits.worldbank.org/wits/Documents.html.

simple averages of applied tariffs from the simple averages of bound tariffs to obtain the respective tariff overhangs. Figure B.3 separates the tariff overhangs faced by complainants in defendant (left panel) and non-defendant (right panel) countries. For example, suppose India exports women's and girl's wool coats (HS product category: 610210) to the United States, the European Union and Canada in 1996. If India files a trade dispute citing this product category in that year against the US but not against Canada and the EU, I include the tariff overhang faced by India in the US in 1995 in HS category 610210 in the left panel of Figure B.3. Similarly, I include the tariff overhangs faced by India in the EU and Canada in the same category in the right panel.

Table B.3 depicts the means, medians and standard deviations of tariff overhangs in actual disputes, the cases in the left panel in Figure B.3, and in the non-dispute country pairs, the cases in the right panel in Figure B.3. As in the compilation of Figure B.3, Table B.3 excludes tariff overhang outliers of more than 100 and less than -100 percentage points, leaving us with 98 and 97 percent of the original observations in the defendant and non-defendant samples, respectively. Table B.3 also lists the sample size in each case and the p-value from testing the hypothesis that the respective statistics take on the same value in both samples. Mean, median and standard deviation of tariff overhangs are much lower in dispute sectors in defendant than in non-defendant countries. In fact, we can always reject the hypothesis that either means, medians or standard deviations are identical in both samples at the 0.1 percent level of statistical significance.

Income Classifications: The definition of income groups in Figure B.1 corresponds to the years' respective classifications by the World Bank.[3] As of 2011 (the last year of disputes in the sample), the income categories for countries in per-capita terms are: low income ($1,005 or less), lower middle income ($1,006 to $3,975), upper middle income ($3,976 to $12,275) and high income ($12,276 or more). As of the end of 2011, 27 of the 153 WTO member countries (not counting Vanuatu, Russia, Montenegro and Samoa whose memberships were not ratified at that point) are low income, 38 are lower middle income, 39 are upper middle income and 49 are high income economies.

[3] Available at http://data.worldbank.org/about/country-classifications.

Industry Sections: For the exact grouping of 2-digit HS sections into the industry definitions used in Figure B.2, see http://www.usitc.gov/tata/hts/bychapter/_1202.htm.

Chapter 3

THE ELUSIVE EFFECTS OF TRADE ON GROWTH: EXPORT DIVERSITY AND ECONOMIC TAKE-OFF[1]

3.1 Introduction

The elusive effects of trade are a fundamental puzzle in the growth determinants literature. Numerous theories link trade to economic growth, but exhaustive analyses of growth determinants have not produced robust trade effects.[2] Endogeneity bias compounds the issue since feedback effects from growth to trade are commonly ignored in studies that examine a wide range of growth determinants.[3] Complicating matters further is the multitude of trade channels and their positive or negative effects on growth that different theories suggest. When competing theories propose alternative candidate regressors and/or opposing effects, the associated model uncertainty may artificially inflate t-statistics and narrow confidence intervals (see Raftery, 1995, and Raftery and Zhang, 2003).

In this chapter, we extend the empirical trade-and-growth literature in two dimensions. First, we provide a structured approach to identifying trade effects on growth. We follow Hausmann et al. (2007) who advocate that growth is determined by the composition of trade, not simply by export volumes. While previous growth determinant approaches use aggregate trade measures, we examine trade-driven growth through sectoral export diversification. We do not rely on aggregate tariff levels or aggregate (primary) trade volumes, but instead examine variations in the breadth of countries' comparative advantages across sectors as a potential growth determinant. Second, we address model uncertainty and endogeneity

[1] Coauthored with Theo S. Eicher. We thank Chih Ming Tan, Andros Kourtellos and Chris Papageorgiou for sharing their data and for extensive discussions.

[2] Rodriguez and Rodrik (2001) provide a skeptics' guide to the related literature of reduced-form trade-and-growth empirics which includes trade measures but only a fraction of potentially relevant growth determinants. The authors side with Edwards' (1993) previous trade-and-growth survey assessment that these studies "have been plagued by empirical and conceptual shortcomings. The theoretical frameworks used have been increasingly simplistic, failing to address important questions such as the exact mechanism through which export expansion affects GDP growth."

[3] The exceptions are Barro (2003) and Durlauf et al. (2008).

simultaneously to produce consistent test statistics and reduce endogeneity/omitted variable bias.

Levine and Renelt (1992) first included trade measures in their seminal study of growth determinants. "Primary export shares", "import and export volumes" and/or "years open"[4] have since become standard candidate growth determinants in this literature. Their effects are well known not to be robust, with the exception of isolated specifications (usually for "years open"). Levine and Renelt (1992) also included Leamer's (1988) "openness" measure, and two measures of "foreign exchange rate distortions" in their Extreme Bound Analysis of growth determinants but find that no trade measure is robustly linked to growth. Sala-i-Martin (1997) subsequently used Levine and Renelt's trade measures and added "primary export shares of GDP," Sachs and Warner's (1995) "years open" measure, as well as the "trade share" (imports plus exports over GDP). After lowering Renelt and Levine's Extreme Bound effect thresholds, he found "trade share" and "years open" to be robust.

Since the Extreme Bound thresholds are entirely arbitrary, Sala-i-Martin's analysis has since been replicated in a multitude of studies that use Bayesian Model Averaging (BMA), where effect thresholds are theory-specified. Using the original (and/or updated) Sala-i-Martin data, in cross sections or panels, with different parameter and model priors, not a single BMA paper identifies any one of the above trade measures as having a decisive effect on growth.[5] In the most recent and extensive analysis of trade, growth, and model uncertainty (without controlling for endogeneity), Eris and Ulasan (2013) examine openness, real openness, years open, tariff rates, non-tariff barriers, and the black market premium. They concur with the previous literature by finding "no evidence that trade openness is directly and robustly correlated with economic growth in the long run."

In this chapter, we move away from aggregate trade measures and focus on sectoral diversity. To measure export diversity, we use the extensive margin measure introduced by Hummels and Klenow (2005), which is based on earlier work by Feenstra (1994).[6] The

[4] The proportion of years in which an economy was "open to international trade."

[5] See Fernández et al. (2001), Brock and Durlauf (2001), Sala-i-Martin et al. (2004), Durlauf et al. (2008), Ciccone and Jarocinski (2010) and Eicher et al. (2011). Note that BMA results have better predictive performance and a lower Mean Squared Error than any single regression model (Raftery and Zhang, 2003).

[6] Our empirical results are robust to using other export diversity measures commonly employed in the literature, such as Herfindahl, Gini and Theil indices. Detailed results are provided below in the robustness

Hummels-Klenow measure has been employed extensively in the study of trade diversity and income patterns –although its relationship to economic growth has not been explored to date. The descriptive literature examining trade diversity and income patterns finds conflicting results. For advanced countries, income was found to be correlated with increasing or constant export diversification (Proudman and Redding, 2000, and Funke and Ruhwedel, 2001). Studies utilizing global panels find that exports first diversify and then re-concentrate with income (Cadot et al., 2011, and Papageorgiou and Spatafora, 2012), or that diversity is rising throughout, but with decreasing intensity (see Figure C.1 and also Brasili et al., 2000, De Benedictis et al., 2009, Parteka, 2010, and Besedes and Prusa, 2011). The only one salient and uncontroversial feature of this literature is then that diversification levels differ distinctly by development stages. That is, the relationship between diversity and income is positive for low income countries while the correlation for high income countries is somewhat uncertain.[7]

The structure of this paper builds on Durlauf et al's (2008) seminal BMA panel growth study. We extend the time dimension of the Durlauf et al. panel and introduce trade diversity as a potential growth determinant. In addition, we utilize a methodology that fully accounts for model uncertainty and endogeneity, since Durlauf et al. examined model uncertainty in the second stage only. Our findings confirm Durlauf et al's earlier results that aggregate trade is not a robust growth determinant in a panel of countries.

Once we allow for nonlinear effects of export diversity, however, we find that it is a crucial determinant of economic growth for low income countries. The effect features not only a high inclusion probability, but is also economically important: a one standard deviation increase in export diversity is shown to increase the average annual growth rate by one percentage point for low income countries. Aside from trade diversity, the growth determinants suggested by our approach are those central to all previous studies: initial GDP, population

section.

[7] The descriptive literature also developed stylized facts that relate trade diversity to aggregate trade growth. Hummels and Klenow (2005) show that larger (in terms of GDP) and richer countries (in terms of GDP per capita) have greater trade volumes and more diversified exports. Brenton and Newfarmer (2007) document that increased trade diversity accounts for 20 percent of trade growth in developing nations, while Kehoe and Ruhl (2013) show that it explains 10 percent of trade growth in advanced countries. Below we take this literature one step further and examine the effects of diversity on economic growth.

growth and investment reflecting neoclassical models, governance quality and government expenditures reflecting new growth theories as well as some support for recent religion and growth theories with an effect of the fraction Jewish.

The remainder of the chapter is organized as follows. Section 3.2 sketches the various links between trade, diversity and growth suggested in the literature and highlights the importance of addressing model uncertainty in this context. Section 3.2 also discusses our preferred measure of export diversity and our empirical specification. Section 3.3 provides an overview of the IVBMA methodology, Section 3.4 describes the structure of the panel of countries used in our empirical analysis and also introduces alternative export diversity measures considered in the literature. Section 3.5 presents a discussion of the empirical results and Section 3.6 concludes.

3.2 Trade, Diversity and Growth Determinants

To appreciate the dichotomy between the absence of trade effects in growth regressions and the number of theories that relate trade to growth, we briefly summarize the trade and growth effects and their associated candidate regressors that have been suggested by trade theories. Theories that link trade to growth rely either on transition dynamics (e.g., the HOS, Ricardo, or two-sector open economy Solow models), or on dynamics that alter the growth rate in perpetuity. Models that rely on transition dynamics focus on static comparative advantage and aggregate trade volumes. Empirical estimates of these models pick up the expansion of export volumes due to trade-induced resource reallocation from uncompetitive to competitive sectors (see Bernhofen, 2011).

Endogenous growth models that focus on international trade imply dynamic sectoral reallocations and trade effects via learning by doing across sectors (Young, 1991), intra- and intersectoral knowledge spillovers (Grossman and Helpman, 1991), higher quality products and product cycle dynamics (Aghion and Howitt, 1992), or increases in varieties (Rivera-Batiz and Romer, 1991). These theories all suggest growth accelerations through export expansions at the extensive margin, since more sectors generate additional learning, spillovers, or incentives to invent better qualities or more varieties.

There is, however, no theoretical presumption in favor of unambiguously positive trade

effects on growth. Unless trade takes place between identical countries, endogenous growth theories imply that counties experience differential effects of trade on growth. Laggard countries may well experience growth reductions when trade shifts production towards less dynamic sectors in terms of learning, spillover or R&D intensive goods, see Grossman and Helpman (1991), Feenstra (1996), Matsuyama (1992), Rivera-Batiz and Romer (1991), and Young (1991). Given that fast growth rates in developing countries are often attributed to the adoption of technologies that originated elsewhere, imitation is potentially a more relevant source of growth for low income countries (see e.g., Edwards, 1992). Depending on the degree of imitation and intellectual property rights protection, growth in such economies might be enhanced via increased product market competition or slowed by reduced innovation incentives (see Aghion et al., 2001).

Recent monopolistically competitive trade models that feature heterogeneous firms allow for stochastic differences in technologies across countries and their empirical implementations usually focus on export dynamics within sectors, see Eaton and Kortum, 2002, Melitz, 2003, Bernard et al., 2007, and Chaney, 2008. Feenstra and Kee (2008) point out, however, that even in heterogeneous firm trade models increases in the share of exporting firms (or exported varieties) imply increased average productivity and growth, since only the most productive firms export. It is exactly these dynamics that we hope to capture in our empirical analysis. While global firm data is not available, we can capture the dynamic evolution of exports by considering countries' extensive margin of trade.

Dynamic and static trade models thus provide diverse trade and growth channels that might differ in importance depending on a country's level of development. The importance of trade for growth is then best captured by examining sectoral export diversity, since it allows for a disaggregation of trade flows to account for dynamic trade effects. To quantify the effect of sectoral export expansion on growth, we use the extensive margin measure suggested by Hummels and Klenow (2005), which has the advantage of being firmly rooted in trade theory.[8] The Hummels-Klenow measure appropriately integrates new products into price indices (see Feenstra, 1994) which is crucial in dynamic sectoral studies. Specifically,

[8] Alternative measures exist (e.g., Gini, Theil and Herfindahl indices) and we shall examine their implication in our robustness analysis.

the extensive margin measure for country j's exports to country n in year t, EM_{jnt}, is given by:

$$EM_{jnt} = \frac{\sum_{i \in I_{jnt}} X_{knit}}{\sum_{i \in I_{kt}} X_{knit}} \tag{3.1}$$

where i denotes a Comtrade sector, and I_{jnt} and I_{kt} are the sets of sectors in which j and the rest-of-the-world, k, have positive exports to n in year t, respectively. X_{knit} is the value of exports in sector i from all countries other than j to country n in year t. EM_{jnt} then measures the diversification of j's export basket to country n in year t by calculating the share of the rest-of-the-world's exports to n that is contributed by the set of sectors that is also exported by j to n. The importance of each sector i in computing the diversity of j's exports to n then corresponds to its share in n's imports from the rest-of-the-world. To obtain a single export diversity measure for each country, we aggregate the individual EM_{jnt} measures over all markets other than j, N_{-jt}:

$$EM_{jt} = \prod_{n \in N_{-jt}} EM_{jt}^{a_{jnt}} \tag{3.2}$$

Following Hummels and Klenow (2005), a_{jnt}, weighs the individual diversity measures by the logarithmic mean of country n's share in country j's and the rest-of-the-world's exports in year t.[9]

Identifying the effect of export diversity on economic growth is, however, complicated by endogeneity considerations. A country's growth rate may be a key determinant of its ability to invest into R&D, which in turn drives the number of new product varieties that can be exported. To address endogeneity, we instrument our export diversity measure in the spirit of Frankel and Romer (1999) with a number of exogenous geographical features: the log of a country's land area, a dummy taking the value one for landlocked countries, and the log of a country's population.

All additional covariates and instruments used in our empirical analysis below were obtained from Durlauf et al. (2008) and the associated data update in Henderson et al. (2012). Durlauf et al. base the selection of their variables on Barro (2003), which was

[9] Formally, let λ be country n's share in country j's overall exports at time t, and Λ be the rest-of-the-world's export share to n, then $a_{jnt} = [(\lambda - \Lambda)/(ln\lambda - ln\Lambda)] \,/\, \sum_{n \in N_{-jt}} [(\lambda - \Lambda)/(ln\lambda - ln\Lambda)]$.

previously one of the most comprehensive approaches to growth determinants in a panel of countries. Durlauf et al. include proxies for seven different growth theories, including regressors suggested by I) neoclassical growth theory (initial per capita income, population growth, investment, and education). We follow Durlauf et al. and instrument for these four variables with one-period lagged values. Also included are II) proxies for demographic change (life expectancy, fertility), and III) theories that link macroeconomic policies to growth (government consumption, openness, and average changes in the CPI). As in Durlauf et al., the latter three variables are instrumented with their respective lagged values. We also consider IV) regressors that link geography to growth (land area within 100km of ice-free coast, percent tropical land area) and V) theories linking institutions to growth (risk of expropriation, constraints on the executive, and a governance index). In addition, we include dummy variables for the English and French origin of a country's legal system and use lagged values of the expropriation risk as instrument for the current value of the same variable. VI) Theories relating to religion and growth are proxied using the share of all major religions in a country's population (Eastern, Hindu, Jewish, Muslim, Orthodox, Protestant, and other religions). As Durlauf et al., we use the respective religious shares in 1900 as instruments. Finally, we also include regressors capturing VII) theories that predict a detrimental effect of ethnic tensions on growth (using linguistic fractionalization and ethnic tension indices). Exact definitions and sources of each variable are provided in the Data Appendix to this chapter.

3.3 Model Uncertainty and Endogeneity

The diversity of growth theories and their associated candidate regressors has given rise to a sizable literature that seeks to identify robust growth determinants. Early approaches used Leamer's (1978) Extreme Bound Analysis (Levine and Renelt, 1992, and Sala-i-Martin, 1997), which suffers from arbitrary robustness thresholds ("Extreme Bounds"). Subsequent approaches employ Bayesian Model Averaging, which was developed specifically to address model uncertainty empirically (Fernández et al., 2001, Brock and Durlauf, 2001, Sala-i-Martin et al., 2004, Ciccone and Jarocinski, 2010, and Eicher et al., 2011). None of the above approaches tackle endogeneity, with the exception of Durlauf et al. (2008) who derive fitted

values in a single first stage and address endogeneity in the second stage only. Subsequently, Eicher et al. (2009) developed a comprehensive Instrumental Variable (IV) extension of BMA that allows for model selection in both stages, which we apply below.[10]

We provide a brief sketch of the mechanics of IVBMA that follows the details in Eicher et al. (2009). IVBMA functions as a BMA procedure at the first and second stages where final model weights take into account uncertainty in both stages. Traditionally, endogeneity is addressed by applying 2SLS and certifying over-identification and instrument restrictions (e.g., Wooldridge, 2002) in the canonical setup

$$y = \beta' \begin{pmatrix} w \\ x \end{pmatrix} + \gamma \tag{3.3}$$

$$w = \theta_z' z + \theta_x' x + \epsilon \tag{3.4}$$

where y is the dependent variable, x is a set of covariates, w is the set of endogenous variables, and z is the set of instruments. The x and θ_x are of dimension p_x, and z and θ_z have dimension p_z. To simplify the exposition, we assume that w is univariate. Assuming that

$$\begin{pmatrix} \eta \\ \epsilon \end{pmatrix} \sim N\left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_\eta^2 & \sigma_{\eta\epsilon}^2 \\ \sigma_{\eta\epsilon}^2 & \sigma_\epsilon^2 \end{pmatrix} \right), \tag{3.5}$$

the classical endogenous variable situation arises when $\sigma_{\eta\epsilon}^2 \neq 0$, causing w to violate the regression assumption of independence of the error term, η. The determination of w then leads to inconsistent estimates of the entire coefficient vector, β. 2SLS solves the consistency problem, but relies on the existence of a set of instrumental variables (IV), z, which are independent of y, given w and the vector of covariates, x. The IV-based estimates, $\beta_{IV} = (\overline{w}'\overline{w})^{-1}\,\overline{w}'y$, obtained using the fitted values from the first stage, $\overline{w}$, are consistent if the conditional independence assumptions are valid.

IVBMA combines the IV and BMA methodologies. It processes the data much like a

[10] Similar approaches have been suggested by Moral-Benito (2012) and Chen et al. (2009), who extend BMA to Generalized Method of Moments. Koop et al. (2012) develop a Bayesian IV methodology that does not rely on Eicher et al.'s (2009) approximations to integrated likelihoods and Karl and Lenkoski (2012) introduce conditional Bayes factors to resolve mixing difficulties associated with Koop et al.'s (2012) search algorithm. To implement IVBMA, we use Lenkoski's IVBMA R-package below.

two stage least square estimator while also addressing model uncertainty in both stages. The first stage is a straight BMA application to identify effective instruments. Let Δ be a quantity of interest and let the set of potential models in the first stage, $\tilde{M}$, be comprised of $\tilde{M}_i \in \tilde{M}$ individual models. The posterior distribution of Δ given the data, D, is given by the weighted average of the predictive distribution under each model, using as weights the models' corresponding posterior probabilities:

$$pr(\Delta|D) = \sum_{\tilde{M}_i \in \tilde{M}} pr\left(\Delta|\tilde{M}_i, D\right) pr\left(\tilde{M}_i|D\right), \tag{3.6}$$

where $pr(\Delta|\tilde{M}_i, D)$ is the predictive distribution and $pr(\tilde{M}_i|D)$ is the posterior model probability of model $\tilde{M}_i$. The posterior model probability, $\tilde{\pi}_i$, for each model in the first stage is given by

$$\tilde{\pi}_i = pr\left(\tilde{M}_i|D\right) \propto pr\left(D|\tilde{M}_i\right) pr\left(\tilde{M}_i\right), \tag{3.7}$$

where

$$pr\left(D|\tilde{M}_i\right) = \int pr\left(D|\theta_i, \tilde{M}_i\right) \left(\theta_i, \tilde{M}_i\right) d\theta_i \tag{3.8}$$

is the integrated likelihood of model $\tilde{M}_i$ with model parameters θ_i. The prior densities for parameters and models are given by $pr\left(\theta_i, \tilde{M}_i\right)$ and $pr\left(\tilde{M}_i\right)$, respectively. The posterior mean in stage 1 is then

$$\hat{\theta}_{BMA} = \sum_{\tilde{M}_i \in \tilde{M}} \hat{\theta}_i \tilde{\pi}_i, \tag{3.9}$$

which is given by the sum of the posterior means of all models, weighted by their respective posterior model probabilities. Similarly, the posterior variance can be calculated as

$$\hat{\sigma}_{BMA}[\theta] = \sum_{\tilde{M}_i \in \tilde{M}} \tilde{\pi}_i \hat{\sigma}_i + \sum_{\tilde{M}_i \in \tilde{M}} \tilde{\pi}_i \left(\hat{\theta}_i - \hat{\theta}_{BMA}\right)^2 . \tag{3.10}$$

The variance has a clear interpretation that highlights how model uncertainty is accounted for by standard errors of the BMA methodology. The first term in (3.10) is the weighted variance for each model, $\hat{\sigma}_i = Var\left(\hat{\theta}_i|\tilde{M}_i, D\right)$, summed over all relevant models, and the second term indicates how stable the estimates are across models. The more the estimates

differ across models, the greater is the posterior variance.

The posterior distribution for a parameter is a mixture of a regular posterior distribution and a point mass at zero, which represents the probability that the parameter equals zero. The sum of the posterior probabilities of the models that contain the variable is called the inclusion probability and can then be taken as a measure of the importance of a variable:

$$\mu_{BMA}[\theta] = pr\left(\hat{\theta} \neq 0|D\right) = \sum_{\tilde{M}_i \in \tilde{M}_A} \tilde{\pi}_i \ . \tag{3.11}$$

where $\tilde{M}_A$ is the set of models in the first stage in which parameter θ is not constrained to zero.

IVBMA is then a nested approach that first determines the posterior model probabilities in the first stage according to the BMA methodology, and then uses the predicted values from each model, $\overline{w}_i$, to derive second stage model posterior model probabilities, $\pi_j\left[\overline{w}_i\right]$, and estimates, $\hat{\beta}_j\left[\overline{w}_i\right]$. The set of models in the second stage is denoted by M, which consists of all second stage models $M_j \in M$.

The posterior means for the second stage can then be derived to be

$$\begin{aligned} \tilde{\hat{\beta}}_{IVBMA} &= \sum_{\tilde{M}_i \in \tilde{M}} \sum_{M_j \in M} \tilde{\pi}_i \pi_j\left[\overline{w}_i\right] \hat{\beta}_j\left[\overline{w}_i\right] \\ &= \sum_{\tilde{M}_i \in \tilde{M}} \tilde{\pi}_i \tilde{\hat{\beta}}_{i,BMA} \end{aligned} \tag{3.12}$$

which implies that the IVBMA estimate is the sum of the averaged posterior IV means obtained using the fitted values from each first stage model, $\tilde{M}_i$, weighted by the respective quality of each individual first stage specification.

The posterior variance reflects how stable the estimates are across models, and how estimates differ across models in both the first and second stage, just as in the canonical BMA setup in (3.10), captured by $\tilde{\hat{\sigma}}_{BMA}[\beta]$. However, IVBMA also takes into account the model weights derived in the first stage so that the posterior variance is again weighted by

the quality of its instrumenting models:

$$\tilde{\hat{\sigma}}_{IVBMA}[\beta] = \sum_{\tilde{M}_i \in \tilde{M}} \tilde{\pi}_i \tilde{\hat{\sigma}}_{i,BMA}[\beta] \ . \tag{3.13}$$

Therefore, results generated by underperforming instrument models are deemphasized, while those based on strong instrument models receive relatively high posterior weights. A similar interpretation holds for the IVBMA inclusion probabilities:

$$\mu_{IVBMA}[\beta] = pr\left(\hat{\beta} \neq 0 | D\right) = \sum_{\tilde{M}_i \in \tilde{M}, M \in M_A} \tilde{\pi}_i \mu_{i,BMA}[\beta] \tag{3.14}$$

where M_A indicates the subset of second stage models for which the coefficient β is not constrained to zero. Standard rules of thumb for interpreting μ_{IVBMA} have been provided by Kass and Raftery (1995) and Eicher et al. (2009). They establish the following effect thresholds: $< 50\%$ evidence against the effect, $50-75\%$ weak evidence for the effect, $75-95\%$ positive evidence, $95-99\%$ strong evidence, and $> 99\%$ decisive evidence.

3.4 Data

The dataset is an unbalanced panel of 84 countries from 1965 to 2009. Using 5-year periods, the dataset comprises 589 country-period observations. To extend the datasets of Durlauf et al. (2008) and Henderson et al. (2012), we used government expenditure as share of GDP instead of government expenditures net of education and military expenditures. In addition, the Durlauf et al. "Cheque" data on legal procedures required to collect a bounced check (from World Bank Doing-Business Indicators) is only available for a limited set of countries. Djankov et al. (2003) and La Porta et al. (2008) document the strong empirical relationship between legal origin and current legal procedures and standards, hence we substitute LegalOrigins (French and English) for Cheque in our regressions.

Since our focus is on the relationship between diversity and growth, we exclude from our analysis resource-rich economies that generate more than 20 percent of their GDP from resource rents (as reported by the World Development Indicators). Resource-rich countries represent sizable outliers with unusually low export diversity relative to their income levels.

These countries have developed significant volumes of natural resource exports, which is not a relevant development path for the vast majority of countries in our sample. Removing resource-rich countries allows us to focus on understanding whether the development of diversified export structures and broad-based comparative advantages are advantageous for growth. While the combination of the described changes overall allows for a larger dataset, they do not affect our findings; qualitatively similar results can be derived with fewer countries and years, and when allowing for the inclusion of resource-rich economies.

The dependent variable in our analysis is the average growth rate of GDP per capita during each 5-year period. Growth rates were calculated using data on per capita incomes from the Penn World Tables versions 6.2 (until 2004) and 7.1 (2005-2009). We also include period and regional dummies (Sub-Saharan Africa, East Asia, Latin America and the Caribbean) to control for spatial and time effects on growth. To construct the Hummels and Klenow (2005) extensive margin measure of export diversification, we use trade data from Feenstra et al. (2005, 4-digit SITC for 1962-1989) and from the UN Comtrade database (6-digit HS for 1990-2009).[11] For both classifications, sectoral exports were compiled using mirror import data.

To check the robustness of our empirical results, we also provide estimates based on alternative export diversity indicators that have previously been used in the trade diversity literature (see Cadot et al., 2011, for a survey of these measures): Herfindahl, Gini, Total Theil, Between Theil and Within Theil indices. Each of these indices captures slightly different dimensions of export diversification. The Herfindahl index is a measure of the concentration of export shares. Both the Gini and Total Theil indices, on the other hand, gauge export diversification based on the inequality between export shares of individual sectors. The Total Theil index is composed of the Between Theil and the Within Theil indices. The Between Theil index measures export diversification based on the evolution of the extensive margin, while the Within Theil index captures export diversification at the intensive margin. In particular, the latter measures how equally exports are distributed across

[11] Trade data in the more detailed 6-digit HS nomenclature is not available before 1988. Although not reported in the results section below, we also estimated our baseline specification controlling for a potential structural break in the export diversity measure. We neither find evidence for a structural break nor that observations prior to or after 1990 drive our results. Detailed results are available on request.

active export lines independent of the actual of number of active export sectors. While all alternative measures are quite similar in nature to the Hummels-Klenow diversity measure, the Within Theil index adds one distinctly different diversity dimension by focusing on how evenly sectoral export volumes evolve over time. To ensure comparability, all alternative export diversity measures are normalized to lie between zero and one. As shown in the robustness section, our results are not dependent on the choice of the diversity measure.

Finally we also construct an entirely new diversity measure, based on the Hummels-Klenow approach to control for potentially serious measurement errors in the Comtrade data. It is well known that the UN trade database features arbitrary and potentially misleading sector classifications in the HS and SITC nomenclatures, as they were not designed to provide meaningful sectoral trade statistics, but primarily to monitor tariff collection (see Cadot et al., 2011). The measurement error arises when sector classifications contain either excessively irrelevant or insufficiently differentiated sectors.[12]

For example, for our use of the data it is crucial to understand whether a country is expanding its export sectors from leather sandals to leather loafers, or from leather sandals to computers. To address this issue, we cluster the 4-digit SITC and 6-digit HS sectors by the similarity of their production processes. Using the 2002 US benchmark Input-Output table from the US Bureau of Economic Analysis, we employ complete-linkage clustering to aggregate individual sectors into broad clusters based on the similarity of their input usage (using a Euclidian distance measure). The sensitivity of the algorithm can be adjusted from a Euclidian distance of 0 (replicating the original SITC/HS sectors) to 1 (grouping all sectors into one single sector). We then use the generated product clusters to calculate an alternative Hummels-Klenow measure, which accounts for the similarity of the export sectors' production processes.

[12] For example, "Woman Suits" HS6201 and "Woman Suits knitted" HS6204 contain 47 HS six-digit sectors while all "Machinery Parts Without Electrical Connectors" are grouped into a single HS 8485 four-digit sector that contains only two six-digit subsectors ("Ships' Propellers" HS 878510 and "All Other Machinery Parts Not Containing Electrical Features" HS 848590).

3.5 Export Diversity, Stages of Development and Growth

The approach of our paper dictates the order in which we present the results. We first introduce i) sectoral export diversity as a potential growth determinant. Then we examine ii) the importance of endogeneity in trade/growth regressions. Finally we address iii) model uncertainty and endogeneity simultaneously. To highlight the importance of model uncertainty, we first compare OLS and 2SLS results and then introduce IVBMA and trade diversity in stages to isolate their individual effects. We conclude with a discussion of the robustness of our results. In the robustness section, we allow for alternative export diversity measures, control for the intensive margin of exports and motivate additional controls that have previously been linked to trade and diversity.

3.5.1 OLS Baseline Results

Our OLS results provide a direct baseline comparison with previous growth determinant studies. Column 1 in Table C.1 reports OLS results without export diversity, producing roughly comparable results to the OLS regressions in Barro (2003). As expected, Initial-GDP, Investment and PopulationGrowth are significant, as suggested by the neoclassical model, along with institutional factors such as GovernanceQuality, GovExpenditures, and ExecutiveConstraint. As in Barro (2003), religious measures (Jewish, Protestant) are significant while one trade measure, FilteredOpenness (the filtered ratio of imports plus exports over GDP), is significant at the 10% level. Barro (2003) and Durlauf et al. (2008) found that the weak OLS trade effect disappeared once they controlled for endogeneity.

Column 2 adds export diversity to the standard growth determinants, but it is not significant in the global sample. The result is not surprising given that the slope of the partial correlation between growth and export diversity is close to zero in Figure C.2. On the other hand, we are able to confirm that the effect of diversity on growth is declining with income, as shown in column 3 of Table C.1.[13] The OLS regression traces out the relationship

[13] The income dummies included in column 3 are derived from the World Bank's definition of high, upper medium, lower medium, and low income levels. Diversity effects by country-income levels are calculated as the sum of the main export diversity coefficient and the respective country-income interaction with the diversity term. The standard errors of the composite coefficients effects are calculated using the Delta method.

in Figure C.1, where diversity is positively related to growth, but it is diminishing with income. The economic effect of diversity on low income countries is sizable, implying that a one standard deviation increase in export diversity raises average annual growth in low income countries by just about 1 percentage point.[14]

3.5.2 2SLS: Controlling for Endogeneity

As outlined in Section 3.2, there is ample evidence for feedback effects from growth to trade. Column 4 in Table C.1 acknowledges not only trade endogeneity, but also the potential endogeneity of 18 other growth determinants in our dataset whose respective instruments are described in Section 3.2.[15] Given the large number of endogenous regressors, we report the Angrist-Pischke test statistics that indicate whether a particular endogenous regressor is identified. The Angrist-Pischke first-stage chi-squared and F statistics are tests of underidentification and weak identification, respectively.[16] Underidentification and weak identification are rejected at the 5 percent level for all endogenous variables. In the full 2SLS model, the Sargan-Hansen J statistic rejects, however, instrument validity, indicating that a more parsimonious 2SLS specification may be preferred as we will show below.

In terms of significance, the 2SLS results in column 4 coincide by and large with the OLS growth determinants in column 3. Aside from Investment, only the marginally significant ExecutiveConstraint and EasternReligionFraction in the OLS regression lose significance in the 2SLS approach. The loss of significance for Investment is worrisome, but not surprising. While Investment is seen as a universal growth determinant in theory, previous panel studies (e.g., Durlauf et al., 2008, and Barro, 2003) also find that the significance of Investment decreases substantially after controlling for endogeneity. Note that Investment becomes insignificant only after controlling for endogeneity, but before we address model uncertainty.

[14] The coefficient of 0.062 and the 0.16 standard deviation of export diversity for low income countries imply that a one standard deviation increase in diversity should increase growth by 100x0.062x0.16 = 0.992%.

[15] Following Durlauf et al. (2008), the endogenous regressors are InitialGDP, ExecutiveConstraint, FilteredOpenness, GovExpenditures, Education, Investment, PopulationGrowth, Inflation, EasternReligionFraction, OrthodoxFraction, HinduFraction, MuslimFraction, OtherRelFraction, JewishFraction, ProtestantFraction, Diversity, and Diversity with three income interactions. Our instruments follow directly from Barro (2003) and Durlauf et al. (2008).

[16] In the case of a single endogenous regressor, the AP statistic is identical to the Cragg-Donald (if errors are i.i.d.) or the Kleibergen-Paap (if errors are not i.i.d.) underidentification statistics, respectively.

Export diversity remains significant for low (and upper medium) income countries.

3.5.3 Model Uncertainty, Endogeneity and Export Diversity

Since the set of candidate regressors in growth regressions is always an amalgam of variables suggested by a range of growth theories, it is important to control not only for endogeneity but also for the associated model uncertainty. Here it is important to note that single regressions do not account for the uncertainty surrounding the validity of the particular model in question. And while an extensive literature on model uncertainty in growth regressions exists to date, only Durlauf et al. (2008) control simultaneously for endogeneity. In addition, all empirical studies that previously included trade regressors as growth determinants focused exclusively on aggregate quantities, such as imports, exports or "openness" (the share of imports and exports in GDP). Below we examine whether the addition of sectoral trade diversity leads to an effect on growth, even after we control for endogeneity and model uncertainty.

Column 5 in Table C.2 presents IVBMA results without diversity, while columns 6 and 7 add the linear and nonlinear diversity specification. In addition to posterior inclusion probabilities (PIP), we also report conditional means and standard deviations for our coefficients in order to facilitate comparisons with our OLS and 2SLS estimates above. The posterior inclusion probability provides a probability statement regarding the importance of a regressor, which directly addresses the researchers' prime concern: it identifies the probability that a coefficient has a non-zero effect on the dependent variable.

The first set of estimates in column 5 indicates that IVBMA results are much more parsimonious than the 2SLS and OLS specifications. JewishFraction, LegalOriginsUK, HinduFraction, OrthodoxFraction, ExecutiveConstraint, EasternReligionFraction, FilteredOpenness, Fertility and LandNearCoastPct are no longer associated with an effect on growth. Instead the traditional growth determinants exhibit the highest effect thresholds: InitialGDP, GovernanceQuality, Investment, PopulationGrowth, GovExpenditures in addition to ProtestantFraction, LegalOriginsFrench, SubSaharanAfrica and Inflation. Adding Diversity in column 6 does still not lead to an effect in the global sample, but once we con-

trol for nonlinearities in column 7 we find again that export diversity has a decisive impact on growth for low income countries. A one standard deviation increase in export diversity raises growth by about 1.1 percentage points for low income countries. The IVBMA-Sargan test outlined in Eicher et al. (2009) indicates instrument validity in all IVBMA specifications in Table C.2.

At this stage, it is important to contrast the IVBMA and 2SLS results to highlight the importance of controlling simultaneously for both endogeneity and model uncertainty. Of the 14 suggested growth determinants by 2SLS (Table C.1, column 4) only 8 find support once we control for model uncertainty (Table C.2, column 7). In addition, the IVBMA approach assigns an effect to two additional regressors that were not found to be effective in the 2SLS approach: Investment and the LowIncomeDummy. The set of growth determinants identified by IVBMA is parsimonious but expected. With InitialGDP, GovernanceQuality, Investment, PopulationGrowth, and GovExpenditures, the results show that the data provide support for both the neoclassical growth model as well as new growth theories that rely on productive government expenditures and the quality of institutions. Most importantly, we have documented a crucial effect of trade, through trade diversity, that drives growth in low income countries.

3.5.4 Robustness: Intensive Margin, Alternative Diversity Measures and Additional Controls

In this section, we examine whether our results are sensitive to the definition of our export diversity measure as well as to the inclusion of additional control variables and intensive margin measures of trade. A number of alternative export diversity indices have been suggested in the literature and we examine their relevance below. Although all measures identify different dimensions of sectoral export diversity, we will show that our IVBMA growth determinants and the effect of trade diversity on growth remains remarkably stable. In addition, we confirm that our results from the previous section are robust when accounting for trade volumes via intensive margin measures. We also examine whether our results could be caused by factors which have been identified as drivers of export diversification, for

example economic integration agreements, output volatility, primary export shares, the real exchange rate and a country's terms-of-trade. We will again illustrate that our conclusions from the previous section remain unchanged.

Alternative Diversity Measures

Table C.3 reports IVBMA results with alternative trade diversity measures. The results in column 8 use the clustered diversity measure (with a Euclidian distance sensitivity threshold of 0.1) which groups together the original sectors by the similarity of their input structures based on the hierarchical complete-linkage clustering algorithm.[17] We choose this particular threshold to generate a parsimonious set of sectors. Thresholds below 0.1 replicate the sectors of the UN nomenclatures and thresholds above 0.1 quickly lead to excessive aggregation into only a handful sectors. The clustered results are just about identical to those in column 7 in Table C.2, only the formerly weakly effective UKLegalOrigins loses its effect. This finding indicates that the arbitrary nomenclature of the UN sectors does not drive our results.

Columns 9-13 in Table C.3 present alternative measures of export diversity that we discussed in the data section above: Herfindahl, Gini, Total Theil, Between-Theil and Within-Theil indices. The table indicates that the baseline IVBMA results are remarkably stable and hardly change if we use alternative diversity indices. In addition, the results for the Between-Theil and the Within-Theil indices indicate that growth in low income countries is stimulated through both i) increases in diversity at the extensive margin, as well as through ii) a more equal distribution of exports among existing export sectors.

Intensive versus Extensive Margins

Table C.4 presents results controlling for the intensive margin of a country's exports. This point is of particular interest, since there is substantial evidence that the expansion of export volumes to existing trade partners in already active product lines plays a large role in driving trade growth (Felbermayr and Kohler, 2006, Helpman et al., 2008, and Amiti and Freund,

[17] The clustered diversity measure groups our original 4,894 6-digit HS sectors (752 4-digit SITC sectors) into 481 (296) clusters with similar production structures.

2010). Our computation of a country's aggregate intensive margin measure follows again Hummels and Klenow (2005, p. 710-711). The Hummels-Klenow intensive margin measure is a weighted average of a country's export shares in its active product lines relative to the rest-of-the-world's exports to its trading partners.

Column 14 reports results when we include a linear intensive margin term (Intensive-Margin) and respective interactions with the low, lower middle and upper middle income categories. This specification indicates that the intensive margin could potentially be an important driver of growth in low income countries as well. However, when controlling simultaneously for export diversity in column 15, the intensive margin effect for low income countries vanishes while the importance of export diversity for low income countries is again confirmed. Thus, the results in column 15 provide additional evidence that export diversification pushes low income countries up the development ladder and not trade intensity per se.

Additional Control Variables

Table C.5 introduces additional control variables that are potentially linked to export diversification. The regressors are not standard in growth regressions, but their omission in this context could lead to an overstatement of the diversity effect on growth. The new covariates are introduced in three stages. Column 16 adds output volatility (GDPVolatility), primary export shares (Primary), WTO membership (WTO), and membership in Preferential Trading Agreements (PTA). These variables can all be directly related to trade diversity. For instance, diversity insures against volatility and WTO/PTA membership might bring out an expansion in export volumes and sectors. In addition, we add as exchange rate measures in columns 17 and 18 countries' real effective exchange rate (REER), real exchange rate volatility (FXVolatility), terms-of-trade (TOT) and TOT volatility (TOTVolatility). All additional covariates are treated as exogenous and the results again support our previous findings. The additional control variables do not change the effect of trade diversity and neither of the new variables is identified as key growth determinant. The one exception is FXVolatility, which is not traditionally included in growth regressions. In our regressions,

it is estimated to have an impact on growth but without affecting the diversity-growth relationship.

3.6 Concluding Remarks

In this paper, we reexamine the effect of trade on growth. Previous empirical studies of growth determinants have not found a robust relationship between trade and growth, and in this study we extend the literature to introduce disaggregated measures of trade, specifically export diversity. Using Hummels and Klenow's (2005) extensive trade margin, we find decisive evidence that export diversification is a substantial driver of growth in low income countries, but that the effect weakens and eventually vanishes for rich countries. Our findings are robust to the two major caveats encountered in growth regressions: endogeneity and model uncertainty. Our results are also robust to the inclusion of at least five alternative export diversification measures.

Overall, our findings suggest that the benefits from trade diversity are largest at the early stages of development. When the development process advances further, export diversification seems to be rather a by-product of prosperity than its cause. Export diversity could be the driver of a country's early development through several channels. More diversified economies offer an insurance against idiosyncratic sectoral shocks, especially early in the development process, when countries export only few products. Alternatively, countries with greater export diversification at early development stages may be more likely to move into the production of new products to spur growth. Hausmann and Hidalgo (2011) and Kali et al. (2013) offer a detailed discussion of this point from an economic network's perspective.

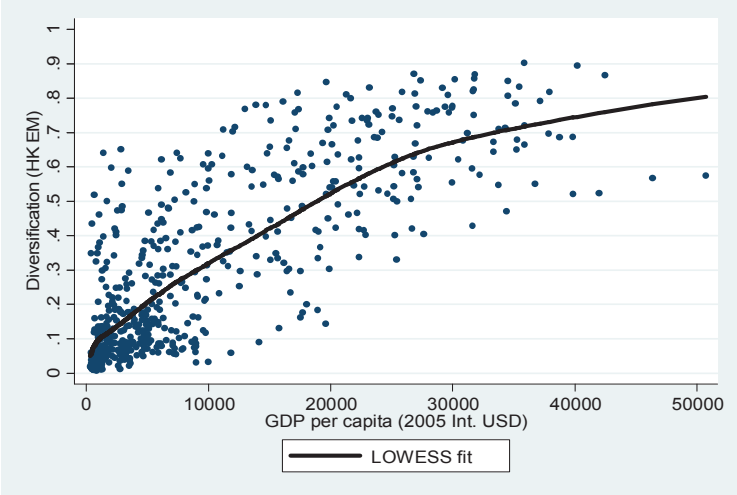
Finally, in the light of our results it is also of interest to note the finding of Besedes and Prusa (2011) that the extensive margin growth in developing countries is less stable than in developed economies. Since we consider in our analysis 5-year averages, and thus a somewhat longer time horizon, our findings suggest that short-run fluctuations in export diversity are of less importance for low income countries than a steady long-run trend to climb the development ladder. Examining more carefully the link between short-run fluctuations in export diversity and development is a promising avenue for future research.

Appendix 3

APPENDIX TO CHAPTER 3

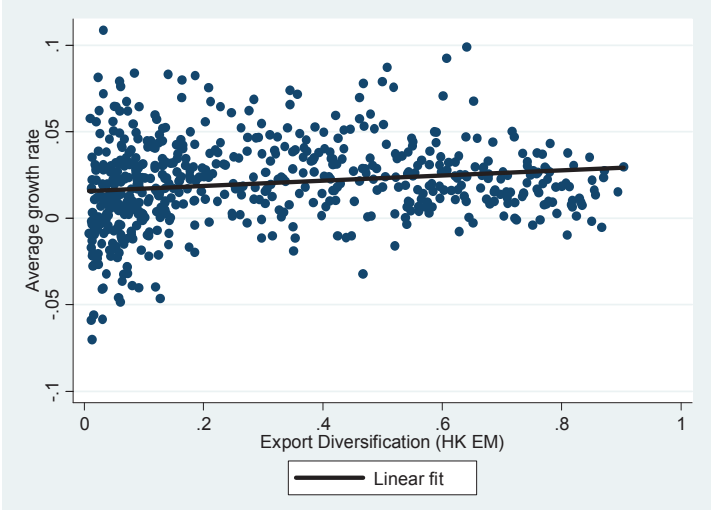
C.1 Figures and Tables

Figure C.1: Export Diversity and Per Capita Income, 1965-2009



Fitted values obtained using locally weighted scatter plot smoothing (LOWESS) of the Hummels-Klenow extensive margin diversity measure on real GDP per capita (2005 international Dollars, PWT 7.1).

Figure C.2: Average Growth and Export Diversity, 1965-2009



Fitted values obtained using linear regression of the average growth rate on a constant and the Hummels-Klenow export diversity measure.

Table C.1: OLS and 2SLS Estimates

	1		2		3		4			
	Extended DKT ols		Extended DKT ols		Extended DKT ols		Extended DKT 2sls		AP p-values	
	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	χ^2	F
InitialGDP	**-0.011*** **	0.003	**-0.012*** **	0.003	**-0.015*** **	0.004	**-0.020*** **	0.005	0.000	0.000
GovernanceQuality	**0.005***	0.003	**0.006***	0.003	**0.010*** **	0.003	**0.013*** **	0.003		
Investment	**0.010*** **	0.003	**0.010*** **	0.003	**0.011*** **	0.003	0.006	0.004	0.000	0.000
GovExpenditures	**-0.107*** **	0.026	**-0.108*** **	0.026	**-0.112*** **	0.026	**-0.133*** **	0.039	0.000	0.000
PopulationGrowth	**-0.042*** **	0.012	**-0.042*** **	0.012	**-0.044*** **	0.012	**-0.058** **	0.023	0.000	0.001
JewishFraction	**0.039*** **	0.009	**0.040*** **	0.009	**0.035*** **	0.009	**0.062*** **	0.016	0.000	0.000
LegalOriginsUK	0.005	0.003	0.004	0.003	**0.007** **	0.003	**0.008***	0.005		
LegalOriginsFrench	-0.002	0.003	-0.002	0.004	-0.002	0.004	-0.001	0.005		
ProtestantFraction	**-0.007***	0.004	**-0.008***	0.004	**-0.008** **	0.004	**-0.010***	0.006	0.000	0.000
OrthodoxFraction	0.008	0.005	**0.010***	0.006	0.006	0.006	0.008	0.006	0.000	0.000
Inflation	**-0.000*** **	0.000	**-0.000*** **	0.000	**-0.000*** **	0.000	**-0.000***	0 .000	0.017	0.030
Fertility	**-0.003***	0.002	**-0.003***	0.001	-0.002	0.002	-0.003	0.002		
LatinAmerica	-0.001	0.005	0.001	0.005	-0.002	0.005	-0.005	0.007		
HinduFraction	-0.001	0.012	-0.003	0.013	**-0.024***	0.014	**-0.028***	0.017	0.000	0.000
LinguisticFractionalization	-0.008	0.005	-0.007	0.005	-0.002	0.006	-0.007	0.007		
EthnicFractionalization	-0.005	0.006	-0.006	0.006	-0.008	0.006	-0.004	0.007		
OtherRelFraction	-0.007	0.008	-0.007	0.008	-0.011	0.008	-0.017	0.015	0.000	0.000
ExecutiveConstraint	**-0.006***	0.004	**-0.006***	0.004	**-0.007***	0.004	-0.003	0.005	0.000	0.000
FilteredOpenness	**0.007***	0.004	**0.007***	0.004	0.003	0.004	0.004	0.005	0.000	0.000
ExpropriationRisk	0.001	0.010	-0.001	0.011	-0.007	0.011	-0.005	0.011		
SubSaharanAfrica	-0.003	0.005	-0.003	0.005	0.000	0.006	0.000	0.008		
LifeExpectancy	0.011	0.013	0.012	0.013	0.008	0.014	0.002	0.014		
EastAsia	0.005	0.004	0.004	0.005	-0.006	0.005	0.001	0.008		
EasternReligionFraction	0.005	0.006	0.005	0.006	**0.012***	0.006	0.001	0.009	0.000	0.000
LandTropicsPct	0.003	0.004	0.003	0.004	0.005	0.005	0.003	0.005		
MuslimFraction	0.000	0.004	0.001	0.004	-0.002	0.005	-0.006	0.007	0.000	0.000
Education	-0.001	0.001	0.000	0.001	-0.001	0.001	-0.001	0.001	0.000	0.000
LandNearCoastPct	**-0.007***	0.004	**-0.007***	0.004	-0.006	0.004	**-0.009** **	0.004		
Diversity			0.007	0.008	-0.002	0.009	-0.003	0.011	0.000	0.000
Diversity Low Income♠					**0.062*** **	0.019	**0.062** **	0.032		
Diversity Lower Medium Income♠					**0.024** **	0.011	0.004	0.017		
Diversity Upper Medium Income♠					0.035	0.023	**0.056***	0.029		
Diversity*LowIncome					**0.064*** **	0.019	**0.065** **	0.03	0.000	0.000
Diversity*MedIncome					**0.026** **	0.012	0.007	0.018	0.000	0.000
Diversity*UpperMedIncome					**0.037***	0.022	**0.059** **	0.029	0.000	0.000
LowIncomeDummy					**-0.020** **	0.01	-0.02	0.014		
LowerMedIncomeDummy					-0.005	0.009	0.001	0.012		
UpperMedIncomeDummy					-0.011	0.01	-0.02	0.013		
R-squared	0.409		0.410		0.434			0.403		
Sargan test p-value								0.000		
Observations	589		589		589			589		

♠ Composite coefficient comprised of Diversity and Diversity*CountryIncome interaction, standard errors calculated using Delta Method.

Table C.2: IVBMA Estimates (Extensive Margin)

	5			6			7		
	Extended DKT IVBMA			Extended DKT IVBMA			Extended DKT IVBMA		
	PIP	Post. Mean	Post. SD	PIP	Post. Mean	Post. SD	PIP	Post. Mean	Post. SD
InitialGDP	**1.000**	-0.016	0.002	**1.000**	-0.016	0.002	**1.000**	-0.022	0.002
GovernanceQuality	**0.999**	0.010	0.002	**0.996**	0.011	0.002	**0.999**	0.011	0.002
Investment	**0.993**	0.012	0.003	**0.992**	0.013	0.003	**0.997**	0.014	0.003
GovExpenditures	**0.749**	-0.075	0.028	**0.848**	-0.078	0.032	**0.994**	-0.112	0.027
PopulationGrowth	**0.872**	-0.045	0.013	**0.842**	-0.042	0.014	**0.996**	-0.062	0.013
JewishFraction	0.231	0.027	0.016	0.270	0.031	0.020	**0.979**	0.047	0.012
LegalOriginsUK	0.126	0.000	0.004	0.118	0.000	0.005	**0.541**	0.006	0.002
LegalOriginsFrench	**0.649**	-0.006	0.002	**0.712**	-0.006	0.002	0.294	-0.005	0.003
ProtestantFraction	**0.919**	-0.016	0.005	**0.908**	-0.016	0.005	0.206	-0.009	0.005
OrthodoxFraction	0.087	0.008	0.006	0.109	0.010	0.006	0.188	0.011	0.006
Inflation	**0.593**	0.000	0.000	0.331	0.000	0.000	0.191	0.000	0.000
Fertility	0.349	-0.002	0.002	0.342	-0.003	0.001	0.124	-0.001	0.001
LatinAmerica	0.065	-0.002	0.003	0.092	-0.002	0.004	0.125	-0.004	0.003
HinduFraction	0.033	-0.004	0.009	0.060	-0.006	0.009	0.099	-0.016	0.011
LinguisticFractionalization	0.061	-0.004	0.005	0.102	-0.005	0.006	0.103	-0.006	0.004
EthnicFractionalization	0.070	-0.004	0.006	0.071	-0.003	0.005	0.096	-0.004	0.005
OtherRelFraction	0.154	0.010	0.012	0.147	0.012	0.011	0.067	-0.005	0.007
ExecutiveConstraint	0.043	0.000	0.004	0.046	0.000	0.005	0.081	-0.003	0.004
FilteredOpenness	0.039	0.002	0.004	0.081	0.005	0.004	0.098	0.004	0.003
ExpropriationRisk	0.065	-0.001	0.008	0.071	0.000	0.009	0.051	0.002	0.007
SubSaharanAfrica	**0.910**	-0.011	0.004	**0.915**	-0.011	0.004	0.055	-0.002	0.004
LifeExpectancy	0.115	-0.003	0.008	0.113	-0.003	0.007	0.029	0.000	0.005
EastAsia	0.116	0.004	0.004	0.068	0.004	0.003	0.052	0.001	0.004
EasternReligionFraction	0.073	0.007	0.007	0.054	0.005	0.007	0.047	0.005	0.006
LandTropicsPct	0.071	0.001	0.003	0.045	0.001	0.003	0.043	0.002	0.003
MuslimFraction	0.056	0.003	0.004	0.059	0.003	0.004	0.044	0.002	0.003
Education	0.056	0.000	0.001	0.043	0.000	0.001	0.037	0.000	0.001
LandNearCoastPct	0.060	-0.002	0.003	0.026	-0.001	0.003	0.041	0.000	0.003
Diversity				0.123	0.008	0.007	0.093	0.006	0.007
Diversity Low Income♠							**0.999**	0.070	0.016
Diversity Lower Medium Income♠							0.142	0.005	0.008
Diversity Upper Medium Income♠							0.156	0.010	0.013
Diversity*LowIncome							**0.998**	0.069	0.016
Diversity*MedIncome							0.054	0.003	0.009
Diversity*UpperMedIncome							0.076	0.012	0.016
LowIncomeDummy							**1.000**	-0.026	0.005
LowerMedIncomeDummy							0.066	-0.001	0.005
UpperMedIncomeDummy							0.062	-0.003	0.007
Sargan test p-value		0.999			0.999			0.999	
Observations		589			589			589	

♠ Composite coefficient reported, based on the joint posterior distribution of Diversity and Diversity*CountryIncome interaction. Since the PIP is not defined for the joint, we report the percentage of the joint posterior distribution of Diversity and Diversity*CountryIncome interaction which is non-zero.

Table C.3: IVBMA Robustness Regressions – Alternative Diversity Measures

	8			9			10			11			12			13		
	Clustered			Gini			HHI			Between Theil			Within Theil			Theil		
	PIP	Post. Mean	Post. SD	PIP	Post. Mean	Post. SD	PIP	Post. Mean	Post. SD	PIP	Post. Mean	Post. SD	PIP	Post. Mean	Post. SD	PIP	Post. Mean	Post. SD
InitialGDP	**1.000**	-0.022	0.003	**1.000**	-0.021	0.003	**1.000**	-0.021	0.002	**1.000**	-0.023	0.002	**1.000**	-0.022	0.003	**1.000**	-0.022	0.002
GovernanceQuality	**1.000**	0.012	0.002	**1.000**	0.011	0.002	**1.000**	0.013	0.002	**1.000**	0.013	0.002	**1.000**	0.011	0.002	**1.000**	0.011	0.002
Investment	**1.000**	0.014	0.003	**1.000**	0.014	0.003	**1.000**	0.015	0.003	**1.000**	0.013	0.003	**1.000**	0.015	0.003	**1.000**	0.015	0.003
GovExpenditures	**0.970**	-0.105	0.028	**0.990**	-0.125	0.030	**0.970**	-0.102	0.030	**0.990**	-0.106	0.026	**0.990**	-0.119	0.029	**0.970**	-0.107	0.027
PopulationGrowth	**0.960**	-0.058	0.014	**0.990**	-0.061	0.014	**1.000**	-0.060	0.013	**1.000**	-0.054	0.012	**1.000**	-0.064	0.014	**0.980**	-0.060	0.013
JewishFraction	**0.930**	0.044	0.013	**0.970**	0.047	0.013	**0.890**	0.045	0.013	**0.990**	0.046	0.012	**0.980**	0.050	0.014	**0.950**	0.045	0.012
LegalOriginsUK	0.420	0.005	0.002	0.480	0.006	0.002	0.150	0.004	0.003	0.180	0.004	0.002	0.250	0.005	0.002	0.360	0.005	0.002
LegalOriginsFrench	0.290	-0.006	0.003	0.310	-0.005	0.003	0.390	-0.005	0.002	0.260	-0.004	0.002	0.340	-0.006	0.003	0.210	-0.005	0.003
ProtestantFraction	0.280	-0.011	0.005	0.260	-0.010	0.005	**0.540**	-0.013	0.006	0.190	-0.009	0.005	0.310	-0.011	0.005	0.240	-0.010	0.005
OrthodoxFraction	0.240	0.012	0.006	0.120	0.010	0.006	0.200	0.011	0.006	0.270	0.012	0.006	0.180	0.009	0.006	0.160	0.011	0.006
Inflation	0.230	0.000	0.000	0.410	0.000	0.000	0.310	0.000	0.000	0.120	0.000	0.000	0.430	0.000	0.000	**0.650**	0.000	0.000
Fertility	0.190	-0.002	0.001	0.220	-0.002	0.001	0.140	-0.001	0.001	0.090	0.000	0.001	0.260	-0.002	0.001	0.150	-0.001	0.001
LatinAmerica	0.110	-0.004	0.003	0.230	-0.006	0.003	0.080	-0.003	0.003	0.170	-0.005	0.003	0.170	-0.006	0.004	0.040	-0.003	0.003
HinduFraction	0.090	-0.013	0.011	0.050	0.007	0.011	0.070	-0.003	0.011	0.070	-0.009	0.010	0.030	0.007	0.010	0.030	-0.003	0.010
LinguisticFractionalization	0.130	-0.006	0.004	0.110	-0.006	0.005	0.100	-0.005	0.004	0.100	-0.006	0.004	0.110	-0.006	0.005	0.110	-0.005	0.004
EthnicFractionalization	0.090	-0.005	0.005	0.070	-0.005	0.005	0.060	-0.003	0.005	0.100	-0.005	0.005	0.070	-0.005	0.005	0.070	-0.003	0.005
OtherRelFraction	0.090	-0.005	0.009	0.130	-0.009	0.009	0.080	-0.004	0.008	0.080	-0.005	0.007	0.090	-0.009	0.008	0.070	-0.005	0.008
ExecutiveConstraint	0.060	-0.003	0.004	0.060	-0.002	0.004	0.060	-0.001	0.004	0.070	-0.004	0.004	0.080	-0.001	0.004	0.060	-0.002	0.004
FilteredOpenness	0.080	0.005	0.003	0.090	0.005	0.004	0.120	0.005	0.004	0.040	0.002	0.004	0.130	0.005	0.004	0.070	0.003	0.003
ExpropriationRisk	0.050	0.002	0.008	0.060	0.005	0.007	0.080	0.004	0.007	0.060	0.001	0.007	0.070	0.005	0.008	0.050	0.003	0.007
SubSaharanAfrica	0.090	-0.004	0.005	**0.570**	-0.009	0.003	0.130	-0.005	0.004	0.050	-0.002	0.004	0.310	-0.007	0.004	0.180	-0.006	0.004
LifeExpectancy	0.070	-0.002	0.005	0.040	-0.001	0.006	0.070	-0.001	0.006	0.070	-0.001	0.007	0.100	-0.002	0.005	0.060	-0.003	0.006
EastAsia	0.040	0.000	0.004	0.110	0.005	0.004	0.080	0.004	0.003	0.060	0.003	0.004	0.110	0.004	0.003	0.070	0.004	0.003
EasternReligionFraction	0.080	0.006	0.006	0.120	0.009	0.006	0.070	0.005	0.006	0.120	0.009	0.006	0.080	0.006	0.007	0.060	0.005	0.006
LandTropicsPct	0.060	0.002	0.003	0.040	0.001	0.003	0.060	-0.001	0.003	0.050	0.003	0.003	0.030	-0.001	0.003	0.030	0.001	0.003
MuslimFraction	0.050	0.001	0.004	0.050	0.001	0.004	0.040	0.000	0.003	0.060	0.000	0.004	0.060	0.000	0.004	0.050	0.001	0.004
Education	0.060	0.000	0.001	0.060	0.000	0.001	0.080	0.000	0.001	0.030	0.000	0.001	0.050	-0.001	0.001	0.040	0.000	0.001
LandNearCoastPct	0.050	0.001	0.003	0.050	-0.002	0.003	0.060	-0.003	0.003	0.060	0.002	0.003	0.030	-0.002	0.003	0.040	-0.001	0.003
Diversity	0.190	0.010	0.007	0.100	-0.027	0.030	0.220	0.002	0.040	0.310	-0.050	0.038	0.140	0.017	0.020	0.080	-0.011	0.013
Diversity Low Income♠	**0.990**	0.048	0.012	**0.860**	-0.049	0.039	**0.940**	-0.045	0.014	**1.000**	-0.102	0.019	**0.870**	-0.040	0.024	**0.990**	-0.042	0.017
Diversity Lower Medium Inc.♠	0.230	0.009	0.007	0.230	-0.020	0.031	0.310	0.013	0.029	0.400	-0.032	0.021	0.260	0.018	0.024	0.170	-0.008	0.012
Diversity Upper Medium Inc.♠	0.240	0.010	0.009	0.160	-0.012	0.037	0.240	-0.004	0.068	0.350	-0.053	0.044	0.250	0.043	0.056	0.120	-0.008	0.016
Diversity*LowIncome	**0.980**	0.047	0.012	**0.830**	-0.047	0.039	**0.880**	-0.049	0.018	**0.930**	-0.094	0.022	**0.850**	-0.044	0.024	**0.990**	-0.041	0.017
Diversity*MedIncome	0.040	0.005	0.007	0.140	-0.012	0.026	0.160	0.022	0.041	0.190	0.015	0.051	0.130	0.017	0.028	0.090	-0.005	0.011
Diversity*UpperMedIncome	0.050	0.010	0.013	0.080	0.011	0.033	0.040	-0.036	0.143	0.060	-0.057	0.064	0.110	0.074	0.070	0.040	-0.001	0.021
LowIncomeDummy	**1.000**	-0.027	0.005	**0.680**	0.035	0.042	0.210	-0.009	0.006	0.110	0.002	0.007	0.340	0.007	0.018	**0.510**	0.018	0.011
LowerMedIncomeDummy	0.110	0.000	0.005	0.130	0.015	0.025	0.090	0.004	0.004	0.080	-0.001	0.004	0.100	-0.004	0.012	0.060	0.000	0.006
UpperMedIncomeDummy	0.070	-0.001	0.008	0.080	-0.008	0.030	0.040	0.002	0.005	0.060	0.002	0.004	0.100	-0.022	0.022	0.040	0.001	0.007
Sargan test p-value		0.999			0.999			0.999			0.999			0.999			0.999	
Observations		589			589			589			589			589			589	

♠ Composite coefficient reported, based on the joint posterior distribution of Diversity and Diversity*CountryIncome interaction. Since the PIP is not defined for the joint, we report the percentage of the joint posterior distribution of Diversity and Diversity*CountryIncome interaction that is non-zero.

Table C.4: IVBMA Estimates: Intensive versus Extensive Margins

	14			15		
	Extended DKT IVBMA			Extended DKT IVBMA		
	PIP	Cond. Mean	Cond. SD	PIP	Cond. Mean	Cond. SD
Initial GDP	**1.000**	-0.022	0.003	**1.000**	-0.022	0.003
GovernanceQuality	**1.000**	0.012	0.002	**1.000**	0.012	0.002
Investment	**0.649**	0.010	0.004	**0.965**	0.013	0.003
GovExpenditures	**0.975**	-0.113	0.030	**0.991**	-0.107	0.027
PopulationGrowth	**0.906**	-0.052	0.019	**0.984**	-0.059	0.015
JewishFraction	**0.935**	0.046	0.013	**0.978**	0.045	0.012
LegalOriginsUK	0.430	0.006	0.003	**0.523**	0.006	0.002
LegalOriginsFrench	0.376	-0.006	0.003	0.229	-0.005	0.003
ProtestantFraction	0.311	-0.012	0.005	0.184	-0.009	0.005
OrthodoxFraction	0.132	0.010	0.006	0.296	0.013	0.006
Inflation	**0.657**	0.000	0.000	0.306	0.000	0.000
Fertility	**0.766**	-0.004	0.001	0.248	-0.002	0.001
LatinAmerica	0.153	-0.004	0.004	0.116	-0.005	0.003
HinduFraction	0.063	-0.006	0.012	0.110	-0.016	0.011
LinguisticFractionalization	0.127	-0.006	0.005	0.169	-0.006	0.004
EthnicFractionalization	0.054	-0.004	0.005	0.088	-0.005	0.005
OtherRelFraction	0.216	-0.014	0.008	0.070	-0.007	0.008
ExecutiveConstraint	0.070	-0.002	0.005	0.087	-0.003	0.004
FilteredOpenness	0.073	0.003	0.004	0.084	0.004	0.003
ExpropriationRisk	0.043	0.001	0.008	0.045	0.001	0.008
SubSaharanAfrica	0.109	-0.005	0.004	0.073	-0.002	0.004
LifeExpectancy	0.082	0.000	0.006	0.060	0.000	0.004
EastAsia	0.042	0.001	0.004	0.045	0.001	0.004
EasternReligionFraction	0.067	0.004	0.007	0.072	0.006	0.007
LandTropicsPct	0.027	0.001	0.004	0.057	0.000	0.003
MuslimFraction	0.047	0.000	0.004	0.034	0.002	0.003
Education	0.059	0.000	0.001	0.041	0.000	0.001
LandNearCoastPct	0.075	0.003	0.003	0.072	0.002	0.003
IntensiveMargin	0.047	0.018	0.039	0.064	0.028	0.042
Diversity				0.135	0.006	0.008
Diversity Low Income♠				**0.943**	0.071	0.020
Diversity Lower Medium Income♠				0.198	0.007	0.009
Diversity Upper Medium Income♠				0.203	0.006	0.017
Intensive Margin Low Income♠	**0.978**	1.354	0.406	0.214	0.470	0.787
Intensive Margin Lower Medium Income♠	0.162	0.199	0.219	0.131	0.066	0.166
Intensive Margin Upper Medium Income♠	0.184	0.472	0.504	0.212	0.522	0.525
Diversity*LowIncome				**0.919**	0.072	0.018
Diversity*MedIncome				0.073	0.006	0.010
Diversity*UpperMedIncome				0.079	0.005	0.025
IntensiveMargin*LowIncome	**0.977**	1.355	0.403	0.169	0.584	0.848
IntensiveMargin*MedIncome	0.118	0.266	0.220	0.070	0.098	0.220
IntensiveMargin*UpperMedIncome	0.144	0.605	0.499	0.156	0.699	0.506
LowIncomeDummy	**0.992**	-0.034	0.007	**0.995**	-0.026	0.006
LowerMedIncomeDummy	0.103	0.000	0.007	0.068	0.001	0.005
UpperMedIncomeDummy	0.105	-0.006	0.010	0.163	-0.009	0.009
Sargan test p-value		0.999			0.999	
Observations		589			589	

♠ Composite coefficient reported, based on the joint posterior distribution of Diversity and Diversity*CountryIncome (IntensiveMargin and IntensiveMargin*CountryIncome) interaction. Since the PIP is not defined for the joint, we report the percentage of the joint posterior distribution of Diversity and Diversity*CountryIncome (Intensive Margin and IntensiveMargin*CountryIncome) interaction which is non-zero.

Table C.5: IVBMA Estimates (Extensive Margin): Additional Controls

	16			17			18		
	Extended DKT IVBMA			Extended DKT IVBMA			Extended DKT IVBMA		
	PIP	Post. Mean	Post. SD	PIP	Post. Mean	Post. SD	PIP	Post. Mean	Post. SD
Initial GDP	**1.000**	-0.929	0.108	**1.000**	-0.020	0.003	**1.000**	-0.020	0.003
GovernanceQuality	**0.999**	0.411	0.088	**0.998**	0.010	0.002	**0.763**	0.008	0.003
Investment	**0.990**	0.289	0.062	**0.985**	0.012	0.003	**0.955**	0.013	0.004
GovExpenditures	**0.891**	-0.226	0.062	**0.895**	-0.093	0.028	**0.861**	-0.103	0.033
PopulationGrowth	**0.955**	-0.370	0.091	**0.963**	-0.054	0.015	**0.972**	-0.072	0.019
JewishFraction	**0.862**	0.185	0.051	**0.859**	0.043	0.012	**0.663**	0.047	0.016
LegalOriginsUK	0.339	0.098	0.049	0.417	0.005	0.003	0.342	0.009	0.004
LegalOriginsFrench	0.399	-0.108	0.054	0.475	-0.006	0.003	**0.753**	-0.010	0.004
ProtestantFraction	0.345	-0.114	0.055	0.368	-0.011	0.005	0.437	-0.017	0.008
OrthodoxFraction	0.193	0.072	0.035	0.150	0.010	0.006	0.197	0.015	0.009
Inflation	0.329	-0.119	0.060	0.126	0.000	0.000	0.092	0.000	0.000
Fertility	0.252	-0.175	0.118	0.286	-0.002	0.002	0.201	-0.003	0.002
LatinAmerica	0.131	-0.084	0.064	0.061	-0.001	0.004	0.091	-0.004	0.005
HinduFraction	0.106	-0.066	0.046	0.149	-0.019	0.011	0.352	-0.027	0.012
LinguisticFractionalization	0.132	-0.071	0.054	0.188	-0.007	0.004	0.159	-0.009	0.005
EthnicFractionalization	0.083	-0.046	0.051	0.111	-0.006	0.005	0.114	-0.006	0.006
OtherRelFraction	0.085	-0.043	0.058	0.082	-0.001	0.008	0.070	0.004	0.011
ExecutiveConstraint	0.076	-0.032	0.061	0.115	-0.005	0.004	0.090	-0.005	0.006
FilteredOpenness	0.069	0.044	0.043	0.070	0.003	0.004	0.066	-0.001	0.004
ExpropriationRisk	0.051	0.002	0.066	0.086	-0.002	0.008	0.072	0.000	0.009
SubSaharanAfrica	0.072	-0.046	0.061	0.092	-0.004	0.004	0.130	-0.004	0.006
LifeExpectancy	0.062	-0.048	0.117	0.091	-0.003	0.006	0.132	-0.003	0.006
EastAsia	0.067	0.011	0.047	0.062	0.004	0.004	0.065	0.000	0.007
EasternReligionFraction	0.087	0.041	0.050	0.160	0.011	0.006	0.232	0.014	0.009
LandTropicsPct	0.037	0.041	0.046	0.100	0.003	0.003	0.134	0.005	0.004
MuslimFraction	0.056	-0.008	0.068	0.025	0.000	0.004	0.067	0.004	0.004
Education	0.050	0.011	0.058	0.057	0.000	0.001	0.075	-0.001	0.001
LandNearCoastPct	0.034	0.018	0.044	0.059	0.002	0.003	0.044	0.003	0.004
WTO	0.038	0.039	0.039	0.044	0.002	0.003	0.050	-0.001	0.003
PTA	0.052	-0.031	0.045	0.042	0.000	0.000	0.110	0.000	0.000
Primary	0.067	0.024	0.052	0.084	0.006	0.004	0.080	0.005	0.006
GDPVolatility	0.058	-0.032	0.038	0.039	0.002	0.037	0.056	0.010	0.045
REER				0.067	0.002	0.002	0.053	0.002	0.004
FXVolatility				**0.987**	-0.004	0.001	**0.756**	-0.003	0.001
TOT							0.047	0.002	0.003
TOTVolatility							0.068	-0.001	0.001
Diversity	0.083	0.053	0.077	0.103	0.005	0.007	0.154	0.012	0.010
Diversity Low Income♠	**0.998**	0.069	0.017	**1.000**	0.073	0.017	**0.989**	0.068	0.023
Diversity Lower Medium Income♠	0.111	0.005	0.008	0.133	0.004	0.008	0.218	0.007	0.013
Diversity Upper Medium Income♠	0.170	0.009	0.012	0.158	0.006	0.010	0.240	0.014	0.011
Diversity*LowIncome	**0.998**	0.246	0.061	**1.000**	0.073	0.017	**0.969**	0.067	0.022
Diversity*MedIncome	0.031	0.016	0.052	0.034	0.003	0.008	0.079	-0.003	0.013
Diversity*UpperMedIncome	0.097	0.053	0.065	0.058	0.009	0.013	0.097	0.015	0.012
LowIncomeDummy	**0.999**	-0.409	0.077	**0.997**	-0.023	0.005	**0.988**	-0.025	0.006
LowerMedIncomeDummy	0.081	-0.022	0.088	0.077	0.001	0.004	0.153	-0.005	0.006
UpperMedIncomeDummy	0.048	-0.043	0.088	0.025	-0.001	0.007	0.067	0.004	0.006
Sargan test p-value		0.999			0.999			0.999	
Observations		589			584			407	

♠ Composite coefficient reported, based on the joint posterior distribution of Diversity and Diversity*CountryIncome interaction. Since the PIP is not defined for the joint, we report the percentage of the joint posterior distribution of Diversity and Diversity*CountryIncome interaction which is non-zero.

C.2 Data Appendix

Variable Name	Mean	StDev	Min	Max	Definition	Source
Between Theil	0.103	0.100	0.000	0.550	Average Between Theil measure of export diversifications, calcluated using 4-digit SITC data (for 1960-1989) and 6-digit HS data (1990-2009).	Authors' own calculations, trade data: Feenstra et al. (2005), Comtrade
EastAsia	0.105	0.307	0.000	1.000	Dummy variable for East Asia.	World Bank
EasternReligionFraction	0.055	0.187	0.000	0.967	Eastern Religion share in 1970, 1980, 1990 and 2000 as fraction of the population who expressed adherence to some religion and corresponding share in 1900.	Durlauf, Kourtellos, Tan (EJ 2008) for 1900, 1970, 1980, 1990 and McCleary for 2000
Education	-3.769	1.864	-11.555	-0.488	Logarithm of the average percentage of a country's working age population that attended secondary school times the completion rate of secondary school for all periods.	Barro and Lee dataset
Diversity	0.305	0.258	0.008	0.904	Average Hummels-Klenow extensive margin measure of a country's exports, calcluated using 4-digit SITC data (for 1960-1989) and 6-digit HS data (1990-2009).	Authors' own calculations, trade data: Feenstra et al. (2005), Comtrade
EthnicFractionalization	0.400	0.261	0.002	0.930	Measures the degree of tension within a country attributable to racial, nationality, or language divisions.	Alesina (2003)
ExecutiveConstraint	0.633	0.352	0.000	1.000	A measure of the extent of institutionalized constraints on the decision making powers of chief executives. This variable ranges from one to seven where higher values equal a greater extent of institutionalized constraints on the power of chief executives. This variable is calculated as per period average. The variable was transformed first using (x-1)/6.	Henderson, Papageorgiou, Parmeter (EJ 2011) and Polity IV Project
ExpropriationRisk	0.718	0.206	0.160	1.000	Risk of "outright confiscation and forced nationalization" of property. Rescaled, from 0 to 1, with a higher score indicating less risk of expropriation.	Henderson, Papageorgiou, Parmeter (EJ 2011) and Durlauf, Kourtellos, Tan (EJ 2008)
Fertility	3.575	2.104	0.073	8.072	Logarithm of the total fertility rate in initial years of 5-year periods.	Henderson, Papageorgiou, Parmeter (EJ 2011) and World Bank
FilteredOpenness	-0.035	0.303	-0.505	1.497	Average ratio exports plus imports to GDP, filtered for the relation of this ratio to the logs of population and area.	Openness, GDP, population and area data from PWT 7.1 and World Bank
g	0.020	0.025	-0.070	0.109	Average per capita GDP growth rate.	Henderson, Papageorgiou, Parmeter (EJ 2011 - PWT 6.2), PWT 7.1
Gini	0.942	0.058	0.699	0.999	Average Gini measure of export diversification, calculated using 4-digit SITC data (for 1960-1989) and 6-digit HS data (1990-2009).	Authors' own calculations, trade data: Feenstra et al. (2005), Comtrade

Variable Name	Mean	StDev	Min	Max	Definition	Source
GovernanceQuality	0.338	0.912	-1.870	1.930	Average Composite Governance index. It is calculated as the average of six variables: voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law, and control of corruption.	World Bank
GovExpenditures	0.149	0.054	0.041	0.387	Average ratio of government consumption to GDP.	World Bank
HHI	0.125	0.154	0.002	0.859	Average Herfindahl measure of export diversification, calculated using 4-digit SITC data (for 1960-1989) and 6-digit HS data (1990-2009).	Authors' own calculations, trade data: Feenstra et al. (2005), Comtrade
HinduFraction	0.019	0.100	0.000	0.820	Hindu share in 1970, 1980, 1990 and 2000 as fraction of the population who expressed adherence to some religion.	Durlauf, Kourtellos, Tan (EJ 2008) for 1900, 1970, 1980, 1990 and McCleary for 2000
Inflation	13.067	23.325	-3.079	270.651	The average consumer price inflation rate.	Henderson, Papageorgiou, Parmeter (EJ 2011) and World Bank
InitialGDP	8.539	1.090	6.177	10.806	Logarithm of initial per capita GDP in each period.	Henderson, Papageorgiou, Parmeter (EJ 2011 - PWT 6.2), PWT 7.1
IntensiveMargin	0.023	0.033	0.000	0.267	Average Hummels-Klenow intensive margin measure of a country's exports, calcluated using 4-digit SITC data (for 1960-1989) and 6-digit HS data (1990-2009).	Authors' own calculations, trade data: Feenstra et al. (2005), Comtrade
Investment	2.746	0.538	1.097	4.515	Average ratio of investment to GDP.	Henderson, Papageorgiou, Parmeter (EJ 2011), PWT 7.1
JewishFraction	0.015	0.103	0.000	0.896	Jewish share in 1970, 1980, 1990 and 2000 as fraction of the population who expressed adherence to some religion.	Durlauf, Kourtellos, Tan (EJ 2008) for 1900, 1970, 1980, 1990 and McCleary for 2000
LandNearCoastPct	0.504	0.347	0.000	1.000	Percentage of a country's land area within 100km of an ice-free coast.	Henderson, Papageorgiou, Parmeter (EJ 2011)
LandTropicsPct	0.308	0.395	0.000	1.000	Percentage of land area classified as tropical and subtropical via the in Koeppen-Geiger system.	Henderson, Papageorgiou, Parmeter (EJ 2011)
LatinAmerica	0.233	0.423	0.000	1.000	Dummy variable for Latin America and the Caribbean.	World Bank
LegalOriginsFrench	0.472	0.500	0.000	1.000	Dummy variable that takes value 1 if a country's legal system is based on French legal code.	Durlauf, Kourtellos, Tan (EJ 2008)
LegalOriginsUK	0.345	0.476	0.000	1.000	Dummy variable that takes value 1 if a country's legal system is based on British legal code.	Durlauf, Kourtellos, Tan (EJ 2008)
LifeExpectancy	0.205	0.497	0.012	2.253	Reciprocal of life expectancy at age 1 in initial years of 5-year periods.	Henderson, Papageorgiou, Parmeter (EJ 2011) and World Bank
LinguisticFractionalization	0.354	0.304	0.000	0.923	Measure of linguistic fractionalization based on data describing shares of languages spoken as "mother tongues".	Henderson, Papageorgiou, Parmeter (EJ 2011) and Alesina (2003)
LowerMedIncomeDummy	0.399	0.490	0.000	1.000	Dummy variable taking value one for lower medium income dummies using 1988 World Bank definition.	World Bank
LowIncomeDummy	0.219	0.414	0.000	1.000	Dummy variable taking value one for low income dummies using 1988 World Bank definition.	World Bank

Variable Name	Mean	StDev	Min	Max	Definition	Source
MuslimFraction	0.191	0.330	0.000	0.995	Muslim share in 1970, 1980, 1990 and 2000 as fraction of the population who expressed adherence to some religion.	Durlauf, Kourtellos, Tan (EJ 2008) for 1900, 1970, 1980, 1990 and McCleary for 2000
OrthodoxFraction	0.037	0.157	0.000	0.972	Orthodox share in 1970, 1980, 1990 and 2000 as fraction of the population who expressed adherence to some religion.	Durlauf, Kourtellos, Tan (EJ 2008) for 1900, 1970, 1980, 1990 and McCleary for 2000
OtherRelFraction	0.109	0.182	-0.560	0.904	Other Religion share in 1970, 1980, 1990 and 2000 as fraction of the population who expressed adherence to some religion.	Durlauf, Kourtellos, Tan (EJ 2008) for 1900, 1970, 1980, 1990 and McCleary for 2000
GDPVolatility	0.033	0.025	0.003	0.244	Standard deviation of per capita GDP growth rates during each period.	Authors' own calculations, growth rate data: Henderson, Papageorgiou, Parmeter (EJ 2011 - PWT 6.2), PWT 7.1
PopulationGrowth	-2.718	0.164	-3.201	-2.204	Logarithm of average population growth rate plus 0.05.	Henderson, Papageorgiou, Parmeter (EJ 2011), PWT 7.1
Primary	0.536	0.298	0.023	0.992	Average share of primary exports in total exports. Primary exports are defined as categories 0,1,2,3,4 and 68 in SITC (Rev.1) classification.	Authors' own calculations, trade data: Comtrade
ProtestantFraction	0.153	0.259	-0.007	1.460	Protestant share in 1970, 1980, 1990 and 2000 as fraction of the population who expressed adherence to some religion.	Durlauf, Kourtellos, Tan (EJ 2008) for 1900, 1970, 1980, 1990 and McCleary for 2000
PTA	10.131	10.687	0.000	56.000	Number of economic integration agreements at the beginning of each period.	NSF-Kellogg Institute EIA database
REER	4.698	0.455	3.306	9.567	Average real effective exchange rate.	Bruegel real effective exchange rate database
FXVolatility	1.877	1.053	-0.722	10.074	Standard deviation of real effective exchange rate during each period.	Authors' own calculations, real exchange rate data: Bruegel real effective exchange rate database
SubSaharanAfrica	0.190	0.393	0.000	1.000	Dummy variable for Sub-Saharan Africa.	World Bank
TOT	0.084	0.356	-1.387	3.015	Terms-of-trade, calculated as the average ratio of export and import price indices.	Authors' own calculations, import and export price index data: World Bank, IMF
Total Theil	0.488	0.182	0.151	0.938	Average Total Theil measure of export diversification, calculated using 4-digit SITC data (for 1960-1989) and 6-digit HS data (1990-2009).	Authors' own calculations, trade data: Feenstra et al. (2005), Comtrade
TOTVolatility	-2.831	1.025	-5.821	1.837	Standard deviation of terms-of-trade during each period.	Authors' own calculations, import and export price index data: World Bank, IMF
UpperMedIncomeDummy	0.104	0.305	0.000	1.000	Dummy variable taking value one for upper medium income dummies using 1988 World Bank definition.	World Bank
Within Theil	0.387	0.123	0.143	0.739	Average Within Theil measure of export diversification, calculated using 4-digit SITC data (for 1960-1989) and 6-digit HS data (1990-2009).	Authors' own calculations, trade data: Feenstra et al. (2005), Comtrade
WTO	0.153	0.360	0.000	1.000	Dummy taking value one if country is WTO member at the beginning of a period.	WTO homepage
Instruments						
EasternReligionFraction1900	0.059	0.205	0.000	0.990	Eastern Religion share in 1900 as fraction of the population who expressed adherence to some religion and corresponding share in 1900.	Durlauf, Kourtellos, Tan (EJ 2008) for 1900, 1970, 1980, 1990 and McCleary for 2000

Variable Name	Mean	StDev	Min	Max	Definition	Source
HinduFraction1900	0.024	0.110	0.000	0.816	Hindu share in 1900 as fraction of the population who expressed adherence to some religion.	Durlauf, Kourtellos, Tan (EJ 2008) for 1900, 1970, 1980, 1990 and McCleary for 2000
JewishFraction1900	0.006	0.016	0	0.09	Jewish share in 1900 as fraction of the population who expressed adherence to some religion.	Durlauf, Kourtellos, Tan (EJ 2008) for 1900, 1970, 1980, 1990 and McCleary for 2000
LagEducation	-4.113	2.029	-12.183	-1.024	One period lag of logarithm of the average percentage of a country's working age population that attended secondary school times the completion rate of secondary school for all periods.	Durlauf, Kourtellos, Tan (EJ 2008) for 1900, 1970, 1980, 1990 and McCleary for 2000
LagExecutiveConstraint	0.620	0.370	0.000	1.000	One period lag of constraints on executive measure.	Durlauf, Kourtellos, Tan (EJ 2008) for 1900, 1970, 1980, 1990 and McCleary for 2000
LagFilteredOpenness	-0.080	0.288	-0.569	1.364	One period lag of filtered openness ratio.	Durlauf, Kourtellos, Tan (EJ 2008) for 1900, 1970, 1980, 1990 and McCleary for 2000
LagGovExpend	0.146	0.055	0.041	0.406	One period lag of average ratio of government consumption to GDP.	Durlauf, Kourtellos, Tan (EJ 2008) for 1900, 1970, 1980, 1990 and McCleary for 2000
LagInflation	14.265	23.749	-3.079	270.651	One period lag of average consumer price inflation rate.	Durlauf, Kourtellos, Tan (EJ 2008) for 1900, 1970, 1980, 1990 and McCleary for 2000
LagInitial GDP	8.432	1.053	5.805	10.445	One period lag of logarithm of initial per capita GDP in each period.	Durlauf, Kourtellos, Tan (EJ 2008) for 1900, 1970, 1980, 1990 and McCleary for 2000
LagInvestment	2.677	0.555	0.75	4.515	One period lag of average ratio of investment to GDP.	Durlauf, Kourtellos, Tan (EJ 2008) for 1900, 1970, 1980, 1990 and McCleary for 2000
LagPopulationGrowth	-2.706	0.165	-3.255	-2.204	One period lag of logarithm of average population growth rate plus 0.05.	Durlauf, Kourtellos, Tan (EJ 2008) for 1900, 1970, 1980, 1990 and McCleary for 2000
lLand	12.635	1.578	9.131	16.048	Logarithm of land area.	CEPII
lPop	9.666	1.376	6.473	13.978	Logarithm of average population size.	PWT 7.1
MuslimFraction1900	0.163	0.301	0.000	0.964	Muslim share in 1900 as fraction of the population who expressed adherence to some religion.	Durlauf, Kourtellos, Tan (EJ 2008) for 1900, 1970, 1980, 1990 and McCleary for 2000
OrthodoxFraction1900	0.041	0.163	0	0.982	Orthodox share in 1900 as fraction of the population who expressed adherence to some religion.	Durlauf, Kourtellos, Tan (EJ 2008) for 1900, 1970, 1980, 1990 and McCleary for 2000
OtherRelFraction1900	0.206	0.326	0.000	0.997	Other Religion share in 1900 as fraction of the population who expressed adherence to some religion.	Durlauf, Kourtellos, Tan (EJ 2008) for 1900, 1970, 1980, 1990 and McCleary for 2000
ProtestantFraction1900	0.150	0.301	0.000	0.999	Protestant share in 1900 as fraction of the population who expressed adherence to some religion.	Durlauf, Kourtellos, Tan (EJ 2008) for 1900, 1970, 1980, 1990 and McCleary for 2000

Chapter 4

UNRAVELING PREFERENTIAL TRADE AGREEMENT EFFECTS: THE IMPACT OF AGREEMENT COMPONENTS ON TRADE

4.1 Introduction

By now it is well understood that the impact of preferential trade agreements (PTA) on bilateral trade flows can vary substantially across agreements. Trade agreements which demand deeper liberalization commitments from individual member countries lead to larger increases in trade flows than agreements which impose few constraints on commercial policy.[1] The standard approach to identify PTA effects is the inclusion of membership dummies in a gravity regression framework of bilateral trade volumes on a number of trade determinants. While this conventional estimation approach permits the identification of trade gains along different agreement types, such as customs unions or free trade agreements, and to differentiate between individual agreements, such as the EU or MERCOSUR, it cannot explain which individual components make some agreements much more successful than others. In particular, do PTA dummies mainly proxy for the removal of tariff barriers, or do they rather capture less tangible benefits, such as the harmonization of product standards or other regulations across countries?

In this chapter, I take a first stab at this question and disentangle the success of trade agreements by considering the impact of varying sets of trade agreement provisions on bilateral trade flows. Using a detailed WTO dataset on provisions included in individual trade agreements, I create three distinct dimensions of trade agreement components that measure (i) the removal of explicit goods trade barriers, (ii) the harmonization of product standards and regulations, and (iii) the extent to which individual provisions can be

[1] By introducing individual agreement dummies, Eicher and Henn (2011) provide evidence that the trade effects of different agreements exhibit substantial heterogeneity. Baier et al. (2013) show that the intensive and extensive margins of trade are much more responsive to countries' memberships in customs unions and free trade agreements compared to other preferential trade arrangement and one-sided liberalization commitments.

legally enforced. Quantifying and understanding the impact of PTA provisions beyond pure trade liberalization measures becomes increasingly important in a world that has witnessed substantial decreases in tariff rates since the introduction of the WTO/GATT.[2] Given that policy makers continue to push for additional and ever deeper trade agreements at this time, we need to better understand the impact of different PTA components when evaluating the effectiveness of new trading arrangements, in particular in the face of public skepticism. A prime example for the increasing importance of non-tariff considerations in trade agreements is the currently negotiated Transatlantic Trade and Investment Partnership (TTIP) between the European Union and the United States. The official TTIP assessment report of the EU asserts (Francois et al., 2013): "Reducing non-tariff barriers will be a key part of transatlantic liberalization. As much as 80% of the total potential gains come from cutting costs imposed by bureaucracy and regulations, as well as from liberalizing trade in services and public procurement.[3]" This chapter analyzes whether based on past experiences this optimism is indeed warranted.

Using a gravity regression framework and a panel on bilateral trade flows from 1994 to 2008, I find that the removal of tariff barriers and explicit protection measures has been a crucial driver of increases in bilateral export flows following successful trade agreement negotiations, even when controlling for the harmonization of regulations and the legal enforceability of an agreement. Moreover, the legal enforcement status of agreement provisions turns out be a positive and significant contributor to the success of PTAs on its own, while the harmonization of product standards and other regulations is estimated to have a negative impact on trade flows when a trade agreement enters into force. Although this result might seem surprising in the light of the previously cited arguments for the TTIP, it follows naturally when the harmonization of regulations across countries induces additional costs for firms and consumers during the initial phase-in of the agreement. Consistent with this observation we should then expect that the positive impact of harmonization efforts will

[2] The major European economies and the United States reduced their average applied tariff levels from high double-digit rates in the early 1930s to 5.2 percent and 3.5 percent in 2007, respectively (Bown, 2009).

[3] In a similar vein, Fontagné et al. (2013) estimate that trade between the EU and the US would increase on average by 50 percent following the TTIP, with the bulk of the increase arising from lower non-tariff barriers.

only be realized over much longer time horizons.[4] By disentangling bilateral export flows into extensive and intensive margins, I further show that the PTA component effects on bilateral exports are mainly operating through the intensive margin.

The empirical strategy I follow builds on recent developments in the literature on gravity equations. In particular, I employ a standard gravity framework with country-year and country-pair fixed effects which accounts for general equilibrium effects, or multilateral resistance terms (Anderson and van Wincoop, 2003), and bilateral heterogeneity. By simultaneously controlling for multilateral resistance terms and bilateral heterogeneity, I minimize the risk to obtain biased estimates of the PTA component effects due to the omission of country and country-pair specific determinants, as well as the potential endogeneity of PTA membership with respect to trade flows (Baldwin and Taglioni, 2006, Baier and Bergstrand, 2007, and Egger et al., 2008). Omitting either multilateral resistance or country-pair controls can lead to severe upward biases in the PTA and PTA component estimates.

The remainder of this chapter is organized as follows. Section 4.2 presents the estimation framework and illustrates the differences to previous approaches. Section 4.2 also briefly reviews existing estimates of PTA effects on bilateral trade flows. Section 4.3 discusses the classification of individual agreement provisions into the 'Protection', 'Harmonization' and 'Legal' dimensions, which will then be employed in the estimation of the PTA component effects. Section 4.4 summarizes the data. Section 4.5 provides the empirical results. And section 4.6 concludes.

4.2 Empirical Framework and Relation to Literature

The gravity equation is the workhorse model in the empirical international trade literature to identify the impact of PTAs on trade flows. The gravity estimation framework emerges naturally in trade models with Armington demand (Anderson, 1979, and Anderson and van Wincoop, 2003), monopolistic competition (Krugman, 1980), heterogeneous firms (Melitz, 2003, and Chaney, 2008) or a Ricardian production structure (Eaton and Kortum, 2002).

[4] Most PTAs in the WTO dataset entered into force between the mid-1990s and the late 2000s, making an analysis of the long-term effects an impossible exercise at this point.

The conventional gravity approach implies the estimation of the following model of bilateral trade flows:

$$lnexports_{ijt} = \beta PTA_{ijt} + \gamma X_{ijt} + \epsilon_{it} + \epsilon_{jt} + \epsilon_{ij} \tag{4.1}$$

where the dependent variable is the natural log of exports from country i to country j in year t. The explanatory variables include the dummy variable PTA_{ijt} which takes the value one if a bilateral trade agreement is in place between countries i and j in a given year and a vector of variables, X_{ijt}, varying by country pair and year. The remaining terms are importer-year, exporter-year and country-pair fixed effects and implicitly control for all determinants of bilateral trade that vary by country pair but not across time (e.g. distance), as well as all variables which vary across time for individual importer and exporters (e.g. GDPs). Including country-year fixed effects is crucial to control for importer and exporter multilateral resistance terms (Anderson and van Wincoop, 2003), while estimating equation (2.1) without country-pair fixed effects has been dubbed the 'gold medal error' of gravity estimation (Baldwin and Taglioni, 2006). Omitting country-pair fixed effects will ultimately cause a downward bias in the estimated PTA impact on trade (Baldwin and Taglioni, 2006, Baier and Bergstrand, 2007, and Egger et al., 2008). In addition, country-pair fixed effects mitigate potential endogeneity issues with regard to countries' self-selection into PTAs with respect to bilateral trade flows.

When estimating equation (2.1), the previous literature has found a wide range of estimates for the PTA coefficient, β.[5] In the first comprehensive analysis of PTA effects that simultaneously accounts for country-year and country-pair fixed effects, Baier and Bergstrand (2007) find that a PTA on average increases bilateral trade flows by 58 percent in the year the agreement enters into force and eventually doubles bilateral trade after 10 years.[6] Using their 'tetrad' method, Head et al. (2010) reach a similar conclusion and esti-

[5] There is a large number of studies which estimate the impact of PTAs on bilateral trade flows using variations of equation (2.1). In particular, many studies opt to include a set of specific control variables instead of country-year or country-pair fixed effects. Independent of any fixed effect considerations, Cipollina and Salvatici (2010) find in a meta-analysis of 87 studies on PTA effects that the mean and median estimates of β in equation (2.1) are 0.59 and 0.38, which correspond to increases in bilateral trade flows of 80 percent ($e^{0.59} - 1$) and 46 percent ($e^{0.38} - 1$), respectively. In a similar analysis, Head and Mayer (2013) confirm these results, although the median and mean of the PTA coefficient from structural gravity estimations –studies which use country fixed effects or a ratio-type method– drop to 0.36 and 0.28, respectively.

[6] Baier and Bergstrand (2007) obtain comparable results when estimating equation (2.1) using first dif-

mate that a PTA on average raises bilateral trade flows immediately by 47 to 52 percent. Eicher and Henn (2011) provide evidence that the impact on trade flows varies considerably among different PTAs. In particularly, deeper integration agreements like NAFTA increase bilateral trade flows strongly while agreements which barely engage in trade liberalization, such as APEC, have only little impact on trade. When distinguishing trade agreements by different degrees of integration, Baier et al. (2013) show that customs unions and free trade agreement are most effective in increasing trade flows, both at the intensive and extensive margins. They also find that trade agreements implementing a lower level of integration, such as one-sided liberalization commitments or agreements only granting preferential but not free access to markets, are substantially less successful in raising bilateral trade flows.

In this paper, I go one step further and extend the empirical approach in equation (2.1) by decomposing the traditional PTA dummy into individual trade agreement components to tackle the question why some trade agreements raise trade flows so much more than others. In particular, I divide the different agreement provisions that countries negotiate into n different dimensions, D, and replace the standard specification in (2.1) by the following estimation equation:

$$lnexports_{ijt} = \beta_D \sum_{D=1}^{n} M_{D,ijt} + \gamma X_{ijt} + \epsilon_{it} + \epsilon_{jt} + \epsilon_{ij} \tag{4.2}$$

where $M_{D,ijt}$ is a measure of the trade agreement depth along dimension D between countries i and j in year t. Coefficient β_D then captures the impact of agreement dimension D on bilateral trade flows. In my baseline analysis, I focus on three agreement dimensions: (i) the liberalization of goods trade protection measures, (ii) regulatory and institutional harmonization, and (iii) the legal enforcement status of the trade agreement provisions. The measurement of the individual agreement components is discussed in detail in the next section.

In addition to considering aggregate export flows as dependent variable, I also examine in the empirical analysis below whether the influence of the different agreement dimensions

ferences to wipe out the country-pair fixed effects. Using the same approach, Magee (2008) finds no statistically significant effect of PTAs on bilateral trade flows.

operates mainly through the extensive or intensive margins of trade. The extensive margin of a country's exports captures the variety of its exported products, while the intensive margin measures the amount of exports in a country's active product lines. I decompose bilateral exports into the their respective extensive and intensive margins by using the approach of Hummels and Klenow (2005), which is based on Feenstra's (1994) work on appropriately integrating new product varieties into price indices. The intensive margin, IM_{ij}, and the extensive margin, EM_{ij}, of bilateral exports from country i to country j in a given year are then

$$IM_{ij} = \frac{\sum_{s \in S_{ij}} X_{ijs}}{\sum_{s \in S_{ij}} X_{kjs}}$$

and

$$EM_{ij} = \frac{\sum_{s \in S_{ij}} X_{kjs}}{\sum_{s \in S_{k}} X_{kjs}}$$

where s denotes a Comtrade sector, and S_{ij} and S_k are the sets of sectors in which i and all origins in the world, k, have positive exports to j, respectively. X_{ijs} is the value of exports from country i to country j in sector s, while X_{kjs} denotes the combined value of exports in sector s from all origins in the world to country j. In particular, the Hummels-Klenow intensive margin, IM_{ij}, then measures the share of i's exports relative to the world's exports to j in i's active export lines with j. The Hummels-Klenow extensive margin, EM_{ij}, in turn captures the variety of i's export basket to country j by calculating the share of the world's exports to j that is contributed by the set of sectors which is also exported by i to j. The importance of each sector s in computing the variety of i's exports to j corresponds to its share in j's total imports. Both IM_{ij} and EM_{ij} are bounded between zero and one, with higher values indicating larger volumes of trade in active export lines or a more diverse export portfolio when compared to all origins in the world, respectively. To infer the impact of the trade agreement dimensions on the intensive and extensive margins of trade, I specify

the following estimation equations:

$$ln\left(IM_{ijt}\right) = \beta_D \sum_{D=1}^{n} M_{D,ijt} + \gamma X_{ijt} + \epsilon_{it} + \epsilon_{jt} + \epsilon_{ij} \tag{4.3}$$

$$ln\left(EM_{ijt}\right) = \beta_D \sum_{D=1}^{n} M_{D,ijt} + \gamma X_{ijt} + \epsilon_{it} + \epsilon_{jt} + \epsilon_{ij} \tag{4.4}$$

where a time subscript t is added to both dependent variables to indicate that the intensive and extensive margin measures vary by year.

4.3 The Measurement of Trade Agreement Dimensions

I obtain data on individual trade agreement provisions from a recently updated WTO dataset which was originally employed to document stylized patterns of the content of PTAs in the World Trade Report 2011.[7] The dataset is an extension of the analysis in Horn et al. (2010b) and contains information on contract provisions in 100 PTAs, which according to the WTO "represent almost 90 percent of world trade and cover most regions of the world." The data takes the form of a large collection of dummy variables which capture the content of PTA provisions in 52 different areas. In addition, the WTO dataset also specifies whether individual agreement components can be legally enforced by member countries. The individual agreement provisions vary substantially in their scope and have been broadly categorized by Horn et al. (2010b) into 14 WTO+ ('WTO-plus') and 38 WTO-X ('WTO-extra') areas. The former category describes agreement provisions that fall under the current mandate of the WTO and equates to commitments beyond the WTO rules. WTO-X provisions describe commitments outside the WTO mandate.

Since many of the individual agreement provisions proxy for similar agreement features, I divide, based on the similarity of their content, the individual dummy variables into a number of subgroups to capture different dimensions of PTAs. As noted in the previous section, I identify three distinct groups of agreement provisions that are potentially important determinants of trade costs between countries. The first group, 'Protection', collects provisions which target the elimination of explicit goods trade barriers. I include in this

[7] The dataset is available at http://www.wto.org/english/res_e/publications_e/wtr11_dataset_e.htm .

group agreement provisions that aim at removing measures which explicitly protect domestic goods producers from foreign competition, such as tariffs, export taxes, and antidumping and countervailing measures. The second group, 'Harmonization', captures provisions which aim at harmonizing product standards and regulations across PTA member countries to facilitate trade. The third dimension, 'Legal', measures the legal enforceability of a trade agreement. In particular, I differentiate between provisions that can be legally enforced by member countries and provisions that do not possess legal status. A priori, agreements which include a higher number of 'Protection' and 'Legal' provisions should result in larger increases in bilateral trade flows due to greater goods trade liberalization efforts and the improved enforcement of underlying agreement provisions. 'Harmonization' provisions, on the other hand, can either increase trade flows by facilitating imports and exports through common product standards and other regulations, or hamper trade by forcing additional compliance costs on producers and consumers.

I calculate for each of the three dimensions an index that captures to what extent a trade agreement includes provisions addressing issues in the respective group. For each dimension $D = \{Protection, Harmonization, Legal\}$, I compute an index M for a country pair ij in year t using the following formula:

$$M_{D,ijt} = \frac{\sum_{p=1}^{D_N} I_{p,ijt}}{\sum_{p=1}^{D_N} I_{p,klt}} \tag{4.5}$$

where $I_{p,ijt}$ is an indicator variable that takes the value one if provision p is included in a trade agreement between countries i and j. D_N denotes the maximum number of provisions, N, in dimension D, while klt denotes the country pair kl with a trade agreement in force that includes the maximum number of provisions in dimension D in year t. Table D.1 lists the provisions that were employed to compute the 'Protection' and 'Harmonization' indices in (4.5). Provisions with only loose references to either explicit goods trade protection measures or the harmonization of product standards and other regulations are excluded in both dimensions, respectively. In order to obtain a complete picture of the legal depth of an agreement, all legally enforceable provisions that countries negotiated are considered in the computation of the 'Legal' index.

Intuitively, each $M_{D,ijt}$ index then measures the trade agreement depth for country pair ij along dimension D compared to the most extensive agreement in force in said dimension in year t. Larger index values indicate that countries i and j have made deeper integration commitments along the respective dimension compared to other country pairs. By definition, all index values lie between zero and one. The former value implies that no agreement is in place with provisions in dimension D, while the latter value means that countries i and j have the deepest agreement in place of all countries in year t in dimension D.

4.4 Data

The empirical analysis below uses bilateral export data for the years 1994-2008 from Comtrade. All export flows were compiled using mirror import data. The focus on trade flows during this span follows from the increased emergence of PTAs since the early 1990s. In the WTO dataset on PTA components, 84 out of 100 PTAs entered into force after 1993. To compute the Hummels-Klenow extensive and intensive margin measures, I use disentangled trade data at the 6-digit Harmonized System (HS) level. Data on WTO membership are from the WTO homepage. PTA membership status of country pairs is directly derived from the WTO PTA components dataset. The variables captured in the vector X_{ijt} in equations (4.1), (4.2), (4.3) and (4.4) are compiled using a variety of sources. GDP data are from the Penn World Tables, version 8.0. The classification of a countries' exchange rate regime is based on the IMF's Annual Report on Exchange Rate Arrangements and Restrictions. Currency union data are from de Sousa (2012). Detailed definitions, summary statistics and additional information on the data sources of all variables are provided in the data appendix to this chapter.

4.5 Empirical Results

In this section, I present the results of the empirical impact of trade agreement components on bilateral trade flows. The analysis first focuses on the effects of different PTA dimensions on bilateral export volumes by employing the estimation equation in (4.2). In a second step, I then further disentangle the results by separately considering the extensive and intensive

margins of exports.

4.5.1 Trade Agreement Components and Bilateral Exports Flows

Table D.2 presents the baseline regression results when estimating equations (4.1) and (4.2).[8] All specifications include country-year and country-pair fixed effects. Column 1 presents results using the standard approach in (4.1) which includes a PTA dummy variable to infer the impact of trade agreements on bilateral trade flows. As expected, the coefficient of the PTA dummy is positive and highly significant. The coefficient estimate of 0.1495 implies that the average PTA increases bilateral exports by 16.1 percent ($e^{0.1495} - 1$) during the year in which the agreement enters into force. While this estimate is at the lower end of the estimates reported in the literature, the difference is likely due the fact that our data spans a more recent period than most gravity studies on PTA effects.

In column 2, the 'Protection', 'Harmonization' and 'Legal' indices replace the PTA dummy. Three results emerge. First, lowering tariff barriers or other explicit protection measures for goods, as captured by the 'Protection' index, has a positive and significant impact on bilateral trade flows. Second, the harmonization of product standards and regulations as consequence of a trade agreement is estimated to significantly decrease exports, at least at the time when the trade agreement enters into force. This result indicates that there might be significant compliance costs associated with harmonization which must be borne by both producers and consumers and lead to lower initial trade volumes. And third, the legal enforceability of a trade agreement exercises a positive and significant effect on bilateral exports. Based on the estimates in column 2, a country which enters an average trade agreement, that is, an agreement with the average index values in all three categories, can expect an initial increase in its bilateral trade flows by 12.2 percent. However, the results indicate that the effects of trade agreements vary widely by the design of the underlying agreement provisions, which is not captured by the PTA dummy in column 1. Countries which enter a legal-based agreement that mainly focuses on the liberalization of

[8] Due to the limitations of standard regression packages to cope with models that include a large number of three-way fixed effects, I use the Stata package REG3HDFE introduced by Carneiro et al. (2012) to estimate the regressions in Tables D.2-D.4.

goods trade protection measures can expect the largest increases in trade flows. In contrast, preferential trade agreements which focus on the harmonization of product standards and other regulations are predicted to be a drag on bilateral trade flows, at least initially.

Column 3 expands the specification in column 2 by additionally controlling for other factors that potentially influence bilateral trade flows and which vary by country pair and year. In particular, I include a WTO dummy which takes the value one if both countries are members of the WTO (WTO), a currency union dummy (CU) and the variable Float which takes the values one and two if one or two of the countries have a floating exchange rate regime, respectively. I also add a country pairs' product of nominal GDPs (logGDPs), product of real per capita GDPs (loggdps), and the absolute value of the log difference in real per capita GDPs (absdiffgdps). The variable logGDPs proxies for the combined market size of trading partners, while loggdps and absdiffgdps control for the differences in income levels within a country pair. All these variables could matter for the structure of bilateral trade flows. In particular, larger markets could induce more trade due to scale effects and countries with similar per capita incomes are expected to have a more similar demand structure and an increased volume of intra-industry trade. After introducing these additional regressors, the signs and statistical significance of the three trade agreements dimension coefficients still prevail. In addition, the magnitudes of the different dimension effects remain stable when compared to column 2. Moreover, only WTO and currency union membership are estimated to have positive and significant effects on bilateral export flows.

4.5.2 Extensive versus Intensive Margin Effects

Employing the estimation equations (4.3) and (4.4), Tables D.3 and D.4 decompose the impact of the individual agreement dimensions on the extensive and intensive margins of bilateral exports. As in Table D.2, all specification include country-year and country-pair fixed effects to control for multilateral resistance and bilateral heterogeneity.

Table D.3 presents the results for the extensive margin. Following the general structure in Table D.2, column 4 only includes the regular PTA dummy, column 5 introduces the three individual agreement dimensions and column 6 also controls for the additional set

of potential trade determinants. Column 4 shows that a trade agreement significantly decreases the diversity of bilateral export flows, on average by 14 percent ($e^{-0.151} - 1$). That is, the average PTA tends to strengthen patterns of comparative advantage between trading partners, at least initially, which leads to a drop in the extensive margin of exports. Column 5 shows that this drop in the extensive margin measure is completely driven by the 'Protection' dimension of agreements, while the coefficients of both the 'Harmonization' and the 'Legal' dimensions are not statistically different from zero. When controlling for additional determinants of bilateral trade flows in column 6, the conclusions from column 5 remain unchanged.

Table D.4 presents the estimates of the impact of trade agreement membership on the intensive margin of exports. It is evident from columns 7-9 that the intensive margin drives the overall trade effects presented in Table D.2. Looking at column 7, the average PTA is estimated to boost the intensive margin of exports by 35 percent ($e^{0.3007} - 1$) for member countries, which in terms of magnitude is about twice as large as the negative impact of PTA membership on the extensive margin of exports. Column 8 illustrates that the positive effect of PTA membership on the intensive margin of trade is mainly driven by the reduction in explicit goods trade protection measures and the legal enforceability of the agreement. At the same time, the harmonization of product standards and other regulations has an adverse effect on the intensive margin of exports. Column 9 confirms that the results in Column 8 also hold when introducing the previously discussed set of additional control variables.

Overall, the results in this section suggest that trade agreements initially increase the intensive margin of exports while the extensive margin is sluggish to respond, or even decreases at the time when an agreement enters into force. These results are consistent with recent findings in the literature on trade agreement effects. Using panel data from 1962-2000, Baier et al. (2013) find evidence that the intensive margin effects materialize much quicker than changes in the extensive margin, in particular for deep trade agreements, such as custom unions and free trade agreements. Baier et al. also provide evidence that trade agreements only fully unfold their full impact on bilateral trade flows after 10-15 years, a time frame which goes beyond the scope of this study due to the focus on a more recent time range and the shorter length of the panel. It is also of interest to note that the intensive

and extensive margin results are exactly the opposite for WTO membership. Tables D.3 and D.4 illustrate that the positive effect of both trading partners' WTO membership on bilateral exports is driven by the extensive and not the intensive margin. This result is line with the study of Dutt et al. (2013) who conduct a comprehensive analysis of WTO effects on the intensive and extensive margins of trade. Dutt et al. find that WTO membership increases the extensive margin by 25 percent, while there is relatively little movement in the intensive margin of bilateral exports.

4.6 Concluding Remarks

This chapter suggests a new approach to disentangle the impact of various types of trade agreements on bilateral trade flows. Using detailed data on individual trade agreement provisions, I estimate the impact of different agreement dimensions on the evolution of bilateral trade flows between member countries. Employing a gravity estimation framework that simultaneously controls for multilateral resistance and country-pair heterogeneity, I find that agreement provisions which eliminate explicit goods trade protection measures are the key for creating a successful preferential trading relationship. The same is true for the inclusion of legally enforceable agreement provisions. However, countries' efforts to harmonize product standards and other regulations are predicted to decrease bilateral trade flows among trade agreement signatories. Overall, the trade creation effects of trade agreements are estimated to vary substantially based on which agreement dimensions are emphasized in the negotiation of PTAs. Furthermore, the results in this chapter show that the trade effects of the different agreement dimensions mostly operate through adjustments on the intensive margin.

My findings therefore suggest that trade agreements between countries which already have low tariffs as well as strong legal institutions in place have little scope to increase bilateral trade flows. In addition, this chapter also raises substantial doubts whether the harmonization of product standards and other regulations can generate substantial trade and welfare increases, as has been suggested, for instance, by the European Union and the United States in the ongoing negotiations of the Transatlantic Trade and Investment Partnership. This chapter provides evidence that the creation of common standards and

institutions could also impose substantial costs on firms and consumers, leading in turn to a decrease in trade flows, at least in the early years of a trade agreement. It might be well possible, however, that harmonization effects take much longer to fully materialize than the removal of tariff barriers or other explicit protection measures. Carefully disentangling the dynamic effects of harmonized product standards and other regulations across countries is certainly a fruitful area for future research.

Appendix 4

APPENDIX TO CHAPTER 4

D.1 Tables

Table D.1: Trade Agreement Provisions and Dimensions

Trade Agreement Dimension	Provision	Description
Protection	FTA Industrial	Tariff liberalization on industrial goods; elimination of non-tariff measures
	FTA Agriculture	Tariff liberalization on agriculture goods; elimination of non-tariff measures
	Export Taxes	Elimination of export taxes
	Antidumping	Retention of antidumping rights and obligations under the WTO agreement
	Countervailing measures	Retention of countervailing measures, rights and obligations under the WTO agreement
Harmonization	Competition Policy	Maintenance of measures to proscribe anticompetitive business conduct; harmonization of competition laws; establishment or maintenance of an independent competition authority
	Environmental Laws	Development of environmental standards; enforcement of national environmental laws; establishment of sanctions for violation of environmental laws; publications of laws and regulation
	Investment	Information exchange; development of legal frameworks; harmonization and simplification of procedures; national treatment; establishment of mechanism for the settlement of disputes
	Labor Market Regulation	Regulation of the national labor market; affirmation of International Labour Organization (ILO) commitments; enforcement
	Consumer Protection	Harmonization of consumer protection laws; exchange of information and experts; training
	Industrial Cooperation	Assistance in conducting modernization projects; facilitation and access to credit and finance
	Civil Protection	Implementation of harmonized rules
	Money Laundering	Harmonization of standards; technical and administrative assistance

Table D.2: Bilateral Exports and Trade Agreement Dimension Effects

VARIABLES	1 ln(exports)	2 ln(exports)	3 ln(exports)
PTA	0.1495***		
	(0.0323)		
Protection		0.1504***	0.1227**
		(0.0567)	(0.0573)
Harmonization		-0.2837***	-0.2452**
		(0.1012)	(0.1021)
Legal		0.4305***	0.4250***
		(0.0937)	(0.094)
WTO			0.2280***
			(0.0652)
logGDPs			-0.1454
			(1.3351)
loggdps			-1.6969
			(6.0839)
absdiffgdps			-0.0183
			(0.0513)
CU			0.1014**
			(0.0464)
Float			1.7158
			(11.0722)
Observations	247,656	247,656	242,183
R-squared	0.9036	0.9036	0.9031
Importer-Year FE	Yes	Yes	Yes
Exporter-Year FE	Yes	Yes	Yes
Country pair FE	Yes	Yes	Yes

Clustered standard errors at the country-pair level are listed in parentheses. ***, ** and * indicate 1 percent, 5 percent and 10 percent statistical significance levels, respectively.

Table D.3: Extensive Margin Effects of Trade Agreement Dimensions

VARIABLES	4 ln(EM)	5 ln(EM)	6 ln(EM)
PTA	-0.1512***		
	(0.0229)		
Protection		-0.1622***	-0.1489***
		(0.0399)	(0.0403)
Harmonization		0.0528	0.0399
		(0.0731)	(0.0734)
Legal		-0.0175	-0.0139
		(0.0692)	(0.0690)
WTO			0.2818***
			(0.0539)
logGDPs			0.0879
			(1.0745)
loggdps			-0.8303
			(5.0710)
absdiffgdps			0.0240
			(0.0397)
CU			0.0091
			(0.0409)
Float			-1.8124
			(8.9953)
Observations	247,656	247,656	242,183
R-squared	0.8107	0.8107	0.8108
Importer-Year FE	Yes	Yes	Yes
Exporter-Year FE	Yes	Yes	Yes
Country pair FE	Yes	Yes	Yes

Clustered standard errors at the country-pair level are listed in parentheses. ***, ** and * indicate 1 percent, 5 percent and 10 percent statistical significance levels, respectively.

Table D.4: Intensive Margin Effects of Trade Agreement Dimensions

VARIABLES	7 ln(IM)	8 ln(IM)	9 ln(IM)
PTA	0.3007***		
	(0.0285)		
Protection		0.3126***	0.2716***
		(0.0504)	(0.0499)
Harmonization		-0.3364***	-0.2851***
		(0.0910)	(0.0910)
Legal		0.4479***	0.4389***
		(0.0865)	(0.0868)
WTO			-0.0539
			(0.0550)
logGDPs			1.1634
			(1.2347)
loggdps			-0.6014
			(5.4212)
absdiffgdps			-0.0423
			(0.0459)
CU			0.0922**
			(0.0462)
Float			1.9011
			(10.3995)
Observations	247,656	247,656	242,183
R-squared	0.7168	0.7167	0.7171
Importer-Year FE	Yes	Yes	Yes
Exporter-Year FE	Yes	Yes	Yes
Country pair FE	Yes	Yes	Yes

Clustered standard errors at the country-pair level are listed in parentheses. ***, ** and * indicate 1 percent, 5 percent and 10 percent statistical significance levels, respectively.

D.2 Data Appendix

Variable Name	Mean	SD	Min	Max	Definition	Source
absdiffgdps	2.407	1.915	0.000	10.740	Absolute log difference in real GDP per capita	GDP data from Penn World Tables 8.0
CU	0.011	0.106	0.000	1.000	Dummy (1 if countries share common currency)	de Sousa (2012)
ln(EM)	-3.501	2.489	-19.448	0.000	Log of Hummels-Klenow extensive margin measure	Author's own computations, trade data from COMTRADE
Float	0.464	0.594	0.000	2.000	Number of countries with a floating exchange rate (0, 1, 2)	IMF Annual Report on Exchange Rate Arrangements and Restrictions
Harmoniza-tion	0.046	0.178	0.000	1.000	Index collecting agreement provisions that aim at harmonizing product standards and regulations	Author's own computations, see equation (4.5)
ln(IM)	-5.154	2.340	-21.183	0.000	Log of Hummels-Klenow intensive margin measure	Author's own computations, trade data from COMTRADE
Legal	0.031	0.120	0.000	1.000	Index of legal enforceability of agreement provisions	Author's own computations, see equation (4.5)
ln(exports)	7.654	4.027	-6.908	19.691	Log of bilateral exports	COMTRADE
logGDPs	25.806	4.246	0.424	43.441	Log of the product of nominal GDPs	GDP data from Penn World Tables 8.0
loggdps	-5.760	3.073	-14.860	5.663	Log of the product of real GDPs per capita	GDP data from Penn World Tables 8.0
PTA	0.089	0.285	0.000	1.000	Dummy (1 if preferential trade agreement is in force between countries)	WTO dataset on the content of PTAs: http://www.wto.org/english/res_e/publications_e/wtr11_dataset_e.htm
Protection	0.066	0.227	0.000	1.000	Index collecting agreement provisions that limit protection of domestic producers	Author's own computations, see equation (4.5)
WTO	0.707	0.455	0.000	1.000	Dummy (1 if both countries are WTO members)	WTO homepage: www.wto.org

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