Wesleyan Economic Working Papers

http://repec.wesleyan.edu/
N°: 2015-002

WTO Dispute Determinants

David J. Kuenzel

April, 2015

WESLEYAN UNIVERSITY

Department of Economics
Public Affairs Center
238 Church Street
Middletown, CT 06459-007

Tel: (860) 685-2340
Fax: (860) 685-2301
http://www.wesleyan.edu/econ

WTO Dispute Determinants

David J. Kuenzel*
Wesleyan University

First version: November 2013
This version: April 2015

Abstract

A functioning enforcement mechanism is crucial to ensure the continued success of the GATT/WTO agreements. In this paper, I examine the WTO members' dispute selection decisions to judge the effectiveness of the WTO's enforcement institution, the Dispute Settlement Body. Previous research shows that measures of retaliatory capacity (GDP, trade volumes, export structure) correlate with the incidence of WTO disputes, but fails to account for a number of empirical facts, such as the steady drop in trade quarrels since the early 2000s. To explain the observed dispute pattern, I extend the 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. Lower tariff overhangs constrain WTO members' policy flexibility to respond to adverse shocks, which I motivate in my model by sectoral productivity adjustments due to decreases in trade costs after successful trade negotiations. Guided by this theoretical framework, I present empirical evidence that tariff overhangs are an essential determinant of the WTO dispute pattern.

JEL codes: F13, F51, F53, F55
Keywords: GATT/WTO, Trade Disputes, Tariff Overhangs

*Contact information: Department of Economics, Wesleyan University, 238 Church St, Middletown, CT 06459, E-mail: dkuenzel@wesleyan.edu, Tel: +1 (860)685-3052. I am grateful to Theo Eicher for his guidance, encouragement and support. I wish to thank Yu-chin Chen, Kar-yiu Wong, Saadia Pekkanen, Laine Rutledge, Jennifer Meredith and seminar participants at the University of Washington, University of Georgia, Bowdoin College, Wesleyan University, Clark University and the 2014 Fall Midwest International Trade Meetings for their helpful comments and suggestions. I gratefully acknowledge financial support from the Grover and Creta Ensley Fellowship in Economic Policy.

I. 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. The widely regarded key tenets for the success of the GATT/WTO are reciprocity, nondiscrimination and enforcement (Bagwell and Staiger, 2002). With the integration of the GATT into the WTO in 1995, the approach to enforcement experienced the most drastic paradigm shift. 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 500 cases, mostly with large developed and developing member countries as both dispute complainants and defendants (Tables 1 and 2). Earlier empirical studies of the WTO dispute pattern confirm this notion and find that countries with high incomes and substantial retaliatory capacity 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).

Since 2000, however, the WTO dispute pattern has become more nuanced (Figure 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 export structure) 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. And second, WTO members' sectoral trade policy structure, a previously overlooked factor, is closely linked to dispute activity. In particular, defendants in WTO disputes have substantially less trade policy flexibility than non-defendants (WTO members not subject to dispute filings). Notably, dispute defendants feature significantly lower "tariff overhangs" (Figure 2), which represent the difference between bound tariffs (by WTO negotiations) and the actually applied tariffs.

In this paper, I extend the WTO theory to account for the above documented dispute pattern

[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.

[3] A similar pattern holds when considering the income groups of defendants, or when grouping members by GDP size.

by integrating political economy aspects and country asymmetries into the standard terms-of-trade framework. I leverage the recent literature on tariff overhangs and 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 thereafter.

In the model, tariff overhangs also play a crucial role for countries debating a dispute filing with the DSB after observing a violation of WTO rules. 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, legal precedent 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 WTO members' 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 (2010b), Maggi and Staiger (2011) and Park (2011). None of these studies relate, however, their findings to the observed WTO dispute pattern. Maggi and Staiger (2015), 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 motivate the existence of tariff overhangs, I assume that governments face time-varying political pressure by domestic lobbying groups which cannot be verified by trading partners. More specifically, my theoretical analysis builds on recent contributions in the literature on tariff bounds by Bagwell and Staiger (2005) and its extension to asymmetric countries by Beshkar and Bond (2012). The latter model is a convenient starting point for the analysis due to two reasons. First, it allows for trade agreements between countries of different 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. More generally, 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 lobbying efforts on foreign governments are not verifiable.[4]

The remainder of the paper proceeds as follows. Section II motivates a trade agreement with tariff bounds and derives the equilibrium trade policies. Section III extends the model to allow for trade disputes and examines a country's incentive to violate the trade agreement after facing an unexpected productivity shock. Section IV analyzes a country's dispute filing decision after detecting a violation. Section V provides empirical evidence for the link between tariff overhangs and WTO dispute incidence. Section VI concludes.

II. A Trade Agreement with Tariff Bounds

To explain the selection of WTO members into trade disputes, I follow the theoretical setup of Bagwell and Staiger (2005) and its extension by Beshkar and Bond (2012). There are two countries, Home (no *) and Foreign (*), that produce and consume three goods, $i = 0, 1, 2$. Good 0 is a freely tradeable numeraire good. Home (Foreign) is the natural importer of good 1 (2).

II.1 Basic Structure

There are N and N^* households in the domestic and the foreign economy, respectively. Goods markets are competitive in both economies. Let p_i and p_i^* denote goods prices in the Home and Foreign markets. The demand and supply relationships for the non-numeraire goods in Home are given by $D_i = N(1 - p_i)$ and $S_i = N\phi_i p_i$, where ϕ_i is a measure of Home's labor productivity in sector $i = 1, 2$.[5] Similar relationships hold for Foreign. Labor productivity in sector 2 (1) is greater

[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. (2010).

in Home (Foreign), $\phi_2 = \phi_1^* > 1$ 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 in the non-numeraire sectors 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 $p_2^* = (1+t^*)p_2$.

Since the production and demand structure is symmetric across countries, it is sufficient for now to focus the analysis on Home's import sector. Home's import demand and Foreign's export supply functions 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. Since goods prices in Home and Foreign are homogeneous of degree zero in both countries' population sizes, only relative and not absolute population in Home and Foreign affect equilibrium prices. Normalizing the world population to 1, with share λ living in Home and share $1-\lambda$ living in Foreign, the price of good 1 in Home is

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

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 is politically motivated and assigns a higher weight, $\gamma \geq 1$, to producer welfare in the import-competing sector.[6] Foreign government welfare in sector 1 is the sum of producer and consumer surplus. Thus, the government welfare functions in Home and Foreign for sector 1 are

$$W(t,\gamma) = CS(t) + \gamma PS(t) + TR(t) \tag{2}$$

$$W^*(t) = CS^*(t) + PS^*(t) \tag{3}$$

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, γ, can vary from period to period and is distributed uniformly 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 verify the exact political pressure realization in the other country.[7] The tariff bound literature shows that mutual uncertainty about political pressures has important implications for

[5] Home's demand functions follow from the assumption of identical and quasi-linear preferences of each household, $U = c_0 + \sum_{i=1,2} c_i(1-.5c_i)$, where c_i describes the amount of consumption of good i. On the supply side, labor is the only factor of production and every household in each country supplies the quantity l_i in the respective labor market. Per household production in Home uses a constant returns to scale technology in the production of good 0, $x_0 = l_0$, and a decreasing returns to scale technology for the two non-numeraire goods, $x_i = (2\phi_i l_i)^{1/2}$. Total domestic production of each good is then $X_i = Nx_i$. The production technology for good 0 is identical in Foreign, but the production processes for the non-numeraire goods differ, $x_i^* = (2\phi_i^* l_i)^{1/2}$. Labor supplies are large enough for the production of the numeraire good 0 to occur in either country. Normalizing its price to one, the wage rate in either economy is then fixed at the same level.

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

[7] For instance, the information could arrive with time lags in the other country, which makes contemporary reviews of Home's political constraints an imprecise undertaking for the Foreign government.

trade agreement negotiations between Home and Foreign — a result which I briefly review next.

II.2 Optimal Trade 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 $W(t,\gamma)$ in (2) with respect to t:

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

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 (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 its true political pressure. In the presence of mutual uncertainty about political pressures, Home and Foreign can solve this issue by negotiating tariff bounds instead of fixed applied tariff rates.[8] 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. This feature does not only ensure truthfulness but is also preferred from a welfare perspective by either country to a fixed tariff rate (Bagwell and Staiger, 2005). The incentive-compatible tariff schedule for Home in the agreement is therefore

$$t = min[t^N(\gamma), t^B] \tag{5}$$

where $t^N(\gamma)$ is given by (4) and t^B is the negotiated tariff bound. Using (4), we can then solve for the political economy weight, $\gamma^N(t^B)$, above which Home's Nash tariff exceeds its tariff bound:

$$\gamma^N(t^B) = \frac{t^B[3(1+\phi^*)+4\lambda]+(1+\phi^*)-2\lambda(\phi^*-1)}{(1+t^B)(1+\phi^*)} \tag{6}$$

where $t^N(\gamma^N) = t^B$. When international transfer payments are feasible and both governments are risk-neutral, the optimal agreement in the presence of uncertainty maximizes expected world welfare in each sector.[9] Conditional on negotiating a tariff bound, expected world welfare in sector 1 is

$$\begin{aligned} E[W+W^*|t^B] = &\int_1^{\gamma^N(t^B)} \Big[W(t^N(\gamma),\gamma)+W^*(t^N(\gamma))\Big] f(\gamma)d\gamma \\ &+ \int_{\gamma^N(t^B)}^{\overline{\gamma}} \Big[W(t^B,\gamma)+W^*(t^B)\Big] f(\gamma)d\gamma \end{aligned} \tag{7}$$

[8] If both countries would instead 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.

[9] 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 incentive compatibility of the agreement in more detail.

where $f(\gamma) = 1/(\overline{\gamma} - 1)$ is the probability density function of the uniform distribution. Using (1), (2) and (3), we find the optimal tariff bound in sector 1 by maximizing (7) with respect to t^B:[10]

$$t^B = \begin{cases} \frac{\overline{\gamma}-1}{5-\overline{\gamma}} & \text{if} \quad t^B \leq t^N(1) \\ \frac{(\overline{\gamma}-1)(1+\phi^*)-2\lambda(\phi^*-1)}{(3-\overline{\gamma})(1+\phi^*)-4\lambda} & \text{if} \quad t^N(1) < t^B \leq t^N(\overline{\gamma}) \end{cases} \tag{8}$$

where Home has always a tariff overhang, $t^B - t$, of zero when the first line applies, which I term case 1 from now on. In case 2, on the second line, both the realization of a positive and a zero tariff overhang is possible, depending on the exact political pressure draw. 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.

III. The Emergence of Trade Disputes

In this section, I extend the baseline 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, see Amiti and Konings (2007) and Melitz and Ottaviano (2008). When lower tariffs —through a new trade agreement or newly negotiated tariff bounds— lead to unexpected relative productivity adjustments over time, an ex post violation of the agreement will become attractive under certain conditions. This result arises because countries' optimal tariffs and government welfare functions subsequently change as well.

I first outline, for a given period, the condition under which a trade agreement is incentive compatible between potentially asymmetric countries when international productivity differences remain constant over time. I then introduce productivity shocks and examine the conditions under which Home is more likely to breach the trade agreement. Throughout this section I presume the presence of the dispute settlement body ensures the survival of the agreement, which is reasonable given that under the WTO dispute settlement mechanism an agreement breach is unlikely to result in the termination of the violating country's WTO membership. Foreign's incentive to file a trade dispute with the DSB when observing a trade policy violation is considered in the next section.

III.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

[10] The FOC of (7) with respect to the tariff bound is $\frac{\partial E[W+W^*|t^B]}{\partial t^B} = \int_{\gamma^N(t^B)}^{\overline{\gamma}} \frac{\partial [W(t^B,\gamma)+W^*(t^B)]}{\partial t^B} f(\gamma) d\gamma = 0$. See Beshkar and Bond (2012) for the proof that (8) is indeed a maximum.

the larger country needs to receive a transfer from the smaller country to refrain from setting its Nash tariff.[11] While I do not explicitly model the exact bargaining process here, I presume that both Home and Foreign can agree on a 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.

In modeling the incentive compatibility of the trade agreement between Home and Foreign, I focus without loss of generality on Home's perspective; a similar reasoning applies to Foreign. In a given period, the agreement is self-enforcing for Home if its welfare realization under the negotiated agreement policies is at least as high as in the case of a violation. 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 in case of a breach. I define instead Home's per period welfare under the trade agreement as

$$W^E = W_1(t(\gamma), \gamma) + W_2(t^*(\gamma^*)) - T \tag{9}$$

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 tariff schedule in (5).

The incentive for Home to adhere to the negotiated agreement lies in the presence of the Dispute Settlement Body. In case of an agreement violation by Home, Foreign has the option to resort to the DSB to obtain the right to set a retaliation tariff beyond the negotiated agreement schedule until the violation is removed.[12] The DSB takes on primarily the role of a judge and rules in favor of the complaining country with exogenous probability π^{DSB} in case a dispute emerges.[13] The imperfection 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.[14] Note that the presence of a DSB that can issue a ruling is sufficient to establish the retaliation threat. This feature

[11] Amador and Bagwell (2013) provide the conditions under which an optimal trade agreement takes the form of a tariff bound instead of an applied 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.

[12] If Foreign decides to retaliate without notifying the DSB, both countries would enter a tariff war resulting in the break-up of the agreement. I do not consider this possibility, since it is unlikely to occur in practice.

[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 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] Beshkar (2010a) shows that a DSB which randomizes its decisions can improve the efficiency of a trade agreement in the presence of uncertainty. This point is particularly relevant if Home can justify in some instances the application of a tariff above its bound through the application of WTO-consistent contingent protection measures, such as safeguard and anti-dumping duties. In addition, as Beshkar (2010a, p. 462) notes, the insufficient compensation of complainants in some periods is unproblematic as long as "governments can maintain an intertemporal balance of concessions under an optimal trade agreement even though an instantaneous balance is not maintained."

of the model is consistent with the observation that in practice many WTO disputes are settled before reaching the panel stage.

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 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.

When deviating from the agreement in a given period, Home will set its Nash tariff level, t^N, to maximize its potential welfare gain. In case of a successful complaint with the DSB, Foreign will in turn respond with the dispute tariff t^{*D} or otherwise be bound by the initial agreement. In case of an agreement violation, Home therefore realizes the following welfare level:

$$W^N = W_1(t^N, \gamma) + W_2(t^{*D}) \tag{10}$$

where $t^{*D} = min[t^{*N}(\gamma^*), t^{*DSB}]$ in case of a successful complaint by Foreign with the DSB. That is, in case of winning the dispute, Foreign sets the retaliation tariff granted by the DSB, t^{*DSB}, or if lower, apply its Nash tariff to maximize its own welfare while adhering to the trade agreement rules. The determination of t^{*DSB} is discussed below. If Foreign loses the dispute or fails to file a complaint with the DSB, its tariff choice follows from the tariff schedule specified in the agreement, $t^{*D} = min[t^{*N}(\gamma^*), t^{*B}]$, which resembles Home's schedule in (5).

In order for the trade agreement to be incentive-compatible for Home in the present period, deviating should not offer a welfare improvement over cooperation. Home cannot, however, base its violation decision on the comparison of welfare under cooperation, equation (9), and non-cooperation, equation (10). Home's welfare realization in its export sector, W_2, depends on Foreign's tariff choice and therefore implicitly on the political pressure in Foreign, γ^*. Because Foreign's political pressure is private information at the time of the breach decision, Home instead considers its expected welfare realization in sector 2 under the two possible cases of cooperation and violation:

$$\text{Cooperation: } E[W_2(t^*(\gamma^*))] = \int_1^{\gamma^{*N}} W_2(t^{*N}(\gamma^*)) f(\gamma^*) d\gamma^* + \int_{\gamma^{*N}}^{\bar{\gamma}^*} W_2(t^{*B}) f(\gamma^*) d\gamma^* \tag{11a}$$

$$\begin{aligned}\text{Violation: } E[W_2(t^{*D})] = &\int_1^{\gamma^{*N}} W_2(t^{*N}(\gamma^*)) f(\gamma^*) d\gamma^* + \pi^{DSB} P^F \int_{\gamma^{*N}}^{\bar{\gamma}^*} W_2(t^{*D}(\gamma^*)) f(\gamma^*) d\gamma^* \\ &+ (1 - \pi^{DSB} P^F) \int_{\gamma^{*N}}^{\bar{\gamma}^*} W_2(t^{*B}) f(\gamma^*) d\gamma^*\end{aligned} \tag{11b}$$

where Foreign sets the dispute tariff, $t^{*D} = min[t^{*N}(\gamma^*), t^{*DSB}]$, if it files and wins the dispute, which happens with probability $\pi^{DSB} P^F$. Since Foreign has only an incentive to file a trade dispute when its Nash tariffs exceeds the tariff bound, $t^{*N} > t^{*B}$, the likelihood for a dispute filing, P^F, coincides with the probability that the following condition is satisfied: $\gamma^* > \gamma^{*N}$.

Otherwise, a dispute filing offers no potential welfare improvement to Foreign as the DSB can at most grant the right to set a higher tariff than specified in the initial agreement. Foreign's probability to file a complaint with the DSB after an observed agreement violation by Home is thus $P^F = min\left[Pr(\gamma^* > \gamma^{*N}), 1\right] = min\left[\frac{\overline{\gamma}^* - \gamma^{*N}}{\overline{\gamma}^* - 1}, 1\right]$, where P^F always takes the value one if $\gamma^{*N} < 1$. The second equality follows from the uniform distribution of Foreign's political pressure parameter γ^* with support $[1, \overline{\gamma}^*]$.

Taking the expectation over γ^* in equations (9) and (10), we can now compare Home's expected welfare realization under cooperation and non-cooperation. Using the definitions in (11a) and (11b), Home will comply with the trade agreement's tariff schedule in a given period as long as

$$W_1(t^N, \phi^*, \gamma) - W_1(t^B, \phi^*, \gamma) + T \leq \pi^{DSB} P^F E\left[W_2(t^{*B}) - W_2(t^{*D}) | \gamma^* > \gamma^{*N}\right] \tag{12}$$

where the right-hand side is Home's expected cost from deviating and the left-hand side describes the benefit from an agreement breach. Home's expected welfare loss is conditioned on $\gamma^* \in (\gamma^{*N}, \overline{\gamma^*}]$ because only within this range of political economy weights Foreign's Nash tariff exceeds the tariff bound. Outside this range, filing a case with the DSB cannot provide a welfare improvement, because Foreign is already able to set its individually optimal tariff. The term T on the left-hand side in (12) arises from skipping the per-period transfer when Home deviates from the agreement. I am not concerned with the exact bargaining mechanism by which countries have initially reached the efficient trade agreement and therefore assume in what follows that equation (12) always holds. That is, given the initial model parameters, Home never intends to breach the efficient agreement.

One question that deserves discussion is how the DSB chooses the retaliation tariff, t^{*DSB}, in case Foreign wins the dispute. 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." While the WTO does not provide a formal definition of the meaning of *suspension of equivalent concessions*, I follow Bagwell and Staiger (2001) and define the term as mutual changes in trade policy which lead to equivalent adjustments in import values in Home and Foreign, as measured at original world prices. That is, the DSB assigns Foreign a tariff t^{*DSB} which reduces the value of Home's imports by the same amount as the reduction in Foreign's exports due to Home's agreement-violating application of its Nash tariff:[15]

$$\left[p_1^*(t^B) - p_1^*(t^N)\right] M_1(t^N) = \left[p_2(t^{*B}) - p_2(t^{*DSB})\right] M_2^*(t^{*DSB}) \tag{13}$$

[15] Balanced trade at existing world prices between both countries implies the following reciprocity condition:

$$p_1^*(t^B)\left[M_1(t^N) - M_1(t^B)\right] + M_0(t^N, t^{*DSB}) - M_0(t^B, t^{*B}) = p_2(t^{*B})\left[M_2^*(t^{*DSB}) - M_2^*(t^{*B})\right]$$

That is, the change in trade volumes of goods 1 and 2 due to the tariff adjustments has to be matched by changes in the trade volume of the numeraire good 0, M_0. Condition (13) results when inserting the definitions of Home's net imports of the numeraire good at the old and new tariffs rates, $M_0(t^B, t^{*B}) = p_2(t^{*B})M_2^*(t^{*B}) - p_1^*(t^B)M_1(t^B)$ and $M_0(t^N, t^{*DSB}) = p_2(t^{*DSB})M_2^*(t^{*DSB}) - p_1^*(t^N)M_1(t^N)$, respectively, into the reciprocity condition.

where M_1 and M_2^* are Home's and Foreign's import quantities of goods 1 and 2, respectively, and $p_1^*(t^B)$ and $p_2(t^{*B})$ are the associated world prices that would prevail in the absence of Home's agreement breach. World prices and imports are evaluated at both countries' respective tariff bounds, since both Home and Foreign require a zero tariff overhang to enter a dispute — the former requirement is discussed in more detail in the next subsection.

III.2 Agreement Breach and the Structure of Tariff Overhangs

Given the outline of the model so far, a breach of the trade agreement should never happen. Home and Foreign negotiate a tariff bound as specified in section II.2 and a transfer, T, which induces both countries to always choose cooperation over a violation. Any breach has to follow in turn from an unexpected event which is not foreseen during the initial negotiations. I motivate agreement breaches by introducing into the model a link between trade liberalization and aggregate productivity shocks.[16] Since post-agreement productivity changes are hard to predict ex ante, either country will still be bound by the initial constraints of the agreement after any shock. To fix ideas, consider an unexpected permanent shock, ϵ, to Foreign's productivity parameter in sector 1, ϕ^*, after the trade agreement enters into force.[17] Foreign's productivity advantage then equals $\phi^{*'} = \phi^* + \epsilon$, where ϕ^* is Foreign's productivity parameter at the time of the agreement signing.

After the productivity shock materializes in Home's import sector, when will Home decide to breach the agreement? The likelihood of a breach by Home is closely tied to the size of its tariff overhang, $t^B - t$. In general, an agreement violation is only a sensible strategy if Home cannot set its preferred tariff rate, t^N, under the agreement's current tariff schedule. The necessary condition for Home to commit a breach is then a zero tariff overhang in its import sector after the realization of the productivity shock. Otherwise, an agreement violation is pointless because Home can already implement its individually optimal trade policy.

The intuition behind Home's increased incentive to violate the agreement after a positive shock to Foreign's productivity bears similarity to the "managed trade" argument in Bagwell and Staiger (1990). In their paper, Bagwell and Staiger show that countries are more likely to implement additional protection in periods when trade volumes surge. A similar channel is at work here.[18]

[16] 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.

[17] One could of course argue that the countries would incorporate future productivity adjustments in the negotiation of the original agreement. In this case, the negotiated tariff bound in (8) would change to account for the additional uncertainty in the productivity parameter ϕ^*. Independent of the negotiated tariff bound, the initial agreement would nonetheless have to satisfy the non-violation condition in (12) for all expected political pressure and productivity realizations. To motivate an agreement breach by Home, one would still require an unexpected event, such as a productivity realization beyond what was expected in the initial negotiations. Thus, introducing an uncertain but expected element for productivity realizations would lead to a more complex equilibrium condition but leave the general insights of the model unchanged. To not distract from the main points of the analysis, I focus only on the unexpected component of productivity shocks while fixing the initial productivity parameter.

[18] However, Bagwell and Staiger (1990) do not investigate the implications of tariff overhangs and country asymmetries.

An increase in Foreign's productivity will lead to a rise in exports of good 1 to Home, which will induce the domestic government to raise its Nash tariff in (4) and potentially violate the agreement to provide greater protection to domestic producers. Having a lower tariff overhang prior to the shock then raises the probability to be constrained by the agreement afterward and to commit a violation. Proposition 1 summarizes this link.

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

Proof: See Appendix A.1.

Thus, after a positive productivity shock a violation becomes a potential policy option in more scenarios for Home. This result emerges in the model because a positive productivity shock increases Home's likelihood to always have a zero tariff overhang (incidence of case 1) by lowering the country size threshold below which a country is always constrained by its tariff bound, $\tilde{\lambda}$. In addition, it increases the share of political pressure realizations which result in a zero tariff overhang in Home in case 2 by raising the threshold $\gamma^N(t^B)$ in (6).

As discussed in the introduction, Figure 2 offers empirical support that tariff overhangs are indeed an essential determinant of WTO agreement violations. One year 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. 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 2 provides evidence that having a zero or tight tariff overhang is a necessary condition to breach the WTO agreement. Table 3 also provides summary statistics of both samples in Figure 2, showing that the tariff overhang distributions differ significantly between dispute defendants and non-defendants.[19]

III.3 The Welfare Incentive for an Agreement Breach

In addition to facing a tight tariff overhang, a WTO member also needs to enjoy a welfare benefit to rationally justify an agreement breach. This part examines how the model parameters affect Home's incentive to violate the agreement when the prerequisite of a zero tariff overhang is met after a productivity shock. I first discuss how the shock changes Home's welfare realizations in its import

[19] The presence of negative tariff overhangs in Figure 2 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 (see Appendix B), and 4. after negotiating new bound rates, WTO members are usually granted phase-in periods during which applied tariffs can exceed the new tariff bounds.

and export sectors and then derive conditions under which an increase in Foreign's productivity is more likely to result in a breach of the agreement's non-violation condition in (12).

Starting with Home's welfare in sector 1, we notice that the productivity shock has two distinct impacts. There is a direct effect of the rise in ϕ^* on welfare through a change in Foreign's export supply function and an indirect effect through an adjustment in Home's Nash tariff. Home's welfare function in sector 2, on the other hand, only depends on Home's export sector productivity (ϕ) but is independent of ϕ^*. The same applies to Foreign's Nash tariff and tariff bound. In the case when the dispute tariff equals Foreign's Nash tariff, $t^{*D} = t^{*N}$, Home's expected welfare loss in that sector, $E[W_2(t^{*B}) - W_2(t^{*N}|\gamma^* > \gamma^{*N}]$, is then not affected by the productivity shock. When the dispute tariff instead equals the DSB-granted retaliation tariff, $t^{*D} = t^{*DSB}$, Home's expected welfare loss from breaking the agreement depends negatively on the choice of t^{*DSB}: $E\left[W_2(t^{*B}) - W_2(t^{*DSB})|\gamma^* > \gamma^{*N}\right] = W_2(t^{*B}) - W_2(t^{*DSB})$, where the equality follows from W_2's independence of γ^*. While the DSB's choice of the retaliation tariff depends implicitly on Home's Nash tariff and ϕ^* through the reciprocity condition in (13), the productivity shock will again not affect Home's expected welfare loss in sector 2 as long as t^{*DSB} is set in line with the original agreement information.[20]

We can now determine the effect of the productivity shock on Home's welfare incentive to violate the agreement by taking the total differential of the non-violation condition in (12) with respect to ϕ^*. The discussion in the previous paragraph implies that the productivity shock will only affect the left-hand side of the inequality. Defining this term as $\Delta W_1 = W_1(t^N(\gamma), \gamma, \phi^*) - W_1(t^B, \gamma, \phi^*)$, the overall change in Home's welfare incentive to violate the agreement is then given by

$$\Delta\Omega = \frac{d\Delta W_1}{d\phi^*} \quad , \tag{14}$$

which implies that the productivity shock only affects Home's welfare gain from an agreement breach in its import sector. Appendix A.2 provides the detailed expression of equation (14). Using the envelope theorem and the fact that Home cannot adjust its tariff bound retroactively, I show there that Home's welfare incentive to breach the agreement is completely driven by the direct effect of the productivity shock on Home's welfare function in sector 1 and not its Nash tariff adjustment. That is, $\Delta\Omega = \frac{\partial W_1(t^N,\gamma,\phi^*)}{\partial\phi^*} - \frac{\partial W_1(t^B,\gamma,\phi^*)}{\partial\phi^*}$.

As long as the non-violation condition in (12) 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 status of the binding will be determined by the bargaining power distribution between Home and Foreign in the agreement

[20] In practice, the DSB bases its retaliation decision on the most recent available trade data between the dispute participants, see Bown and Ruta (2010) for a detailed account of the arbitration process for a selected number of disputes. Following this logic, the DSB chooses the retaliation tariff in the model using trade flow observations that have been generated with the original agreement parameters as long as violations are promptly reported.

negotiations over the transfer payment T. I therefore consider the more general scenario when (12) binds with inequality. In that case, a positive value of $\Delta\Omega$ implies that the welfare incentive to breach the agreement increases after the productivity shock but it might not be sufficient to trump the benefits from cooperation. Suppose $\gamma \in [\gamma^N, \overline{\gamma}]$ and $W_1(t^N, \phi^*, \gamma) - W_1(t^B, \phi^*, \gamma) + T = G + \pi^{DSB} P^F E[W_2(t^{*B}) - W_2(t^{*D}) | \gamma^* > \gamma^{*N}]$, where G is the gain from implementing an agreement-consistent policy and 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. Breaching the agreement is then only preferable as long as $\Delta\Omega > G$.

In general, the sign of $\Delta\Omega$ in (14) 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 possible political pressure realizations in Home, $\overline{\gamma}$. Proposition 2 summarizes the conditions under which Home's breaching incentive is ensured to increase, that is, when $\Delta\Omega > 0$.

Proposition 2 *After a positive shock to Foreign's productivity parameter, ϕ^*, and when meeting the prerequisite of a zero tariff overhang, 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 Appendix A.2.

Inspection of Proposition 2 reveals 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 small, and (iii) there is substantial uncertainty about Home's political pressure. Part (i) results because either condition in Proposition 2 is more easily met when λ increases. Parts (ii) and (iii) follow since the right-hand sides of both inequalities in Proposition 2 are increasing in ϕ^* and decreasing in $\overline{\gamma}$, respectively. Intuitively, the benefits from trade and a trade agreement are relatively small for a large country with only a small productivity lag behind its trading partner; a breach is an attractive scenario under these circumstances. In addition, if a country is constrained by its tariff bound, a rise in the maximum political economy weight implies on average a greater government preference to protect domestic producer interests, lowering the benefits from trade and cooperation as well.

We can now predict which country characteristics raise the likelihood for an agreement violation by Home. At this point, it is crucial to emphasize that Home's decision to breach the agreement operates through two channels: (i) a tight tariff overhang, and (ii) the welfare incentive for a breach when this prerequisite is met. The comparative statics of the Nash tariff in (4) and the tariff bound

in (8) imply that larger countries (high λ) with a substantial productivity disadvantage in their import sector (high ϕ^*) and a narrow range of 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 zero tariff overhang prerequisite after a post-agreement productivity shock. Considering the results from Proposition 2, country size emerges as the only parameter that simultaneously raises Home's probability to face a tight tariff overhang and to experience a guaranteed increase in the welfare incentive to breach the agreement.

More generally, tariff overhangs presort agreement members into two 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. But even if they meet the prerequisite of a low tariff overhang, the gains from an agreement breach are often not sufficient for smaller countries to make up for the potential welfare losses they face when their trading partners retaliate with the help of the DSB. Relatively large countries, on the other hand, are more frequently defendants in WTO disputes because they are more likely to simultaneously feature lower tariff overhangs and to experience a guaranteed increase in their welfare incentive to breach the agreement after a productivity shock. The results in this and the previous subsection thus provide the theoretical basis that can explain the previously found strong empirical link between country size and WTO dispute participation.

IV. The Likelihood of Dispute Filings

This section moves on from Home's agreement breaching incentive to consider Foreign's decision to file a trade dispute after discovering 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. Specifically, I illustrate how the likelihood of filing a complaint with the DSB varies with the importance of Home as an export destination for Foreign.

IV.1 Determinants of the Filing Decision

As outlined above, the likelihood of a dispute filing by Foreign 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 is distributed uniformly with support $[1, \overline{\gamma}^*]$.[21] Intuitively, the filing

[21] Notice that the results below do not hinge on this assumption. The only requirement for the results to hold more generally is that $\partial P^F / \partial \gamma^{*N} < 0$, 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 condition is trivially met by any cumulative distribution function unless the applied tariff is always at its bound rate.

probability captures the likelihood of Foreign's Nash tariff to be greater than its tariff bound. Only if this requirement is met and Foreign has a zero tariff overhang, the country benefits from setting a retaliation tariff above its tariff bound. Proposition 3 illustrates how the three different parameters in Foreign's own import market $(\lambda, \phi, \overline{\gamma}^*)$ affect its dispute filing probability when observing an agreement violation by Home.

Proposition 3 *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 3: see Appendix A.3.

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 then 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 due to the additional demand for tariff setting flexibility. 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 of a dispute filing. 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 that Foreign wishes to implement. In addition, in case 2, an increase in ϕ also lowers the negotiated tariff bound to limit Foreign's trade taxation power, which it can otherwise use too excessively. Both effects imply that a higher productivity disadvantage in its import sector decreases Foreign's trade policy flexibility in the agreement, which in turn increases the appeal of a dispute filing.

IV.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 a detected 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

$$E^* = \frac{\lambda(1-\lambda)[\phi^{*'} - 1 - 2t^N]}{2\lambda(1+t^N) + (1-\lambda)(1+\phi^{*'})} = \frac{\lambda(1-\lambda)[\phi^{*'}(3-\gamma) - (1+\gamma)]}{8\lambda + (1-\lambda)(1+\phi^{*'})(3-\gamma)} \tag{15}$$

where the Nash tariff indicates that Home chooses to deviate from the agreement and $\phi^{*'}$ is Foreign's new productivity paramter after the shock. Equation (15) shows that Foreign's exports depend on Home's relative size to Foreign (λ), Foreign's productivity edge in Home's import sector ($\phi^{*'}$) 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 $\phi^{*'}$ and γ are per se not related to Foreign's filing probability, see Proposition 3, the only connecting link between Foreign's exports to Home and its filing probability is both countries' relative size.

Equation (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 (15) with respect to λ.[22] The value of 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, $\phi^{*'}$, but in general tends toward $\lambda = 0.5$:

$$\hat{\lambda} = \begin{cases} 0.5 & \text{if} \quad \gamma = \frac{3\phi^{*'} - 5}{1 + \phi^{*'}} \\ \sqrt{(1+\phi^{*'})(3-\gamma)} \left[\frac{\sqrt{8} - \sqrt{(1+\phi^{*'})(3-\gamma)}}{8 - (1+\phi^{*'})(3-\gamma)} \right] & \text{otherwise} \end{cases} \tag{16}$$

where $\hat{\lambda}$ is either increasing or decreasing in $\phi^{*'}$, 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 (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 bilateral trade flows are proportional to the product of the economic mass of the two trading partners (see, e.g., Head and Mayer, 2013). The left panel in Figure 3 depicts E^* as function of λ, with $\hat{\lambda}$ indicating the maximum level of Foreign's exports to Home.

The right panel in Figure 3 shows the dispute filing probability as function of λ, conditional on an observed agreement violation by Home. Foreign always files a dispute as long as its tariff overhang is zero, that is when $\gamma^{*N} \leq 1$. Otherwise, as the proof of Proposition 3 in Appendix A.3 indicates, Foreign's filing probability is decreasing in Home's size, λ. More specifically, Foreign's filing probability declines as long as λ exceeds the following value:

$$\dot{\lambda} = \frac{2[(3\phi - 1) - \overline{\gamma}^*(1+\phi)]}{2(3\phi - 1) - (1 + \overline{\gamma}^*)(1+\phi)} \quad . \tag{17}$$

[22] The FOC with respect to λ is 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 (15) is negative, implying a concave shape of E^* with respect to λ.

Notice that when λ exceeds the value in (17) Foreign has a tariff bound which, for low enough realizations of γ^*, allows for the application of Nash tariff.[23]

Using Figure 3, 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 3 is most relevant for the analysis. More specifically, Proposition 4 summarizes the condition under which a qualitative statement about the relationship between Foreign's filing probability and its exports to Home is feasible.

Proposition 4 *If $\lambda > max[\hat{\lambda}, \dot{\lambda}]$, Foreign's exports to Home and Foreign's likelihood to file a dispute after an observed violation are positively correlated.*

Proposition 4 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 probability of a tight tariff overhang increases with country size, dispute filings must become more likely 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 4 presents a histogram of the percentile positions of complainants' export volumes to defendants in dispute sectors. For each dispute and dispute sector, I rank the complainant's complete set of export destinations in ascending order by the respective bilateral export volume. I then obtain the percentile distribution in Figure 4 by collecting for each dispute and dispute sector the ratio of the defendant's rank to the total number of ranked export destinations ($\times$ 100). 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 of Figure 4 therefore confirms the hypothesis of more dispute filings against important export partners. Notice that the average number of a complainant's export destinations in a dispute sector is 65 in the data. The results are therefore not driven by complainants with only a few export destinations.

[23] 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 can be derived in a similar fashion as Home's tariff bound in (8).

V. Tariff Overhangs and WTO Dispute Incidence: Empirical Evidence

The theoretical analysis above has shown that the structure of tariff overhangs is potentially an essential but previously neglected element for countries' selection into WTO disputes. This section empirically tests this hypothesis by employing a standard binary choice framework and two regression approaches. I first link countries average' MFN tariff overhangs to their likelihood to emerge as a participant in a WTO dispute by estimating the following econometric specification:

$$DISPUTE_{cd,t} = \beta_0 + \beta_1 OVERHANG_{c,t-1} + \beta_2 OVERHANG_{d,t-1} + \beta_3 RELSIZE_{cd,t-1} + \delta Z_{cd,t-1} + \epsilon_{cd,t} \tag{18}$$

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.[24] $OVERHANG_c$ and $OVERHANG_d$ are the potential complainant's and potential defendant's average MFN tariff overhangs, respectively.[25] In line with Propositions 1 and 3, 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.

In the second specification, I account for the fact that countries face varying tariff overhang pressures across sectors and trading partners. Instead of using an averaged tariff overhangs as in (18), I include for each country pair the bilateral share of 6-digit HS sectors in which the complainant and defendant have negative or zero tariff overhangs, respectively. Specifically, I estimate:

$$DISPUTE_{cd,t} = \gamma_0 + \gamma_1 OVERHANGSHARE_{cd,t-1} + \gamma_2 OVERHANGSHARE_{dc,t-1} + \gamma_3 RELSIZE_{cd,t-1} + \theta Z_{cd,t-1} + \eta_{cd,t} \tag{19}$$

[24] The theoretical model focuses on tariff violations which, taken literally, restricts its applicability to a subset of WTO disputes, e.g. complaints on the illegal use of anti-dumping, safeguard and countervailing measures. However, non-tariff measures are in many instances used as substitutes for tariffs, in particular when WTO members have low tariff overhangs. This point is confirmed by Beverelli et al. (2014) who identify an existing tendency among WTO members to implement Technical Barriers to Trade (TBT) and Sanitary and Phytosanitary (SPS) measures if they committed to larger tariff reductions in the past. The analysis therefore includes WTO disputes that allege either tariff or non-tariff violations.

[25] I calculate tariff overhangs using simple averages of the most-favored-nation tariff rates across sectors; the results are similar with trade-weighted averages.

where

$$OVERHANGSHARE_{cd,t-1} = \frac{\sum_{I_{cdi,t-1}} \mathbf{1}(t_i^B - t_i \leq 0)}{\sum_{I_{cdi,t-1}} \mathbf{1}}$$

and $I_{cdi,t-1}$ denotes the set of 6-digit HS sectors, i, in which country c records imports from country d in year $t-1$. $OVERHANGSHARE_{cd,t-1}$ is then the share of all active 6-digit HS import sectors from country d for which the difference between the MFN bound and the MFN applied tariff is zero or negative in country c. $OVERHANGSHARE_{dc,t-1}$ is defined accordingly. In line with the models predictions, country pairs with a greater share of sectors with zero tariff overhangs are more likely to appear either as complainants or defendants in WTO disputes, $\gamma_1 > 0$ and $\gamma_2 > 0$.

In accordance with the model, I also include in both specifications 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 3 also predicts that larger countries are more likely to file a dispute. Combining these two predictions, dispute pairs should involve countries of not too different size, implying a negative impact of $RELSIZE_{cd}$ on dispute incidence, $\beta_3 < 0$ ($\gamma_3 < 0$). 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 2014. Every country pair enters the dataset twice in a given 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 4 provides definitions, sources and summary statistics for all variables used in the analysis. As indicated by the specifications in (18) and (19), I include one period lagged values of all independent variables in each regression to control for information lags.[26] Overall, the unbalanced panel includes 53,524 observations.

V.1 Average MFN Tariff Overhangs and WTO Dispute Incidence

Table 5 provides logit regression results of the WTO dispute incidence variable on average tariff overhangs in potential complainant and defendant countries as specified in (18) with a varying set of control variables.[27] In column (1), I first consider the most parsimonious specification by regressing dispute incidence on both the potential complainant's and defendant's average tariff overhangs and $RELSIZE_{cd}$. The tariff overhang estimates are negative and significant at the 1 percent level, which supports the hypothesis that lower tariff overhangs increase the likelihood for member countries to participate both as complainants and defendants in WTO disputes. The

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

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

negative and significant coefficient of $RELSIZE_{cd}$ confirms the theoretical prediction that countries of similar size are more likely to meet in a WTO dispute. Thus, in accordance with the model, the structure of tariff overhangs and WTO members' relative size are inversely linked to WTO dispute incidence. The Pseudo R^2 of .124 also indicates that tariff overhangs alone explain a substantial share of the variation in the WTO dispute pattern.

One possible alternative explanation to explain the spike of disputes in the early years of the WTO is the notion of precedent. Members might have felt the need to establish legal precedent in certain areas of WTO law early on, or in case of later membership, soon after joining the organization. To control for this possibility, column (2) adds both year fixed effects and two variables capturing the potential complainant's and defendant's duration of WTO membership, $PRECEDENT_c$ and $PRECEDENT_d$, respectively. Two results emerge. First, all previous coefficient estimates remain stable and significant. Tariff overhangs are inversely linked to WTO dispute incidence even after controlling for potential legal precedent motives. And second, there is no evidence for increased dispute activity to set legal precedent shortly after members join the organization. In fact, the positive coefficients of $PRECEDENT_c$ and $PRECEDENT_d$ indicate that countries tend to be more active in dispute proceedings the longer their membership lasts.

In section III.2, I argue that country pairs which lower their tariff barriers will face productivity shocks that 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, country pairs 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 pair'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 their applied mean MFN tariff rates until year $t-1$.[28] The negative and significant coefficient of UR_LIB_{cd} confirms that country pairs which witnessed deeper trade liberalization (more negative UR_LIB_{cd}), and thus had 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.

Instead of measuring the continuous effect of tariff overhangs on WTO dispute participation, I include tariff overhang bins in column (4). The bins are identical to dummy variables, taking the value 1 if a country's average tariff overhang lies within a prespecified limit. I consider three bins for both complainants and defendants. The bins containing the lowest tariff overhangs for

[28] Note that due to limited tariff data availability prior to 1995, the sample size in columns (3)-(5) drops to 39,314. 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 (3)-(5).

complainants, $OVERHANG\_LOW_c$, and defendants, $OVERHANG\_LOW_d$, take the value one if a country's tariff overhang is 0 percentage points or less. The bins $OVERHANG\_HIGH_c$ and $OVERHANG\_HIGH_d$ capture tariff overhangs between 0 and 20 percentage points for potential complainants and defendants, respectively. The excluded benchmark categories in column (4) are in turn the bins which include tariff overhangs of 20 percentage points or higher. Two results emerge. First, the coefficients of all included overhang bins are positive and significant at the 1 percent level, indicating that countries with a tariff overhang of 20 percentage points or less are more likely to participate in disputes than their counterparts with tariff overhangs of more than 20 percentage points. And second, the estimated coefficients drop substantially in magnitude from the lower to the higher bins. This result, in accordance with Propositions 1 and 3, implies again that WTO members with lower tariff overhangs are more likely to be party to a trade dispute.

The specification in column (5) introduces a number of additional control variables whose omission could potentially bias the tariff overhang coefficient estimates. According to proposition 4, greater sectoral import volumes of the defendant from the complainant are positively linked to dispute filings. I therefore include in the estimation the defendant's average bilateral imports (at the 6-digit HS level) from the complainant country, $HS6IMPORTS_{dc}$. I also add the respective counterpart, $HS6IMPORTS_{cd}$, which we should expect to enter with a positive sign because higher sectoral imports from the defendant imply a greater retaliatory capacity for the complainant. To control for political economy aspects, I introduce a dummy variable taking the value 1 if a country pair has a preferential trading relationship, PTA_{cd}. Controlling for preferential trading relationships is potentially important because the MFN tariff overhang should be a less relevant margin for dispute participation decisions between countries that grant each other freer market access. Nonetheless, the effect of existing PTAs between WTO members on dispute participation is unsure ex ante. A PTA can decrease 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. However, a positive effect of PTA membership on dispute participation is also possible if countries with tighter tariff overhangs are more likely to select into PTAs. In order to examine whether the impact of tariff overhangs on dispute participation varies with PTA membership status, I include interactions of the PTA dummy with $OVERHANG_c$ and $OVERHANG_d$, respectively.

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 at the 1 percent level. Countries with lower average MFN tariff overhangs are more likely to meet in WTO disputes even when controlling for a range of other potential determinants. In addition, UR_LIB_{cd}, $HS6IMPORTS_{cd}$ and $HS6IMPORTS_{dc}$ have the expected signs and are significant contributors (at the 1 percent level) to WTO dispute participation. $RELSIZE_{cd}$ still features a negative coefficient but the variable is not significant anymore, which could be due the fact that the relative country size effect is now partly captured by the average sectoral import volumes. Moreover, the

positive and significant coefficients of the PTA and tariff overhang interactions illustrate that the impact of the tariff overhang channel on WTO dispute incidence is weaker for country pairs with an existing preferential trading relationship.

V.2 Bilateral Tariff Overhang Shares and WTO Dispute Incidence

Table 6 presents logit regression results of the WTO dispute incidence variable on bilateral tariff overhang shares in potential complainant and defendant countries as specified in (19).[29] Employing the bilateral share of import sectors with tight tariff overhangs in the estimation has at least two substantial advantages over the previously used average MFN tariff overhangs. First, it allows for a tariff overhang measure that varies at the bilateral level. And second, we can gauge how important the issue of tight tariff overhangs is across the different products that are traded between a given country pair. Specifications (6)-(10) follow the estimation structure in Table 5. Column (6) provides the results from the baseline specification which includes only the potential complainant's and defendant's relative size and their respective bilateral shares of import sectors with a zero or negative tariff overhang, $OVERHANGSHARE_{cd}$ and $OVERHANGSHARE_{dc}$. All coefficients are of the expected sign and significant at the 1 percent level. WTO members are more likely to participate as complainants or defendants in trade disputes when a greater share of bilateral import sectors feature zero or negative tariff overhangs.

Column (7) introduces year fixed effects and the precedent variables. The tariff overhang share and relative size estimates remain stable. Countries with a greater share of bilateral import sectors that feature zero or below zero tariff overhangs are still more likely to select into WTO disputes. In addition, the sign and statistical significance of $PRECEDENT_c$ and $PRECEDENT_d$ are comparable to column (2) in Table 5. WTO members tend to participate more frequently in disputes the longer their membership lasts. Column (8) adds again a country pair's combined tariff reductions since the conclusion of the Uruguay Round to proxy for trade policy-induced changes in productivity. The results in column (8) confirm the prior findings. Country pairs with deeper tariff cuts, and thus a greater likelihood to be exposed to productivity adjustments, are more likely to meet in WTO disputes. And most importantly, the reduction in the sample size due to the addition of UR_LIB_{cd} leave the conclusions regarding tariff overhang shares and relative country size unchanged. Overall, the structure of tariff overhang shares can account well for the general evolution of the number of WTO disputes since 1995. Using the estimates in column (8), the correlation between the number of predicted and actual WTO disputes, as shown in the upper graph in Figure 5, is .91. Note that this strong positive correlation is not driven by the year fixed effects and the two precedent variables. The bottom graph in Figure 5 compiles the number of predicted disputes when these variables are excluded from the estimation. The close relationship between

[29] The results are again similar when using instead a probit framework or a linear probability model.

predicted and actual WTO disputes still remains intact with a correlation coefficient of .79. In fact, including both the year fixed effects and the precedent controls tends to overestimate the number of disputes during the early WTO years.[30]

In column (9), the bilateral tariff overhang shares are again sorted into different bins. For a potential complainant, the dummy $OVERHANGSHARE\_LOW_{cd}$ takes the value 1 if between 1/3 and 2/3 of the import sectors from a potential defendant feature a tariff overhang of zero or less. $OVERHANGSHARE\_HIGH_{cd}$ takes in turn the value 1 if the share is greater than 2/3. The definitions for the tariff overhang share bins for bilateral imports of the defendant follow the same convention. The estimates show again that potential complainants and defendants with high shares of bilateral trade occurring in sectors with tight tariff overhangs are most likely to meet in WTO disputes. The coefficient estimates of all previously introduced variables remain stable.

Column (10) introduces the same set of additional control variables as in column (5). The conclusions regarding the impact of tariff overhang shares on dispute participation remain unchanged. Countries with a higher share of sectors with tight tariff overhangs are more likely to initiate and receive trade policy complaints through the WTO dispute settlement mechanism. While the magnitude of the tariff overhang share coefficients has decreased, both effects have the predicted sign and are significant at the 1 percent level. The coefficient estimates of $RELSIZE_{cd}$, UR_LIB_{cd}, and both precedent variables are in line with the prior findings in columns (6)-(9). The decrease in magnitude and significance of $RELSIZE_{cd}$ is again most likely due to the inclusion of the bilateral import variables, $HS6IMPORTS_{cd}$ and $HS6IMPORTS_{dc}$. As expected, the signs of the latter two variables are positive and highly significant. As before, the negative and significant coefficients of the PTA and tariff overhang share interactions indicate that PTA members with tight tariff overhangs have less of an incentive to engage in WTO dispute proceedings.

VI. Concluding Remarks

This paper 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 actually applied tariffs, is an essential 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 result 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

[30] Both graphs in Figure 5 have been compiled under the assumptions that (i) disputes occur independently of each other, and (ii) the number of country pair observations is identical in each year. When estimating the specification in column (8) without the year fixed effects and the precedent controls, the coefficient estimates of the remaining variables are nearly identical. Detailed results are available on request.

gain from dispute filings, since the awarded compensation by the DSB moves their applied tariff closer to the individually optimal level.

This paper also provides the underlying channels through which power asymmetries operate in the WTO dispute context, the main determinant previously emphasized in the empirical 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 a consequence of potentially scarce legal resources but also due to a missing welfare incentive to commit violations and to file disputes. These predictions also hold empirically. Using a panel of WTO disputes between 1995 and 2014, I show that tariff overhangs are a significant predictor of dispute participation, even when controlling for countries' relative size, trade volumes, legal precedent motives, preferential trading relationships and recent trade liberalization efforts.

Given these predictions about the WTO dispute pattern, how can the WTO induce economically less 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.[31] 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. (2007) for an analysis of this point.

[31] Moreover, if private information on political pressures is persistent through time, countries with low tariff overhangs could suffer additional welfare losses because they might be forced to apply above-optimal tariffs to conceal their retaliation weakness, see Bagwell (2009).

References

Amador, Manuel and Kyle Bagwell, "The Theory of Optimal Delegation with an Application to Tariff Caps," *Econometrica*, 2013, *81* (4), 1541–1599.

Amiti, Mary and Jozef Konings, "Trade Liberalization, Intermediate Inputs, and Productivity: Evidence from Indonesia," *American Economic Review*, 2007, *97* (5), 1611–1638.

Bagwell, Kyle, "Self-enforcing Trade Agreements and Private Information," *NBER Working Paper 14812*, 2009.

_ **and Robert W. Staiger**, "A Theory of Managed Trade," *American Economic Review*, 1990, *80* (4), 779–795.

_ **and** _ , "An Economic Theory of GATT," *American Economic Review*, 1999, *89* (1), 215–248.

_ **and** _ , "Reciprocity, Non-discrimination and Preferential Agreements in the Multilateral Trading System," *European Journal of Political Economy*, 2001, *17* (2), 281–325.

_ **and** _ , *The Economics of the World Trading System*, Cambridge, MA: MIT Press, 2002.

_ **and** _ , "Enforcement, Private Political Pressure, and the General Agreement on Tariffs and Trade/World Trade Organization Escape Clause," *Journal of Legal Studies*, 2005, *34* (2), 471–513.

_ **, Petros C. Mavroidis, and Robert W. Staiger**, "Auctioning Countermeasures in the WTO," *Journal of International Economics*, 2007, *73* (2), 309–332.

Beshkar, Mostafa, "Optimal Remedies in International Trade Agreements," *European Economic Review*, 2010, *54* (3), 455–466.

_ , "Trade Skirmishes Safeguards: A Theory of the WTO Dispute Settlement Process," *Journal of International Economics*, 2010, *82* (1), 35–48.

_ **and Eric W. Bond**, "Cap and Escape in Trade Agreements," *Working Paper*, 2012.

Beverelli, Cosimo, Mauro Boffa, and Alexander Keck, "Trade Policy Substitution; Theory and Evidence form Specific Trade Concerns," *WTO Staff Working Paper ERSD-2014-18*, 2014.

Bond, Eric W. and Jee-Hyeong Park, "Gradualism in Trade Agreements with Asymmetric Countries," *Review of Economic Studies*, 2002, *69* (2), 379–406.

Bown, Chad P., "The Economics of Trade Disputes, the GATT's Article XXIII, and the WTO's Dispute Settlement Understanding," *Economics and Politics*, 2002, *14* (3), 283–323.

_ , "On the Economic Success of GATT/WTO Dispute Settlement," *Review of Economics and Statistics*, 2004a, *86* (3), 811–823.

_ , "Trade Disputes and the Implementation of Protection Under the GATT: an Empirical Assessment," *Journal of International Economics*, 2004b, *62* (2), 263–294.

_ , "Participation in WTO Dispute Settlement: Complaints, Interested Parties and Free Riders," *World Bank Economic Review*, 2005, *19* (2), 287–310.

_ **and Michele Ruta**, "The Economics of Permissible WTO Retaliation," in Chad P. Bown and Joost Pauwelyn, eds., *The Law, Economics and Politics of Retaliation in WTO Dispute Settlement*, Cambridge, UK: Cambridge University Press, 2010.

Busch, Marc L. and Eric Reinhardt, "Developing Countries and General Agreement on Tariffs and Trade/World Trade Organization Dispute Settlement," *Journal of World Trade*, 2003, *37* (4), 719–735.

Davis, Christina L. and Sarah Blodgett Bermeo, "Who files? Developing Country Participation in GATT/WTO Adjucation," *Journal of Politics*, 2009, *71* (3), 1033–1049.

de Sousa, José, "The Currency Union Effect on Trade is Decreasing over Time," *Economics Letters*, 2012, *117* (3), 917–920.

Grossman, Gene M. and Elhanan Helpman, "Protection for Sale," *American Economic Review*, 1994, *84* (4), 833–850.

Guzman, Andrew T. and Beth A. Simmons, "Power Plays and Capacity Constraints: The Selection of Defendants in World Trade Organization Disputes," *Journal of Legal Studies*, 2005, *34* (2), 557–598.

Head, Keith and Thierry Mayer, "Gravity Equations: Workhorse, Toolkit and Cookbook," *Working Paper*, 2013.

Horn, Henrik, Giovanni Maggi, and Robert W. Staiger, "Trade Agreements as Endogenously Incomplete Contracts," *American Economic Review*, 2010, *100* (1), 394–419.

_ **, Petros C. Mavroidis, and Hakan Nordström**, "Is the Use of the WTO Dispute Settlement System Biased?," in Petros C. Mavroidis and Alan Sykes, eds., *The WTO and International Trade Law/Dispute Settlement*, Cheltenham, UK: Edward Elgar, 2005.

Klimenko, Mikhail, Garey Ramey, and Joel Watson, "Recurrent Trade Agreements and the Value of External Enforcement," *Journal of International Economics*, 2008, *74* (2), 475–499.

Limão, Nuno, "Are Preferential Trade Agreements with Non-trade Objectives a Stumbling Block for Multilateral Liberalization?," *Review of Economic Studies*, 2007, *74* (3), 821–855.

_ **and Kamal Saggi**, "Tariff Retaliation versus Financial Compensation in the Enforcement of International Trade Agreements," *Journal of International Economics*, 2008, *76* (1), 48–60.

Maggi, Giovanni and Robert W. Staiger, "The Role of Dispute Settlement Procedures in International Trade Agreements," *Quarterly Journal of Economics*, 2011, *126* (1), 475–515.

_ **and** _ , "Trade Disputes and Settlement," *Working Paper*, 2015.

Melitz, Marc J., "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity," *Econometrica*, 2003, *71* (6), 1695–1725.

_ **and Giancarlo I. P. Ottaviano**, "Market Size, Trade, and Productivity," *Review of Economic Studies*, 2008, *75* (1), 295–316.

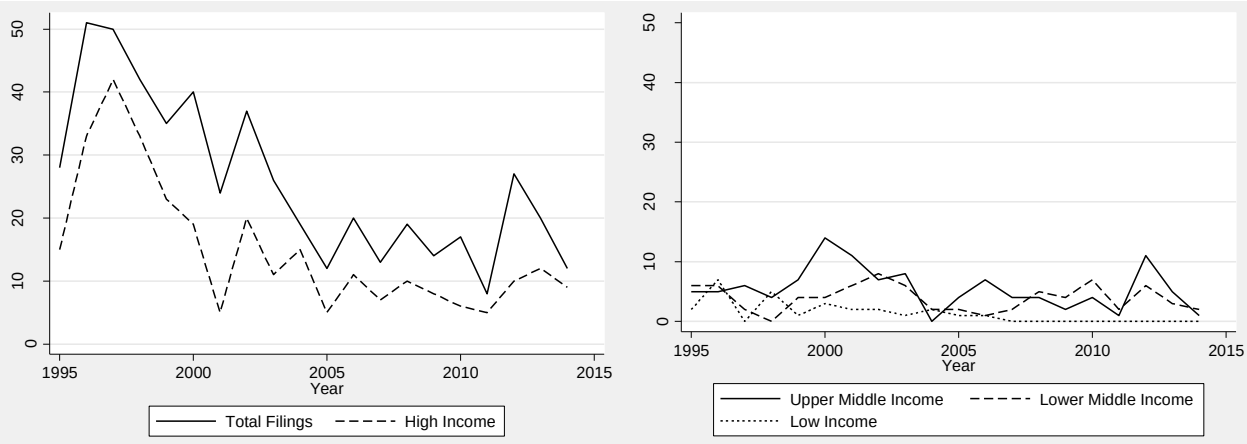
Park, Jee-Hyeong, "Enforcing International Trade Agreement with Imperfect Private Monitoring," *Review of Economic Studies*, 2011, *78* (3), 1102–1134.

Sattler, Thomas and Thomas Bernauer, "Gravitation or Discrimination? Determinants of Litigation in the World Trade Organisation," *European Journal of Political Research*, 2011, *50* (2), 143–167.

Syropoulos, Constantinos, "Optimum Tariffs and Retaliation Revisited: How Country Size Matters," *Review of Economic Studies*, 2002, *69* (3), 707–727.

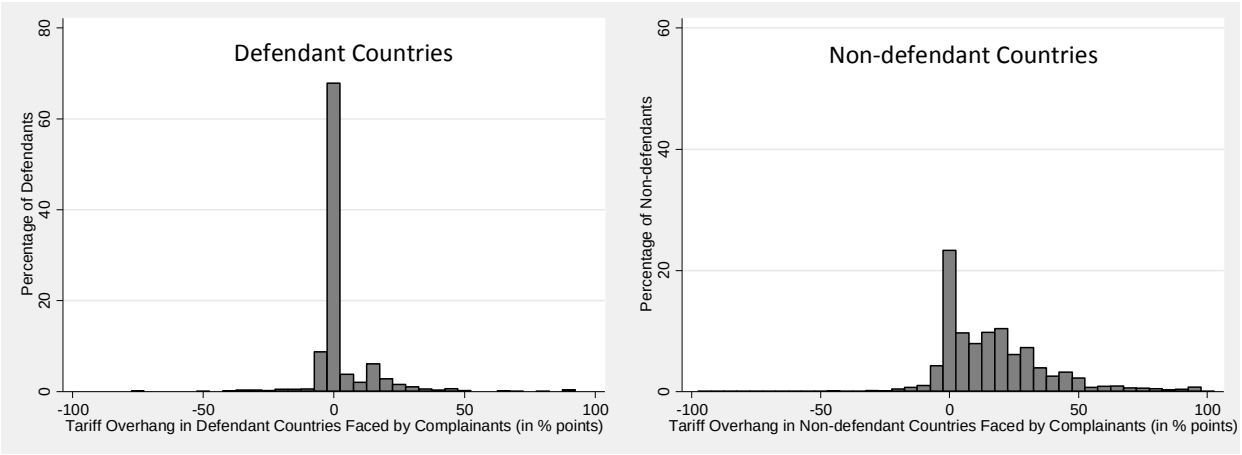
Figures

Figure 1: WTO Disputes (Total and by Income Group of Complainants), 1995-2014



Notes: 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 1 counts cases with multiple complainants separately, resulting in a total of 518 trade disputes between 1995 and 2014. The income categories are derived from the World Bank definition, see Appendix B for details.

Figure 2: Tariff Overhangs in Dispute Sectors in Defendant and Non-defendant Countries



Notes: Figure 2 shows tariff overhangs in dispute sectors in defendant and non-defendant countries one year prior to a dispute. The tariff overhang computations are based on sectoral simple averages of applied and bound tariff rates from the TRAINS database, 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 3: The Relation between Exports and Dispute Filing Probability

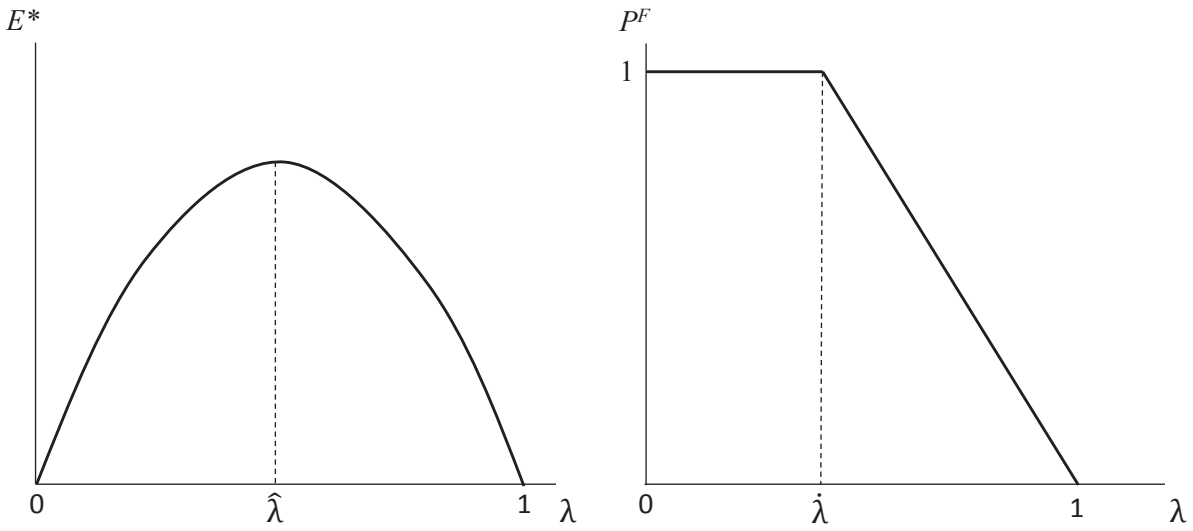
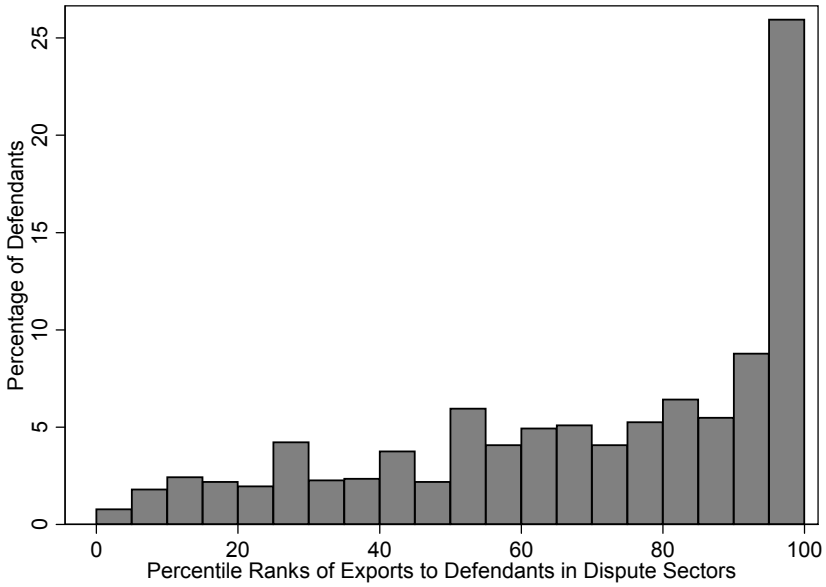
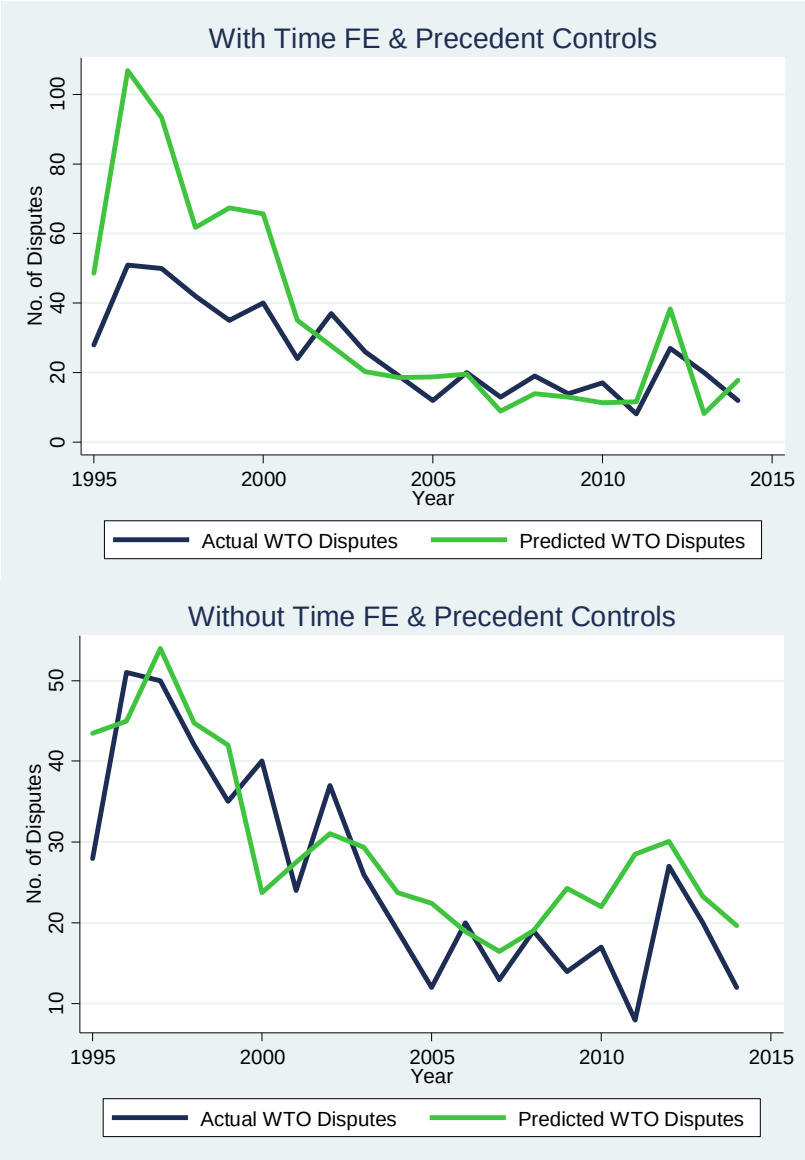


Figure 4: Percentile Ranks of Complainants' Exports to Defendants in Dispute Sectors



Notes: Author's own calculations based on data from the Comtrade database. Figure 4 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 5: Predicted vs. Actual Number of WTO Disputes



Notes: In the upper graph, the number of predicted disputes has been computed using specification (8) in Table 6. The number of predicted disputes in the lower graph is based on the re-estimation of specification (8) without the year fixed effects and the precedent controls. Two assumptions were made in the computations: 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 to match the sample size from the year with the highest number of available country pairs).

Tables

Table 1: Top Complainants and Defendants in WTO Disputes, 1995-2014

Complainants	No. of Disputes	Defendants	No. of Disputes
United States	107	United States	135
European Union	96	European Union	106
Canada	34	China	32
Brazil	27	Argentina	22
Mexico	23	India	22
India	21	Canada	20
Argentina	20	Australia	15
Japan	20	Brazil	15
Korea	17	Japan	15
Thailand	13	Mexico	14

Table 2: Top WTO Dispute Pairs, 1995-2014

Country Pair	No. of Disputes (Initiated Complaints)
United States - European Union	67 (34 – 33)
United States - China	24 (15 – 9)
Canada - United States	20 (15 – 5)
European Union - India	17 (10 – 7)
Korea - United States	17 (11 – 6)
Canada - European Union	16 (9 – 7)
Mexico - United States	15 (9 – 6)
Brazil - United States	14 (10 – 4)
Japan - United States	14 (8 – 6)
India - United States	14 (8 – 6)
European Union - Argentina	14 (8 – 6)

Table 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]
Standard deviation	12.5967	21.9164	0.000[b]
Sample size	1,131	33,598	N/A

[a] p-value based on Welch's t-test.

[b] p-value based on Levene's robust F-test for the equality of variances between two groups.

Notes: Author's own calculations using data from TRAINS database, see Appendix B for details.

Table 4: Summary Statistics

Variable	Mean	SD	Min	Max	Definition	Source
$DISPUTE_{cd}$	0.01	0.08	0	1	WTO Dispute(1: Yes, 0: No)	WTO homepage
$HS6IMPORTS_{cd}$	4.75	2.33	-6.91	12.98	Complainant's log average 6-digit HS imports from defendant	COMTRADE
$HS6IMPORTS_{dc}$	4.75	2.33	-6.91	12.98	Defendant's log average 6-digit HS imports from complainant	COMTRADE
$OVERHANG_c$	23.95	25.63	-22.68	151.01	Complainant's average MFN tariff bound − average applied MFN tariff (in % points)	TRAINS
$OVERHANG_d$	23.95	25.63	-22.68	151.01	Defendant's average MFN tariff bound − average applied MFN tariff (in % points)	TRAINS
$OVERHANGSHARE_{cd}$	0.25	0.33	0	1	Complainant's share of 6-digit HS import sectors from defendant with zero or negative tariff overhang	Author's own calculations, data: COMTRADE, TRAINS
$OVERHANGSHARE_{dc}$	0.25	0.33	0	1	Defendant's share of 6-digit HS import sectors from complainant with with zero or negative tariff overhang	Author's own calculations, data: COMTRADE, TRAINS
$OVERHANG\_LOW_c$	0.11	0.31	0	1	$OVERHANG_c \leq 0$ (1: Yes, 0: No)	Author's own calculations
$OVERHANG\_HIGH_c$	0.47	0.5	0	1	$0 < OVERHANG_c \leq 20$ (1: Yes, 0: No)	Author's own calculations
$OVERHANG\_LOW_d$	0.11	0.31	0	1	$OVERHANG_d \leq 0$ (1: Yes, 0: No)	Author's own calculations
$OVERHANG\_HIGH_d$	0.47	0.5	0	1	$0 < OVERHANG_d \leq 20$ (1: Yes, 0: No)	Author's own calculations
$OVERHANGSHARE\_LOW_{cd}$	0.13	0.33	0	1	$OVERHANGSHARE_{cd}$ is between 1/3 and 2/3 (1: Yes, 0: No)	Author's own calculations
$OVERHANGSHARE\_HIGH_{cd}$	0.17	0.37	0	1	$OVERHANGSHARE_{cd}$ is greater than 2/3 (1: Yes, 0: No)	Author's own calculations
$OVERHANGSHARE\_LOW_{dc}$	0.13	0.33	0	1	$OVERHANGSHARE_{dc}$ is between 1/3 and 2/3 (1: Yes, 0: No)	Author's own calculations
$OVERHANGSHARE\_HIGH_{dc}$	0.17	0.37	0	1	$OVERHANGSHARE_{dc}$ is greater than 2/3 (1: Yes, 0: No)	Author's own calculations
PTA_{cd}	0.13	0.34	0	1	Country pair is member of the same PTA (1: Yes, 0: No)	de Sousa (2012)
$PRECEDENT_c$	10.19	4.68	0	19	Years since complainant joined WTO	WTO homepage
$PRECEDENT_d$	10.19	4.68	0	19	Years since defendant joined WTO	WTO homepage
$RELSIZE_{cd}$	2.8	2.08	0	10.63	Absolute difference in log GDPs between complainant and defendant	GDPs from World Development Indicators

UR_LIB_{cd}	-20.32	15.55	-120.88	19.1	Sum of bilateral reduction in average applied MFN tariffs (in % points) since Uruguay Round (1986 or first year with available tariff data before 1994)	Author's own calculations, data: World Development Indicators

Table 5: Logit Regressions - Dispute Incidence and Average MFN Tariff Overhangs

Dependent variable: WTO Dispute (1: Yes, 0: No)	(1)	(2)	(3)	(4)	(5)
$OVERHANG_c$	-.059***	-.066***	-.076***		-.027***
	(.006)	(.007)	(.007)		(.005)
$OVERHANG_d$	-.077***	-.082***	-.091***		-.041***
	(.006)	(.007)	(.007)		(.007)
$RELSIZE_{cd}$	-.190***	-.170***	-.127***	-.209***	-.062
	(.028)	(.029)	(.031)	(.029)	(.041)
UR_LIB_{cd}			-.028***	-.021***	-.027***
			(.006)	(.005)	(.005)
$HS6IMPORTS_{cd}$					.578***
					(.039)
$HS6IMPORTS_{dc}$					.597***
					(.041)
PTA_{cd}					-1.241***
					(.213)
$PTA_{cd} \times OVERHANG_c$					.039***
					(.010)
$PTA_{cd} \times OVERHANG_d$					.043***
					(.010)
$PRECEDENT_c$		.171***	.172***	.091*	.267***
		(.053)	(.058)	(.055)	(.053)
$PRECEDENT_d$		.085**	.046	-.020	.129***
		(.035)	(.034)	(.034)	(.038)
$OVERHANG\_LOW_c$				2.737***	
				(.199)	
$OVERHANG\_HIGH_c$				.912***	
				(.192)	
$OVERHANG\_LOW_d$				3.609***	
				(.267)	
$OVERHANG\_HIGH_d$				1.713***	
				(.256)	
Const.	-3.149***	-2.504***	-2.643***	-7.145***	-11.500***
	(.120)	(.350)	(.356)	(.500)	(.568)
Time FE	No	Yes	Yes	Yes	Yes
N (Country pairs)	53524	53524	39314	39314	39314
Pseudo R2	.124	.18	.202	.222	.412

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

Table 6: Logit Regressions - Dispute Incidence and Bilateral Tariff Overhang Shares

Dependent variable: WTO Dispute (1: Yes, 0: No)	(6)	(7)	(8)	(9)	(10)
$OVERHANGSHARE_{cd}$	2.113***	2.173***	2.465***		.626***
	(.170)	(.171)	(.182)		(.212)
$OVERHANGSHARE_{dc}$	2.517***	2.528***	2.808***		.971***
	(.173)	(.177)	(.191)		(.209)
$RELSIZE_{cd}$	-.256***	-.249***	-.260***	-.271***	-.079**
	(.027)	(.028)	(.028)	(.028)	(.039)
UR_LIB_{cd}			-.015***	-.014***	-.014***
			(.004)	(.004)	(.005)
$HS6IMPORTS_{cd}$					.591***
					(.039)
$HS6IMPORTS_{dc}$					.601***
					(.042)
PTA_{cd}					1.279***
					(.322)
$PTA_{cd} \times OVERHANGSHARE_{cd}$					-1.883***
					(.469)
$PTA_{cd} \times OVERHANGSHARE_{dc}$					-1.643***
					(.442)
$PRECEDENT_c$		.145***	.120**	.131**	.220***
		(.051)	(.053)	(.053)	(.051)
$PRECEDENT_d$		.058*	-.003	.007	.076**
		(.034)	(.032)	(.032)	(.036)
$OVERHANGSHARE\_LOW_{cd}$				.455**	
				(.224)	
$OVERHANGSHARE\_HIGH_{cd}$				2.089***	
				(.143)	
$OVERHANGSHARE\_LOW_{dc}$				-.015	
				(.281)	
$OVERHANGSHARE\_HIGH_{dc}$				2.282***	
				(.145)	
Const.	-6.581***	-6.086***	-6.455***	-5.815***	-12.812***
	(.146)	(.368)	(.382)	(.373)	(.586)
Time FE	No	Yes	Yes	Yes	Yes
N (Country pairs)	53524	53524	39314	39314	39314
Pseudo R2	.132	.184	.209	.208	.404

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

Appendix

A Mathematical Appendix

A.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 $\frac{\partial \gamma^N}{\partial \phi^*} = -\frac{4\lambda}{(1+\phi^*)^2}$. ■

A.2 Proof of Proposition 2

In equation (14), the total differential of the welfare change in Home's import sector, $d\Delta W_1$, with respect to the productivity shock equals:

$$\frac{d\Delta W_1}{d\phi^*} = \frac{\partial W_1(t^N,\phi^*;\overline{\gamma})}{\partial \phi^*} - \frac{\partial W_1(t^B,\phi^*;\overline{\gamma})}{\partial \phi^*} + \frac{\partial W_1(t^N,\phi^*;\overline{\gamma})}{\partial t^N}\frac{dt^N}{d\phi^*} - \frac{\partial W_1(t^B,\phi^*;\overline{\gamma})}{\partial t^B}\frac{dt^B}{d\phi^*} \quad .$$

Using the envelope theorem, $\partial W_1(t^N,\phi^*;\overline{\gamma})/\partial t^N = 0$, and the fact that Home's tariff bound cannot be retroactively adjusted, $\frac{dt^B}{d\phi^*} = 0$, this expression simplifies to

$$\frac{d\Delta W_1}{d\phi^*} = \frac{\partial W_1(t^N,\phi^*;\overline{\gamma})}{\partial \phi^*} - \frac{\partial W_1(t^B,\phi^*;\overline{\gamma})}{\partial \phi^*}$$

where

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

with $\partial W_1(t,\gamma,\phi^*)/\partial \phi^*|_{t=t^N} > 0$ for $\phi^* > 1$ and $\gamma < \frac{3\phi^*-1}{1+\phi^*}$.

In order for $\Delta\Omega > 0$, it is then sufficient 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

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

While it is not feasible to derive directly from the above expression the parameter combinations for which (A.1) holds, we can use the individual elements l_1, l_2, r_1, r_2 to derive the conditions under which (A.1) is guaranteed to be met. Noting that all individual elements are positive as long as $0 < \lambda < 1$, (A.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 $t^B = \frac{\overline{\gamma}-1}{5-\overline{\gamma}}$, the following condition results for λ:

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

which corresponds to the upper condition stated in Proposition 2. Similarly, 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:

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

which corresponds to the lower condition stated in Proposition 2.

(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 (4), this expression can be written as

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

which is always met as long as $\phi^* < 5$. The second inequality, $l_1 > r_2$, 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 $\gamma \in [\gamma^N, \overline{\gamma}]$ as long as $\overline{\gamma} < 2$. ■

A.3 Proof of Proposition 3

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). In case $\gamma^{*N} > 1$, $P^F = \frac{\overline{\gamma}^* - \gamma^{*N}}{\overline{\gamma}^* - 1}$ and both a zero or a positive tariff overhang are possible for Foreign (case 2). The proof of Proposition 3 consists of two parts. I show first that the conditions in Proposition 3 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 II.2 for Home, Foreign always has a zero tariff overhang if

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

Part (i) in Proposition 3 follows because (A.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 $P^F = \frac{\overline{\gamma}^* - \gamma^{*N}}{\overline{\gamma}^* - 1}$, the filing probability 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 3 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

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

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

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

(A.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 (A.3), (A.4), (A.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

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

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

(A.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

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

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

(A.8) and (A.9) hold with inequality as long as $\lambda \in (0, 1)$. (A.4), (A.8), (A.9) and $\partial P^F/\partial \gamma^{*N} < 0$ 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 3, which directly results in an increase in the probability to file a dispute. ■

B 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`. Notice that 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: In Figure 2, I calculate sectoral 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 that complainants encounter in defendant and non-defendant countries in dispute sectors one year prior to the initiation of a dispute.[32] The simple tariff averages also include estimates of ad-valorem equivalents of non-ad valorem tariffs.[33] In the second step, I subtract the simple averages of applied tariffs from the simple averages of bound tariffs to obtain the respective tariff overhangs. Figure 2 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 category 610210) to the United States, the European Union and Canada in 1996. If India files a trade dispute against the US in that year citing this product category but not against Canada and the EU, I include the tariff overhang faced by India in the US in HS category 610210 in 1995 in the left panel of Figure 2. Similarly, I include the tariff overhangs faced by India in the EU and Canada in the same category in the right panel.

Table 3 provides the means and standard deviations of tariff overhangs one year prior to the actual disputes, the cases in the left panel in Figure 2, and in the non-dispute country pairs, the cases in the right panel in Figure 2. As in the compilation of Figure 2, Table 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 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 and standard deviation of tariff overhangs in dispute sectors are much lower in defendant than in non-defendant countries. In fact, we can always reject the hypothesis that either means or standard deviations are identical in both

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

[33] For calculation details see the notes in the methodology section on the WITS homepage: `http://wits.worldbank.org/wits/Documents.html`.

samples at the 0.1 percent level of statistical significance.

Income Classifications: The definition of income groups in Figure 1 corresponds to the years' respective classifications by the World Bank.[34] As of 2014 (the last year of disputes in the sample), the income categories for countries in per-capita terms are: low income ($1,045 or less), lower middle income ($1,046 to $4,125), upper middle income ($4,126 to $12,745) and high income ($12,746 or more). As of the end of 2014, 27 of the 160 WTO member countries are low income, 39 are lower middle income, 39 are upper middle income and 54 are high income economies.

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