WTO Dispute Determinants

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Abstract

The notion of dispute resolution is central to WTO theory, which emphasizes country size and the ability to retaliate against trading partners as major determinants of WTO disputes. But these explanations cannot account for the steady drop in trade quarrels since the early 2000s and are silent on the link between trade policy and dispute initiations. This paper presents a new theory to show that "tariff overhangs", the difference between WTO members' bound and applied tariffs, are the key to understanding the WTO dispute pattern. In the model, lower tariff overhangs constrain WTO members' legal policy options when responding to adverse shocks. Moreover, countries are more likely to gain from dispute filings through WTO-administered tariff retaliation when applied tariff rates are close to their bindings. Guided by this framework, the paper presents empirical evidence that tariff overhangs are an essential determinant of WTO disputes.

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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 the early 2000s, 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 considerably. This drop in disputes was driven by a significant reduction in high income country participation, although their retaliatory power has certainly not been reduced. And second, the data suggests a close link between WTO members' trade policy structure and dispute activity, a fact that has received little attention so far. In particular, defendants in WTO disputes have substantially less trade policy flexibility in dispute sectors than non-defendants (WTO members not subject to dispute filings) as indicated by 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 Bown (2005), Horn et al. (2005), Sattler and Bernauer (2011) and Li and Qiu (2014) 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 the 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 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 reduction periods. Given that the phase-in periods for the newly negotiated Uruguay Round tariff bindings 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.

The model predicts that productivity adjustments can lead to import surges which countries wish to counter by additional protection measures. While the theoretical setup below focuses on tariff violations, the applicability of the dispute determinant channels outlined in this paper is not restricted to the subset of WTO disputes that directly deal with alleged tariff infractions, e.g. complaints on the illegal use of unfair trade laws in the form of anti-dumping, safeguard and countervailing duties.[4] It is well known that non-tariff measures are used in many instances as substitutes for tariffs, in particular when WTO members have low tariff overhangs.[5] Given the close link between tariff and non-tariff measures, in particular for countries with less tariff policy flexibility, the incentive mechanism outlined below is therefore also at the heart of WTO disputes that allege non-tariff violations. In the model, a country's tariff structure also plays a crucial role in the decision to file a dispute with the DSB after observing a WTO rule violation. Since the DSB enforcement threat is directly tied to the complainant country's willingness to retaliate, a dispute filing only occurs when a temporary increase of the tariff rate seems desirable. As a result, a harmed WTO member solely considers entering a dispute when the agreement prohibits the application of its individual optimal tariff, as revealed again 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, export diversity, legal capacity and political economy aspects. This paper therefore contains two major contributions. First, I

[4] Alleged illegal applications of anti-dumping, safeguards and countervailing measures account for around half of all WTO disputes (Horn et al., 2011).

[5] For instance, Beverelli et al. (2014) identify an existing tendency among WTO members to implement Technical Barriers to Trade (TBT) and Sanitary and Phytosanitary (SPS) measures after larger tariff reductions.

provide the theoretical argument and empirical evidence that tariff overhangs are crucial for WTO members' agreement violation and dispute filing decisions. And 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. Rosendorff (2005), Klimenko et al. (2008), Beshkar (2010b) and Park (2011) analyze the role of the DSB for cooperation among WTO members, while Maggi and Staiger (2011) characterize the optimal DSB mandate under different trade agreement contracts. Focusing on the outcomes of WTO disputes, Maggi and Staiger (2015) model and empirically test the relationship between different contract classes, early settlement decisions and DSB ruling precision. Bown and Reynolds (2015), on the other hand, present evidence that changes in trade volumes after resolved WTO disputes are in line with the terms-of-trade theory, in particular for high-income member countries. But none of these studies address the question which underlying factors explain the emerged pattern of WTO disputes.[6]

In its search for the determinants of the WTO dispute pattern, this paper is closest to Bown (2002, 2004b) who identifies political pressure as the key factor for WTO agreement breaches in a model that focuses on symmetric countries with fixed productivities and the negotiation of applied tariffs. I relax these assumptions by considering a world in which asymmetric countries negotiate a trade agreement with tariff bindings. Disputes can arise in the model due to unexpected productivity adjustments after successful WTO negotiation rounds. Dispute participation incentives then vary across countries due to differences in their underlying characteristics and, importantly, in the negotiated tariff overhang structure. The model's main prediction is that disputes should arise more frequently right after negotiations are concluded and between WTO members that feature low tariff overhangs — an empirically relevant but previously not considered determinant of the WTO dispute pattern.

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. This modeling approach builds on recent contributions in the literature on tariff bindings by Bagwell and Staiger (2005) and its extension to asymmetric countries by Beshkar and Bond (2015). 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 WTO dispute pattern. 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

[6] A recent exception is Conconi et al. (2015) who link US dispute filings to the President's re-election date.

Amador and Bagwell (2013) highlight the importance to differentiate between the negotiation of applied and bound tariff rates in trade agreements. In particular, tariff bindings can offer welfare improvements in an agreement when political pressure on foreign governments is not verifiable.[7]

The remainder of the paper proceeds as follows. Section II derives the equilibrium trade policies in an agreement with tariff bindings. Section III introduces trade disputes and examines a country's incentive for an agreement breach when facing unexpected productivity shocks. 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 Bindings

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 (2015). I derive the baseline agreement policies in this part and extend the framework by introducing disputes in section III.

II.1 Basic Setup

There are two countries, Home (no *) and Foreign (*) with N and N^* households, respectively. Each country produces and consumes three goods, $i = 0, 1, 2$. Good 0 is a freely tradeable numeraire good. 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 $i = 1, 2$.[8] Similar relationships hold for Foreign. Labor productivity in sector 2 (1) is greater in Home (Foreign), $\phi_2 = \phi_1^* > 1$ and $\phi_1 = \phi_2^* = 1$, making Home (Foreign) the natural importer of good 1 (2). 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

[7] A second way to motivate tariff bindings is the presence of non-negligible negotiation costs. If trade negotiations are very costly, an incomplete agreement with tariff bindings is an appealing alternative (Horn et al., 2010).

[8] Home's demand functions follow from the assumption of identical quasi-linear preferences of each household, $U = c_0 + \sum_{i=1,2} c_i(1 - .5c_i)$, where c_i describes consumption of good i. Labor is the only factor of production and every household in each country supplies the quantity l_i in the respective labor market. Each household 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 $X_i = Nx_i$. The production technology for good 0 is identical in Foreign, but differs for the non-numeraire goods, $x_i^* = (2\phi_i^* l_i)^{1/2}$. 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. Note that this three-goods environment is a stylized version of a general equilibrium framework which might not capture all policy effects on welfare.

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. Because goods prices 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 market-clearing price of good 1 in Home is found by setting $M = E^*$:

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

which along with Home's tariff rate is the key welfare determinant for both countries in Home's import sector. 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.[9] 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, varies 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 political pressure realization in the other country.[10] The literature on tariff bindings shows that mutual uncertainty about political pressures has important implications for 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:

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

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

[10] 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.

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. Equation (4) shows that larger and relatively less productive countries seek more protection given their greater market power and import volumes (particularly when facing high political pressure).

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 bound tariffs instead of fixed applied tariff rates.[11] Both countries can then apply their Nash tariff when political pressure is low and a tariff equal to the tariff binding 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

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

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

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

where $t^N(\gamma^N) = t^B$. As will be shown below, a country's government will only consider an agreement breach or a dispute filing after a violation if it faces political pressure above the level in (6).

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. Conditional on negotiating a bound tariff, expected world welfare in sector 1 is

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

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 binding in sector 1 by maximizing (7) with respect to t^B:[12]

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

[11] 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.

[12] See Beshkar and Bond (2015) for the proof that (8) is indeed a maximum.

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 binding proceeds in similar steps.

I am not concerned in this paper with the exact bargaining mechanism by which countries reach the efficient agreement and simply assume that Home and Foreign have successfully negotiated the tariff schedule in (5). In case Home and Foreign are too asymmetric, the larger country will require a transfer from the smaller country to refrain from setting its Nash tariff (Syropoulos, 2002).[13] However, support of the agreement is also possible through cooperation on non-trade issues in place of a monetary reward; see Limão (2007) for a discussion of this point.

III. The Emergence of Trade Disputes

In this section, I extend the baseline model to analyze under which circumstances countries are more likely to violate the previously negotiated trade agreement. I will focus throughout on the case when tariff bindings are pre-determined and cannot be renegotiated by Home and Foreign. The theoretical analysis should therefore be interpreted to apply to time periods between the completion of major WTO tariff negotiation rounds. To motivate agreement violations, I presume a link between trade liberalization and productivity, an empirical feature widely documented in the literature (Amiti and Konings, 2007, and Melitz and Ottaviano, 2008). When lower tariffs —through a new trade agreement or newly negotiated tariff bindings— lead to unexpected relative productivity adjustments over time, an ex post violation will become attractive under certain conditions. This result arises because countries' optimal tariffs and government welfare functions subsequently change as well.

Below, I first examine how a country's tariff overhang structure affects the likelihood to consider an agreement breach when facing an adverse shock. I then consider Home's welfare incentive to follow through with a violation. Foreign's incentive to file a complaint with the DSB after detecting a violation is considered in the next section.

III.1 Agreement Breach and the Structure of Tariff Overhangs

In modeling the incentive to breach the trade agreement, I focus without loss of generality on Home's perspective; a similar reasoning applies to Foreign. The prerequisite for Home to consider an agreement violation in a given period is an optimal tariff that exceeds the negotiated bound tariff. Given the outline of the model so far, a breach of the trade agreement should never happen.

[13] Amador and Bagwell (2013) provide the conditions under which an optimal trade agreement takes the form of a bound tariff instead of an applied tariff if no transfers between countries are available.

Home and Foreign negotiate a bound tariff as specified in section II.2 and potentially a transfer which induces both countries to always choose cooperation over a violation. Any agreement breach has to follow in turn from an unexpected event which is not foreseen during the initial negotiations. I motivate agreement violations by introducing into the model a link between trade liberalization and aggregate productivity shocks.[14] 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.[15] 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, when will Home consider a breach of the agreement? Home's decision is closely tied to the size of its tariff overhang, $t^B - t$. In general, a violation is only a sensible strategy if Home cannot set its preferred tariff rate, t^N, under the agreement's 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, a violation is pointless because Home can already set its individually optimal tariff. The intuition behind Home's incentive to violate the agreement after a shock to Foreign's productivity bears similarity to the "managed trade" argument in Bagwell and Staiger (1990). Bagwell and Staiger show that countries are more likely to implement additional protection in periods with import surges. A similar channel is at work here. A positive shock to Foreign's productivity causes a boost in exports of good 1, which will induce Home's government to raise its Nash tariff in (4) to provide greater protection to domestic producers. A lower tariff overhang prior to the shock then increases 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.

A positive productivity shock induces more violations by lowering the country size limit, $\tilde{\lambda}$, below which Home is always constrained by its tariff binding (incidence of case 1). In addition, by raising

[14] 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. A productivity shock is, however, only one plausible channel that could generate ex post violations of the agreement. The literature on the political economy of protection emphasizes several factors that potentially affect trade policy choices, such as import penetration, industry competition, factor ownership, unions or industry growth. See, e.g., Trefler (1993) for a detailed discussion.

[15] One could of course argue that future productivity adjustments would be incorporated into the original agreement. The negotiated tariff binding in (8) would then account for the additional uncertainty in the productivity parameter ϕ^*. But independent of the negotiated bound tariff, Home and Foreign would only close an agreement if cooperation is preferred to violations for all expected political pressure and productivity realizations. A breach would still require an unexpected event, such as a productivity shock beyond initial expectations. Thus, introducing an uncertain but expected productivity element would leave the general insights of the model unchanged. The analysis therefore focuses only on the unexpected component of productivity shocks while fixing the initial parameter.

the threshold $\gamma^N(t^B)$ in (6), a positive shock increases the share of political pressure realizations which result in a zero tariff overhang in Home in case 2.

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. Thus, most defendants are constrained by their tariff bindings. 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.[16] The sectoral tariff data further reveals that most defendants feature tight bindings in dispute sectors in earlier years as well, and there are only a few defendants with positive tariff overhangs which lower their applied tariffs prior to disputes (not shown, detailed statistics are available upon request).

III.2 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 when the prerequisite of a zero tariff overhang is met. In this part, I first discuss how the shock changes Home's welfare realizations in its import and export sectors and then derive conditions under which a breach is more likely to be welfare-improving.

Under the negotiated trade agreement, Home's aggregate welfare in a given period is

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

where W_i is Home's welfare in sector i. Welfare in sector 1 is now written as explicit function of ϕ^* since the parameter is not fixed anymore. Home makes a positive transfer payment, $T > 0$, if Foreign is large relative to Home, and vice versa. An agreement breach affects Home's welfare in two ways. First, Home will experience a welfare increase in its import sector by applying its Nash tariff instead of the agreement-consistent tariff binding: $W_1(t^N(\gamma), \gamma, \phi^*) - W_1(t^B, \gamma, \phi^*)$. And second, after a breach Foreign can resort to the DSB to obtain the right to set a retaliation tariff beyond the negotiated agreement schedule until the violation is removed, which would lower Home's welfare in its export sector, W_2. To analyze the adverse effects of a breach, a discussion is needed of the role of the dispute settlement institution in the agreement and the timing of events in each period.

In this paper, the DSB takes on primarily the role of a judge and rules in favor of the complainant

[16] 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 at least three reasons: 1. no bindings are set for certain sectors (which can bias the average bound rate), 2. specific bound and applied tariff rates might distort the calculation of tariff averages due to the necessary conversion into ad valorem equivalents (see Data Appendix), and 3. after negotiating new bound rates, WTO members are usually granted phase-in periods during which applied tariffs can exceed the new tariff bindings.

with exogenous probability π^{DSB} in case of a dispute.[17] The imperfection in the ruling pattern can follow from numerous reasons, such as limited information due to monitoring costs or the provision of misleading information.[18] The presence of the DSB is presumed to ensure the survival of the agreement, which implies the continuation of the transfer payment and is in line with the fact that a breach is unlikely to result in the termination of a country's WTO membership.[19] 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) in case of a violation by Home, i.e. $t > t^B$, Foreign decides whether to file a case with the DSB, (3) after a dispute filing, the DSB grants Foreign with exogenous probability π^{DSB} the right to retaliate, and (4) trade flows are realized.[20]

Given this time line, Home's welfare realization in its exports sector is marred by uncertainty since Foreign's strategic response to a violation depends on the (to Home) unknown political pressure parameter γ^*. Greater political pressure implies that Foreign chooses a higher dispute tariff, t^{*D}, in response to Home's violation. If Foreign fails to file a complaint with the DSB or loses the dispute, its tariff choice follows again from the agreement's tariff schedule, $t^{*D} = min[t^{*N}(\gamma^*), t^{*B}]$. In case of a successful complaint with the DSB, Foreign sets the retaliation tariff granted by the DSB, t^{*DSB}, or if lower, applies its Nash tariff to maximize its own welfare while adhering to the DSB ruling: $t^{*D} = min[t^{*N}(\gamma^*), t^{*DSB}]$. The determination of t^{*DSB} is discussed below.

Moreover, Foreign's political pressure realization also affects the probability that the DSB is alerted in the first place. Foreign only has an incentive to file a dispute when its Nash tariff exceeds the bound tariff, $t^{*N} > t^{*B}$, which coincides with the probability that the following condition is satisfied: $\gamma^* > \gamma^{*N}$. Otherwise, involving the DSB offers no potential welfare improvement because Foreign can already set its individually optimal tariff. Thus, Foreign's dispute filing probability after observing a violation is: $P^F = min\left[Pr(\gamma^* > \gamma^{*N}), 1\right] = min\left[\frac{\overline{\gamma}^* - \gamma^{*N}}{\overline{\gamma}^* - 1}, 1\right]$, where P^F always equals one if $\gamma^{*N} < 1$. The second equality follows from the uniform distribution of Foreign's political pressure parameter γ^* with support $[1, \overline{\gamma}^*]$.

[17] Maggi and Staiger (2011), focusing on the cases of protectionism and free trade, 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.

[18] Beshkar (2010a) shows that a DSB which randomizes its decisions can improve the efficiency of a trade agreement in the presence of uncertainty. 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."

[19] If the importer pays the transfer, the country could also renege on the payment instead of raising its tariff. However, the exporter might then stop cooperating under the WTO agreement altogether, even if the transfer does not involve a WTO obligation, which is not in the interest of the importer. The analysis below abstracts from this case.

[20] This setup implicitly assumes that Foreign never decides to retaliate without notifying the DSB and successful dispute filings always lead to tariff retaliation. While the latter assumption seems strict, it could be relaxed by allowing for an additional stage where Home decides early to comply with the ruling, The key point for the analysis below is that Foreign only files a case if it is willing to pursue retaliation against Home.

Home's welfare incentive to breach the agreement in a given period can then be summarized as:

$$\Omega = W_1(t^N, \gamma, \phi^*) - W_1(t^B, \gamma, \phi^*) - \pi^{DSB} P^F E\left[W_2(t^{*B}) - W_2(t^{*D}) | \gamma^* > \gamma^{*N}\right] \quad . \tag{10}$$

The first two terms describe Home's welfare gain in its import sector after a breach. The last term is Home's expected cost from deviating. Foreign successfully files and wins a dispute with probability $\pi^{DSB} P^F$, in which case a dispute tariff in excess of the negotiated tariff binding is set: $t^{*B} < t^{*D}$. Home's expected welfare loss (over the unknown pressure parameter γ^*) in its export sector is conditioned on $\gamma^* \in (\gamma^{*N}, \overline{\gamma}^*]$ because only within this range Foreign files a dispute.

How does the productivity shock affect Home's welfare incentive for an agreement breach? When ϕ^* rises, there is a direct effect on Home's welfare in its import sector through a change in Foreign's export supply function and an indirect effect through Home's Nash tariff adjustment. Home's welfare function in sector 2, however, only depends on Home's export sector productivity (ϕ) but is independent of ϕ^*. The same applies to Foreign's Nash tariff and tariff binding. If the dispute tariff equals Foreign's Nash tariff, $t^{*D} = t^{*N}$, Home's expected welfare loss in that sector, $E[W_2(t^{*B}) - W_2(t^{*D}) | \gamma^* > \gamma^{*N}]$, is then not affected by the shock.

How does the productivity shock affect Home's welfare in its export sector when Foreign sets instead the DSB-granted retaliation tariff, $t^{*D} = t^{*DSB}$? To answer this question, we need to consider how the DSB determines t^{*DSB}. 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." Bagwell and Staiger (2001, p. 303) define the *suspension of equivalent concessions* as mutual changes in trade policy which lead to equivalent adjustments in import values in Home and Foreign, as measured at the original world prices. While according to this reciprocity condition the DSB tariff then implicitly depends on Home's Nash tariff choice and ϕ^*, 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.[21]

The discussion in the previous two paragraphs implies that the productivity shock only affects the first two terms in equation (10). The overall change in Home's welfare incentive for a breach can now be determined by taking the total differential of the expression in (10) with respect to ϕ^*:

$$\Delta\Omega = \frac{d\Omega}{d\phi^*} = \frac{\partial W_1(t^N, \gamma, \phi^*)}{\partial \phi^*} - \frac{\partial W_1(t^B, \gamma, \phi^*)}{\partial \phi^*} \quad . \tag{11}$$

Appendix A.2 provides the detailed expression of equation (11). Using the envelope theorem and the fact that Home cannot adjust its bound tariff retroactively, I show there that Home's welfare

[21] 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.

incentive to breach the agreement is completely driven by the direct effect of the productivity shock on Home's welfare function in its import sector, W_1, and not its Nash tariff adjustment. The sign of $\Delta\Omega$ in (11) is ambiguous and depends on the model's parameters. 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 welfare 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 is more likely to result in a breach when (i) Home is large (high λ), (ii) Home's productivity disadvantage in its import sector is small (low ϕ^*), and (iii) there is substantial uncertainty about Home's political pressure (high $\overline{\gamma}$). 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 a trade agreement are smaller for a relatively large country with only a slight productivity lag behind its trading partner; a breach is attractive under these circumstances. Moreover, a rise in the maximum political economy weight implies on average a greater government preference to protect domestic producer interests, lowering the benefits from cooperation as well.

At this point, it is crucial to reiterate that Home's breach decision 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 bound tariff in (8) reveal that larger countries (high λ) with a substantial import sector productivity disadvantage (high ϕ^*) and a narrow range of political pressure (low $\overline{\gamma}$) have lower tariff overhangs. In conjunction with Proposition 1, the same parameters determine when Home is more likely to meet the zero tariff overhang prerequisite after an adverse productivity shock. Considering also Proposition 2, country size emerges then as the only parameter that simultaneously raises Home's probability for a tight tariff overhang and the welfare incentive for a breach. Hence, smaller WTO members, such as many developing countries, are less likely to face a tariff setting constraint and can react to adverse shocks within the limits of the agreement. Moreover, the gains from a breach are often not sufficient for them to make up for the potential welfare losses through DSB-administered retaliation. Relatively large countries, on the other hand, are more frequently defendants in WTO disputes because of their lower tariff

overhangs and greater welfare incentive for a breach. These findings provide the theoretical basis for the previously identified link between country size and WTO dispute participation.

IV. The Likelihood of Dispute Filings

This section moves on 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, and then explore which countries are the most likely targets of dispute filings.

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 expression follows directly from the assumption that Foreign's political pressure is distributed uniformly with support $[1, \overline{\gamma}^*]$.[22] Intuitively, the filing probability captures the likelihood that Foreign's Nash tariff is greater than its bound tariff because only then the country benefits from a DSB-authorized retaliation tariff. Proposition 3 illustrates how the three different parameters in Foreign's own import market $(\lambda, \phi, \overline{\gamma}^*)$ affect its dispute filing probability.

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, Foreign faces a lower bound tariff in its own import sector when the country is large. Since the value of a DSB-granted retaliation tariff is greater for countries with less tariff setting flexibility, a dispute filing is then more appealing for large economies. Second, if the range of political pressure realizations increases, the trade agreement negotiations result in a higher tariff binding 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). When Foreign can set its Nash tariff more frequently, a dispute filing becomes less attractive. 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 Foreign's Nash tariff. An increase in ϕ also lowers the

[22] 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.

negotiated bound tariff in case 2 to limit Foreign's trade taxation power, which it can otherwise use too excessively. Both effects imply that a higher import sector productivity disadvantage decreases Foreign's trade policy flexibility in the agreement, which makes a dispute filing more appealing.

IV.2 Exports and Dispute Filings

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

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

$$E^* = \frac{\lambda(1-\lambda)[\phi^{*'} - 1 - 2t^N]}{2\lambda(1+t^N) + (1-\lambda)(1+\phi^{*'})} = \frac{\lambda(1-\lambda)[\phi^{*'}(3-\gamma) - (1+\gamma)]}{8\lambda + (1-\lambda)(1+\phi^{*'})(3-\gamma)} \quad , \tag{12}$$

where the Nash tariff indicates that Home deviates from the agreement and $\phi^{*'}$ is Foreign's new productivity parameter after the shock. Equation (12) shows that Foreign's exports depend on Home's size (λ), Foreign's productivity edge in Home's import sector ($\phi^{*'}$) and political pressure 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 and its filing probability is Home's size.

Equation (12) 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 (12) with respect to λ.[23] The value of Home's size which maximizes Foreign's exports, $\hat{\lambda}$, depends on the political pressure in Home and Foreign's relative productivity edge in Home's import sector but in general tends toward $\lambda = 0.5$:

$$\hat{\lambda} = \begin{cases} 0.5 & \text{if} \quad \gamma = \frac{3\phi^{*'} - 5}{1+\phi^{*'}} \\ \sqrt{(1+\phi^{*'})(3-\gamma)}\left[\frac{\sqrt{8} - \sqrt{(1+\phi^{*'})(3-\gamma)}}{8-(1+\phi^{*'})(3-\gamma)}\right] & \text{otherwise} \end{cases} \tag{13}$$

where $\hat{\lambda}$ is either increasing or decreasing in $\phi^{*'}$, depending on the exact realization of γ. In particular, $\hat{\lambda}$ tends to rise for larger values of political pressure in Home, and vice versa. Thus, the expression in (13) predicts that Foreign's exports to Home are highest if both countries are of similar size ($\lambda = 0.5$). 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

[23] 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 a bell-shaped function, note that for any $\lambda \in (0, 1)$ the second order condition of (12) is negative, implying a concave shape of E^* with respect to λ.

economic mass of the two trading partners (see, e.g., Head and Mayer, 2014). The left panel in Figure 3 depicts E^* as function of λ, with $\hat{\lambda}$ indicating the maximum level of Foreign's exports.

The right panel in Figure 3 shows the dispute filing probability as function of λ, conditional on an agreement violation by Home. Foreign always files a dispute as long as its tariff overhang is zero, that is, when the country is relatively large. Otherwise, as Proposition 3 indicates, Foreign's filing probability is decreasing in Home's size. More specifically, Foreign's filing probability declines as long as Home's size exceeds the following value:

$$\dot{\lambda} = \frac{2[(3\phi - 1) - \overline{\gamma}^*(1 + \phi)]}{2(3\phi - 1) - (1 + \overline{\gamma}^*)(1 + \phi)} \quad . \tag{14}$$

Intuitively, the filing probability decreases above the value in (14) because there are low enough political pressure realizations which allow Foreign to set its Nash tariff without alerting the DSB.[24]

Using Figure 3, we can now establish that a positive correlation between exports and the dispute filing probability is the logical outcome of the previous analysis. While we cannot solve for the exact probability of a breach, the earlier results show that larger WTO members violate the agreement more frequently than smaller economies. The right-hand portion of both graphs in Figure 3 is then most relevant for the analysis. Proposition 4 summarizes the condition under which a qualitative statement about the relationship between filing probability and exports 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 from the fact that increases in Home's size 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 exports and filing probability is thus imperative when λ is greater than both thresholds. Intuitively, the harmed country only files a dispute in case of a zero tariff overhang, which becomes more likely when Foreign increases in size. And as long as Foreign is smaller than Home, an increase in its size also simultaneously boosts Foreign's exports 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 greater dependence of the complainant on the defendant as

[24] Following similar steps as in the derivation for Home in section II.2, Foreign's bound tariff in the trade agreement is $t^{*B} = \frac{\overline{\gamma}^* - 1}{5 - \overline{\gamma}^*}$ if $\lambda \leq \dot{\lambda}$, and $t^{*B} = \frac{(\overline{\gamma}^* - 1)(1+\phi) - 2(1-\lambda)(\phi - 1)}{(3 - \overline{\gamma}^*)(1+\phi) - 4(1-\lambda)}$ if $\lambda > \dot{\lambda}$.

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.

V. Tariff Overhangs and WTO Disputes: 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 linear probability framework and two regression approaches. The first specification examines whether countries' average MFN tariff overhangs are linked to dispute participation by estimating the following linear probability model:

$$DISPUTE_{cdt} = \beta_0 + \beta_1 OVERHANG_{c,t-1} + \beta_2 OVERHANG_{d,t-1} + \beta_3 RELSIZE_{cd,t-1} + \delta Z_{cd,t-1} + \nu_{cd} + \omega_t + \mu_{cdt} \tag{15}$$

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.[25] As previously noted, I also include in the analysis WTO disputes which are not directly concerned with tariff measures given the empirical evidence that non-tariff barriers are close substitutes for tariffs.[26] In addition to the variables of interest, the empirical model includes country-pair fixed effects, ν_{cd}, and year fixed effects, ω_t, to control for unobservables at the bilateral level and common time trends. Note that in the present framework with a large number of fixed effects, a linear probability model is preferable to both a probit or logit estimator which suffer from the incidental parameters problem that leads to biased marginal effect estimates; see Greene (2002, 2008) for a discussion.

To control for information delays, I include one period lagged values of all independent variables. $OVERHANG_{c,t-1}$ and $OVERHANG_{d,t-1}$ are the potential complainant's and defendant's average MFN tariff overhangs in a given year, respectively.[27] In line with Propositions 1 and 3, we should expect that $\beta_1 < 0$ and $\beta_2 < 0$. For dispute defendants, a lower tariff overhang increases the likelihood to meet the prerequisite for an agreement violation after a productivity shock. On the

[25] One caveat that applies when interpreting the empirical results is the move from the theoretical model's sectoral structure to a more aggregate level. However, due to the lack of sector-specific data for many countries and variables of interest this disclaimer applies to much of the literature. For a detailed discussion see, for instance, Goldberg and Maggi (1999) and Gawande et al. (2015).

[26] The results below are robust to excluding disputes that cover export policies, intellectual property rights and services. Detailed results are available upon request.

[27] I calculate tariff overhangs as the difference between the simple averages of a country's bound and most-favored-nation applied tariff rates across sectors; the results are similar with trade-weighted averages.

complainant side, the link is more subtle. According to the model, only countries with zero tariff overhangs file disputes. However, with many import goods, this requirement does not have to be met in each sector. We can still expect a negative impact of $OVERHANG_{c,t-1}$ on dispute incidence as long as the average tariff overhang is inversely related to the incidence of zero tariff overhangs.

In line with the theory, I also include a measure of size asymmetry which I proxy with a country pair's absolute difference in log GDPs, $RELSIZE_{cd,t-1}$. While the earlier analysis shows that larger economies have a greater incentive for a breach, Proposition 3 also suggests that larger countries are more likely to file a dispute. Combining these two predictions, disputes should involve countries of not too different size, implying a negative impact of $RELSIZE_{cd,t-1}$ on dispute incidence, $\beta_3 < 0$. Finally, $Z_{cd,t-1}$ describes a collection of additional covariates which I discuss in passing below.

The second specification accounts for the fact that countries face varying tariff overhang pressures across sectors and trading partners. In place of average tariff overhangs as in (15), I include for each country pair the bilateral share of import sectors (at the 6-digit HS level) in which the complainant and defendant have negative or zero tariff overhangs, respectively. Specifically, I estimate:

$$\begin{aligned} DISPUTE_{cdt} = \gamma_0 + \gamma_1 OVERHANGSHARE_{cd,t-1} + \gamma_2 OVERHANGSHARE_{dc,t-1} \\ + \gamma_3 RELSIZE_{cd,t-1} + \theta Z_{cd,t-1} + \nu_{cd} + \omega_t + \eta_{cdt} \end{aligned} \tag{16}$$

where

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

$\mathbf{1}$ is an indicator function, and $I_{cdi,t-1}$ denotes the set of 6-digit HS sectors (indexed by i) in which country c records imports from country d in year $t-1$. $OVERHANGSHARE_{cd,t-1}$ is then country c's share of active 6-digit HS import sectors from country d with a zero or negative tariff overhang in year $t-1$. $OVERHANGSHARE_{dc,t-1}$ is defined accordingly. In line with the model's predictions, countries with a greater share of sectors with zero tariff overhangs should be more likely to appear as either complainants or defendants in WTO disputes: $\gamma_1 > 0$ and $\gamma_2 > 0$. As above, $RELSIZE_{cd,t-1}$ is expected to have a negative effect on dispute incidence: $\gamma_3 < 0$.

I consider in the analysis all potential WTO dispute pairs between 1995 and 2014. The member countries of the European Union are treated as a single entity. 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 one year prior to a potential dispute. Data on tariffs (including ad valorem equivalents) and trade flows come from the TRAINS and COMTRADE databases, respectively. Table 3 provides definitions, sources and summary statistics for all variables. Overall, the unbalanced panel includes 43,890 observations.

V.1 Average MFN Tariff Overhangs and WTO Dispute Incidence

Table 4 provides OLS regression results of the WTO dispute incidence variable on average tariff overhangs as specified in (15) with a varying set of control variables. Column (1) considers the most parsimonious specification which includes both the potential complainant's and defendant's average tariff overhangs, $RELSIZE_{cd,t-1}$ and two measures that control for the complainant's and defendant's tariff liberalization since the Uruguay Round, $UR\_LIB_{c,t-1}$ and $UR\_LIB_{d,t-1}$. As argued in section III, country pairs that implement larger tariff cuts after successful negotiation rounds are at the greatest risk to face productivity shocks which motivate in turn ex post violations of the WTO agreement. While we cannot directly observe these shocks, both variables can proxy for tariff-induced productivity adjustments after the Uruguay Round, the last successful large-scale GATT/WTO tariff liberalization. For each WTO member, the post-Uruguay Round liberalization measures are computed as the change in the average applied MFN tariff rate from 1994 (or the first available earlier year) until one year prior to a potential dispute.[28] For countries that joined the WTO after 1994, I include instead the change in tariffs since the year before they became members. Since larger tariff cuts should lead to more WTO dispute participation, both $UR\_LIB_{c,t-1}$ and $UR\_LIB_{d,t-1}$ are expected to enter with a negative sign in the regressions.

In line with the theory, the tariff overhang estimates in column (1) are negative and significant at the one percent level (all standard errors are robust to clustering by country pairs). The results support the hypothesis that lower tariff overhangs raise the likelihood for member countries to participate either as complainants and defendants in WTO disputes. The negative and significant coefficient of $RELSIZE_{cd,t-1}$ also confirms the theoretical prediction that countries of similar size are more likely to meet in a WTO dispute. Thus, in line with the model, the structure of tariff overhangs and WTO members' relative size are inversely linked to WTO dispute incidence.

One possible alternative explanation to explain the spike of disputes in the early years of the WTO is that members might have felt the need to establish legal precedent in certain areas of WTO law. To control for this possibility, columns (2)-(5) add year fixed effects to the regressions. Moreover, I introduce country-pair fixed effects to account for unobservable time-invariant dispute determinants. The tariff overhang estimates remain negative and significant in column (2), and the magnitude of both effects nearly doubles compared to the specification without fixed effects. Using the estimates in column (2), a one standard deviation drop in the complainant's (defendant's) average tariff overhang raises the probability for a WTO dispute with a trading partner in a given year by .6 percentage points (.8 percentage points).[29] The estimates of the tariff-induced

[28] Trefler (2004) points out that tariff adjustments through trade agreements can have substantial long-run effects on productivity. This observation is particularly relevant for the WTO where members were granted phase-in periods of 5 to 10 years after the conclusion of the Uruguay Round (or when they newly joined thereafter).

[29] The standard deviation for the complainants' and defendants' tariff overhangs in the sample is .2481 (in ad valorem terms) which combined with the tariff overhang coefficients imply an increase in the dispute participation probabilities of $-.2481 \times -.0248 = .6\%$ and $-.2481 \times -.0311 = .8\%$, respectively.

productivity shock proxies, $UR\_LIB_{c,t-1}$ and $UR\_LIB_{d,t-1}$, also enter now negatively and are both significant at the one percent level. $RELSIZE_{cd,t-1}$ still has a negative impact but is not significant anymore. Relative country size changes only very little over shorter periods of time, implying that the country-pair fixed effects now capture most of the variation in this variable.

Columns (3)-(5) subsequently introduce additional potential determinants of WTO disputes, some of which have been previously suggested in the literature. In specification (3), I decompose the relative size measure and include both the defendant's and complainant's GDP (in logs) in the regression, $logGDP_{d,t-1}$ and $logGDP_{c,t-1}$, respectively. Absolute country size, as measured by GDP, only has a significant effect on dispute initiations on the defendant side. The results regarding tariff overhangs and the tariff liberalization controls remain unchanged.

According to Proposition 4, imports of the defendant from the complainant are positively linked to dispute filings. Specification (4) therefore includes the defendant's bilateral imports (in logs) from the complainant country, $logIMPORTS_{dc,t-1}$. The complainant's respective counterpart is also added, $logIMPORTS_{cd,t-1}$, which we should expect to enter with a positive sign because higher imports from the defendant imply a greater retaliatory capacity. To control for political economy aspects, the dummy variable $PTA_{cd,t-1}$ is introduced which takes the value one if a country pair has a preferential trading relationship. Controlling for PTAs is potentially important because MFN tariff overhangs should be a less relevant margin for disputes when countries grant each other freer market access. Nonetheless, the effect of a PTA is unsure ex ante. It can decrease dispute participation because retaliation threats have a higher deterrent effect in this case, and PTA members might potentially use alternative forums to resolve disputes.[30] However, a positive effect of PTA membership on dispute participation is also possible if countries with tighter tariff overhangs are more likely to form PTAs. To examine whether the impact of tariff overhangs varies with PTA membership status, I also include interactions of the PTA dummy with the overhang variables. The results in column (4) show that the additional controls slightly increase the magnitude of the tariff overhang estimates. Moreover, $logIMPORTS_{dc,t-1}$ has a positive and significant effect, which offers empirical support for Proposition 4: there is a positive link between dispute initiation and the complainant's exports to the defendant. The estimated effect of the complainant's bilateral imports is positive and significant (at the five percent level) as well. Finally, neither the linear PTA term nor the interactions with the tariff overhang measures significantly affect WTO dispute initiation.

To further examine the robustness of the results, specification (5) adds WTO dispute determinants suggested in the previous literature. Using a simulation exercise, Horn et al. (2005) predict that export diversity increases WTO dispute incidence. To account for this channel, I include the Hummels and Klenow (2005) extensive margin measures of bilateral exports between complainants and defendants, $DIVERSITY_{cd,t-1}$ and $DIVERSITY_{dc,t-1}$, respectively. Column (5) also considers proxies for a

[30] Porges (2011) and Chase et al. (2013) note that up till now most PTA dispute settlement mechanisms do not appear to have been used at all or only at a very low frequency.

complainant's legal (GNI per capita) and retaliation capacities (complainant's share in defendant's total exports), $LEGALCAPACITY_{c,t-1}$ and $RETALIATIONCAPACITY_{c,t-1}$, which previously have been found to raise the likelihood to initiate and to succeed with a dispute filing (Bown, 2004a, and Davis and Bermeo, 2009). To control for potential macroeconomic causes of import protection and WTO disputes, as suggested by Bown and Crowley (2013), both the complainant's and defendant's unemployment rates, $UNEMPRATE_{c,t-1}$ and $UNEMPRATE_{d,t-1}$, and real GDP growth, $rGDPGROWTH_{c,t-1}$ and $rGDPGROWTH_{d,t-1}$, are also added.

As predicted, both diversity terms are positive and significant in column (5). And while legal capacity does not exert a significant effect, a complainant's retaliation capacity is confirmed to be a positive and significant contributor to dispute filing decisions. When directly accounting for a complainant's retaliation capacity, the actual level of imports from the defendant, $logIMPORTS_{cd,t-1}$, ceases to be a driver of the filing decision. Of the macroeconomic determinants, only the defendant's unemployment rate has a significant negative effect on dispute initiations, which could indicate that WTO members can more easily justify contingent protection measures during business cycle downturns. Most importantly, however, specification (5) confirms the previous tariff overhang findings. Low tariff overhangs are a crucial contributor to dispute filing decisions even when controlling for a wide range of previously suggested dispute determinants.

V.2 Bilateral Tariff Overhang Shares and WTO Dispute Incidence

Table 5 presents results for the empirical model specified in (16) which replaces the average MFN tariff overhang measures used in Table 4 with bilateral tariff overhang shares. Specifications (6)-(10) follow the estimation structure in Table 4. Column (6) provides the results from the baseline regression which includes the potential complainant's and defendant's relative size measure, their average applied tariff reductions since the Uruguay Round and their respective bilateral shares of import sectors with a zero or negative tariff overhang, $OVERHANGSHARE_{cd,t-1}$ and $OVERHANGSHARE_{dc,t-1}$. The coefficients of the relative size and overhang share variables are of the expected signs and significant at the one percent level, respectively. 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 again year and country-pair fixed effects. While the magnitude of the tariff overhang estimates decreases, the coefficients are still significant at the five percent level for defendants and borderline significant for complainants with a p-value of .101. Using the estimates in column (7), complainants and defendants that feature zero tariff overhangs in all active bilateral import sectors have each a .4 percentage point higher probability to participate in a WTO dispute with a partner in a given year. While the negative impact of $RELSIZE_{cd,t-1}$ is preserved in column (7), the inclusion of country-pair fixed effects produces again an insignificant estimate. As in Table

4, both $UR\_LIB_{c,t-1}$ and $UR\_LIB_{d,t-1}$ exert the expected significant negative effects (at the one and five percent level, respectively). At least part of the drop in disputes after the early 2000s can be attributed to changes in the tariff overhang structure of WTO members over time. Figure 5 depicts the evolution of the bilateral share of import sectors with zero or negative tariff overhangs, as defined in (16), for the most active dispute pair in the early years of the WTO, the United States and the European Union. In both countries, the respective shares dropped from nearly 100 percent in 1995 to around 90 percent in 2007, with slight variations thereafter. This trend is mostly due the decreases in applied tariff rates while most tariff bindings were held steady in both the EU and the US since the Uruguay Round. Thus, the tariff overhang pressure for US-EU trade has diminished over time, leading in turn to fewer WTO disputes.

When replacing $RELSIZE_{cd,t-1}$ with each country's log GDP in column (8), the overhang term estimates are of comparable magnitude to specification (7) but decrease slightly in terms of statistical significance. After adding again the PTA and trade covariates in specification (9) and reintroducing the countries' relative size measure, the defendant's overhang share returns to the five percent significance level while the complainant's measure turns significant at the ten percent level. The results for the other regressors are comparable to specification (4). As predicted by Proposition 4, the positive and significant sign of $logIMPORTS_{dc,t-1}$ implies that WTO members are more likely to file disputes against important export destinations. None of the PTA terms is significant.

Column (10) introduces the same set of additional control variables as in specification (5). The impact of the tariff overhang shares on dispute participation is unchanged. A higher share of sectors with tight tariff overhangs induces countries to initiate and receive more trade policy complaints through the WTO dispute settlement mechanism. The coefficient estimates and statistical significance of the other potential dispute determinants are similar to column (5) of Table 4. Export diversity exerts a positive and significant effect on dispute participation, as does the complainant's retaliation power which absorbs the previously positive effect of the complainant's bilateral imports. The defendant's unemployment rate has still a significant negative effect on dispute incidence.

V.3 Robustness

Table 6 further investigates the robustness of the results by considering (i) alternative tariff overhang specifications, (ii) tariff overhangs determinants suggested in the literature, (iii) a more extensive set of controls for existing preferential tariff arrangements, and (iv) additional proxies for tariff-induced productivity shocks. All regressions in Table 6 include the same set of potential WTO dispute determinants as specifications (5) and (10), which therefore serve as the relevant reference points.[31]

To examine whether the average and bilateral share measures of tariff overhangs are separate

[31] To conserve space, Table 6 only reports the estimation results for the tariff overhang variables, the relative size measure, the productivity shock proxies and the additional covariates that are introduced for robustness checks. The conclusions for the remaining variables are unchanged. The complete set of results is available upon request.

drivers of WTO disputes, specification (11) simultaneously includes both sets of variables. The magnitude and statistical significance of all tariff overhang variables remains stable compared to specifications (5) and (10), respectively. Hence, the different measures capture similar but distinct effects of the tariff overhang structure on WTO dispute incidence. Specification (12) replaces the 0-percent threshold for the tariff overhang share measures with a 5-percent cutoff, i.e. the overhang share measures now capture the proportion of bilateral import sectors with a tariff overhang of five percent or less. While the magnitude of the overhang share coefficients slightly decreases, the effects for complainants and defendants are still statistically significant at the ten percent level, implying that a less stringent definition of tariff overhang pressure results in similar findings.

Specifications (13) to (16) focus again exclusively on the average tariff overhang measures. To rule out that the previous estimates are biased due to the omission of variables which could simultaneously drive a country's WTO tariff structure and dispute participation decisions, specification (13) adds the tariff overhang determinants suggested by Beshkar et al. (2015). In particular, the regression includes for both defendants and complainants a measure of political stability ($POL\_STABILITY$) – taken from the Worldwide Governance Indicators, the country's share of world imports ($WORLDIMPSHARE$), and the proportion of imports sourced from PTA partners ($PTAIMPSHARE$). According to theory, a more stable political environment and a greater world import share, which indicates more market power, should both lower tariff overhangs. The import share from PTA partners further helps to account for the potential interplay between PTAs and countries' MFN tariff structure. Column (13) shows that the coefficients of the average tariff overhang variables remain stable and significant, with a slight decrease in magnitude for complainants and an increase for defendants. While the theory is silent on the expected impact of the new variables on dispute incidence beyond their effect on tariff overhangs, the estimates indicate that countries which are more politically stable and trade more with PTA partners tend to participate more frequently in WTO disputes. Similarly, WTO members with a greater share of world imports are more likely to become dispute defendants, while the opposite is true for complainants.

Specification (14) adds further controls for preferential trading arrangements in the form of three dummy variables. $GSP_{cd,t-1}$ and $GSP_{dc,t-1}$ take the value one if the complainant or defendant grant GSP benefits to their respective trading partner, while $ITA_{cd,t-1}$ indicates if both countries are signatories to the WTO IT Agreement. The tariff overhang coefficient estimates remain again stable, and none of the GSP and ITA controls has a significant effect on dispute incidence.

Specifications (15) and (16) examine whether the tariff overhang results are sensitive to the choice of the tariff-induced productivity shock measures, $UR\_LIB_{c,t-1}$ and $UR\_LIB_{d,t-1}$. The regression in (15) replaces the one-year with two-year lag measures to avoid potential multicollinearity issues with the tariff overhang measures. After this change, the average tariff overhang measures remain significant predictors of the WTO dispute pattern. It is, of course, also possible that $UR\_LIB_{c,t-1}$ and $UR\_LIB_{d,t-1}$ overstate the potential incidence of productivity shocks (and trade disputes) in

the later years of the sample which are farther removed from the end of the Uruguay Round in 1994. To account for the possibility that the impact slowly faded out over time, specification (16) attenuates the Uruguay Round tariff reduction terms in later years using the exponential discount factor $e^{-\rho t}$, where t is the number of years after which a country's post-Uruguay Round tariff phase-in period ended. The regression model in (16) uses a discount rate of $\rho = .05$ which implies a 40 percent drop in the impact of the tariff reductions after 10 years.[32] The results in column (16) show that the average tariff overhang estimates are robust to accounting for a diminished impact of tariff-induced productivity shocks in later years of the sample. Average tariff overhangs remain a robust predictor of the WTO dispute pattern.

Finally, specifications (17)-(20) repeat the same robustness diagnostics as in specifications (13)-(16) but replace the average tariff overhangs with the overhang share measures. The overhang share coefficients are throughout of the same magnitude and statistical significance as in the baseline specification (10) in Table 5. The results in Table 6 thus provide further evidence that tariff overhangs are an important driver of the emerged WTO dispute pattern since 1995.

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 a result of tariff reductions in the WTO. Countries with tight tariff overhangs are also more likely to gain from dispute filings, since in the case of noncompliance the DSB-awarded retaliation tariff is then a more promising policy option.

This paper also provides insights into the underlying theoretical 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 adverse shocks. The lack of dispute participation by most developing countries 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 incidence, even when controlling for countries' size, trade volumes, export diversity, legal capacity, preferential

[32] The discount factor calculations assume that the tariff phase-in periods after the Uruguay Round (or the WTO accession for nations that joined after 1994) were 5 years for high-income and 10 years for other member countries. The results are robust to a wide range of discount factors; detailed results are available upon request.

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? This paper suggests that the key to making the WTO system more accessible is to reform the compensation mechanism. 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.[33] 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 as in Bagwell et al. (2007).

[33] If political pressure is persistent through time, countries with high tariff overhangs could suffer additional welfare losses because they may have to apply above-optimal tariffs to conceal their retaliation weakness (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*, 2015.

_ **,** _ **, and Youngwoo Rho**, "Tariff Binding and Overhang: Theory and Evidence," *Journal of International Economics*, 2015, *97* (1), 1–13.

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

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 Kara M. Reynolds**, "Trade Agreements and Enforcement: Evidence from WTO Dispute Settlement," *World Bank Policy Research Paper No. 7242*, 2015.

_ **and Meredith A. Crowley**, "Import Protection, Business Cycles, and Exchange Rates: Evidence from the Great Recession," *Journal of International Economics*, 2013, *90* (1), 50–64.

_ **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, pp. 149–193.

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.

Chase, Claude, Alan Yanovich, Jo-Ann Crawford, and Pamela Ugaz, "Mapping of Dispute Settlement Mechanisms in Regional Trade Agreements – Innovative or Variations on a Theme?," *WTO Staff Working Paper ERSD-2013-07*, 2013.

Conconi, Paoloa, David R. DeRemer, Georg Kirchsteiger, Lorenzo Trimarchi, and Maurizio Zanardi, "Suspiciously Timed Trade Disputes," *Working Paper*, 2015.

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.

Gawande, Kishore, Pravin Krishna, and Marcelo Olarreaga, "A Political-Economic Account of Global Tariffs," *Economics & Politics*, 2015, *27* (2), 204–233.

Goldberg, Pinelopi K. and Giovanni Maggi, "Protection for Sale: An Empirical Investigation," *American Economic Review*, 1999, *89* (5), 1135–1155.

Greene, William H., "The Bias of the Fixed Effects Estimator in Nonlinear Models," *Working Paper*, 2002.

_ , *Econometric Analysis*, 6th ed., Pearson Prentice Hall, 2008.

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," in Gita Gopinath, Elhanan Helpman, and Kenneth S. Rogoff, eds., *Handbook of International Economics*, Vol. 4, Oxford, UK: North-Holland, 2014, pp. 131–195.

Henn, Christian and Arevik Gnutzmann-Mkrtchyan, "The Layers of the IT Agreement's Trade Impact," *WTO Working Paper ERSD-2015-01*, 2015.

Horn, Henrik and Petros C. Mavroidis, "WTO Dispute Settlement Database," 2011. Available at: `http://go.worldbank.org/X5EZPHXJY0`.

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

_ **, Louise Johannesson, and Petros C. Mavroidis**, "The WTO Dispute Settlement System 1995–2010: Some Descriptive Statistics," *Journal of World Trade*, 2011, *45* (6), 1107–1138.

_ **, 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.

Hummels, David and Peter J. Klenow, "The Variety and Quality of a Nation's Exports," *American Economic Review*, 2005, *95* (3), 704–723.

Hungerford, Thomas L., "GATT: A Cooperative Equilibrium in a Noncooperative Trading Regime?," *Journal of International Economics*, 1991, *31* (3/4), 357–369.

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.

Kovenock, Dan and Marie Thursby, "GATT, Dispute Settlement, and Cooperation," *Economics and Politics*, 1992, *4*, 151–170.

Li, Tan and Larry D. Qiu, "Beyond Trade Creation: Free Trade Agreements and Trade Disputes," *Working Paper*, 2014.

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.

Liu, Xuepeng, "GATT/WTO Promotes Trade Strongly: Sample Selection and Model Specification," *Review of International Economics*, 2009, *17* (3), 428–446.

Ludema, Rodney D., "Optimal International Trade Agreements and Dispute Settlement Procedures," *European Journal of Political Economy*, 2001, *17*, 355–376.

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 Agreements with Imperfect Private Monitoring," *Review of Economic Studies*, 2011, *78* (3), 1102–1134.

Porges, Amelia, "Dispute Settlement," in Jean-Pierre Chauffour and Jean Christophe Maur, eds., *Preferential Trade Agreement Policies for Development*, Washington, DC: World Bank Group, 2011, pp. 467–501.

Rosendorff, B. Peter, "Stability and Rigidity: Politics and Design of the WTO's Dispute Settlement Procedure," *American Political Science Review*, 2005, *99* (3), 389–400.

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.

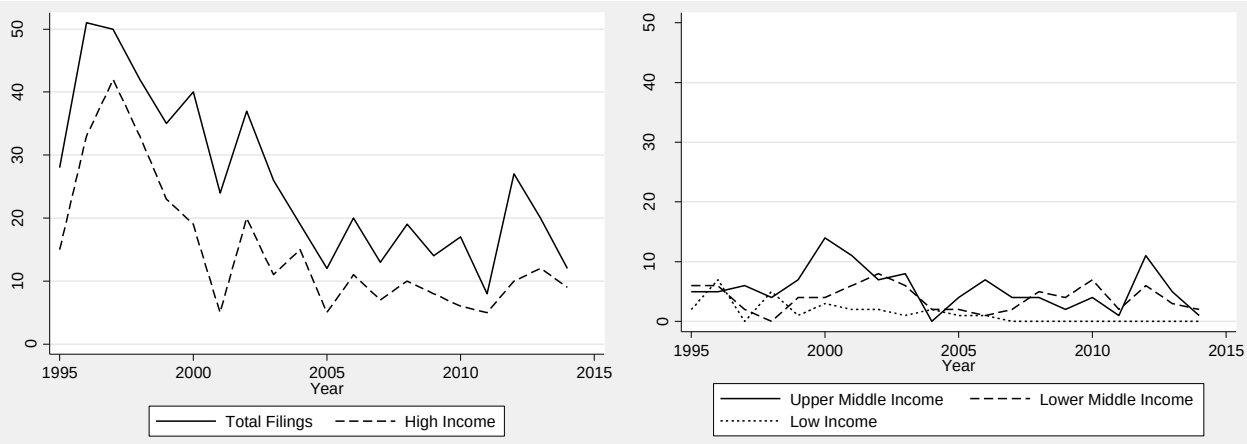
Syropoulos, Constantinos, "Optimum Tariffs and Retaliation Revisited: How Country Size Matters," *Review of Economic Studies*, 2002, *69* (3), 707–727.

Trefler, Daniel, "Trade Liberalization and the Theory of Endogenous Protection: An Econometric Study of U.S. Import Policy," *Journal of Political Economy*, 1993, *101* (1), 138–160.

_ , "The Long and Short of the Canada-U.S. Free Trade Agreement," *American Economic Review*, 2004, *94* (4), 870–895.

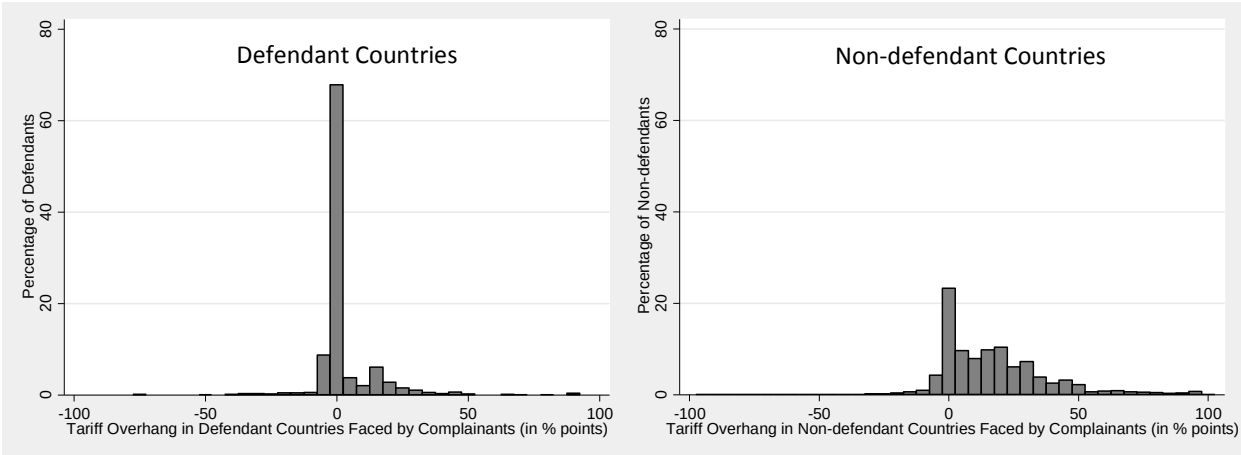
Figures

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



Notes: Figure 2 shows tariff overhangs in dispute sectors in defendant and non-defendant countries one year prior to a dispute. The tariff overhangs are based on sectoral simple averages of applied and bound tariff rates from the TRAINS database, see Appendix B for details. Outliers of more than 100 and less than −100 percentage points are excluded, leaving us with 98 and 97 percent of the observations in the defendant and non-defendant samples, respectively.

Figure 3: The Relation between Exports and Dispute Filing Probability

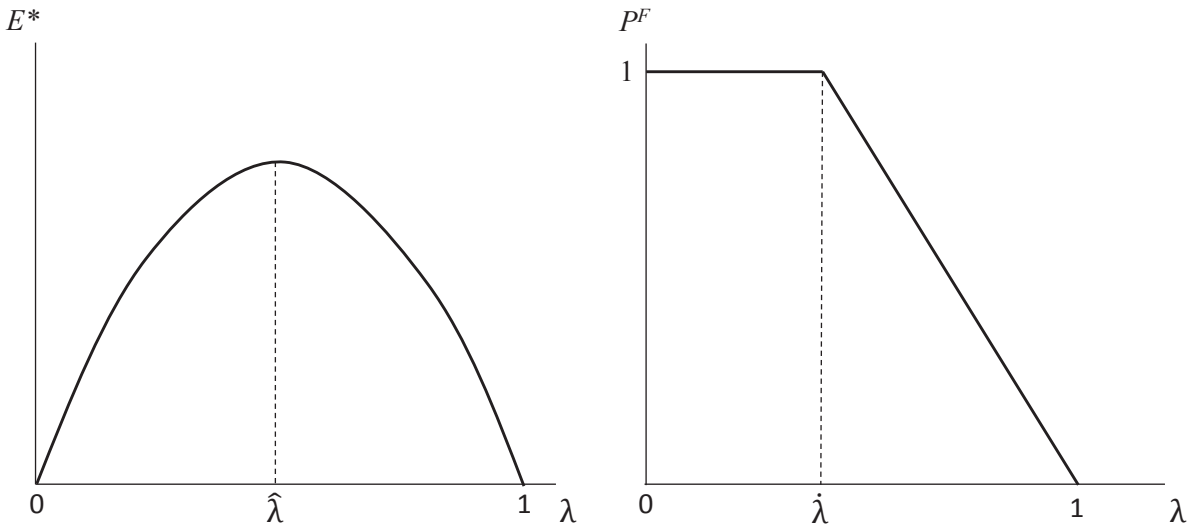
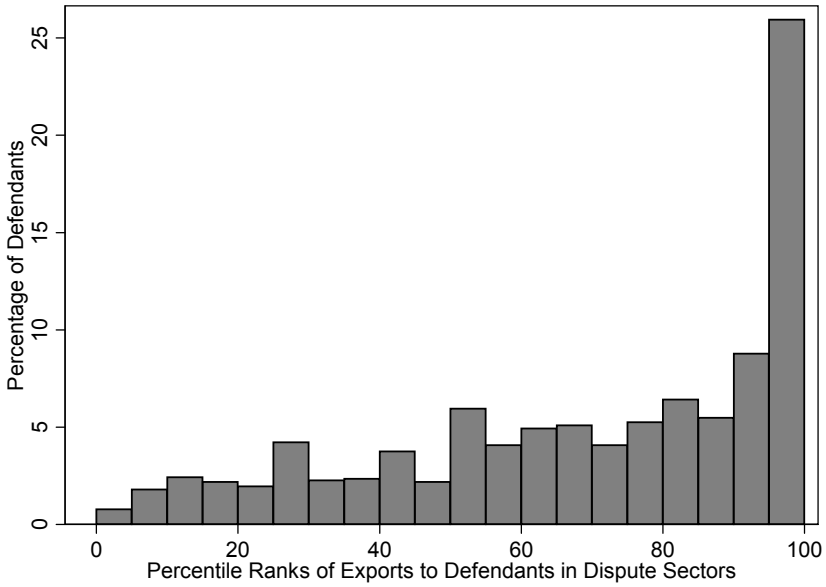
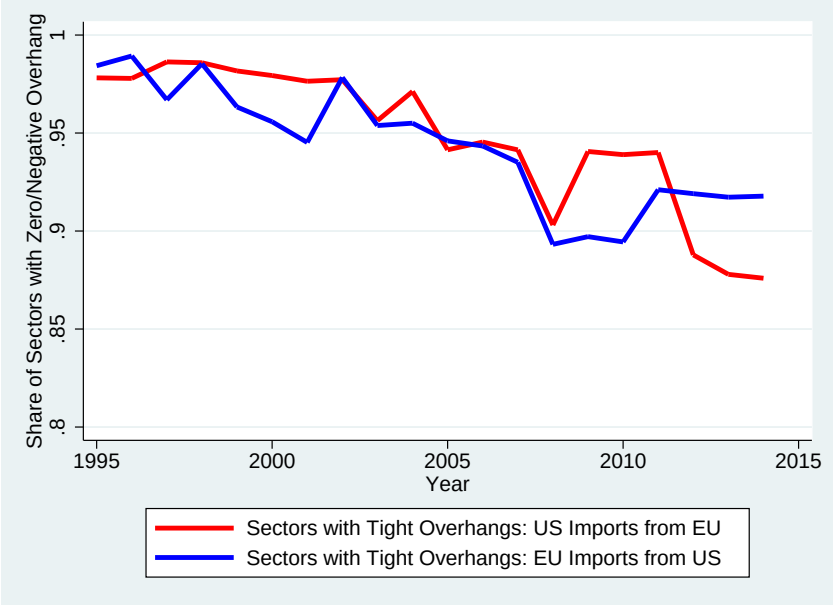


Figure 4: Percentile Ranks of Complainants' Exports to Defendants in Dispute Sectors



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: Bilateral Shares of Sectors with Tight Tariff Overhang: US – EU, 1995-2014



Notes: Author's own calculations based on data from TRAINS and COMTRADE databases. Figure 5 shows the share of bilateral import sectors with a zero or negative tariff overhang, as defined by (16), for the United States and the European Union.

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: Summary Statistics

Variable	Mean	SD	Min	Max	Definition	Source
$DISPUTE_{cdt}$	0.01	0.08	0.00	1.00	WTO Dispute (1: Yes, 0: No)	WTO homepage
$DIVERSITY_{cd,t-1}$	0.33	0.32	0.00	1.00	Extensive margin of complainant's exports to defendant (Hummels-Klenow measure)	Author's own calculations, data: COMTRADE
$DIVERSITY_{dc,t-1}$	0.33	0.32	0.00	1.00	Extensive margin of defendant's exports to complainant (Hummels-Klenow measure)	Author's own calculations, data: COMTRADE
$GSP_{cd,t-1}$	0.14	0.34	0.00	1.00	Complainant grants GSP preferences to defendant (1: Yes, 0: No)	Liu (2009) and UNCTAD
$GSP_{dc,t-1}$	0.14	0.34	0.00	1.00	Defendant grants GSP preferences to complainant (1: Yes, 0: No)	Liu (2009) and UNCTAD
$ITA_{cd,t-1}$	0.24	0.43	0.00	1.00	Defendant and complainant are signatories to WTO IT Agreement (1: Yes, 0: No)	Henn and Gnutzmann-Mkrtchyan (2015)
$LEGALCAPACITY_{c,t-1}$	8.50	1.45	4.70	11.55	Complainant's log GNI per capita (in current $)	World Bank (WDI)
$logGDP_{c,t-1}$	25.17	2.23	19.28	30.58	Complainant's log GDP (in current $)	World Bank (WDI)
$logGDP_{d,t-1}$	25.17	2.23	19.28	30.58	Defendant's log GDP (in current $)	World Bank (WDI)
$logIMPORTS_{cd,t-1}$	16.45	3.71	0.69	26.85	Complainant's log imports from defendant	COMTRADE
$logIMPORTS_{dc,t-1}$	16.45	3.71	0.69	26.85	Defendant's log imports from complainant	COMTRADE
$OVERHANG_{c,t-1}$	0.21	0.25	-0.23	1.51	Complainant's average bound tariff − average applied MFN tariff (in ad valorem terms)	Author's own calculations, data: TRAINS
$OVERHANG_{d,t-1}$	0.21	0.25	-0.23	1.51	Defendant's average bound tariff − average applied MFN tariff (in ad valorem terms)	Author's own calculations, data: TRAINS
$OVERHANGSHARE_{cd,t-1}$	0.29	0.34	0.00	1.00	Complainant's share of 6-digit HS import sectors from defendant with zero or negative tariff overhang	Author's calculations, data: COMTRADE, TRAINS
$OVERHANGSHARE_{dc,t-1}$	0.29	0.34	0.00	1.00	Defendant's share of 6-digit HS import sectors from complainant with zero or negative tariff overhang	Author's calculations, data: COMTRADE, TRAINS
$POL\_STABILITY_{c,t-1}$	0.62	0.17	0.13	0.92	Index of complainant's political stability (0: unstable, 1: stable)	World Bank (WGI)
$POL\_STABILITY_{d,t-1}$	0.62	0.17	0.13	0.92	Index of defendant's political stability (0: unstable, 1: stable)	World Bank(WGI)
$PTA_{cd,t-1}$	0.12	0.32	0.00	1.00	Country pair is member of the same PTA (1: Yes, 0: No)	de Sousa (2012)
$PTAIMPSHARE_{c,t-1}$	0.35	0.27	0.00	0.93	Complainant's share of imports from PTA partners	Author's own calculations, data: de Sousa (2012), COMTRADE
$PTAIMPSHARE_{d,t-1}$	0.35	0.27	0.00	0.93	Defendant's share of imports from PTA partners	Author's own calculations, data: de Sousa (2012), COMTRADE
$rGDPGROWTH_{c,t-1}$	0.04	0.04	-0.15	0.27	Complainant's real GDP growth rate	World Bank (WDI)
$rGDPGROWTH_{d,t-1}$	0.04	0.04	-0.15	0.27	Defendant's real GDP growth rate	World Bank (WDI)
$RELSIZE_{cd,t-1}$	2.75	2.01	0.00	10.89	Absolute difference in log GDPs of complainant and defendant	GDPs from World Bank (WDI)
$RETALIATIONCAPACITY_{c,t-1}$	0.02	0.07	0.00	0.92	Complainant's share in defendant's overall exports	Author's calculations, data: COMTRADE
$UNEMPRATE_{c,t-1}$	0.08	0.05	0.00	0.37	Complainant's unemployment rate (as share of labor force)	World Bank (WDI)
$UNEMPRATE_{d,t-1}$	0.08	0.05	0.00	0.37	Defendant's unemployment rate (as share of labor force)	World Bank (WDI)
$UR\_LIB_{c,t-1}$	-0.06	0.08	-0.38	0.10	Complainant's average applied MFN tariff change (in ad valorem terms) since Uruguay Round or WTO accession (if after 1994)	Author's own calculations, data: World Bank (WDI)
$UR\_LIB_{d,t-1}$	-0.06	0.08	-0.38	0.10	Defendant's average applied MFN tariff change (in ad valorem terms) since Uruguay Round or WTO accession (if after 1994)	Author's own calculations, data: World Bank (WDI)
$WORLDIMPSHARE_{c,t-1}$	-6.04	2.02	-11.45	-0.91	Complainant's share of world imports (in logs)	Author's own calculations, data: COMTRADE
$WORLDIMPSHARE_{d,t-1}$	-6.04	2.02	-11.45	-0.91	Defendant's share of world imports (in logs)	Author's own calculations, data: COMTRADE

Table 4: WTO Dispute Incidence and Average MFN Tariff Overhangs

Dependent variable: WTO Dispute (1: Yes, 0: No)	(1)	(2)	(3)	(4)	(5)
$OVERHANG_{c,t-1}$	-.0139***	-.0248***	-.0236***	-.0285***	-.0268***
	(.0027)	(.0089)	(.0090)	(.0098)	(.0098)
$OVERHANG_{d,t-1}$	-.0161***	-.0311**	-.0331**	-.0361**	-.0361**
	(.0028)	(.0154)	(.0155)	(.0167)	(.0166)
$RELSIZE_{cd,t-1}$	-.0008**	-.0039		-.0041	-.0045*
	(.0004)	(.0027)		(.0027)	(.0027)
$UR\_LIB_{c,t-1}$	.0093	-.0716***	-.0675***	-.0722***	-.0617***
	(.0068)	(.0195)	(.0184)	(.0195)	(.0180)
$UR\_LIB_{d,t-1}$	.0082	-.0652***	-.0530**	-.0658***	-.0628**
	(.0063)	(.0252)	(.0238)	(.0252)	(.0246)
$logGDP_{c,t-1}$			.0034		
			(.0034)		
$logGDP_{d,t-1}$			.0161***		
			(.0042)		
$logIMPORTS_{cd,t-1}$				.0004**	-.0003*
				(.0002)	(.0002)
$logIMPORTS_{dc,t-1}$				.0007***	.0004**
				(.0002)	(.0002)
$PTA_{cd,t-1}$				-.0075	-.0061
				(.0066)	(.0066)
$PTA_{cd,t-1} \times OVERHANG_{c,t-1}$				.0001	.0001
				(.0002)	(.0002)
$PTA_{cd,t-1} \times OVERHANG_{d,t-1}$				.0002	.0002
				(.0002)	(.0002)
$DIVERSITY_{cd,t-1}$					.0115**
					(.0051)
$DIVERSITY_{dc,t-1}$					.0173***
					(.0059)
$LEGALCAPACITY_{c,t-1}$					.0032
					(.0033)
$RETALIATIONCAPACITY_{c,t-1}$					.1066***
					(.0392)
$rGDPGROWTH_{c,t-1}$					.0119
					(.0114)
$rGDPGROWTH_{d,t-1}$					.0037
					(.0110)
$UNEMPRATE_{c,t-1}$					.0376
					(.0303)
$UNEMPRATE_{d,t-1}$					-.1057***
					(.0371)
N (Country pairs)	43,890	43,890	43,890	43,890	43,890
R^2	.0053	.2869	.2878	.2871	.2883
Time FE	No	Yes	Yes	Yes	Yes
Country-pair FE	No	Yes	Yes	Yes	Yes

Notes: The table presents linear probability model regression results. Clustered standard errors at the country-pair level are in parentheses. ***, ** and * indicate 1 percent, 5 percent and 10 percent significance levels, respectively. Intercept in specification (1) not reported.

Table 5: WTO Dispute Incidence and Bilateral MFN Tariff Overhang Shares

Dependent variable: WTO Dispute (1: Yes, 0: No)	(6)	(7)	(8)	(9)	(10)
$OVERHANGSHARE_{cd,t-1}$	.0166***	.0041	.0037	.0046*	.0044*
	(.0042)	(.0025)	(.0025)	(.0026)	(.0026)
$OVERHANGSHARE_{dc,t-1}$	.0206***	.0037**	.0032*	.0043**	.0042**
	(.0044)	(.0017)	(.0018)	(.0018)	(.0018)
$RELSIZE_{cd,t-1}$	-.0019***	-.0040		-.0043	-.0046*
	(.0006)	(.0027)		(.0027)	(.0027)
$UR\_LIB_{c,t-1}$	.0154**	-.0529***	-.0497***	-.0510***	-.0415***
	(.0065)	(.0168)	(.0158)	(.0165)	(.0154)
$UR\_LIB_{d,t-1}$	.0146**	-.0410**	-.0268	-.0389**	-.0359**
	(.0059)	(.0186)	(.0171)	(.0183)	(.0176)
$logGDP_{c,t-1}$			.0033		
			(.0034)		
$logGDP_{d,t-1}$			.0160***		
			(.0042)		
$logIMPORTS_{cd,t-1}$				.0004**	-.0003**
				(.0002)	(.0002)
$logIMPORTS_{dc,t-1}$				.0007***	.0004**
				(.0002)	(.0002)
$PTA_{cd,t-1}$				.0056	.0043
				(.0077)	(.0077)
$PTA_{cd,t-1} \times OVERHANGSHARE_{cd,t-1}$				-.0128	-.0086
				(.0120)	(.0121)
$PTA_{cd,t-1} \times OVERHANGSHARE_{dc,t-1}$				-.0143	-.0129
				(.0169)	(.0168)
$DIVERSITY_{cd,t-1}$					.0113**
					(.0051)
$DIVERSITY_{dc,t-1}$					.0172***
					(.0058)
$LEGALCAPACITY_{c,t-1}$					.0033
					(.0033)
$RETALIATIONCAPACITY_{c,t-1}$					.1058***
					(.0395)
$rGDPGROWTH_{c,t-1}$					.0113
					(.0114)
$rGDPGROWTH_{d,t-1}$					.0028
					(.0110)
$UNEMPRATE_{c,t-1}$					.0393
					(.0302)
$UNEMPRATE_{d,t-1}$					-.1040***
					(.0370)
N (Country pairs)	43,890	43,890	43,890	43,890	43,890
R^2	.0130	.2869	.2877	.2871	.2883
Time FE	No	Yes	Yes	Yes	Yes
Country-pair FE	No	Yes	Yes	Yes	Yes

Notes: The table presents linear probability model regression results. Clustered standard errors at the country-pair level are in parentheses. ***, ** and * indicate 1 percent, 5 percent and 10 percent significance levels, respectively. Intercept in specification (6) not reported.

Table 6: WTO Dispute Incidence – Additional Robustness Checks

Dependent variable: WTO Dispute (1: Yes, 0: No)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
$OVERHANG_{c,t-1}$	-.0242*** (.0091)	-.0265*** (.0091)	-.0224** (.0099)	-.0252*** (.0094)	-.0157* (.0086)	-.0247** (.0100)				
$OVERHANG_{d,t-1}$	-.0332** (.0163)	-.0341** (.0164)	-.0427** (.0170)	-.0344** (.0164)	-.0248* (.0141)	-.0289* (.0151)				
$OVERHANGSHARE_{cd,t-1}$	.0043* (.0026)						.0045* (.0026)	.0040 (.0026)	.0041* (.0023)	.0046* (.0026)
$OVERHANGSHARE_{dc,t-1}$	.0039** (.0017)						.0036** (.0018)	.0040** (.0017)	.0036** (.0018)	.0042** (.0018)
$RELSIZE_{cd,t-1}$	-.0047* (.0027)	-.0046* (.0027)	-.0055** (.0028)	-.0044 (.0027)	-.0043 (.0027)	-.0043 (.0027)	-.0056** (.0028)	-.0045* (.0027)	-.0044 (.0027)	-.0045* (.0027)
$UR\_LIB_{c,t-1}$	-.0626*** (.0180)	-.0632*** (.0179)	-.0629*** (.0185)	-.0640*** (.0186)			-.0467*** (.0155)	-.0450*** (.0160)		
$UR\_LIB_{d,t-1}$	-.0633** (.0246)	-.0635*** (.0245)	-.0640*** (.0248)	-.0651*** (.0251)			-.0318* (.0175)	-.0397** (.0184)		
$OVERHANGSHARE5_{cd,t-1}$		.0033* (.0019)								
$OVERHANGSHARE5_{dc,t-1}$		.0026* (.0014)								
$POL\_STABILITY_{c,t-1}$			.0256** (.0109)				.0260** (.0109)			
$POL\_STABILITY_{d,t-1}$			.0177 (.0122)				.0185 (.0122)			
$WORLDIMPSHARE_{c,t-1}$			-.0069** (.0029)				-.0075*** (.0028)			
$WORLDIMPSHARE_{d,t-1}$			.0057* (.0030)				.0050* (.0029)			
$PTAIMPSHARE_{c,t-1}$			.0101** (.0040)				.0096** (.0040)			
$PTAIMPSHARE_{d,t-1}$			.0134*** (.0036)				.0128*** (.0035)			
$GSP_{cd,t-1}$				.0013 (.0026)				.0007 (.0027)		
$GSP_{dc,t-1}$				-.0040 (.0066)				-.0046 (.0066)		
$ITA_{cd,t-1}$				-.0044 (.0036)				-.0046 (.0036)		
$UR\_LIB_{c,t-2}$					-.0457** (.0178)				-.0368** (.0158)	
$UR\_LIB_{d,t-2}$					-.0395** (.0196)				-.0251 (.0161)	
$UR\_LIB\_DISCTED_{c,t-1}$						-.0709*** (.0198)				-.0535*** (.0174)
$UR\_LIB\_DISCTED_{d,t-1}$						-.0588** (.0255)				-.0385* (.0202)
N (Country pairs).	43,890	43,890	43,890	43,890	42,910	43,890	43,890	43,890	42,910	43,890
R^2	.2884	.2884	.2892	.2884	.2960	.2883	.2891	.2884	.2960	.2883
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-pair FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The table presents linear probability model regression results. Clustered standard errors at the country-pair level are in parentheses. ***, ** and * indicate 1 percent, 5 percent and 10 percent significance levels, respectively. Additional regressors included in all specifications: $PTA_{cd,t-1} \times OVERHANG_{c,t-1}$ (or $PTA_{cd,t-1} \times OVERHANGSHARE_{cd,t-1}$), $PTA_{cd,t-1} \times OVERHANG_{d,t-1}$ (or $PTA_{cd,t-1} \times OVERHANGSHARE_{dc,t-1}$), $DIVERSITY_{cd,t-1}$, $DIVERSITY_{dc,t-1}$, $LEGALCAPACITY_{c,t-1}$, $RETALIATIONCAPACITY_{c,t-1}$, $rGDPGROWTH_{c,t-1}$, $rGDPGROWTH_{d,t-1}$, $UNEMPRATE_{c,t-1}$, and $UNEMPRATE_{d,t-1}$.y

A Mathematical Appendix

A.1 Proof of Proposition 1

To prove Proposition 1, it is sufficient to show that a positive productivity shock 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 binding 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 (11), the total differential of Home's welfare incentive to breach the agreement, Ω, with respect to the productivity shock equals:

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

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

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

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 when (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 term 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 any $\gamma \in [\gamma^N, \overline{\gamma}]$. 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 first show that the conditions in Proposition 3 imply a higher likelihood for Foreign 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 $dP^F/d\lambda < 0$.

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 $\lambda > 0$. Since $\frac{\partial P^F}{\partial\overline{\gamma}^*} + \frac{\partial P^F}{\partial\gamma^{*N}}\frac{d\gamma^{*N}}{d\overline{\gamma}^*} < 0$ is always true, it follows that $dP^F/d\overline{\gamma}^* < 0$.

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 $dP^F/d\phi > 0$. ■

B Data Appendix

Sample Composition: As mentioned in the main text, only potential WTO members pairs with positive two-way trade flows in a given year are included in the empirical analysis. Countries that joined the WTO after 1995 become first eligible to enter the sample in the year their membership officially starts. Throughout the sample period, the European Union is treated as a single entity. The small number of disputes filed against individual EU member states (mostly by the US) is assigned to the EU in its entirety. The results are not sensitive to this choice.

Average Tariff Overhangs: To obtain estimates of the WTO members' average tariff overhangs used in the empirical analysis, I proceed in two steps. I first obtain for each WTO member (if available) annual average bound and MFN applied tariff data (based on the combined HS classification) from the TRAINS database through the WITS system: `http://wits.worldbank.org/wits/`. I then compute the average MFN tariff overhangs by subtracting the average MFN applied tariff from the average bound tariff. All tariff averages include estimated ad valorem equivalents of non-tariff barriers.[34] Since WTO tariff data is not available for 1994, I use the contemporaneous tariff overhang data for 1995.

Tariff Overhang Share Measures: To compute the share of bilateral import sectors with negative or zero tariff overhangs, I first obtain from TRAINS for each WTO member (if available) annual data on tariff bindings and MFN applied tariffs. After matching the sectoral tariff bindings and MFN applied tariffs, I calculate for each country and year MFN tariff overhangs at the 6-digit level. In the final step, I compile for each country pair the annual share of active bilateral import sectors with a zero or negative tariff overhang using information on bilateral trade flows at the 6-digit HS level from Comtrade (combined classification). To minimize the impact of incomplete sectoral overhang data, I replace missing sectoral bound and applied tariffs with data from earlier years (the results are not sensitive to this choice). The tariff data at the 6-digit level include again estimated ad valorem equivalents of non-tariff barriers.

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

Income Classifications: The definition of income groups in Figure 1 follows the respective classifications by the World Bank in each year.[35] As of the end of 2014 (the last year of disputes in the sample), the income categories for countries in per-capita terms were: 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). At the time of writing, 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.

Sectoral Tariff Overhangs in Dispute Sectors: Figure 2 presents data on tariff overhangs in dispute sectors. To identify dispute sectors, I obtain information on sector citations in consultation requests from the Dispute Settlement Database of Horn and Mavroidis (2011) who provide this data for the years 1995-2011. Using data from the TRAINS database on bilateral simple averages of bound and applied tariff rates (including estimates of ad valorem equivalents), I then compute the sectoral tariff overhangs that complainants encounter in defendant and non-defendant countries in dispute sectors one year prior to the initiation of a dispute.[36] 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 B1 below provides summary statistics of the data plotted in Figure 2 (separated again by defendants and non-defendants in dispute sectors). As in the compilation of Figure 2, Table B1 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 B1 also lists the p-values 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 samples at the 0.1 percent level of statistical significance.

Table B1: 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.

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

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