Cooperation in WTO's Tariff Waters?*

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Abstract

This paper examines the extent to which tariff cooperation is observed among World Trade Organization (WTO) members. With the help of a simple political economy model, we show that tariffs are positively correlated with the importer's market power when they are set non-cooperatively, but negatively correlated when set cooperatively. We use this prediction to empirically identify the extent of cooperation in the WTO, and find that more than three quarters of WTO members' tariffs are set non-cooperatively.
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1 Introduction

Trade policy decisions impact not only the domestic economy but also foreign countries. Governments can use tariffs to improve their terms-of-trade by shifting the cost of protection to foreign producers. The mechanism is simple: an increase in tariffs by a sufficiently large importer leads to a decline in world prices and therefore results in a transfer from exporting to importing countries. This terms-of-trade externality implies that unilaterally set tariffs are inefficient. The World Trade Organization (WTO) and its predecessor, the General Agreement on Tariffs and Trade (GATT), offer member countries the possibility of cooperating to internalize these terms-of-trade externalities through reciprocal tariff concessions. Eight rounds of trade negotiations have led so far to an 85 percent reduction in average tariffs.[1] But not all GATT/WTO members have participated in these negotiations, and when they participate, the maximum tariff levels to which they legally commit –known as *bound* tariffs– are often set well above applied tariff levels.[2] Even GATT founders who have been members since 1947 such as Australia, Brazil, India, and New Zealand have average bound tariffs twice as high as applied tariffs. These large differences between bound and applied tariffs –known as tariff water– offer significant amounts of flexibility to set tariffs non-cooperatively. This paper explores the extent to which cooperative tariffs are observed even when the presence of tariff water would allow members to behave non-cooperatively.[3]

We develop a two-country model in which import tariffs are driven by a

[1]For a recent review of GATT and WTO history see Bagwell, Bown and Staiger (2015).

[2]WTO members do not negotiate exact tariff levels, but rather maximum tariffs or bound tariff above which members commit not to set applied tariffs on imports from other members. They can, however, set tariffs below bound levels.

[3]Tariff water is not the only mechanism through which the WTO system offers it members flexibility to behave non-cooperatively. Safeguard measures and anti-dumping also offer the possibility to deviate from tariff binding commitments in the WTO. While this type of flexibility can help sustain an otherwise cooperative equilibrium in the presence of shocks (Bagwell and Staiger, 1990 and Bown and Crowley, 2013), the presence of tariff water questions the notion itself of a cooperative equilibrium in tariffs.

terms-of-trade rationale as well as political economy forces as in Bagwell and Staiger (1999, 2002) and Grossman and Helpman (1995). The model predicts that in the absence of cooperation, one should observe the positive textbook relationship between importers' market power and their import tariffs. A novel prediction of the model is that in the presence of cooperation, the importing country's tariffs are inversely related to market power. This result relies on two important assumptions. First, governments' politically motivated objective function gives more importance to the profits of domestic firms –including those in export-competing sectors– than to consumer surplus or government revenue. In such a setup, incentives for exporting country's governments to negotiate tariff reductions by trading partners in a cooperative setting are stronger the larger the importer's market power. Indeed, a tariff reduction by the importer will result in a larger increase in exporters' profits the smaller their export supply elasticity (i.e., the larger the importer's market power).[4] Second, we assume that the exporting country has no trade policy instrument (i.e., no export subsidy) with which to favor its export lobbies, and so must rely on tariff cuts from the importing country to achieve this goal.[5]

We use these theoretical predictions to test whether WTO members' tariffs reflect non-cooperative behavior in presence of tariff water, and cooperation in absence of tariff water. Our empirical results confirm these predictions. We also find that the shift from cooperative to non-cooperative tariff setting is observed as soon as tariff water makes it possible (i.e., even in the presence of very small amounts of tariff water).

These results are important for at least three reasons. First, recent estimates suggest that the gains from trade can account on average for more than 50

[4]It is important to note that this does not imply that the terms-of-trade externality does not get internalized in the cooperative equilibrium. It does by definition, but it is optimal for the joint welfare of the two countries to set lower tariffs when the importing country has more market power.

[5]Note that this is a reasonable assumption in light of the WTO prohibition on export subsidies (see article 3 of the WTO Agreement on Subsidies and Countervailing measures).

percent of real income (Ossa, 2015).[6] The extent to which these gains can be attributed to cooperation in the WTO depends on whether tariffs are set cooperatively within the WTO's tariff waters. This matters since tariff water is observed in more than three quarters of WTO members' tariff lines. If tariffs are set non-cooperatively in the presence of tariff water, then this seriously limits the contribution of the WTO to the gains from trade. Second, our estimates suggest that a move from cooperative to non-cooperative tariffs in the presence of high levels of market power increases applied tariffs by an average of 34 percentage points. More cooperation could potentially bring even larger gains. Finally, if some flexibility is desirable in the presence of shocks to sustain a cooperative equilibrium as argued by Bagwell and Staiger (1990) and Bown and Crowley, 2013), this flexibility should, in principle, not be used to exploit market power against other members (unless shocks are somehow correlated with market power). The fact that applied tariffs reflect market power in the presence of tariff water may have implications for WTO rules and the extent of tariff water that is allowed. One could, for example, consider rules that limit tariff water. While the normative implications of such rules have to be examined, it is clear that current bound tariffs, which are on average three times as high as applied levels, offer too much flexibility.

To test our predictions we need to address a number of issues. First, we need estimates of importers' market power, which are given by the inverse of the export supply elasticity faced by each importer for as many WTO members as possible. To obtain estimates for large number of WTO members, we build on Kee et al.'s (2008) adaptation of Kohli's (1991) revenue function approach.

Second, because export supply elasticities (i.e., the inverse of market power) and the presence of tariff water are potentially endogenous we use an instrumental variable estimator when explaining applied tariffs. We use a weighted-sum of import demand elasticities in the rest-of-the-world and the world's export

[6]These are the gains from moving from prohibitive to currently observed tariff levels.

supply elasticities (rather than the one faced by each importing country) to instrument for market power. The presence of tariff water is instrumented using the presence of bound tariffs which are higher than prohibitive tariffs. Since tariff water is defined as the difference between bound and applied tariffs, the inclusion restriction is necessarily satisfied. However, bound tariffs above prohibitive levels have no impact on imports, and therefore should be uncorrelated with applied tariffs, which satisfies the exclusion restriction.

Finally, the assumption that non-cooperative behavior is observed as soon tariff water makes it possible needs to be tested. Indeed, even if the presence of tariff water allows WTO members to set tariffs non-cooperatively, they may still behave cooperatively due to possible retaliation by trading partners having tariff water and market power. Fear of retaliation has been shown to be important in curbing the use of other trade policy instruments such as antidumping (Blonigen and Bown, 2003). To test whether retaliation limits non-cooperative behavior in the presence of tariff water, we follow Caner and Hansen (2004) unknown threshold model. This allows us to estimate the tariff water threshold for which we observe a shift from cooperative to non-cooperative tariffs.

We are not the first to examine the relationship between applied tariffs and market power. Johnson (1953) shows that in a non-cooperative setting optimal tariffs and market power should be positively correlated to improve the importing country's terms-of-trade. Broda, Limão and Weinstein (2008) provide empirical evidence that this is the case for countries outside the WTO. Bagwell and Staiger (2011) focus on new WTO members. They show that the tariff cuts agreed in the WTO by acceding members' are larger in those sectors where they have more market power. This implies that trade negotiations during accession have helped internalize the terms-of-trade externalities that were present when these countries were outside the WTO.

More recently, the literature has also explored the links between market power and applied tariffs in a cooperative setting. Ludema and Mayda (2013) show that WTO members' applied tariffs may still reflect the importing country's market power even when in principle tariffs are set cooperatively. The reason is that not all exporting countries necessarily participate in WTO tariff negotiations with all importers. There may be some free-riding, which implies that the terms-of-trade externalities may not be completely internalized. Free-riding will be more likely when exporters are not highly concentrated and Ludema and Mayda (2013) show that the correlation between applied tariffs and market power is stronger when exporters are not highly concentrated. This mechanism may affect our estimates, and we will therefore provide a robustness test in which we control for the concentration of exporters' faced by importers.

The literature has also focused on the determinants of tariff water. Horn, Maggi and Staiger (2010) explain how the presence of uncertainty and contracting costs can lead to upper limits on tariffs (tariff bounds) rather than tariff levels being the optimal policy instrument. Amador and Bagwell (2012, 2013) show that in the presence of uncertainty and asymmetric information regarding lobbying shocks faced by each government, the optimal trade agreement leads to tariff water in equilibrium. Beshkar, Bond and Rho (2015) show in a similar context that the extent of tariff water will be negatively correlated with market power and provide supporting empirical evidence. The mechanism is similar to the one that explains the negative correlation between tariffs and market power in our paper. Even if importers value the flexibility provided by tariff water in the presence of shocks, more market power implies stronger terms-of-trade externalities, and the objective of the trade agreement is to internalize these externalities. This will lead to less tariff water in sectors with more market power.[7] While this literature may suggest modeling the setting of applied tariffs in a more complex environment where asymmetric information and un-

[7] As discussed earlier our model predicts a negative relationship between tariffs and market power when countries cooperate. The reason for this is that the exporting country lobbies will have stronger incentives to reduce the importing country tariff when the latter has more market power.

certainty can endogenously explain the presence of tariff water, this is outside the scope of our paper. Our focus is on the relationship between applied tariffs and market power in the absence or presence of tariff water. Although, the link between the presence of tariff water and absence of cooperation in applied tariffs is not straightforward in a setup with asymmetric information and market power, we circumvent this problem in the empirical section by focusing on what could be considered as exogenous variations in tariff water (i.e., tariff water above prohibitive tariff levels).[8] Finally, note that the results of the unknown threshold regressions tend to suggest that the shift from a negative to a positive correlation between applied tariffs and market power tends to occur as soon as there is some tariff water available, which suggests that the data supports our modeling assumptions.

The remainder of the paper is organized as follows. Section 2 presents the two-country political economy model, as well as the empirical strategy to estimate the model's predictions. Section 3 presents the empirical methodology with which to estimate export supply elasticities faced by importers, and provides external tests for the new estimates. Section 4 presents the empirical results for the model's predictions and Section 5 concludes.

2 Optimal tariffs and the WTO

In a set-up where tariffs are determined by both market power and political economy forces, non-cooperative tariffs reflect both the terms-of-trade rationale and lobbying forces in the importing country.[9] In the presence of cooperation, the terms-of-trade motive vanishes as it captures inefficient transfers from the

[8] There is also a growing literature that looks at how the presence of tariff bindings and the implied reduction on trade policy uncertainty affect exporters. Handley (2014) shows how the presence of tariff bindings leads to more entry by exporters, and that this effect can be larger than the one observed with tariff reductions. Handley and Limão (2015) suggest that this effect can also be extended to firms' investment decisions.

[9] See Grossman and Helpman (1995) and Bagwell and Staiger (1999, 2002).

exporting country to the importing country that are internalized through cooperation. Therefore, one should expect no relationship between cooperative tariffs and market power.

However, this argument ignores that the government in the exporting country may be influenced not only by lobbying by import-competing firms, but also by exporters. In this case, cooperative tariffs may be negatively correlated with a measure of the importing country's market power, even though the terms-of-trade rationale has been internalized. Intuitively, a tariff in the importing country imposes larger costs for politically organized exporters when they have a relatively inelastic export supply elasticity. Therefore, the decline in prices induced by the tariff will be larger the more inelastic is their export supply. The cooperative tariff reflects this and ensures that tariffs are small when the export supply elasticity is small.[10]

We develop a simple model to illustrate how the presence of cooperation changes the relationship between an importer's market power and tariffs. We identify cooperative and non-cooperative tariffs by the absence or presence of tariff water in the importer's schedule. The absence of tariff water signals that tariffs are set at the negotiated bound reflecting cooperation among WTO members. The presence of tariff water allows for non-cooperative tariffs among WTO members.

Note that this assumes that the tariff bound is endogenously set when countries cooperate, but is exogenous in the absence of cooperation.[11] The latter describes well the setting of WTO tariff bounds in many developing countries. As described in Croome (1995), an Australian proposal was adopted during the Uruguay Round to ensure that most countries would bind their tariffs by allowing each member to follow its own approach to tariff binding. This led

[10]Note that this implicitly assumes that export subsidies are not available in the exporting country. Otherwise the government of the exporting country could redistribute rents towards exporters using export subsidies rather than reductions in the importing country's tariffs.

[11]For a recent study that endogenizes tariff bindings in the presence of tariff water see Beshkar, Bond and Rho (2015).

many developing countries, in particular the smaller and poorer countries, to bind almost all of their previously unbound tariffs at arbitrarily high levels.[12] On the other hand, the United States, the European Union, and Japan played a more prominent role in negotiating tariffs under the WTO. Indeed, the very little tariff water in their schedules suggests that their applied MFN tariffs are the outcome of trade negotiations.

2.1 A model of cooperative and non-cooperative tariffs

The model considers a home and a foreign country where the foreign country's variables are identified by superscript "$\star$". These countries trade three goods labeled 0, 1 and 2, where good 0 represents a numéraire good that is freely traded. Consumer preferences are the same across countries and are described by the following additive quasilinear utility function

$$U(c_0, c_1, c_2) = c_0 + u_1(c_1) + u_2(c_2) \tag{1}$$

which describes the preferences in the home country (a similar expression describes preferences in the foreign country). We assume that sub-utility functions are concave and increasing on consumption, i.e. $u_i^{'}(.) > 0$ and $u_i^{''}(.) < 0$.

Perfect competition prevails. The numéraire good is produced using labor under constant returns to scale, which keeps the wage rate constant regardless

[12]For example: 19 of the 36 least developed countries at the time, bound their tariffs at levels above 100 percent, whereas their applied average tariffs were close to 10 percent. The binding levels were also taken arbitrarily. According to interviews with Mauritanian participants in the final Ministerial meeting of the Uruguay Round in Marrakech, their delegation was briefed by the GATT secretariat's staff in a meeting that lasted a couple of hours in a hotel room in Marrakech. The delegation reviewed the last eight years of negotiations in Geneva, where Mauritania did not have a negotiating team, before making a decision on the level at which agriculture and manufacturing tariffs would be bound. More importantly, while most developed countries had locked in their offers before the Marrakech meeting that concluded the Uruguay Round, many developing countries were still drafting their offers during the Marrakech meeting, and least developed countries had an extra year to submit their goods and services tariff schedules. Thus, negotiations with other WTO members were impossible, and it is therefore not surprising that today many developing countries have very large levels of water in their tariff schedules.

of the trade policy imposed on imports of goods 1 and 2. Moreover, we assume that goods 1 and 2 are produced using labor and a specific factor needed to produce each good using a constant return to scale technology.

We assume that the differences in the relative endowments of sector specific capital in sectors 1 and 2 is sufficiently large so that the home country imports good 1 and exports good 2. This implies $x_1(p) < x_1^\star(p)$, where x_1 and $x_1^\star$ are the supply of good 1 in the home and foreign country, respectively. The opposite holds for good 2. As a result, a tariff on good 1 (2) may be imposed by the home (foreign) country as we only consider tariffs and disregard export-related trade instruments.[13] The relationship between the price in the home and foreign country is then described by $p_1 = p_1^\star + t_1$ and $p_2^\star = p_2 + t_2$. Without loss of generality, units are chosen so that, initially, export prices of good 1 and 2 are equal to 1, i.e., $p_1^\star = p_2 = 1$. The cost of negotiating each tariff between these two countries is described by the parameter α which is assumed to be positive. If negotiation costs are high relative to the benefits of negotiation then the importing country imposes a non-cooperative tariff.

We consider that the home country's government objective function $G(p_1, p_2)$ is defined by a weighted average between profits and social welfare. In this case, parameter $\beta > 0$ describes the extra weight given to profits relative to consumer surplus and tariff revenue in this government's objective function. A similar approach applies to the foreign country's government where the extra weight to profits is captured by parameter $\beta^\star$. Using (1), the home country's government objective function is given by

[13]Export subsidies are banned in the WTO, which can be explained by the fact that what matters for overall gains in the cooperative equilibrium is the gap between domestic prices in the home and foreign country. In the presence of negotiating costs for each policy instrument, as in Battigalli and Maggi (2002), it is optimal to ban one of the two instruments and negotiate only over the remaining instrument to reduce negotiating costs.

$$
\begin{aligned}
G\left(p_{1}, p_{2}\right) &= u_{1}\left(d_{1}\left(p_{1}\right)\right)-p_{1} d_{1}\left(p_{1}\right)+u_{2}\left(d_{2}\left(p_{2}\right)\right)-p_{2} d_{2}\left(p_{2}\right) \\
& +t_{1} m_{1}\left(p_{1}\right)+(1+\beta)\left[\pi_{1}\left(p_{1}\right)+\pi_{2}\left(p_{2}\right)\right]
\end{aligned} \tag{2}
$$

where d_i is the demand for good i, $m_1 = d_1 - x_1$ stands for imports of good 1 and π_1 stands for home firms' profits in sector 1.

The choice of assumptions on the supply and demand sides, along with separate costs to negotiate each tariff, allows us to independently consider the choice of whether to negotiate tariffs on goods 1 and 2. Thus, we focus on the decision to negotiate the tariff imposed by the home country on imports of good 1, but a similar logic applies for the tariff imposed by the foreign country on imports of good 2.

We first investigate the tariff for good 1 that emerges with and without negotiation. Later, we use the equilibrium tariffs under the two scenarios to consider the role played by market power and political influence in determining the benefits to negotiate.

The optimal non-cooperative tariff on imports of good 1 is obtained by differentiating expression (2) with respect to tariffs to obtain the first order condition of home's maximization problem

$$
\begin{aligned}
\frac{dG}{dt_1} &= -d_1\left[\frac{dp_1^{\star}}{dt_1}+1\right]+m_1+t_1 m_1^{\prime}\left[\frac{dp_1^{\star}}{dt_1}+1\right] \\
& +(1+\beta)\, x_1\left[\frac{dp_1^{\star}}{dt_1}+1\right]
\end{aligned} \tag{3}
$$

Note that $\frac{dp_1}{dt_1} = \frac{dp_1^{\star}}{dt_1} + 1$. We can solve for the non-cooperative tariff by setting expression (3) equal to zero, and with the assistance of the market clearing condition, we can rearrange terms to obtain

$$t_1^N = \frac{\beta z_1 p_1}{e_1} + \frac{1}{e_1^\star} \tag{4}$$

where t_1^N is the non-cooperative optimal tariff, z_1 stands for the inverse of the import penetration ratio expressed in monetary units, e_1 represents the absolute value of the import demand elasticity, and $e_1^\star$ stands for the export supply elasticity faced by the importing country.

The equilibrium non-cooperative tariff displays the usual two motives for deviations from free trade under perfect competition. The political economy motive is represented by the first term on the right-hand side of (4) while the market power motive, also known as the terms-of-trade motivation, is described in the second term on the right-hand side. As Bagwell and Staiger (1999) explain in detail, the latter motivation corresponds to a negative externality of the importing country's trade policy on the exporting country. Negotiations between countries should internalize this motivation by design while respecting the political economy forces in each negotiating party.

We can now investigate the equilibrium tariff on good 1 that emerges when the two countries cooperate. We adopt the usual assumption that negotiated tariffs maximize the sum of the governments' political functions.[14] In this case, we represent the sum of the political functions by the global political function, which is represented by $G^w = G + G^\star$. Focusing on the equilibrium tariff for good 1, we can totally differentiate G^w to obtain

$$\begin{aligned} \frac{dG^w}{dt_1} = & -d_1\left[\frac{dp_1^\star}{dt_1}+1\right] + m_1 + t_1 m_1'\left[\frac{dp_1^\star}{dt_1}+1\right] \\ & + (1+\beta)\,x_1\left[\frac{dp_1^\star}{dt_1}+1\right] \\ & - d_1^\star\frac{dp_1^\star}{dt_1} + (1+\beta^\star)\,x_1^\star\frac{dp_1^\star}{dt_1} \end{aligned} \tag{5}$$

[14]This follows other papers in the literature such as Bagwell and Staiger (1999), Horn, Maggi and Staiger (2010), and Beshkar, Bond, and Rho (2015).

where the first and second lines can be found in expression (3) and the third line comes from calculating $\frac{dG^{\star}}{dt_1}$.

The equilibrium cooperative tariff can be calculated by setting expression (5) to zero, and with assistance of the market clearing condition, we can rearrange terms to obtain

$$t_1^C = \frac{\beta z_1 p_1}{e_1} - \frac{\beta^{\star} z_1^{\star}}{e_1^{\star}} \tag{6}$$

where (6) is the optimal cooperative tariff, and $z_1^{\star}$ is the inverse of the export penetration ratio in the foreign country.

It is clear from expression (6) that a cooperative tariff differs from zero due to the political forces present in each negotiating party ($\beta \neq 0$ and $\beta^{\star} \neq 0$). Note that foreign lobbies ($\beta^{\star} > 0$) influence the cooperative tariff in a very intuitive way. If the importing country market power is high (low $e_1^{\star}$) then the equilibrium cooperative tariff is lower, as a high tariff would cause a significant decrease in the exporting country's price, which obviously has a negative effect on the politically influential producers in the foreign economy. This suggests that when moving from a non-cooperative to a cooperative setup, market power is more than fully internalized when the foreign country cares about their exporter's profits. Indeed, the cooperative tariff is lower the higher is the market power of the importing country. This is the opposite of the prediction we obtained for non-cooperative tariffs.

Cooperation is possible if the gains from cooperation are larger than its costs, i.e., $G^w\left(t_1^C\right) - G^w\left(t_1^N\right) > \alpha$. We follow Horn, Maggi and Staiger (2010) to obtain the sufficient condition for obtaining sufficiently large gains from cooperation. By definition, the function G^w is concave and $\frac{dG^w(t_1^C)}{dt_1} = 0$ since the cooperative tariff maximizes the global political function. Thus, a sufficient condition for large gains from cooperation is to have $\left|\frac{dG^w(t_1^N)}{dt_1}\right|$ large but this boils down to having $\left|\frac{dG^{\star}(t_1^N)}{dt_1}\right|$ large since $\frac{dG(t_1^N)}{dt_1} = 0$ by definition of the non-cooperative solution. Using the definition of the foreign country's objective function, and with the assistance of the market clearing condition, we can rearrange terms to derive the following sufficient condition in terms of relevant elasticities

$$\left|\frac{dG^{\star}(t_1^N)}{dt_1}\right| = \frac{(m_1 + \beta^{\star} x_1^{\star})}{\left(1 + \frac{e_1^{\star}}{e_1} p_1\right)} \tag{7}$$

We can relate expression (7) to the discussion above about equilibrium tariffs. The gains from cooperation are larger when the importing country has significant market power (low $e_1^{\star}$), or a tariff creates significant distortions in the importing country (high e_1), or foreign exporters are politically influential (high $\beta^{\star}$), or the two countries trade a great deal with each other (high m_1). If the gains from cooperation are sufficiently large, then we should observe cooperative tariffs and therefore no tariff water. Otherwise, countries do not cooperate, water is present, and tariffs reflect the market power of the importing country. This is summarized in the following prediction:

Prediction. *If gains from cooperation described by expression (7) are large relative to negotiation costs, then there is no tariff water and tariffs are negatively related to the inverse of the export supply elasticity of the rest-of-the-world. If gains from cooperation are relatively small, then there is tariff water and tariffs will reflect the market power of the importing country.*

Note that cooperative tariffs necessarily imply side-payments from the foreign to the home government as t_1^C yields a lower value of the government's objective function than t_1^N. These side payments can take the form of monetary or non-monetary transfers in the spirit of Limão (2006 and 2007). However, given that trade agreements involve negotiating simultaneously over several tariff lines in which the home country also has an export interest, side payments can take the form of market access concessions. In our setup these would imply reductions in $t_2^{\star}$, which will necessarily increase the home government's objective function. If the market access gains associated with the reduction in $t_2^{\star}$

are larger than the losses the home country experiences when reducing t_1 to its cooperative level, then the home country will participate in the trade agreement as long as these gains cover its negotiating costs. The same applies to the foreign country which implies that the overall agreement can be Pareto-improving and side-payments may not be necessary.

2.2 Empirical strategy

In order to empirically test the prediction developed in the previous section, we will use tariff data for 92 WTO members at the six-digit level of the HS classification,[15] and investigate the extent to which the importer's market power (i.e., the inverse of the export supply elasticity of the rest-of-the-world) has a different relationship with tariffs in the presence and absence of tariff water. We estimate these two regimes using a sample split whenever tariff water is observed

$$\begin{aligned} t_{c,p} &= \alpha^W W_{c,p} \frac{1}{e^{\star}_{c,p}} + \alpha^{1-W} (1 - W_{c,p}) \frac{1}{e^{\star}_{c,p}} \\ &\quad + \alpha_p + \alpha_{c,2HS} + \beta^W W_{c,p} + \beta^{1-W} (1 - W_{c,p}) + \mu_{p,c} \end{aligned} \tag{8}$$

where $t_{c,p}$ is the applied tariff in country c in product p (defined at the six-digit level of the HS classification), $W_{c,p}$ is a dummy variable that indicates the presence of tariff water in country c in product p, α_p are product fixed effects defined at the six-digit level of the HS classification, $\alpha_{c,2HS}$ are two-digit HS fixed effects that also vary by country, and βs are regime-specific constants. The different sets of fixed effects serve as controls for political economy determinants of tariffs, such as firm concentration and capital/labor intensity, as well as any other HS six-digit and country and HS two-digit unobserved heterogeneity.[16]

[15] For a list of countries, see table 1.

[16] Ideally, we would like to have these types of controls varying at the six-digit level of the

We expect $\alpha^W > 0$ as the relationship between market power and tariffs is positive in the presence of tariff water, and $\alpha^{1-W} < 0$, since the relationship becomes negative in the absence of tariff water.

There are several issues regarding the estimation of (8). First, export supply elasticities of the rest-of-the-world are measured with a lot of noise as suggested by Broda et al. (2008). We follow their strategy and use as an alternative the log of $1/e^\star$, as well as dummy variables that split the sample into high and low levels of market power across countries and products.[17]

The second issue has to do with the endogeneity of market power and tariff water. Tariff water or the extent of cooperation depends on market power as argued in Beshkar et al. (2015). It may also depend on the same unobserved political economy determinants of tariffs within the HS two-digit×country fixed effects. We solve for the endogeneity of the presence of tariff water by instrumenting it with the presence of bound tariffs levels above prohibitive tariffs. Arguably, this instrument satisfies the exclusion restrictions as applied tariffs should not depend on bound tariffs above prohibitive levels, which in principle should be economically irrelevant. Tariffs above prohibitive levels should not affect imports. The instrument also satisfies the inclusion restriction as bound tariffs above prohibitive levels imply the presence of tariff water (unless applied tariffs are set above prohibitive levels, which is never the case in our sample).

The difficulty is that prohibitive tariffs are not observable. We use the approximation in Foletti et al. (2011), which, with the help of import demand elasticities, calculates the prohibitive tariff as the one that will lead to zero imports using a linear approximation around the observed level of imports.

HS classification, but such data does not exist across countries, so a good compromise is to use fixed effects at the two-digit level of the HS classification.

[17]The dummy variables fit our analytical setup better, as they are consistent with a model in which market power needs to be sufficiently large for cooperation gains to be larger than negotiation costs, and therefore have a discrete change in the relationship between market power and tariffs.

The prohibitive tariff is then given by

$$t^{pr}_{c,p} = t_{c,p} + \frac{(1 + t_{c,p})}{e^m_{c,p}} \tag{9}$$

where $e^m_{c,p}$ represents the import demand elasticity which varies by country and by product. Note that the construction of the prohibitive tariff uses the import demand elasticity which may be otherwise correlated with the tariff. This may raises questions regarding the exclusion restriction of our instrument that we will check in the robustness section. Our identifying assumption therefore relies on the non-linearities through which the import demand elasticity appears in (9) and then is transformed into a dummy signalling bound tariffs above prohibitive tariffs. The first four columns of table 1 provide summary statistics of applied and bound tariffs, as well as tariff water, and the difference between bound and prohibitive tariffs by country.

The endogeneity of market power is addressed using theory. Olarreaga et al. (1999) show that two determinants of the export supply elasticity of the rest-of-the-world are the average across all countries of export supply elasticities measured from the exporters' point of view, and the average import demand elasticities in the rest-of-the-world.[18] We have estimates of import demand elasticities at the six-digit level of the HS classification from Kee et al. (2008) that we use to construct e_{ROW}. We adapt their methodology to estimate export supply elasticities for each country in our sample at the six-digit level of the HS classification.[19] We then take averages of these elasticities and use them

[18] For a given product, let us define world export supply as $x_w = \sum_c x_c$ (the sum of each country's export supply). The rest-of-the-world export supply faced by country i is then given by $x_i = x_w - \sum_{c \neq i} m_c$ where m_c are imports of country c. Differentiate both sides by the world price p and multiply by p/x_w, and rearrange the expression to obtain

$$e^{\star}_i = \frac{1}{m_i/x_w}\left(e^{x\star} + e_{ROW}\right)$$

where $e^{x\star}$ is the export supply of the world, and e_{ROW} is the import-weighted sum of the absolute value of import demand elasticities in the rest of the world.

[19] The methodology employed to measure all export supply elasticities is discussed in Section

as instruments for market power (the inverse of the export supply elasticity of the rest-of-the-world from the point of view of the importer). In principle these two averages satisfy the exclusion restriction. We instrument the interaction of market power and the tariff water and no tariff water dummies with the interaction of these averages with a dummy indicating the presence and absence of bound tariffs above prohibitive tariff levels. To check the validity of these instruments we perform over-identification and weak instrumental variables' tests.

Finally, we have assumed that the non-cooperative regime is observed as soon as there is some flexibility offered by tariff water. We relax this assumption using an unknown threshold model a la Hansen (2000) to estimate the level of tariff water that is needed to observe a move from cooperative to non-cooperative tariffs.

We therefore estimate (8) using an adaptation of Hansen (2000) to an instrumental variable setup by Caner and Hansen (2004), combined with Hansen (1999) estimator of threshold models with panel data. This is done as follows. We chose a threshold corresponding to levels of tariff water between 0 and 30 percentage points with 1 percentage point increments.[20] For each threshold level we take deviations to the country $\times$ HS two-digit average, as well as the HS six-digit average as suggested in Hansen (1999). We then follow Caner and Hansen (2004) and estimate by ordinary least squares the reduced form parameters of the first stage regressions to predict our two variables of interest. In the next step we estimate the sum-of-squared residuals of a linear regression of tariffs on the two predicted variables. The estimated threshold level is the one that minimizes the sum of squared residuals across all these linear regressions. Once the threshold is estimated using the procedure above, we estimate the

3.

[20]The median level of tariff water in the sample is 10 percent. Around 26 percent of tariff lines have no tariff water and only 19 percent of tariff lines have levels of tariff water above 30 percent.

slope parameters of the second stage using a GMM procedure.

3 Estimating export supply elasticities

We start by describing our adaptation of the methodology used in Kee et al. (2008) to estimate the export supply elasticities of the rest-of-the-world faced by each importing country ($e^{\star}_{nn}$). We then discuss the adaptation of their methodology to estimate export supply elasticities of each exporting country at the six-digit level of the HS classification that will be used jointly with the estimates in Kee et al. (2008) to instrument the export supply elasticities of the rest-of-the-world faced by each importer. Finally, we describe the data used to estimate the elasticities and provide some descriptive statistics of these estimates, as well as some external tests.

3.1 Rest-of-the-world export supply elasticities

The empirical model is based on the adaptation by Kee et al. (2008) of Kohli's (1991) revenue function approach for the estimation of trade elasticities at the tariff line level. Kee et al. (2008) provide estimates of import demand elasticities at the six-digit HS level, whereas our focus here is the export supply of the rest-of-the-world, so we need to model the GDP function of the rest-of-the-world for each importing country.

We assume that the GDP function is common across all countries up to a constant term that accounts for productivity differences. The GDP function of each country, denoted $G^t\left(p^t, v^t\right)$, is a function of prices and endowments. Without loss of generality, we assume that this GDP function has a flexible translog functional form, where n and k index goods, and m and l index factor endowments, as follows:

$$
\begin{aligned}
\ln G^t\left(p^t, v^t\right) \quad = \quad & a_{00}^t + \sum_{n=1}^{N} a_{0n}^t \ln p_n^t + \frac{1}{2}\sum_{n=1}^{N}\sum_{k=1}^{N} a_{nk} \ln p_n^t \ln p_k^t \\
& + \sum_{m=1}^{M} b_{0m}^t \ln v_m^t + \frac{1}{2}\sum_{m=1}^{M}\sum_{l=1}^{M} b_{ml}^t \ln v_m^t \ln v_l^t \\
& + \sum_{n=1}^{N}\sum_{m=1}^{M} c_{nm} \ln p_n^t \ln v_m^t, \qquad (10)
\end{aligned}
$$

where all the translog parameters a, b and c when indexed by t allow for changes over time.[21] We also impose the necessary restrictions so that the GDP function satisfies the homogeneity and symmetry properties of a GDP function.[22] Then for each country we can construct the GDP function of the rest-of-the-world by summing the GDP functions of each country given by (10). Then, taking the derivative of $\ln G^t\left(p^t, v^t\right)$ with respect to $\ln p_n^t$, and summing across each country c in the rest-of-the-world, we obtain the equilibrium share of exported good n in rest-of-the-world's GDP at period t,[23]

[21]We assume some parameters to be time invariant so that we can estimate them using the variation over time.

[22]More specifically

$$
\sum_{n=1}^{N} a_{0n}^t = 1,\ \ \sum_{k=1}^{N} a_{nk} = \sum_{n=1}^{N} c_{nm} = 0,\ \ a_{nk} = a_{kn},\ \ \forall n, k = 1, ..., N,\ \ \forall m = 1, ..., M.
$$

And

$$
\sum_{n=1}^{N} b_{0n}^t = 1,\ \ \sum_{k=1}^{N} b_{nk}^t = \sum_{m=1}^{M} c_{nm} = 0,\ \ b_{nk}^t = b_{kn}^t,\ \ \forall n, k = 1, ..., N,\ \ \forall m = 1, ..., M.
$$

[23]This assumes that goods exported by the rest-of-the-world are differentiated by destination, and the price of goods to other destinations are included in the second term of the right-hand side on the top line of (11).

$$\begin{aligned} s_n^t\left(p^t, v^t\right) &\equiv \frac{p_n^t q_n^t\left(p^t, v^t\right)}{G^t\left(p^t, v^t\right)} = (C_w - 1)a_{0n}^t + (C_w - 1)\sum_{k=1}^{N} a_{nk}\ln p_k^t \\ &+ \sum_{m=1}^{M} c_{nm} \sum_{c=1}^{C_w - 1} \left(\ln v_m^t\right)_c \\ &= (C_w - 1)\left(a_{0n}^t + a_{nn}\ln p_n^t + a_{nk}\sum_{k \neq n} \ln p_k^t\right) \\ &+ \sum_{m=1}^{M} c_{nm} \sum_{c=1}^{C_w - 1} \left(\ln v_m^t\right)_c \end{aligned} \tag{11}$$

where s_n^t is the share of export good n in the rest-of-the-world GDP, C_w is the total number of countries, and $\sum_{c=1}^{C_w-1} (\ln v_m^t)_c$ is the sum of the log of factor endowment m across all countries in the rest-of-the-world.

The rest-of-the-world export supply elasticity of good n is then given by

$$e_{nn}^{\star} \equiv \frac{\partial q_n^t\left(p^t, v^t\right)}{\partial p_n^t}\frac{p_n^t}{q_n^t} = \frac{(C_w - 1)a_{nn}}{s_n^t} + s_n^t - 1 \geqslant 0 \tag{12}$$

Thus we can calculate the export supply elasticities once a_{nn} is properly estimated. Note that the size of the export supply elasticities positively depends on the size of a_{nn} which captures the changes in the share of exported good n in each country's GDP when the price of good n increases.

With data on export shares, unit values and factor endowments, equation (11) is the basis of our estimation of export elasticities. There are, however, several problems with the estimation of a_{nn} using (11). First, there are literally thousands of goods traded among the countries in any given year. Moreover, there is also a large number of non-traded commodities that compete for scarce factor endowments and contribute to the GDP in each country. Thus, we do not have enough degrees of freedom to estimate all a_{nk}s.

We follow Kee et al. (2008) to solve this problem by transforming the N-good economy problem into a collection of N sets of two-good economies. This is done by constructing a price index of the remaining goods in the economy (including imported and non-traded goods) for each n exported good. For this we use information on GDP deflators, a price index for each of the n exported goods as well as Caves, Christensen and Diewert's (1982) result that if the GDP function follows a translog functional form, and the translog parameters are time invariant, then a Tornquist price index is the exact price index of the GDP function. Using the definition of the Tornquist price index, it is then easy to compute for each good n a price index for all other goods in the economy, denoted p_{-n}. Equation (11) becomes

$$\begin{aligned} s_n^t\left(p_n^t, p_{-n}^t, v^t\right) &= (C_w - 1)a_{0n} + (C_w - 1)a_{nn} \ln \frac{p_n^t}{p_{-n}^t} \\ &+ \sum_{m \neq l, m=1}^{M} c_{nm} \sum_{c=1}^{C_w - 1} \ln \left(\frac{v_m^t}{v_l^t}\right)_c + \mu_n^t, \ \forall n. \end{aligned} \tag{13}$$

With an additive stochastic error term, μ_n^t, to capture measurement errors, equation (13) is the basis used for the estimation of own price effect, a_{nn}, and hence the export supply elasticity of the rest-of-the-world, $e_{nn}^{\star}$.

The second problem is that we do not have enough time variation to estimate these parameters by country. Therefore, given that we assume that the GDP functions are common up to a constant, we pool the data together and estimate the common a_{nn} using both cross-country and time variations and introducing year and country-specific fixed effects that are all specific to each good n. The country-specific fixed effects (for each good n) will control, for example, for the level of trade restrictiveness in each importing country that may be correlated with the price received by exporters, as long as trade restrictiveness does not vary significantly across time. The year fixed effects (for each good n) will capture general shocks to good n's world market.

There are also several econometric problems that need to be addressed to estimate equation (13). Unit prices can be endogenous or measured with error. There may also be selection bias due to the fact that some products may not be exported by the rest-of-the-world to a particular country. Finally, there may be partial adjustments of exported quantities to changes in prices which may lead to serial correlation in the error term. To address these econometric problems, we follow the procedure in Kee et al. (2008).[24]

Finally, for equation (11) to be the solution of the GDP maximization problem, the necessary second order conditions need to be satisfied (i.e., the Hessian matrix needs to be negative semi-definite). This implies that the estimated export elasticities of the rest-of-the-world are not negative. For this to be true for all observations requires

$$a_{nn} \geq \bar{s}_n \left(1 - \bar{s}_n\right) \tag{14}$$

where $\bar{s}_n$ is the maximum share in the sample for good n. Thus, when the estimated a_{nn} does not satisfy the curvature condition described by expression (14), we impose that the estimated $a_{nn} \equiv \bar{s}_n$, which ensures that all elasticities are positive.

[24]We instrumented unit values using the simple and inverse-distance weighted averages of the unit values of the rest-of-the-world, as well as the trade-weighted average distance of country c to all the exporting countries of good n. We corrected for selection bias by introducing the Mills ratio of the probit equation that determines whether or not the good was exported by the rest-of-the-world. We use the procedure in Semykina and Wooldridge (2010), but only when the test they propose suggests that selection bias is a problem. We also test for serial correlation in the error term, and, when serial correlation is present, we then estimate a dynamic model by introducing a lagged dependent variable using the generalized methods of moments (GMM) system estimators developed by Arellano and Bover (1995). This estimation strategy corresponds to the Arellano and Bond (1991) difference GMM estimators, with a level equation added to the system to improve efficiency.

3.2 Export supply elasticities from the exporter's point of view

The export supply elasticities from the exporter's point of view are used as instruments for the export supply elasticity of the rest-of-the-world from the point of view of the importer. The estimation procedure is identical to the one followed above, except for the fact that we are not summing the GDP functions of rest-of-the-world's countries. We then take the derivative of the GDP function with respect to prices and rearrange to obtain:

$$s_n^t\left(p_n^t, p_{-n}^t, v^t\right) = b_{0n} + b_{nn}\ln\frac{p_n^t}{p_{-n}^t} + \sum_{m\neq l, m=1}^{M} d_{nm}\left(\frac{v_m^t}{v_l^t}\right) + u_n^t, \quad \forall n \tag{15}$$

where b and d are parameters to be estimated after pooling observations across countries for each good n. In this case s_n^t represents the share in GDP of exports of good n at time t in each exporting country. The export supply elasticity of good n in each exporting country is then given by

$$e_{nn}^{x\star} \equiv \frac{\partial q_n^t\left(p^t, v^t\right)}{\partial p_n^t}\frac{p_n^t}{q_n^t} = \frac{b_{nn}}{s_n^t} + s_n^t - 1 \geqslant 0 \tag{16}$$

We are facing the same econometric problems and data constraints as when estimating the export supply elasticities of the rest-of-the-world, and we therefore follow the procedure described above.

3.3 Data

The dataset used to estimate export supply elasticities consists of export values and quantities reported by different countries to the United Nations Comtrade system at the six-digit level of the HS classification (revision 2).[25] The basic data set consists of an unbalanced panel of exports by 100 countries for

[25] This database can be accessed through the World Bank's World Integrated Trade Solution.

the period 1988-2007. The number of observations varies across products and time depending on the presence of export flows and on the availability of trade statistics.

There are three factor endowments included in the estimation: labor, capital stock and agricultural land. Data on labor force and agricultural land are from the World Development Indicators (WDI, 2012). Data on capital endowments are constructed using the perpetual inventory method based on real investment data in WDI (2012).

3.4 Empirical Results

We have estimated a total of 212,888 rest-of-the-world export supply elasticities for 100 importers at the six-digit level of the HS classification. The median export supply elasticity is around 10, which implies a median optimal tariff based on market power at 10 percent. But the estimates show substantial variance across products and countries. The top 10 percent estimates are larger than 377 which yields optimal tariffs below 0.2 percent. On the other hand, the bottom 10 percent estimates are smaller than 0.8, which yields optimal tariffs above 125 percent.

The last column of table 1 provides the average and standard deviation of export supply elasticities faced by each importer in the sample used to estimate equation (8). It therefore excludes some countries which are not WTO members or for which we do not have applied or bound tariff data. The economies facing the lowest export supply elasticities and therefore having the strongest market power are the United States and the European Union, with average optimal tariffs above 14 percent. The countries facing the highest export supply elasticity, and therefore being close to price-taking behavior in international markets are Dominica, Central African Republic and Grenada with average optimal tariffs below 0.7 percent.[26]

[26]There is a factor of 50 between the country with the highest average optimal tariff (the

We provide a few external tests for the elasticity estimates. First, as suggested in footnote 18, with information on import demand elasticities and export supply elasticities for each exporter, the rest-of-the-world export supply elasticity faced by importer i can be approximated by

$$e_i^\star = \frac{1}{m_i/x_w}\left(e^{x\star} + e_{ROW}\right) \tag{17}$$

where $e^{x\star}$ is the export supply of the entire world, which can be approximated by the weighted sum of export supply elasticities estimated from the exporter's point of view, and e_{ROW} is the import-weighted sum of the absolute value of import demand elasticities in the rest of the world, which have been estimated by Kee et al. (2008). The average and standard deviation of the weighted-sum of import demand elasticities in the rest of the world is given in the sixth column of table 1. The average and standard deviation of the export supply elasticity of the entire world ($e^{x\star}$) for the products imported by each country are given in the fifth column of table 1. The average could seem high, but it is important to remember that these export supply elasticities are estimated at the six-digit level of the HS classification keeping all prices constant, and among these prices that are kept constant there are some that are very close substitutes. For example, HS 010511 is the product code for live chickens under 185 grams, and HS 010512 is for live turkeys under 185 grams. Note that in order to derive equation (17) we assumed that the export supplies were not differentiated by importer, whereas our estimates of $e^\star$ described in section 3.1 assume that the export supply elasticities of the rest-of-the-world are differentiated by destination. Thus, we do not expect the estimates in section 3.1 to be equal to the ones obtained using equation (17).

In column (1) of table 2 we provide estimates of the correlation between our estimates of the export supply elasticity faced by each importer, and its

European Union) and the country with the lowest average optimal tariff (Dominica).

proxy using equation (17). As expected there is a positive and statistically significant relationship between these two measures of export supply elasticities faced by importers. In column (2) we split equation (17) into its three elements: the world's export supply elasticity for each good, which is proxied by the weighted average export supply elasticity across exporters, the import-weighted import demand elasticity in the rest-of-the-world, and the import share of the importer in world's markets. As expected, we find that both average elasticities have a positive sign (the import demand elasticities are measured in absolute value), and the import share has a negative sign. All coefficients are statistically significant.

We also compare our estimates with those of Broda et al. (2008) for thirteen countries that were not WTO members. Columns (3) in table 2 provide the correlation between the estimates of Broda et al. and our estimates. While the estimated correlation is relatively small, it is positive and statistically significant. Note that their estimates and ours vary in the assumptions made to obtain them, as they impose a constant elasticity of substitution demand structure, whereas our elasticities are derived from the supply side (the revenue function) and we make no assumptions on the demand side. Thus, we should not expect the elasticities to be equal, but positively correlated as they both capture the export supply elasticities faced by importers.

We then follow Broda et al.'s (2008) strategy of external tests for their estimates. They run a regression of export supply elasticities faced by the importer on the GDP of each importing country, the importer's share in world markets, and a measure of the remoteness of each importing country. Remoteness is defined as the inverse of the distance-weighted GDP of all the other countries in the world. In column (4) of table 2 we found, as in Broda et al. (2008), a negative correlation between rest-of-the-world's export supply elasticities and the importer's GDP, share in world markets, and its remoteness. The first two results suggest that larger countries are likely to face smaller elasticities, and therefore have more market power. The third result suggest that countries located far from world markets are more likely to have market power. Broda et al (2008) explain this negative correlation by the fact that isolated markets are likely to absorb a larger share of regional demand due to higher trade costs with the rest-of-the-world.

The final external test explores whether the estimated elasticities are higher for homogeneous goods which is also one of the findings in Broda et al. (2008). In column (5) we report the results of a regression of the elasticities on a dummy that signals an homogeneous good according to the classification in Rauch (1999).[27] Elasticities of homogeneous goods are around 28 percent higher suggesting a higher degree of price-taking by importers as in Broda et al. (2008).

We have also estimated around 65000 elasticities at the four-digit level of the HS by simply aggregating the six-digit raw data at the four-digit level and then implementing the same strategy as followed at the six-digit. The median elasticity is 8, which is slightly lower than the one obtained at the six-digit level of the HS. This is to be expected as the aggregation of data into broader bundles leads to a less responsive supply.[28] The last five columns of table 2 reproduce the same external tests undertaken for the estimates at the six-digit level of the HS, but using instead elasticities estimated at the four-digit level of the HS. All external tests confirm the different *a priori* expectations we had on these elasticities. Also, when aggregating the four and six-digit level estimates at the country level, we find a correlation of 0.9.

We have computed standard errors for the elasticity estimates both at the four and six-digit level. Using equation (12), the standard error of the elasticities is given by the standard error of $a_{nn} \times (C^w - 1)$ estimated using 13, which is then divided by s_n. The elasticities are not as precisely estimated as ideally

[27] Rauch (1999) classification uses the four-digit level SITC disaggregation. We use a concordance table (available upon request) to go from the SITC four-digit classification to the HS six-digit classification.

[28] Note that our elasticity estimates are generally higher than the estimates in Ossa (2014), but this may be due to the higher level of aggregation in his paper.

expected, but one can broadly reject that they are all equal. Around 47 percent of the HS six-digit estimates are statistically different from zero at the 5 percent level. Around 43 percent of the point estimates are statistically different from the elasticities at the bottom 5 percent of the distribution, and 82 percent of the point estimates are statistically different from the elasticities at the top 5 percent of the distribution. The four-digit estimates tend to be estimated with better precision, i.e., 54 percent of the elasticities are statistically different from zero at the 5 percent level. Around 53% of the estimates are statistically different from the elasticities at the bottom 5 percent of the distribution, and 90% are statistically different from the elasticities at the top 5 percent of the distribution.

4 Cooperation beyond WTO tariff bounds?

To estimate the extent to which we observe cooperative tariffs in the absence of tariff water, and non-cooperative behavior in the presence of tariff water, we estimate equation (8).[29]

Table 1 provides the average and standard deviation of applied MFN and bound tariffs as well as information on tariff water across countries. Among developed nations only Australia and New Zealand have significant amounts of tariff water, with an average difference between their bound and applied tariffs of 7 and 8 percentage points, respectively. On the other hand, most developing countries have more than 10 percentage points of tariff water in their tariff schedules, reaching over 40 percentage points in 27 countries (out of the 92 countries in the sample).

[29] We use data on applied MFN tariffs and tariff bounds in 2006. The choice of year has to do with the fact that the end of the implementation period of the Uruguay Round agreement was 2005. We also wanted to avoid the financial crisis period where a surge in protectionism was observed for macroeconomic reasons. The applied MFN tariffs were obtained using the World Integrated Trade System (WITS) while tariff bounds negotiated during the Uruguay round were provided by the WTO.

Estimation of equation (8) requires data on rest-of-the-world export supply elasticities, as well as import demand elasticities, and the export supply elasticity from the point of view of exporters. The estimation of these elasticities was discussed in the previous section, and their mean and standard deviation by country are also provided in table 1.

We estimate equation (8) using five different measures of market power. In the first specification we use our estimates of market power ($1/e^{\star}$). However, the data described in table 1 shows that there are important outliers as the standard deviation is often several times larger than the average elasticity. For this reason, we follow Broda et al. (2008) in considering alternative nonlinear measures of market power. The second specification uses the log of $1/e^{\star}$. The third specification uses a dummy that takes a value of 1 for elasticities that belong to the top 1/3 of the market power distribution across all products and countries. In the fourth specification the dummy takes a value of 1 if market power is above the median, and in the fifth specification market power needs to be in the top 2/3 of the distribution.

The first five columns of table 3 provide the ordinary least square estimates of equation (8). The last five columns provide the instrumental variable estimates. Results in the first row tend to confirm the prediction that in the absence of tariff water (i.e., in the presence of tariff cooperation), the importer's market power is negatively correlated with applied tariffs. With the exception of the specifications in the first and sixth columns, all coefficients on the importer's market power are statistically significant at the 5 percent level.

The ordinary least square estimates in the second row of table 3 do not support the prediction that tariffs and market power are positively correlated in the presence of tariff water. However, while the estimated coefficients tend to be negative and statistically significant, they are much smaller than in the absence of tariff water. This suggests at least that in the presence of tariff water, countries may tend to set tariffs less cooperatively than in the absence of tariff water.

Moreover, the ordinary least squares estimates may suffer from endogeneity bias. Indeed, tariffs affect import demand and therefore quantities exported by the rest-of-the-world in equilibrium, which in turn may affect estimates of the elasticity of export supply in the rest-of-the-world. Also, the presence or absence of tariff water may be affected by the same unobserved variables as tariff levels. We instrumented the presence of tariff water with the presence of bound tariffs higher than prohibitive tariffs. Rest-of-the-world export supply elasticities were instrumented using import demand elasticities in the rest-of-the-world as well as the world export supply elasticity (from the point of view of the exporters).[30] Once we correct for endogeneity, the last five columns of table 3 support the prediction that market power is positively correlated with tariffs in the presence of tariff water. Only in the specification in the sixth column, the coefficient is not statistically different from zero. Note also that with the exception of column (6) we reject the null hypothesis that we are in the presence of weak instruments and we pass the Hansen overidentification test, suggesting that the instruments are valid.

Using the estimates of table 3 we can measure the economic importance of market power for cooperative and non-cooperative tariffs. Using our preferred specification in column (9) of table 3, which proxies market power with a dummy indicating whether market power is above or below the median, we can compute the change in tariffs that will be observed when we have a shift from low to high market power in the presence and absence of tariff water. Results in column (9) of table 3 suggest that a move from low market power to high market power leads to a tariff that is 16 percentage points lower in the absence of tariff water, and a tariff that is 18 percentage points higher in the presence of tariff water. Estimates also imply that in the presence of market power, the shift in regimes from cooperative to non-cooperative tariffs leads to an increase in tariffs of 34

[30]See footnote 11 and the discussion on page 12-13 for a more thorough discussion.

percentage points.

To sum up, the results in table 3 tend to confirm that tariffs are set cooperatively in the absence of tariff water, and that they tend to be set non-cooperatively in the presence of tariff water after controlling for endogeneity. More importantly, the shift from cooperative to non-cooperative tariffs leads to important increases in tariffs in the presence of market power.

4.1 Robustness

In Table 4 we report the results of a series of robustness tests on our preferred specification in column (9) of table 3. Column (1) provides the results with elasticities estimated at the four-digit level of the HS to better address the large number of zero trade flows when elasticities are estimated at the six-digit level of the HS.[31] Column (2) introduces HS four-digit x country fixed effects to account for unobserved heterogeneity within HS two-digit x country fixed effects. Columns (3) and (4) explore differences between OECD and non-OECD countries. The larger levels of tariff water in non-OECD countries may generate differences in behavior. Columns (5) and (6) explore differences between GATT members and new WTO members. Indeed, non-OECD countries are generally late comers to the GATT/WTO system and the extent of cooperation and understanding of the flexibility offered by tariff water may not be the same as for OECD countries. In column (7) the sample only includes observations for which we were able to estimate rest-of-the-world export supply estimates without imposing the constraint in equation (14).[32] In column (8) we use as additional controls the variables identified in Ludema and Mayda (2013), i.e., exporter's concentration, its interaction with market power and the share of preferential trade. The sample in column (9) includes observations in which

[31] Note that our HS six-digit elasticity estimates use a Heckman sample selection estimator to correct for the presence of zeroes.

[32] Indeed 31 percent of the estimates fail to satisfy the constraint in (14) and we therefore impose it on the data.

there are unbound tariffs. We made the assumption that if tariffs are unbound this implies the presence of tariff water. In column (10), to account for the fact that the elasticities are estimated, we provide a Fuller (1987) correction using the standard error of the estimated elasticities to put more weight on observations with small standard errors.[33] Finally, column (11) controls for the import demand elasticity (ϵ). This is due to the fact that the import demand elasticity is used to construct the prohibitive tariff which is then used to construct the dummy that captures the presence of bound tariffs higher than prohibitive tariffs. The concern is that import demand elasticity may directly affect tariffs.[34] Although our identification assumption works through the non-linearities of the functional form behind the construction of the dummy that captures the presence of bound tariffs above prohibitive levels, we check that our results are robust to the inclusion of import demand elasticity as a control.

All robustness tests tend to suggest that tariffs are negatively correlated with market power in the absence of tariff water and positively correlated with market power in the presence of tariff water. The instruments generally pass the over and under-identification tests except perhaps in the sample of new WTO members in column (6) where the first stage seems to perform poorly.

There may be two additional concerns with our instrument for tariff water. First, in a setup with trade policy uncertainty where exporters decisions may depend on whether the bound tariff is above or below the prohibitive level. In

[33]We followed Gawande (1997) and recalculate each elasticity as:

$$\widetilde{\epsilon_i} = \overline{\epsilon} + \frac{\sigma_\epsilon^2 - \overline{\sigma_u^2}}{\sigma_i^2}(\epsilon_i - \overline{\epsilon})$$

where $\overline{\epsilon}$ and σ_ϵ^2 are the sample mean and variance of ϵ, respectively; and σ_u^2 is the mean variance of u_i. Note that $\sigma_\epsilon^2 - \sigma_u^2$ is a proxy for the sample variance of the true elasticity (which is not observed). This allows to put more weight on the estimated elasticities of observations with small standard errors (small u_i). We then construct the high and low elasticity dummy using $\widetilde{\epsilon_i}$ rather than ϵ_i.

[34]There are several reasons for this: Ramsey pricing in a political economy setting is one of them. Note that we have not controlled for the import demand elasticity in the main specification because we expect the HS two-digit $\times$ country dummies to capture most of the political economy determinants of tariffs.

such a setup our instrument may not be valid as bound tariffs below prohibitive levels may affect export decisions. To address this we use as an alternative instrument for tariff water a dummy indicating whether the bound tariff is at least 20 percentage points higher than the prohibitive tariff. All the IV regressions of Table 3 are robust to the use of this alternative instrument and all pass the over-id Hansen test with a p-value that is never smaller than 0.50. Second, the HS 2-digit (and HS 4-digit in column (2) of Table 4) may not fully control for political economy determinants of applied tariffs at the HS 6-digit which may in turn be correlated with our instrument for tariff water. To address this we use as an alternative instrument the share of countries in the rest-of-the-world with bound tariffs above prohibitive levels in the same tariff line. This captures the fact that many countries bound at arbitrary high levels as discussed in footnote 12 above. This share determined in the rest-of-the-world is also unlikely to be correlated with political economy determinants in the importing country. Results using this alternative instruments are very similar to the ones reported in columns (6) to (10) of Table 3 and all over-id tests suggest again that the instruments are valid.[35]

4.2 Estimating the tariff water threshold

The model in section 2 assumes that the mere presence of tariff water leads to non-cooperative behavior by WTO members. We can relax this assumption using an unknown threshold model à la Hansen (2000), and let the data estimate the level of tariff water at which there is a change in regime from co-operative to non-cooperative tariffs. Our methodology described in section 2.2 combines Hansen's (1999) unknown threshold estimator for panel data with the IV estimator for unknown thresholds in Caner and Hansen (2004).

The first five columns in table 5 provide the estimates of the unknown threshold model. All columns tend to confirm that the measure of market power is

[35]Results for all of these robustness tests are available from the authors.

positively correlated with tariffs when there is sufficiently large amounts of tariff water, and negatively correlated otherwise. In all columns, the threshold is estimated at 1 percent, meaning that the change from cooperative to non-cooperative behavior only occurs when tariff water is above 1 percent.

This is a fairly low level of tariff water, and there are less than 2 percent of tariff lines with a level of tariff water between 0 and 1 percent. Nevertheless, the switch in regime does not occur as soon as tariff water is available. Moreover, the threshold is very precisely estimated and is statistically different from zero.[36] This can be seen as problematic given that in principle non-cooperative behavior should be observed as soon as tariff water is available.[37]

A potential explanation is that WTO bindings are only one of the external constraints imposed on importing countries when setting tariffs. The World Bank and IMF lending programs have also imposed a significant amount of trade reforms on developing countries that go well beyond their WTO commitments. According to Edwards (1997) 70 percent of the World Bank adjustment operations include some form of trade conditionality. If the number of trade conditionalities has declined since the early 2000s, and today mainly focuses on customs reform and trade facilitation rather than tariff levels, its importance until the late 1990s has had a lasting impact on the structure of protection in developing countries. Moreover, as argued by Edwards (1997), trade conditionality is one of many aspects through which the World Bank and the IMF affected developing countries' tariff structure. Policy dialogue and trade research have also affected tariff setting in many countries. Chile's move towards a uniform tariff in the late 1970s, Colombia's rapid tariff cut in 1990 from an average of 83 percent to 7 percent, and India and Morocco's halving of average tariffs in

[36] We follow Hansen (2000) to test this. The threshold is statistically different from zero at the α percent confidence level if the likelihood ratio statistics described by expression $n\left(S(\gamma=0)-S(\hat{\gamma})\right)/S(\hat{\gamma})$, , where S is the sum of squared residuals, γ is the threshold, $\hat{\gamma}$ is the optimal threshold that minimizes the sum of square residuals, and n is the number of observations, is greater than $-2\ln(1-\sqrt{1-\alpha})$.

[37] This is also the case in models that rationalize the presence of tariff water based on private information such as Beshkar, Bond and Rho (2015).

the mid 2000s were not the result of trade conditionality, but the outcome of policy dialogue.

If tariff structures are subject to external constraints other than those imposed by WTO's bound tariffs, then one should expect to observe some noise in the move from cooperative to non-cooperative tariffs in developing countries. However, in otherwise externally unconstrained developed countries we should observe a move towards non-cooperative tariff setting as soon as some flexibility is offered. We explore this idea in a sub-sample containing OECD countries only and re-estimate (8) using an unknown threshold model. The results are reported in the last five columns of table 5. Results generally reproduce those for the full sample, but the estimated threshold for the OECD sample occurs when tariff water is 0, suggesting that for countries that have no external constraints on their tariff structure other than those imposed by WTO tariff bounds, the shift from cooperative to non-cooperative tariff setting occurs as soon as some flexibility is available.

5 Concluding Remarks

This paper examines the extent of cooperative and non-cooperative behavior in tariff setting among WTO members. In the absence of tariff water we should observe cooperation, as importers cannot increase their tariffs to exploit their market power without violating their WTO commitments. The presence of tariff water allows for non-cooperative behavior, as tariffs can be increased without violating WTO commitments.

To guide our empirical study, we build a simple model in which politically motivated governments put an extra-weight on the profits of domestic firms. The model reproduces the textbook prediction that non-cooperative tariffs are positively correlated with importers' market power. The novel prediction is that in the presence of cooperation, tariffs and market power are negatively correlated. This is driven by the fact that cooperative tariffs not only reflect the interests of the importing country, but also those of the exporting country. The additional weight given to exporting firms' profits in the exporting country ensures that they have stronger incentives to negotiate tariff reductions in sectors in which the importing country has more market power, which leads to the negative correlation between importers' tariffs and their market power.

We test these predictions using new estimates of market power for 100 countries at the tariff line level. Results are in line with the theoretical prediction. In the presence of tariff water, the relationship between importers' market power and tariffs is positive, which is consistent with non-cooperative tariffs. In the absence of tariff water, importing countries' market power tends to be negatively correlated with applied tariffs, which is consistent with cooperation in tariff setting. More importantly, estimates suggests that a shift from non-cooperative to cooperative tariffs leads to important reductions in applied tariffs in the presence of market power.

We also examine the amount of tariff water that is necessary to observe a shift from cooperative to non-cooperative behavior. In a sub-sample of OECD countries this occurs as soon as tariff water is available, whereas in the full sample it occurs when tariff water is above 1 percent. Around 75 percent of WTO members' tariff lines have levels of tariff water above 1 percent.

These results suggest that non-cooperative behavior is common in WTO tariff waters. Thus, contrary to what is sometimes suggested, the tariff negotiating agenda of the WTO is far from completed. In a large majority of tariff lines, there seems to be room for old-fashion tariff negotiations to help members set cooperative tariffs.

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Table 1: Descriptive statistics of tariffs, tariff water, and elasticities

Country	MFN Applied	Bound Tariff	Tariff Water	Max(0, $t^b - t^{pr}$)	World exp elas. ($e^{x\star}$)	ROW imp. elas. (e_{ROW})	ROW-exp elas. ($e^{\star}$)
Antigua and Barbuda	0.169	0.893	0.724	0.015	115	1.363	114
	(0.104)	(0.366)	(0.329)	(0.063)	(171)	(1.570)	(189)
Argentina	0.115	0.316	0.202	0.012	80	1.488	52
	(0.069)	(0.065)	(0.082)	(0.045)	(143)	(1.974)	(116)
Australia	0.038	0.112	0.073	0.003	91	1.591	30
	(0.044)	(0.116)	(0.083)	(0.020)	(173)	(2.274)	(78)
Bahrain	0.057	0.348	0.294	0.003	88	1.558	91
	(0.096)	(0.156)	(0.088)	(0.023)	(181)	(2.118)	(172)
Bangladesh	0.146	1.542	1.397	0.476	118	1.627	63
	(0.099)	(0.748)	(0.723)	(0.546)	(170)	(2.426)	(116)
Barbados	0.184	0.815	0.631	0.022	83	1.462	101
	(0.244)	(0.268)	(0.267)	(0.127)	(152)	(1.893)	(165)
Belize	0.130	0.612	0.483	0.004	86	1.543	132
	(0.120)	(0.209)	(0.210)	(0.032)	(144)	(1.857)	(197)
Benin	0.140	0.255	0.146	0.002	112	1.739	121
	(0.066)	(0.248)	(0.215)	(0.021)	(219)	(2.408)	(197)
Bolivia	0.083	0.399	0.316	0.004	77	1.486	98
	(0.030)	(0.008)	(0.030)	(0.025)	(142)	(1.884)	(172)
Botswana	0.122	0.237	0.115	0.005	94	1.598	83
	(0.122)	(0.187)	(0.169)	(0.062)	(206)	(2.181)	(158)
Brazil	0.125	0.308	0.183	0.016	83	1.501	41
	(0.060)	(0.077)	(0.077)	(0.049)	(147)	(2.046)	(105)
Brunei Darussalam	0.010	0.244	0.234	0.001	111	1.683	76
	(0.035)	(0.083)	(0.077)	(0.012)	(223)	(2.478)	(146)
Bulgaria	0.106	0.249	0.143	0.001	84	1.495	66
	(0.086)	(0.156)	(0.117)	(0.015)	(164)	(1.900)	(134)
Burkina Faso	0.127	0.343	0.247	0.011	98	1.813	123
	(0.068)	(0.405)	(0.376)	(0.059)	(205)	(2.755)	(200)
Burundi	0.132	0.472	0.390	0.024	102	1.796	139
	(0.108)	(0.446)	(0.438)	(0.122)	(134)	(2.821)	(193)
Cameroon	0.202	0.800	0.598	0.037	119	1.467	92
	(0.106)	(0.000)	(0.106)	(0.110)	(169)	(1.339)	(152)
Canada	0.038	0.054	0.015	0.000	93	1.635	19
	(0.051)	(0.056)	(0.028)	(0.007)	(175)	(2.380)	(51)
Central African Republic	0.190	0.369	0.179	0.000	105	1.776	182
	(0.092)	(0.104)	(0.122)	(0.000)	(164)	(2.424)	(259)
Chile	0.060	0.251	0.191	0.004	80	1.543	57
	(0.003)	(0.020)	(0.020)	(0.025)	(150)	(2.077)	(121)

Country	MFN Applied	Bound Tariff	Tariff Water	Max(0, $t^b - t^{pr}$)	World exp elas. ($e^{x\star}$)	ROW imp. elas. (e_{ROW})	ROW-exp elas. ($e^\star$)
China	0.095	0.097	0.002	0.000	88	1.580	24
	(0.071)	(0.071)	(0.014)	(0.003)	(162)	(2.269)	(72)
Colombia	0.124	0.407	0.283	0.016	79	1.512	57
	(0.071)	(0.193)	(0.186)	(0.093)	(133)	(2.011)	(122)
Costa Rica	0.059	0.425	0.366	0.008	81	1.459	78
	(0.076)	(0.125)	(0.123)	(0.053)	(149)	(1.836)	(154)
Côte d'Ivoire	0.124	0.100	0.018	0.001	88	1.413	96
	(0.067)	(0.074)	(0.056)	(0.018)	(188)	(1.546)	(167)
Croatia	0.053	0.065	0.014	0.000	87	1.589	63
	(0.057)	(0.054)	(0.026)	(0.001)	(179)	(2.094)	(129)
Cyprus	0.034	0.412	0.378	0.006	77	1.460	84
	(0.040)	(0.140)	(0.135)	(0.059)	(156)	(1.713)	(160)
Dominica	0.146	0.725	0.578	0.013	97	1.450	196
	(0.171)	(0.347)	(0.296)	(0.075)	(154)	(1.424)	(250)
Egypt	0.109	0.277	0.175	0.007	79	1.479	65
	(0.346)	(0.242)	(0.136)	(0.041)	(153)	(1.944)	(134)
El Salvador	0.065	0.365	0.300	0.005	85	1.513	83
	(0.075)	(0.121)	(0.114)	(0.031)	(163)	(2.032)	(157)
Estonia	0.044	0.088	0.047	0.000	87	1.576	77
	(0.049)	(0.076)	(0.064)	(0.006)	(174)	(2.169)	(151)
European Union	0.043	0.043	0.001	0.000	93	1.122	4
	(0.044)	(0.044)	(0.007)	(0.002)	(174)	(1.568)	(6)
Gabon	0.180	0.226	0.088	0.001	85	1.442	109
	(0.096)	(0.169)	(0.134)	(0.010)	(167)	(1.742)	(179)
Georgia	0.071	0.072	0.001	0.000	89	1.561	106
	(0.060)	(0.059)	(0.007)	(0.000)	(156)	(2.022)	(178)
Ghana	0.158	0.850	0.692	0.035	143	1.616	72
	(0.070)	(0.257)	(0.228)	(0.129)	(253)	(2.271)	(140)
Grenada	0.140	0.600	0.460	0.005	103	1.707	155
	(0.084)	(0.229)	(0.229)	(0.043)	(166)	(2.252)	(238)
Guatemala	0.059	0.412	0.353	0.013	78	1.537	77
	(0.064)	(0.174)	(0.173)	(0.074)	(145)	(2.136)	(153)
Guyana	0.122	0.587	0.465	0.000	88	1.567	114
	(0.109)	(0.189)	(0.177)	(0.004)	(177)	(1.947)	(189)
Honduras	0.064	0.310	0.246	0.001	74	1.547	91
	(0.068)	(0.087)	(0.095)	(0.011)	(121)	(2.144)	(176)
Hong Kong	0.000	0.000	0.000	0.000	102	1.522	27
	(0.000)	(0.000)	(0.000)	(0.000)	(199)	(2.032)	(76)
Iceland	0.041	0.168	0.127	0.006	80	1.445	82
	(0.062)	(0.203)	(0.188)	(0.064)	(159)	(1.856)	(161)
India	0.176	0.438	0.264	0.033	83	1.562	43
	(0.139)	(0.346)	(0.271)	(0.148)	(148)	(2.262)	(102)

Country	MFN Applied	Bound Tariff	Tariff Water	Max(0, $t^b - t^{pr}$)	World exp. elas. ($e^{x\star}$)	ROW imp. elas. (e_{ROW}))	ROW-exp elas. ($e^\star$)
Indonesia	0.061	0.369	0.308	0.019	83	1.583	44
	(0.060)	(0.107)	(0.112)	(0.076)	(155)	(2.228)	(102)
Israel	0.046	0.199	0.155	0.023	81	1.485	43
	(0.095)	(0.369)	(0.349)	(0.182)	(149)	(2.193)	(100)
Jamaica	0.086	0.525	0.439	0.009	83	1.542	85
	(0.112)	(0.223)	(0.205)	(0.053)	(163)	(2.023)	(157)
Japan	0.031	0.030	0.001	0.000	90	1.489	16
	(0.045)	(0.047)	(0.008)	(0.000)	(167)	(2.143)	(43)
Jordan	0.120	0.167	0.053	0.000	84	1.546	81
	(0.140)	(0.140)	(0.078)	(0.004)	(166)	(2.149)	(153)
Kenya	0.181	0.923	0.742	0.049	158	1.757	84
	(0.167)	(0.205)	(0.214)	(0.148)	(223)	(2.352)	(146)
Kyrgyzstan	0.037	0.067	0.030	0.000	103	1.558	112
	(0.047)	(0.046)	(0.036)	(0.000)	(139)	(1.498)	(175)
Madagascar	0.126	0.253	0.129	0.000	92	1.483	133
	(0.052)	(0.066)	(0.068)	(0.004)	(166)	(1.741)	(197)
Malawi	0.107	0.810	0.703	0.031	113	2.049	88
	(0.102)	(0.402)	(0.352)	(0.098)	(169)	(3.243)	(162)
Malaysia	0.077	0.150	0.075	0.001	87	1.610	40
	(0.097)	(0.117)	(0.090)	(0.030)	(158)	(2.333)	(98)
Mali	0.123	0.214	0.117	0.000	87	1.626	109
	(0.065)	(0.214)	(0.188)	(0.002)	(144)	(1.893)	(195)
Malta	0.045	0.495	0.450	0.004	77	1.451	91
	(0.040)	(0.105)	(0.110)	(0.036)	(145)	(1.876)	(167)
Mauritius	0.062	0.899	0.841	0.105	128	1.578	77
	(0.099)	(0.484)	(0.459)	(0.188)	(247)	(2.398)	(133)
Mexico	0.137	0.350	0.213	0.010	88	1.587	26
	(0.086)	(0.045)	(0.087)	(0.040)	(163)	(2.294)	(70)
Mongolia	0.045	0.174	0.129	0.000	94	1.568	103
	(0.018)	(0.057)	(0.061)	(0.000)	(174)	(2.135)	(187)
Morocco	0.228	0.400	0.196	0.005	83	1.570	65
	(0.196)	(0.129)	(0.169)	(0.044)	(157)	(2.155)	(133)
Namibia	0.121	0.263	0.142	0.011	93	1.621	88
	(0.127)	(0.275)	(0.268)	(0.164)	(201)	(2.185)	(160)
New Zealand	0.037	0.120	0.083	0.001	87	1.523	57
	(0.046)	(0.118)	(0.079)	(0.010)	(172)	(2.023)	(125)
Nicaragua	0.069	0.423	0.354	0.001	80	1.471	101
	(0.080)	(0.092)	(0.087)	(0.020)	(143)	(1.975)	(180)
Niger	0.133	0.453	0.334	0.023	94	1.738	129
	(0.069)	(0.449)	(0.425)	(0.121)	(155)	(2.273)	(196)
Nigeria	0.102	0.969	0.867	0.171	97	1.666	62
	(0.110)	(0.518)	(0.464)	(0.310)	(196)	(2.294)	(129)

Country	MFN Applied	Bound Tariff	Tariff Water	Max(0, $t^b - t^{pr}$)	World exp. elas. ($e^{x\star}$)	ROW imp. elas. (e_{ROW})	ROW-exp elas. ($e^\star$)
Norway	0.009	0.033	0.025	0.000	84	1.620	41
	(0.032)	(0.040)	(0.033)	(0.005)	(163)	(2.333)	(99)
Oman	0.050	0.128	0.079	0.002	88	1.611	76
	(0.056)	(0.143)	(0.112)	(0.047)	(176)	(2.312)	(152)
Panama	0.077	0.224	0.148	0.001	79	1.499	85
	(0.079)	(0.116)	(0.102)	(0.016)	(145)	(2.039)	(165)
Papua New Guinea	0.048	0.373	0.325	0.001	89	1.174	102
	(0.096)	(0.146)	(0.132)	(0.015)	(175)	(1.280)	(174)
Paraguay	0.098	0.325	0.228	0.002	78	1.413	97
	(0.074)	(0.069)	(0.090)	(0.017)	(142)	(1.715)	(176)
Peru	0.094	0.301	0.207	0.005	77	1.446	68
	(0.055)	(0.022)	(0.057)	(0.026)	(136)	(1.809)	(136)
Philippines	0.051	0.245	0.194	0.006	87	1.589	55
	(0.057)	(0.115)	(0.097)	(0.034)	(143)	(2.300)	(122)
Republic of Korea	0.106	0.148	0.044	0.001	87	1.594	28
	(0.353)	(0.356)	(0.065)	(0.013)	(157)	(2.318)	(76)
Rwanda	0.213	0.860	0.665	0.029	80	1.587	140
	(0.107)	(0.288)	(0.286)	(0.107)	(118)	(2.115)	(214)
Saint Kitts and Nevis	0.149	0.840	0.691	0.012	93	1.351	145
	(0.102)	(0.264)	(0.247)	(0.056)	(142)	(1.284)	(205)
Saint Lucia	0.140	0.753	0.613	0.021	90	1.469	132
	(0.117)	(0.365)	(0.337)	(0.078)	(170)	(1.860)	(211)
Saudi Arabia	0.048	0.105	0.059	0.001	89	1.672	44
	(0.020)	(0.056)	(0.045)	(0.009)	(172)	(2.486)	(100)
Senegal	0.126	0.299	0.174	0.000	87	1.597	96
	(0.068)	(0.009)	(0.068)	(0.008)	(167)	(2.057)	(174)
Singapore	0.000	0.070	0.070	0.001	94	1.596	31
	(0.000)	(0.040)	(0.040)	(0.006)	(176)	(2.368)	(83)
Slovakia	0.044	0.053	0.022	0.000	83	1.556	53
	(0.051)	(0.062)	(0.056)	(0.016)	(159)	(2.104)	(112)
South Africa	0.082	0.190	0.108	0.010	81	1.530	45
	(0.112)	(0.217)	(0.201)	(0.127)	(141)	(2.010)	(106)
Sri Lanka	0.090	0.233	0.147	0.002	97	1.781	70
	(0.122)	(0.199)	(0.132)	(0.025)	(170)	(2.316)	(143)
Swaziland	0.124	0.246	0.122	0.004	108	1.657	94
	(0.124)	(0.201)	(0.193)	(0.062)	(231)	(2.209)	(173)
Tanzania	0.240	1.200	0.960	0.087	145	1.535	99
	(0.184)	(0.000)	(0.184)	(0.194)	(213)	(2.140)	(179)
Thailand	0.107	0.253	0.157	0.005	84	1.473	40
	(0.137)	(0.137)	(0.129)	(0.033)	(157)	(1.926)	(105)
Togo	0.169	0.800	0.631	0.000	166	1.562	118
	(0.054)	(0.000)	(0.054)	(0.000)	(303)	(2.492)	(186)

Country	MFN Applied	Bound Tariff	Tariff Water	Max(0, $t^b - t^{pr}$)	World exp. elas. ($e^{x\star}$)	ROW imp. elas. (e_{ROW})	ROW-exp elas. ($e^\star$)
Trinidad and Tobago	0.087	0.575	0.489	0.011	76	1.557	90
	(0.102)	(0.191)	(0.168)	(0.063)	(123)	(2.118)	(169)
Tunisia	0.245	0.492	0.247	0.006	83	1.611	66
	(0.233)	(0.315)	(0.225)	(0.056)	(143)	(2.107)	(124)
Turkey	0.063	0.212	0.150	0.005	74	1.324	30
	(0.150)	(0.221)	(0.156)	(0.046)	(133)	(1.697)	(78)
Uganda	0.201	0.722	0.524	0.030	138	1.896	103
	(0.190)	(0.140)	(0.177)	(0.110)	(207)	(2.661)	(188)
United Arab Emirates	0.048	0.153	0.105	0.007	87	1.337	39
	(0.060)	(0.228)	(0.194)	(0.095)	(193)	(1.349)	(90)
United States of America	0.039	0.038	0.000	0.000	91	1.331	7
	(0.107)	(0.108)	(0.009)	(0.000)	(166)	(1.972)	(27)
Uruguay	0.113	0.312	0.199	0.004	80	1.461	94
	(0.071)	(0.066)	(0.088)	(0.025)	(142)	(1.895)	(173)
Venezuela	0.135	0.355	0.219	0.008	80	1.481	54
	(0.075)	(0.125)	(0.136)	(0.051)	(150)	(2.014)	(117)
Zambia	0.134	0.897	0.763	0.061	148	2.103	83
	(0.107)	(0.415)	(0.354)	(0.179)	(258)	(3.244)	(141)
Zimbabwe	0.184	1.119	0.937	0.104	117	1.389	66
	(0.173)	(0.614)	(0.565)	(0.241)	(274)	(1.432)	(78)

Source: World Bank's WITS at wits.worldbank.org. Standard deviations in parenthesis.

Table 2: External tests of the estimates of ROW export supply elasticities

	HS six-digit estimates					HS four-digit estimates				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Log of ROW Export supply elasticity	0.404**					0.503**				
(left-hand-side of equation (17))	(0.003)					(0.005)				
Log of world's export supply elasticity		0.024**					0.053**			
(right-hand-side of equation (17))		(0.003)					(0.007)			
Log of ROW import demand elasticity		0.035**					0.019**			
(right-hand-side of equation (17))		(0.006)					(0.007)			
Log of import share		-0.418**		-0.400**			-0.445**		-0.489**	
(right-hand-side of equation (17))		(0.003)		(0.003)			(0.005)		(0.004)	
Log of ROW Export supply elasticity			0.021**					0.023**		
(Broda et al. (2008) estimates)			(0.008)					(0.008)		
Log of GDP				-0.032**					-0.024**	
(proxy for size)				(0.002)					(0.004)	
Log of remoteness				-0.076**					-0.231**	
(inverse of distance-weigthed GDP)				(0.013)					(0.021)	
Homogenous goods					0.256**					0.189**
(Rauch's classification)					(0.022)					(0.031)
R^2-adjusted	0.535	0.135	0.051	0.544	0.091	0.635	0.236	0.078	0.621	0.152
Number of observations	202307	202307	8843	202307	183645	66196	66196	8843	64281	66196
Number of countries	100	100	13	100	100	100	100	13	100	100
Number of HS codes	4944	4944	1116	4944	4496	1188	1188	1093	1188	1169
HS fixed effects	Yes	No	No	Yes	No	Yes	No	No	Yes	No
Country fixed effects	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes

OLS estimates. Robust Standard errors in parenthesis: ** and ∗ stand for 5 % and 10 % statistical significance.

Table 3: Cooperative versus non-cooperative tariff setting in the WTO

	Ordinary Least Squares estimates					Instrumental Variables estimates				
	(1) $1/e^*$	(2) Log $1/e^*$	(3) Top 1/3	(4) Top 1/2	(5) Top 2/3	(6) $1/e^*$	(7) Log $1/e^*$	(8) Top 1/3	(9) Top 1/2	(10) Top 2/3
Market Power × No Water	-3E^{-5}	-0.0022**	-0.0044**	-0.0075**	-0.0117**	-0.016	-0.020*	-0.135**	-0.159**	-0.230**
	(6E^{-5})	(0.0003)	(0.0011)	(0.0012)	(0.0017)	(0.020)	(0.010)	(0.033)	(0.027)	(0.037)
Market Power × Water	5E^{-6}	-0.0008**	-0.0016**	-0.0018**	-0.0027**	0.018	0.033**	0.226**	0.183**	0.144**
	(1E^{-5})	(0.0001)	(0.0004)	(0.0005)	(0.0005)	(0.021)	(0.005)	(0.048)	(0.031)	(0.021)
# obs.	146861	146861	146861	146861	146861	146418	146418	146418	146418	146418
R^2	0.606	0.607	0.607	0.607	0.607	.	0.449	0.069	0.208	0.326
Hansen overid. (p-value)	NA	NA	NA	NA	NA	0.011	0.125	0.064	0.632	0.633
Kleibergen-Paap (p-value)	NA	NA	NA	NA	NA	0.786	0.000	0.000	0.000	0.000

All columns include HS six-digit, and country × HS two-digit fixed effects. Robust standard errors in parenthesis: ** and * stand for 5 % and 10 % statistical significance, respectively. Columns (1) and (6) use the inverse of ROW export supply elasticity as a measure of market power; columns (2) and (7) use the log of the inverse; columns (3) and (8) use a dummy that takes the value 1 if the inverse is in the top third of the distribution; columns (4) and (9) take the value 1 if the inverse is above median, and columns (5) and (10) if the inverse is in the top two thirds of the distribution. Columns (1) to (5) use an ordinary least square estimator and columns (6) to (10) a GMM estimator. We use the following instruments in columns (6) to (10): the import demand elasticity in the ROW, a dummy for bound tariffs above prohibitive levels, and the interaction of the dummy with import demand elasticity in the ROW, and with the world's export supply elasticity.

Table 4: Is market power used within tariff waters? Robustness tests

	(1) HS4 level	(2) HS4× ctry fe	(3) Non OECD	(4) OECD	(5) Old GATT	(6) New WTO	(7) w/o $\epsilon^\star$ constr.	(8) L&M (2013)	(9) Not bound	(10) Fuller corr.	(11) With ϵ
Market Power × No Water	-0.696** (0.351)	-0.089** (0.026)	-0.197** (0.032)	-0.072** (0.037)	-0.169** (0.030)	-0.136* (0.079)	-0.156** (0.044)	-0.208** (0.071)	-0.493** (0.065)	-0.192** (0.027)	-0.143** (0.025)
Market Power × Water	0.229** (0.075)	0.109** (0.029)	0.239** (0.040)	0.153** (0.058)	0.173** (0.030)	0.323* (0.184)	0.084** (0.013)	0.187** (0.071)	0.185** (0.031)	0.208** (0.030)	0.185** (0.040)
Herfindhal								0.142** (0.049)			
Market Power × Herf.								-0.038 (0.091)			
PTA share								-0.0577** (0.005)			
Import elasticity (ϵ)											-0.000 (0.000)
# obs.	45818	146418	99362	47056	118314	28104	98837	67652	200963	146851	143088
R^2	.	0.680	0.344	0.100	0.226	.	0.529	0.077	.	0.370	0.218
Hansen overid. p-v	0.939	0.244	0.686	0.906	0.679	0.823	0.510	0.434	0.568	0.325	0.635
Kleibergen-Paap p-v	0.062	0.000	0.000	0.001	0.000	0.222	0.000	0.000	0.000	0.000	0.000

We use the specification in column (7) of Table 3 , except for the first two columns. The first column uses four digit and country × HS two-digit fixed effects, and the second column has six-digit and country × HS four-digit fixed effects. Standard errors in parenthesis: ** and $*$ stand for 5 % and 10 % statistical significance, respectively.

Table 5: Estimating the tariff water cooperation threshold for OECD and non-OECD countries

	Full sample					OECD sample				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	$1/e^*$	Log $1/e^*$	Top 1/3	Top 1/2	Top 2/3	$1/e^*$	Log $1/e^*$	Top 1/3	Top 1/2	Top 2/3
Market Power × No Water	-0.009	-0.014	-0.118**	-0.129**	-0.185**	0.001	0.003	-0.079*	-0.072*	-0.126**
	(0.017)	(0.010)	(0.029)	(0.023)	(0.033)	(0.015)	(0.026)	(0.035)	(0.037)	(0.045)
Market Power × Water	0.019	0.033**	0.243**	0.181**	0.143**	0.076	0.025**	0.139*	0.153**	0.111**
	(0.032)	(0.005)	(0.051)	(0.030)	(0.021)	(0.070)	(0.009)	(0.070)	(0.058)	(0.037)
# obs.	146418	146418	146418	146418	146418	47056	47056	47056	47056	47056
R^2	.	0.467	0.031	0.254	0.372	.	0.283	0.118	0.010	0.218
Hansen overid. (p-value)	0.160	0.352	0.227	0.564	0.597	0.989	0.066	0.194	0.906	0.340
Kleibergen-Paap (p-value)	0.869	0.000	0.000	0.000	0.000	0.664	0.000	0.053	0.001	0.000
Threshold	0.01**	0.01**	0.01**	0.01**	0.01**	0.00	0.00	0.00	0.00	0.00

All columns include HS six-digit and country × HS two-digit fixed effects. Standard errors in parenthesis: ** and * stand for 5 % and 10 % statistical significance, respectively. Columns (1) and (5) use the inverse of ROW export supply elasticity as a measure of market power; columns (2) and (6) use the log of the inverse; columns (3) and (7) use a dummy that takes the value 1 if market power is in the top 1/3 of the distribution; columns (4) and (8) if market power is above the median; and in columns (5) and (10) if market power is in the top 2/3 of the distribution. We use the following instruments: the import demand elasticity in the ROW, a dummy for bound tariffs above prohibitive levels, and the interaction of the dummy with import demand elasticity in the ROW, and with the world's export supply elasticity.