Cooperation in WTO's Tariff Waters[*]

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Abstract

Many members of the World Trade Organization apply tariffs well below the negotiated tariff bounds, a phenomenon known as "tariff water". In principle, there is no legal constraint to set these tariffs to exploit the importing country's market power in international markets. We found that this is the case, but only in the presence of deep tariff water. Indeed, if the difference between applied and bound tariffs is below 20 percent, tariffs of WTO members cannot be explained by their market power, suggesting that cooperation in the WTO goes beyond observed tariff bounds. Cooperation within WTO tariff waters can be explained by the fear of retaliation from trading partners, in particular when these have considerable market power and tariff water in their schedules.

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1 Introduction

As predicted by trade policy models, there is strong empirical evidence suggesting non members of the World Trade Organization (WTO) set import tariffs non-cooperatively to exploit their market power in international markets (Broda, Limão and Weinstein, 2008). The rationale is that a tariff reduces import demand, which in the absence of a perfectly elastic export supply reduces import prices, and therefore improves the terms-of-trade of the importing country. By definition, this also reduces the terms-of-trade of the exporting country, therefore creating the potential for cooperation. Recent evidence suggests that WTO negotiations do facilitate cooperation in tariff setting by allowing recently acceding WTO members to internalize these terms-of-trade externalities, resulting in tariff schedules that do not reflect their market power (Bagwell and Staiger, 2011).

However, even within the WTO legal framework, many member countries maintain a lot of flexibility that could potentially allow them to set non-cooperative tariffs to exploit their market power. This flexibility is provided by the presence of what is called "tariff water", or "binding overhang" (i.e. the difference between WTO legally binding tariffs and applied tariffs). In some countries, these legally binding tariffs are multiples of the applied tariffs, providing them with a lot of policy space. In principle, the absence of tariff water indicates cooperation in tariff setting as the importing country is bound by its commitments to other trading partners. On the other hand, the presence of tariff water provides WTO members with the opportunity to set WTO-consistent tariffs at non-cooperative levels.[1]

In this paper we explore whether cooperation in tariff settings extends beyond the setting of binding tariffs to include the degree of discretion provided by tariff water. In particular, we investigate whether in the presence of tariff water the applied tariffs reflect WTO members' market power. Cooperation beyond bound tariffs may result from fear of retaliation by trading partners which can also legally raise their tariffs within tariff waters, or more general forms of retaliation.

To guide our empirical work, we consider a two-country model in which tariffs are driven by terms-of-trade rationales, as well as political economy forces. In our theoretical setting, countries can set tariffs cooperatively depending on the trade-off between benefits and costs of cooperation.

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[1] Amador and Bagwell (2012) explain the possible presence of tariff water based on a model where uncertainty and private information are present. In their model, there are no costs in negotiating an agreement across countries. On the contrary, Horn, Maggi and Staiger (2010) suggest that tariff water may exist in the presence of uncertainty and contract costs.

We assume that in the absence of cooperation, an exogenous tariff bound is set for the importing country allowing it to implement a non-cooperative tariff policy. Conversely, in the presence of cooperation, the negotiated tariff maximizes the joint political function of the two countries. In the former case, tariff water is present since the exogenous bound is assumed to be high enough to allow for non-cooperative behavior. In the latter case, water is not present presuming that perfect information is present in this framework. This dichotomy in the treatment of importing countries seems to fit well with the different manners in which developed and developing countries have so far participated in multilateral agreements as discussed in Croome (1995) and in Hoekman and Kostechi (2009).

The theoretical predictions of our model show that in the absence of cooperation the importing country sets tariffs that exploit its market power. However, in the presence of cooperation, the importing country's tariffs are inversely related to its market power, as a higher tariff would significantly diminish the profits accrued by the politically influential producers in the exporting country.

We empirically test the predictions by examining whether WTO members are more likely to set non-cooperative tariffs when tariff water makes this legally possible. Our empirical specification explains applied tariffs with the degree of market power enjoyed by the importer (i.e., the inverse of the export supply elasticity of the rest-of-the-world), as well as its interaction with a measure of the importer's tariff water.

This framework requires estimates of rest-of-the-world export supply elasticities. The only available estimates are for non-WTO members (Broda et al. 2008). In order to provide estimates for all WTO members, we build on Kee et al. (2008) adaptation of Kohli's (1991) revenue function approach to the estimation of trade elasticities. We basically estimate the revenue function of the rest-of-the-world for each WTO member, which is a function of the rest-of-the-world factor endowments and the price they face in the WTO member's import market. The price parameter of the revenue function of the rest-of-the-world can then be used to estimate the export supply elasticity of the rest-of-the-world in the WTO member's market as in Kee et al. (2008).

We estimated more than 260,000 export supply elasticities of the rest-of-the-world faced by 119 importing countries at the six-digit level of the Harmonized System (HS) classification.[2] The

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[2] As discussed in the empirical Section, we present our results using the European Union members as one country for trade policy purposes. We also estimate results using data on individual European countries and obtain similar

median of the inverse of the export supply elasticity is 0.044, suggesting that if countries were to set tariffs non-cooperatively, the median tariff in the world would be around 4.4 percent. This is smaller than the 5 percent median tariff we observe in our sample. Because part of the terms-of-trade rationale vanishes through cooperation in trade agreements, other forces than terms-of-trade are needed to explain the tariff levels observed.

With the help of these estimates we found evidence that tariffs are set non-cooperatively in the presence of substantial tariff water, i.e., when the difference between bound and applied tariffs is above 20 percentage points. Below this threshold the correlation between market power and applied tariffs tends to be negative, suggesting that there is cooperation in the presence of moderate amounts of tariff water.

The presence of cooperation within tariff waters calls for an explanation. A potential candidate is that member's fear of retaliation by their trading partners with significant amount of market power and tariff water may prevent them from setting tariffs non-cooperatively within WTO's tariff waters. Fear of retaliation has been shown to be an important determinant of trade policy. Indeed, Blonigen and Bown (2003) show that retaliation threats makes less likely to observe andtidumping measures by the United States. Similarly, Bown (2008) show that fear of retaliation makes WTO's dispute settlement defendants more likely to comply with their WTO commitments.

After building a measure of fear of retaliation that captures trading partner's market power and the scope for tariff increases within their tariff bindings, we found that non-cooperative tariff setting was observed only when importing countries had relatively low fear of retaliation by their trading partners. In other words, non-cooperative behavior within WTO tariff waters is only observed for those members which have little to lose from retaliation by their trading partners.

The remainder of the paper is organized as follows. Section 2 provides the theoretical framework and describes our empirical strategy. Section 3 focuses on the estimation of rest-of-the-world export supply elasticities faced by each importer. Section 4 presents the empirical results regarding the extent of cooperation in tariff setting in the WTO's tariff waters. Section 5 concludes.

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results. Notice that using data for individual European Union members raises the number of estimated elasticities to more than 300,000 and the total number of countries in our sample raises to 131. The results using data for individual European countries are available upon request.

2 Optimal tariffs and the WTO

In the absence of cooperation in tariff setting in the WTO, tariffs could be set non-cooperatively and reflect both market power and domestic political economy rationales as in Grossman and Helpman (1995) and Bagwell and Staiger (1999). If cooperation takes place then the market power rationale vanishes as it only reflects inefficient transfers from the exporting country to the importing country that are internalized through cooperation, and that's why we shouldn't expect negotiated tariffs to reflect the importing country's market power. However, the presence of tariff overhang or tariff water opens the door for non-cooperative tariff setting among WTO members. In order to explore this possibility we first provide an analytical setup where applied tariffs can be set below tariff bindings due to the presence of negotiation costs. We then provide an empirical strategy to examine whether tariffs are set non-cooperatively in the presence of tariff water, i.e., reflecting the importer's market power.

2.1 Theoretical predictions

Assume a two-country world where cooperation in tariff setting prevails as long as negotiation costs are lower than the gains from cooperation. This framework only considers import tariffs and uncertainty is not present. Consequently, in the presence of cooperation, the negotiated applied tariff matches the bound tariff and tariff water is not present. In the absence of cooperation, however, we consider that each country uses an exogenous bound tariff assumed to be much higher than the applied tariff, i.e., tariff water is present, which allows the importing country to set non-cooperative tariffs. Thus, all tariffs will be bound in the agreement but only some will be negotiated.

This setting seems to fit well with the manner in which developing countries participated so far in multilateral agreements. As described in Croome (1995), during the Uruguay Round an Australian proposal was adopted to ensure that most countries would bound their tariffs by allowing each member to follow its own approach to tariff binding. This led many developing countries, in particular the smaller and poorer countries, to bound almost all of their previously unbound tariffs at arbitrarily high levels.[3]

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[3] 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 quite arbitrarily.

On the other hand, it is clear that the United States, the European Union, and Japan play a prominent role in negotiating tariffs under the WTO and the available data (see Table 1) indicate that they have very low applied and bound tariffs, in which the presence of water is almost nonexistent, except in the case of a handful of sensitive products. Our model captures this dichotomy.

We consider a home country and a foreign country where 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:

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

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

On the production side, we assume that the numéraire good is produced using labor under constant returns to scale, which keeps the wage rate constant regardless 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. Perfect competition prevails. Thus, the assumptions on the supply side and on the demand side of the model allow us to conclude that the market equilibrium for good 1 is not affected by the market equilibrium for good 2.[4]

We consider that the home country imports good 1 while it exports good 2. This implies $x_1(p) < x_1^{\star}(p)$, where x_1 and $x_1^{\star}$ are the supply of good one in the home and foreign country, respectively. The reverse happens for good 2. As a result, a tariff on good 1 (2) may be imposed by country 1 (2) as we only consider tariffs and disregard export-related trade instruments. The

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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. They went over 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, this made bilateral negotiations impossible, and it is therefore not surprising that today many developing countries have very large levels of water in their tariff schedules.

[4] This rules out counterlobbying by exporters within the same country as in Krishna et al. 2012.

relationship between the price in the home and in the foreign countries are then described by $p_1 = p_1^\star + t_1$ and $p_2^\star = p_2 + t_2$. 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 $\beta^\star$. Then, the home country's government objective function is described, with the assistance of expression (1), by the following expression:

$$\begin{aligned} G(p_1, p_2) &= u_1(d_1(p_1)) - p_1 d_1(p_1) + u_2(d_2(p_2)) - p_2 d_2(p_2) \\ &\quad + t_1 m_1(p_1) + (1+\beta)\left[\pi_1(p_1) + \pi_2(p_2)\right] \end{aligned} \tag{2}$$

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 on the demand side, along with separate costs to negotiate each tariff, allows us to consider the choice of whether to negotiate tariffs on goods 1 and 2 independently. For tractability, we then focus our attention on the decision to negotiate a tariff for good 1, but a similar analysis applies for good 2. We first investigate the tariff for good 1 that emerges with and without negotiation between the countries. 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 of negotiation.

If countries do not cooperate, then the tariff imposed on imports of good 1 by the home country maximizes its government objective's function. Total differentiation of expression (2) yields the first order condition for this country's government with respect to the choice of tariff on good 1 as follows,

$$\begin{aligned}\frac{dG}{dt_1} &= -d_1\left[\frac{dp_1^\star}{dt_1}+1\right]+m_1+t_1m_1'\left[\frac{dp_1^\star}{dt_1}+1\right] \\ &\quad +(1+\beta)\,x_1\left[\frac{dp_1^\star}{dt_1}+1\right]\end{aligned} \tag{3}$$

where we do not express the demand, supply and import as functions of the domestic price to save on notation. Expression (3) can be rearranged in the following manner:

$$\frac{dG}{dt_1} = -m_1\frac{dp_1^\star}{dt_1}+t_1m_1'\frac{dp_1}{dt_1}+\beta x_1\frac{dp_1}{dt_1} \tag{4}$$

where we 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 (4) equal to zero. As usual, we can use the market clearing condition to solve for the non-cooperative tariff using (4) and express the non-cooperative tariff as a function of the importing country's market power. Since imports equal exports we can express the marketing clearing condition as follows:

$$m_1\left(p_1\right)+m_1^\star\left(p_1^\star\right)=0 \tag{5}$$

and total differentiation of the market clearing conditions yields

$$m_1'\frac{dp_1}{dt_1}=-m_1^{\star\prime}\frac{dp_1^\star}{dt_1} \tag{6}$$

We can apply relationship (6) to solve for the non-cooperative tariff using (4) to obtain:

$$t_1^N=\frac{\beta z_1p_1}{e_1}+\frac{p_1^\star}{e_1^\star} \tag{7}$$

where t_1^N is the non-cooperative optimal tariff, z_1 stands for the inverse of the import penetration ratio, e_1 represents the import demand elasticity, and $e_1^\star$ stands for the export supply elasticity faced by the importing country. Expression (7) displays the usual two motives for deviations from free trade without cooperation across countries under perfect competition. The political economy motive is represented by the first term on the right hand side of (7) 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.[5] In this case, we represent the sum of the political functions by the global political function, which is represented by $G^w = G + G^\star$.[6] Focusing on the equilibrium tariff for good 1, we can totally differentiate G^w to obtain the following expression:

$$\begin{aligned} \frac{dG^w}{dt_1} \quad &= \quad -d_1 \left[\frac{dp_1^\star}{dt_1} + 1 \right] + m_1 + t_1 m_1' \left[\frac{dp_1^\star}{dt_1} + 1 \right] \\ &\quad + (1+\beta)\, x_1 \left[\frac{dp_1^\star}{dt_1} + 1 \right] \\ &\quad - d_1^\star \frac{dp_1^\star}{dt_1} + (1+\beta^\star)\, x_1^\star \frac{dp_1^\star}{dt_1} \end{aligned} \tag{8}$$

where the first and second lines can be found in expression (3) and the third line comes from calculating $\frac{dG^\star}{dt_1}$. Expression (8) can be rearranged to yield the following expression:

$$\frac{dG^w}{dt_1} = t_1 m_1' \frac{dp_1}{dt_1} + \beta x_1 \frac{dp_1}{dt_1} + \beta^\star x_1^\star \frac{dp_1^\star}{dt_1} \tag{9}$$

where it is clear that the political economy forces in each country are driving forces in determining the negotiated tariff. The equilibrium cooperative tariff can be calculated by setting expression (9) to zero, and with assistance of expression (6), we can rearrange to obtain:

$$t_1^C = \frac{\beta z_1 p_1}{e_1} - \frac{\beta^\star z_1^\star p_1^\star}{e_1^\star} \tag{10}$$

where (10) is the optimal cooperative tariff, $z_1^\star$ is the inverse of the export penetration ratio in the foreign country. It is clear from expression (10) that a cooperative tariff differs from zero due to the political forces present in each negotiating party. Otherwise, free trade would prevail. Notice

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[5] This follows other papers in the literature such as Bagwell and Staiger (1999), Horn, Maggi and Staiger (2010), and Beshkar, Bond, and Rho (2012), among others.

[6] The usual rationale for focusing on the joint political payoff is the presence of similar countries in economic and political power or the presence of cross-country transfers. We follow suit in line with the literature.

that politically important exporters ($\beta^\star > 0$) influence the cooperative tariff in a very intuitive way. If the importing country market power is high (low $e_1^\star/p_1^\star$) then the equilibrium tariff under cooperation tends to be 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. Expressions (7) and (10) allow us to elaborate the following prediction:

Prediction 1 *The higher the market power of the importing country, the lower (higher) the equilibrium tariff when countries (do not) cooperate.*

As discussed above, cooperation over tariffs leads to the internalization of the terms of trade motivation for protection and this seems to be the key contribution of negotiations between countries. However, cooperation has a price as identified by the parameter α. Thus, we assume that countries cooperate if the increase in value of the global political function ($G^w\left(t_1^C\right) - G^w\left(t_1^N\right)$) is greater than α. We are looking for the conditions under which the gains from negotiations are high enough to compensate the costs. Putting it in a formal way, the gains from cooperation are described by the following expression:

$$G^w\left(t_1^C\right) - G^w\left(t_1^N\right) = -\int_{t_1^C}^{t_1^N} dG^W, \quad t_1^N > t_1^C \tag{11}$$

Following Horn, Maggi and Staiger (2010), we investigate the sufficient condition for obtaining large gains from cooperation as described by expression (11). 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 have $\left|\frac{dG^\star(t_1^N)}{dt_1}\right|$ 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 we can obtain:

$$\left|\frac{dG^\star(t_1^N)}{dt_1}\right| = \left(d_1^\star - x_1^\star\right)\frac{dp_1^\star}{dt_1} - \beta^\star x_1^\star \frac{dp_1^\star}{dt_1} \tag{12}$$

Expression (12) can be rearranged with the assistance of expression (6) to yield the following sufficient condition:

$$\left|\frac{dG^\star(t_1^N)}{dt_1}\right| = \frac{\left(m_1 + \beta^\star x_1^\star\right) m_1^{'}}{\left(m_1^{'} + m_1^{\star'}\right)} \tag{13}$$

which can be rewritten to display the relevant elasticities as follows,

$$\left|\frac{dG^{\star}(t_1^N)}{dt_1}\right| = \frac{(m_1 + \beta^{\star} x_1^{\star})}{\left(1 + \frac{e_1^{\star}}{p_1^{\star}} \frac{p_1}{e_1}\right)} \tag{14}$$

We can relate expression (14) to the discussion above about the equilibrium tariffs. This sufficient condition indicates that countries are more likely to cooperate if the importing country has significant market power (low $e_1^{\star}/p_1^{\star}$), a tariff creates significant distortions in the importing country (high e_1/p_1), exporters are politically influential (high $\beta^{\star}$), and countries trade a great deal with each other (high m_1). If these conditions apply then countries cooperate and tariff water is not present since the bound and applied tariff are described by the cooperative tariff (10). Otherwise, countries do not cooperate, water is present, and Prediction 1 suggests that tariffs reflect the market power of the importing country. This is summarized in the following prediction:

Prediction 2 *If gains from cooperation described by expression (14) are relatively low (large) compared to negotiation costs, then tariff water is (not) present and tariffs are positively (inversely) related to market power.*

2.2 Empirical strategy

In order to empirically test the two predictions developed in the previous section, we will use tariff data for 113 WTO members at the six-digit of the HS classification,[7] and investigate the extent to which the importer's market power (the inverse of the export supply elasticity of the rest-of-the-world) can explain the variation in tariffs, in particular in the presence of tariff water. The two predictions are that in a world where countries can cooperate in tariff setting: i) the importer's market power should lead to lower tariffs as other WTO members have stronger incentives to negotiate tariff cuts, but ii) in the presence of tariff water, the importer's market power leads to higher tariffs. In order to test these two predictions we start with the following specification:

$$t_{p,c,t} = \alpha_1 \times \frac{1}{e_{p,c}^{\star}} + \alpha_2 \times W_{p,c,t} + \alpha_3 \times \frac{1}{e_{p,c}^{\star}} \times W_{p,c,t} + \alpha_p + \alpha_{c,2HS,t} + \mu_{p,c,t} \tag{15}$$

where $t_{p,c,t}$ is the applied tariff in product p (defined at the six-digit of the HS classification) in

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[7] For a list of countries, see Table 1.

country c at time t, W captures tariff water which is measured as the difference between bound and applied tariffs, α_p is a product fixed effect defined at the six-digit level of the HS classification, and $\alpha_{c,2HS,t}$ is a two-digit HS fixed effect that varies by country and by year, which serves as control for political economy determinants of tariffs, such as firm concentration, capital/labor intensity etc.[8] Our predictions will therefore be identified using the variation across HS six-digit tariff lines within HS two-digit aggregates for each country and year, while controlling for HS six-digit common effects. Our first prediction suggests that $\alpha_1 < 0$, whereas the second prediction implies $\alpha_3 > 0$.

There are several issues with the estimation of (15). First, export supply elasticities of the rest-of-the-world are measured with a lot of noise as suggested by Broda et al. (2008).[9] 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, medium and low levels of market power across all countries, products and time. This last alternative also fits better our analytical setup since it suggests that above a certain level of market power, tariffs tend to be lower than below the threshold, without necessarily implying a variation with the levels of market power below or above the threshold.

The second issue has to do with the endogeneity of our measure of tariff water and market power. We solve the endogeneity of tariff water by instrumenting it with what Foletti et al. (2011) labeled as water vapour:

$$\text{Water Vapour}_{p,c,t} = \max\left\{0, t^{b}_{p,c} - t^{pr}_{p,c,t}\right\} \tag{16}$$

where $t^{b}_{p,c}$ stands for the bound tariff and $t^{pr}_{p,c,t}$ for the prohibitive tariff. So water vapour is tariff water above the prohibitive tariff.[10] Arguably, this satisfies the exclusion and the inclusion restrictions as the level of the applied tariff should not depend on how much water vapour exists, and by construction, water vapour is correlated with tariff water as it is part of it.

To construct water vapour, we need a measure of prohibitive tariffs for every tariff line. These are not observables, but we use the approximation in Foletti et al. (2011) which using import demand elasticities calculates the prohibitive tariff as the one that will lead to zero imports using a

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

[9] We also do not have estimates that vary across time and therefore the only variation in these elasticities is across products and countries.

[10] Notice that tariff bounds do not vary by time given that they were the outcome of the Uruguay round negotiations.

linear approximation around the observed level of imports. The prohibitive tariff is then given by:

$$t^{pr}_{p,c,t} = t_{p,c,t} + \frac{(1 + t_{p,c,t})}{e^{m}_{p,c}} \tag{17}$$

where $e^{m}_{p,c}$ represents the import demand elasticity which varies by country and by product. Table 1 provides summary statistics by country of tariff water and water vapour, as well as applied tariffs and bound tariffs.

The endogeneity of market power is addressed by using a bit of theory. Olarreaga et al. (1999) show that two determinants of the export supply elasticity of the rest-of-the-world are an average of the export supply elasticity across all countries measured from the exporters point of view and an average of the import demand elasticities across all countries in the rest-of-the-world.[11] We have estimates of import demand elasticities at the six-digit of the HS classification from Kee et al. (2008), and we adapt their methodology to estimate export supply elasticities for each country in our sample at the six-digit of the HS classification. The methodology employed to measure the export supply elasticities of the rest-of-the-world from the point of view of the importers is discussed in Section 3. We then take averages of these elasticities and use them 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). Below, we provide more details on this issue. In principle these two averages satisfy the exclusion restriction. We instrument the interaction term with the interaction of these averages with water vapour, which serves as an instrument for water. We perform over-identification and weak instrumental variables' tests to check the validity of our instruments.

3 Estimating export supply elasticities of the rest-of-the-world

We start by describing our adaptation of the methodology used in Kee et al.'s (2008) to estimate export supply elasticities of the rest-of-the-world faced by each importing country ($e^{\star}_{nn}$). We then

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[11] 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 to obtain:

$$e^{\star}_{i} = \frac{1}{m_i/x_w}\left(e^{x\star} + \sum_{c \neq i} e^{m}_{c} \frac{m_c}{x_w}\right)$$

where $e^{x\star}$ is the export supply of the world, and e_c is the absolute value of the import demand elasticity of country c.

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. We then describe the data used to estimate the elasticities, provide some descriptive statistics of these estimates, and also provide further external tests to show that our estimates are in line with basic economic intuition.

3.1 Estimating rest-of-the-world export supply elasticities

In this section, we describe the methodology employed to estimate rest-of-the-world supply elasticities faced by each importer. They correspond to our measure of market power in international markets and capture the ability of countries in changing their terms of trade by using trade policy instruments, for instance. The empirical model is based on Kee et al. (2008) adaptation of Kohli's (1991) GDP 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 here our focus 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:

$$\begin{aligned} \ln G^t\left(p^t, v^t\right) &= a_{00}^t + \sum_{n=1}^{N} a_{0n}^t \ln p_n^t + \frac{1}{2}\sum_{n=1}^{N}\sum_{k=1}^{N} a_{nk} \ln p_n^t \ln p_k^t \\ &\quad + \sum_{m=1}^{M} b_{0m}^t \ln v_m^t + \frac{1}{2}\sum_{m=1}^{M}\sum_{l=1}^{M} b_{ml}^t \ln v_m^t \ln v_l^t \\ &\quad + \sum_{n=1}^{N}\sum_{m=1}^{M} c_{nm} \ln p_n^t \ln v_m^t, \end{aligned} \tag{18}$$

where all the translog parameters a, b and c_s when indexed by t allow for changes over time.[12]

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

We also impose the necessary restrictions so that the GDP function satisfies the homogeneity and symmetry properties of a GDP function.[13] For each country c we can then construct the GDP function of the rest-of-the-world by summing the GDP functions of each country given by (18). 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,[14]

$$\begin{aligned} s_n^t\left(p^t, v^t\right) &\equiv \frac{p_n^t q_n^t\left(p^t, v^t\right)}{G^t\left(p^t, v^t\right)} = (C_w-1)a_{0n}^t + (C_w-1)\sum_{k=1}^{N} a_{nk}\ln p_k^t + \sum_{m=1}^{M} c_{nm}\sum_{c=1}^{C_w-1}\left(\ln v_m^t\right)_c \\ &= (C_w-1)\left(a_{0n}^t + a_{nn}\ln p_n^t + a_{nk}\sum_{k\neq n}\ln p_k^t\right) + \sum_{m=1}^{M} c_{nm}\sum_{c=1}^{C_w-1}\left(\ln v_m^t\right)_c \qquad (19) \end{aligned}$$

where s_n^t is the share of export good n in rest-of-the-world GDP, C_w is the total number of countries in the world, and $\sum_{c=1}^{C_w-1}\left(\ln v_m^t\right)_c$ 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:[15]

$$e_{nn}^{\star} \equiv \frac{\partial q_n^t\left(p^t, v^t\right)}{\partial p_n^t}\frac{p_n^t}{q_n^t} = \frac{(C_w-1)a_{nn}}{s_n^t} + s_n^t - 1 \geqslant 0 \qquad (20)$$

Thus we can calculate the export supply elasticities once a_{nn} is properly estimated. Note that the size of the export supply elasticities, $e_{nn}^{\star}$ positively depends on the size of a_{nn} which captures the changes in the share of 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 (19) is the basis of

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[13] 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:

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

[14] 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 (19).

[15] Cross-price elasticities of export supply are given by: $\varepsilon_{nk}^t \equiv \frac{\partial q_n^t\left(p^t, v^t\right)}{\partial p_k^t}\frac{p_k^t}{q_n^t} = \frac{a_{nk}^t}{s_n^t} + s_k^t,\ \forall n \neq k.$

our estimation of export elasticities. There are, however, several problems with the estimation of a_{nn} using (19). 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 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 for each n exported good a price index of the remaining of the economy (including imported and non-traded goods). 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 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 (19) becomes

$$s_n^t\left(p_n^t, p_{-n}^t, v^t\right) = (C_w - 1)a_{0n} + (C_w - 1)a_{nn} \ln \frac{p_n^t}{p_{-n}^t} + \sum_{m \neq l, m=1}^{M} c_{nm} \sum_{c=1}^{C_w - 1} \ln \left(\frac{v_m^t}{v_l^t}\right)_c + \mu_n^t, \ \forall n. \quad (21)$$

With an additive stochastic error term, μ_n^t, to capture measurement errors, equation (21) is the basis used for the estimation of own price effect, a_{nn}, and hence the export price 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, so given that we assume that the GDP functions are common up to a constant, we will be pooling the data together and estimating 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 world markets of good n.

There are also several econometric problems. 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 adjustment of exported quantities to changes in prices which may lead to serial correlation in the error term.

To address all the econometric problems we follow the procedure in Kee et al. (2008). 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 probit equation that determines whether or not the good was exported by the rest-of-the-world using 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 GMM system estimators developed by Arellano and Bover (1995). This estimation strategy corresponds to Arellano and Bond (1991) difference GMM estimators, with a level equation added to the system to improve efficiency.[16]

Finally, for equation (19) to be the solution of the GDP maximization problem, the second order necessary conditions need to be satisfied (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:

$$a_{nn} \geq \bar{s}_n \left(1 - \bar{s}_n\right) \tag{22}$$

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 (22), we impose that the estimated $a_{nn} \equiv \bar{s}_n$, which ensures that all elasticities are positive.

3.2 Estimating export supply elasticities from the point of view of the exporter

The export supply elasticities from the point of view of the exporter 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

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[16] See Kee et al. 2008 for more details.

not summing the GDP functions of rest-of-the-world countries. In order to derive the export share equation of each exporting country we use the first order condition of GDP maximization of each country. The share equation to be estimated is then given by:

$$s_n^t\left(p_n^t, p_{-n}^t, v^t\right) = b_{0n} + b_{nn} \ln \frac{p_n^t}{p_{-n}^t} + \sum_{m \neq l, m=1}^{M} d_{nm} \left(\frac{v_m^t}{v_l^t}\right) + u_n^t, \quad \forall n \tag{23}$$

where b and ds are parameters to be estimated after pooling observations across countries for each good n. The export supply elasticity of good n in each exporting country is then given by:

$$e_{nn}^{x\star} \equiv \frac{\partial q_n^t\left(p^t, v^t\right)}{\partial p_n^t} \frac{p_n^t}{q_n^t} = \frac{b_{nn}}{s_n^t} + s_n^t - 1 \geqslant 0 \tag{24}$$

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 in the previous section.

3.3 Data

The dataset used to estimate export supply elasticities consists of export values and quantities reported by different countries to the UN Comtrade system at the six-digit level of the HS classification (around 4600 products).[17] The HS classification was introduced in 1988. The basic data set consists of an unbalanced panel of exports for 117 countries at the six-digit level of the HS classification for the period 1988-2009. The number of countries obviously varies across products depending on the presence of export flows and on the availability of trade statistics using the HS classification.

There are three factor endowments included in the regression: 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 is constructed using the perpetual inventory method based on real investment data in WDI (2012).

The estimation sample did not include goods where the recorded trade value at the six-digit level of the HS classification represented less than 0.01 percent of exports (or it had an absolute

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[17] It is available at the World Bank through the World Integrated Trade System (WITS).

value of less than 50 thousand dollars). This eliminated less than 1 percent of the value of exports in the sample, and it is necessary in order to avoid biasing our results with economically meaningless exports. The elasticities are constructed following equation (20), where the export share is the sample average (i.e., we constrained the elasticities to be time invariant). We also purged the reported results from extreme values by dropping from the sample the top and bottom 1 percent of the estimates.

3.4 Empirical Results

We have estimated a total of 268240 rest-of-the-world export supply elasticities corresponding to 119 importers at the six-digit level of the HS classification.[18] Figure 1 provides a plot of the distribution of the inverse of these rest-of-the-world supply elasticities, which captures the importer's market power when facing exports from the rest-of-the world. The inverse of these export supply elasticities is also equal to the level of the optimal tariff if the importer were to use its market power. The median of the inverse of the export supply elasticity of the rest-of-the-world is equal to 0.044, which implies that the median optimal tariff in the world should be around 4.4 percent.

Table 2 provides the mean and standard deviation of export supply elasticities faced by each importer in the sample used to estimate equation (15), so it excludes some countries for which we do not have applied or bound tariffs. Moreover, we drop from Table 2 information about individual members of the European Union given that this preferential trade agreement represents a single decision making unity for trade policy purposes.[19] 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 15 percent. The countries facing the highest export supply elasticity, and therefore being close to price-taking behavior in international markets are Burundi, Grenada and Benin, all with average optimal tariffs below 0.001 percent.

We provide a few external tests of these estimates. First, as suggested in footnote 11, with

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[18] We have also estimated rest-of-the-world export supply elasticities for individual members of the European Union. If we count individual European members, we reach a total number of 317348 rest-of-the-world export supply elasticities corresponding to 131 importers at the six-digit level of the HS classification.

[19] We perform the same analisys using data for individual EU members instead. The results are very similar economically and statistically and are available upon request. In order to calculate the market power of the EU we followed a procedure similar to the one described in Section 3: we first estimate parameter a_{nn} using equation (21) and then, using aggregated data for EU members where we purged intra-EU trade flows, we calculate market power with the assistance of expression (20).

information on import demand elasticities and export supply elasticities for each exporter, rest-of-the-world export supply elasticity faced by importer i can be approximated by:

$$e_i^{\star} = \frac{1}{m_i/x_w}\left(e^{x\star} + \sum_{c\neq i} e_c^m \frac{m_c}{x_w}\right) \qquad (25)$$

where $e^{x\star}$ is the export supply of the world, which can be approximated by the weighted sum of export supply elasticities estimated from the exporter's point of view, and e_c^m is the absolute value of the import demand elasticity of country c, which has been estimated by Kee et al. (2008). The average and standard deviation of export supply elasticities estimated for each exporting country are given in Table 2. The average could seem quite high, but it is important to remember that these are 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 which 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 below 185 grams. Note that in order to derive equation (25) in footnote (11) we assumed that the export supplies were not differentiated by importer, whereas our estimates of $e^{\star}$ described in section 3.1 assume that export supply elasticities of the rest-of-the-world are differentiated by destination. Thus, we do not expect our estimates to be equal to the ones in (25).

In the first column of Table 3 we provide estimates of the correlation between our estimate of the export supply elasticity faced by each importer, and its proxy using equation (25).[20] In the second column we split equation (25) into its three elements, specifically: the export supply elasticity of the world for each good proxied by the weighted average export supply elasticity of each exporter, 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 there is a positive correlation in the first column, and Figure 2 provides a partial plot of our estimate of the export supply elasticity faced by each importer, against the one calculated using the right-hand-side of equation (25). The positive correlation is quite clearly illustrated in Figure 2. In the second column of Table 3, as

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[20] Note that in order to provide estimates of the proxy using equation (25) for all six-digit HS goods, we replaced some missing average export supply elasticities by the four-digit HS average (or the two-digit when the four-digit was also missing). The reason is that it was impossible to estimate some export supply elasticities from the point of view of the exporter for some products using equation (24) because there was not enough variation in the data (not enough exporters). This was not a problem when estimating the export supply elasticity faced by importers using (20) because there is always a sufficiently large number of importers.

expected, when decomposing (25) into its three elements, we find that both average elasticities have a positive sign (the import demand elasticities are measured in absolute value), and the import share a negative sign.

The second external test uses the estimates by Broda et al. (2008) of export supply elasticities faced by importers at the six-digit level of the HS classification for thirteen countries that were not WTO members. Thus, the third column in Table 3 provides a correlation between their estimates and our estimates. It shows again a positive and statistically significant correlation for these thirteen countries, which again confirms the validity of our estimates. Note again that their estimates and ours vary in the assumptions made to obtain them, as they impose a CES structure on the demand side, whereas our elasticities are derived from the supply side (the GDP function) and we make no assumptions on the demand side. Thus, we shouldn't expect them to be equal, but positively correlated as they are both capturing export supply elasticities faced by importers.

Finally, Broda et al. (2008) provide, as an external test, a regression of the export supply elasticities faced by the importer on the GDP of each importing country, their share in import markets and a measure of remoteness of each importing country. Remoteness is built as the inverse of the distance-weighted GDP of all other countries in the world. They found a negative correlation with GDP, and the import share, suggesting that larger countries are likely to face smaller elasticities and therefore have more market power, and a negative correlation was also found with remoteness, suggesting that countries located far away from world markets are more likely to have more market power, as they represent a larger share of regional demand that tends to be isolated from rest-of-the-world demand due to larger trade costs. The fourth column of Table 3 provides the correlation between our estimates and these three variables, and they confirm the findings by Broda et al. (2008).

4 Evidence of non-cooperative behavior on WTO's tariff waters

To empirically assess the degree to which WTO member countries cooperate in the presence of tariff water we rely on the estimation of equation (15). We use data on applied MFN tariffs and tariff bounds for the period 2000-2009.[21] The econometric strategy also relies on data to control for

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[21] This circumvents the problem that bound tariffs negotiated during the Uruguay Round were allowed a transition period until 2000, which may artificially create negative or positive tariff water. The applied MFN tariffs were

the rest-of-the-world export supply elasticities, which are used in measuring the importer's market power, as well as export supply elasticity from the point of view of exporters. These estimated elasticities were discussed in the previous Section. Table 1 provides the average and standard deviation applied MFN and bound tariffs as well as information on tariff water across countries. It is clear that among developed nations only Australia and New Zealand have significant amounts of tariff water, with 7 and 9 percentage points average difference between their bound and applied tariffs, respectively. On the other hand, most developing countries have more than 10 percentage points of tariff water in their tariff schedules, reaching more than 40 percentage points in several cases.

To test our two predictions we estimate equation (15) using six different specifications. In the first specification we use our estimate of market power ($1/e^{\star}$). However, it is clear that these elasticities are measured with errors since they are the outcome of the econometric strategy described in Section 3. Moreover, the data described in Table 2 make it evident that our elasticities are imprecisely estimated. In this case, the presence of outliers is evident given the size of the standard deviation relative to the average values across countries. For these reasons, 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 goods that are in top and middle thirds of the distribution of market power within each country. The fourth column uses a separate dummy for the top third, and the middle third of goods in terms of market power within each country. Broda et al. (2008) build these dummies using the definition above, but one could argue that the top third goods in terms of market power in Burundi may well be at the bottom of the market power distribution when considering all countries and goods. Thus, the fifth specification uses a dummy that takes a value of 1 when the market power of that country in that particular good is on the top or middle thirds of the world distribution of market power. The last specification splits the dummy into two dummies that capture the top third and the middle third separately, as in the fourth specification.

Table 4 presents the OLS results of (15), which broadly confirm our first prediction: importer's market power is negatively correlated with applied tariffs in the absence of water. With the exception of the specification in the first column, all coefficients on importer's market power are

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obtained using the World Integrated Trade System (WITS) while tariff bounds negotiated during the Uruguay round were provided by the WTO.

statistically significant. Results also confirm the second prediction: the interaction term between water and importer's market power is positive and statistically significant, with the exception of the specification in the first column. This suggests that in the presence of sufficiently deep tariff water, countries tend to use their market power.

The degree of tariff water needed for this to be the case varies across specifications between 19 and 67 percentage points. These could seem like extreme cases but as can be seen from Table 1 there are a significant number of countries which have an average level of tariff water above 19 percent. Our dataset suggests that about 33 percent of the observations in the sample used in Table 4 have tariff water levels above 19 percentage points, while about 2.6 percent have tariff water levels above 63 percentage points. Likewise, the results displayed in the fourth and sixth columns strongly suggest that the degree of water needed for countries to use their market power is lower for goods in which countries have high market power than for goods in which countries display medium or low market power. More importantly, the statistical confirmation of our predictions indicates that the WTO does induce cooperation among member countries to a large extent, but also suggests that the presence of deep levels of tariff water may contribute to deviations from cooperative behavior.

The estimates in table 4 could suffer from endogeneity bias as discussed in section 2. Thus, table 5 presents results instrumenting for tariff water and market power. Water is instrumented using measures of water vapour, and market power is instrumented using the exogenous right-hand-side variables in expression (25): the average import demand elasticity in the rest-of-the-world, and the world's export supply elasticity (although the latter is perfectly collinear with the HS six-digit fixed effects and therefore drops from the list of instruments).[22] The interaction of water with the importer's market power is instrumented using the interaction of water vapour with the average import demand elasticity in the rest-of-the-world, and the interaction of water vapour with the world's export supply elasticity ($e^{x\star}$). Note that the number of instruments is larger than the number of endogenous variables, which will allows us to test for the validity of the instruments using an over-identification test.

The results in table 5 confirm again the first prediction: importer's market power is negatively correlated with applied tariffs in the absence of tariff water. The coefficient on the importer's market power is statistically significant across specifications, except in the third column. Results

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[22] We do not use the import share of the importer in world's trade which appears on the right-hand-side of equation (25) because this is likely to be endogenous to applied tariffs.

also tend to confirm our second prediction: importers use their market power in setting trade policy in the presence of large amounts of tariff water. However, the coefficient on the interaction between tariff water and market power is not statistically significant in specifications 1 and 2. Note that in columns 1 and 2 we cannot reject the null that we are in the presence of weak instrument, which may bias our results and explain the statistically insignificant coefficients. The results shown in column 5 and 6 (our preferred specification) suggest that the degree of tariff water needed for importers to use their market power in setting tariffs has to be above 26 percentage points. This implies that significant levels of tariff water are required for the presence of non-cooperative tariff policy behavior under the WTO.[23]

4.1 Fear of Retaliation

The results above suggest that WTO members tend to behave more cooperatively than is legally required. Why is it that they do not use their market power when there are no legal constraints? A potential explanation is fear of retaliation by trading partners. Consider a country with a significant amount of tariff water in its tariff schedule. When evaluating whether or not to raise its tariffs to non-cooperative levels, the cost of retaliatory trade measures by trading partners with significant amounts of market power and tariff water would have to be weighted against the terms-of-trade gains associated with the non-cooperative tariff.

Blonigen and Bown (2003) and Bown (2008) have shown that retaliation threats will make importers less likely to impose antidumping measures, and more likely to behave cooperatively within its WTO's legal commitments. In order to explore whether fear of retaliation can make WTO members behave more cooperatively outside WTO's legal commitments, i.e., within WTO tariff waters, we first need to construct a measure of fear of retaliation, and then check whether importers are more prone to use their market power within their tariff waters when they have little fear of retaliation by their trading partners.

Let's denote the fear of retaliation in country c by F_c which, by construction, does not vary across tariff lines, as trading partners do not necessarily retaliate within the same tariff line, but can

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[23] These results are broadly confirmed when using an IV between estimator instead of the within estimator used for the results reported in Table 5. Indeed our main source of variation is across HS six-digit lines and within HS two-digit for each country and year, and therefore the between estimator provides very similar results. Results of Tables 4 and 5 are also confirmed when using data for individual European countries. The results are similar to the results described in Tables 4-5 and are available upon request.

retaliate across their entire import bundle.[24] We define fear of retaliation as the average maximum increase in tariffs in partner countries that would lead to the same decline in country c's value of exports than if all partners were to increase their current applied tariffs to their bound levels. This definition is similar in spirit to the one used to define trade restrictiveness in Anderson and Neary (1996, 2003). To apply their concept we use the partial equilibrium approach developed by Feenstra (1995) and used by Kee et al. (2009) to measure trade restrictiveness. We denote country c's partner countries by subscript j while we continue using subscript p to identify products. Fear of retaliation in country c is then defined as:

$$F_c : \Delta \left(\sum_p \sum_j p^{\star}_{p,j} m_{p,j,c} \right)_{\Delta t_{p,j} = W_{p,j}} = \Delta \left(\sum_p \sum_j p^{\star}_{p,j} m_{p,j,c} \right)_{\Delta t_{p,j} = F_c} \tag{26}$$

where $m_{p,j,c}$ represents country j's imports of product p from country c. Notice that on the right-hand side of (26) we index the world price by product p, given that we allow for products of type p imported by different countries to be heterogenous, and assume that all countries change their applied MFN tariffs to the same uniform tariff that replicates the change in imports from country c which is described in the left-hand-side of this expression.

Totally differentiating both sides of the equality in (26), noting that by definition the change in partner tariffs on the left hand side is equal to the extent of water available in their tariff schedule, allows us to solve for the fear of retaliation in country c, F_c. Before solving for F_c, note that the marginal change in world prices faced by importer j following a change on its MFN tariff on each good p (assuming goods from different sources are homogenous) is given by:[25]

$$\frac{\partial p^{\star}_{p,j}}{\partial t_{p,j}} = \frac{\varepsilon^{m}_{p,j}}{(1 + t_{p,j}) \left(\varepsilon^{\star}_{p,j} + \varepsilon^{m}_{p,j} \right)} \tag{27}$$

where $\varepsilon^{m}_{p,j} > 0$ is the absolute value of the import demand elasticity of good p in partner j.

Differentiating (26) with respect to changes in partner tariffs $t_{p,j}$, using (27), and solving for F_c yields (while taking the absolute value of the changes in exports):

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[24] There are some well known anecdotal examples of this. In 1999, the United States impose 100 percent tariffs on nine different goods imported from Europe going from pecorino cheese to cashmere clothing, as retaliation for the EU's banana regime.

[25] This is obtained by starting from the identity between total imports of good p by country j being equal to total exports of the rest of the world of good p to country country j, and then differentiating.

$$F_c = \frac{\sum_p \sum_j m_{p,j,c} \frac{\varepsilon^m_{p,j}}{(1+t_{p,j})\left(\varepsilon^\star_{p,j}+\varepsilon^m_{p,j}\right)} \left(1+\varepsilon^{x\star}_{p,c}\right) W_{p,j}}{\sum_p \sum_j m_{p,j,c} \frac{\varepsilon^m_{p,j}}{(1+t_{p,j})\left(\varepsilon^\star_{p,j}+\varepsilon^m_{p,j}\right)} \left(1+\varepsilon^{x\star}_{p,c}\right)}. \tag{28}$$

where $\varepsilon^{x\star}_{p,c}$ is the export supply elasticity of country c as an exporter of product p. The comparative statistics are quite clear. If the importing partner country has a lot of market power (i.e., a small $\varepsilon^\star_{p,j}$), then the tariff water ($W_{p,j}$) on exports of that good from that partner has a greater weight in our measure of fear of retaliation. Similarly, the strongest is the import demand of the partner, the larger the weight given to water in that partner's product. The same is true for exports to that partner as well as the export supply elasticity of country c of product p.

Expression (28) enables us to calculate the fear of retaliation faced by each country in the sample used in Table 5 and this allows us to split the sample into three equally numbered group of countries with low, medium and high fear of retaliation. We use data for the year of 2006 to estimate (28) since this is the year prior to the financial crisis. We then proceed by estimating expression (15) separately for countries with low and high fear of retaliation. We expect that the variable measuring the product between market power and water is positive and statistically significant for the group of countries with low fear of retaliation, while we expect that the interaction between power and water is not statistically significant in the case of countries with high fear of retaliation.

Table 6 shows the IV estimates of expression (15) for the sample of countries with low and high fear of retaliation separately. We use two measures of market power: the log of the inverse export supply elasticity in columns 1 and 2, and a dummy that takes a value of 1 for observations that are in the top and middle third of the distribution of market power across all countries and goods in columns 3 and 4. The first prediction which suggests that in the absence of tariff water market power is negatively correlated with applied tariffs is confirmed for countries in both the low and high fear of retaliation samples, regardless of the measure of market power we used, except perhaps in column 3 where the negative coefficient is not statistically significant.

More interestingly, the use of market power in the presence of large amounts of tariff waters is only present for countries with low fear of retaliation. Indeed, the coefficient on the interaction of market power and tariff water is positive and significant only in the sample of countries which have low fear of retaliation. In the case of countries which have more to lose from retaliation by their trading partners, there is no evidence of non-cooperative tariff setting as the coefficient on the interaction between market power and tariff water is either negative or not statistically significant.

5 Concluding Remarks

In this paper, we investigate whether WTO members set their applied tariffs non-cooperatively when they have the discretion to do so. More precisely, we examine the extent to which WTO members use their market power when their tariff bounds are significantly above their applied tariffs, i.e., in the presence of tariff water. We develop a simple model of tariff setting that suggests that in the absence of tariff water, cooperative tariffs will be negatively correlated with the importer's market power. Indeed, the more market power the importer has, the stronger are the incentives to negotiate lower tariffs. On the other hand, in the presence of tariff-water, non-cooperative tariff setting is possible and the model predicts a positive correlation between the importer's applied tariffs and market power in international markets.

To test these predictions, we first estimate the degree of market power (the inverse of rest-of-the-world export supply elasticity faced by the importer) at the tariff line level for more than 100 WTO member countries. Our econometric approach is based on Kholi's (1991) revenue function approach, and is sufficiently flexible to allow us to also estimate export supply elasticity for each exporter.

We use then our elasticity estimates to study the effects of market power on trade policy with and without the presence of tariff water. Because tariff water and market power may be endogenous we use an instrumental variable approach, where the extent of tariff water above the prohibitive tariff (water vapour), the average import demand elasticity in the rest-of-the-world, the export supply elasticity of the world are used as instruments.

Results are in line with our theoretical predictions. First, we find that importer's market power tends to be negatively correlated with applied tariffs in the absence of tariff water. Second, our results suggest that in the presence of deep tariff water (i.e., levels above 20 percentage points), importing countries employ their market power in setting applied tariffs. These results are robust to different measures of market power, econometric models and instrumental variables.

An important corollary result is that in the presence of moderate levels of tariff water, WTO members tend to set their tariffs cooperatively. This suggests that cooperation is present within

WTO tariff waters. Thus, in spite of significant amounts of policy space provided by tariff water, WTO members tend to behave cooperatively when setting their trade policy.

One explanation for cooperative behavior in the absence of legal constraints is the fear of retaliation by trading partners with significant amounts of market power and tariff water. We show that WTO members which have little to lose from retaliation tend to set tariffs non-cooperatively within their tariff waters, while WTO members that may have more to lose in case of retaliation are more likely to set tariffs cooperatively within their tariff waters.

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Table 1: Descriptive statistics of tariffs and water

Country	Stat	Tariff bound	MFN applied	Tariff water	Vapour water
Antigua and Barbuda	Mean	0.720	0.149	0.571	0.013
	Std. Dev.	0.323	0.093	0.301	0.057
Argentina	Mean	0.319	0.127	0.193	0.014
	Std. Dev.	0.063	0.071	0.083	0.048
Australia	Mean	0.110	0.042	0.068	0.003
	Std. Dev.	0.116	0.053	0.077	0.020
Bahrain	Mean	0.344	0.067	0.280	0.004
	Std. Dev.	0.143	0.109	0.076	0.026
Bangladesh	Mean	1.465	0.167	1.300	0.499
	Std. Dev.	0.776	0.118	0.744	0.578
Barbados	Mean	0.810	0.158	0.654	0.030
	Std. Dev.	0.273	0.219	0.262	0.159
Belize	Mean	0.603	0.127	0.476	0.004
	Std. Dev.	0.200	0.119	0.198	0.032
Benin	Mean	0.229	0.135	0.128	0.004
	Std. Dev.	0.239	0.067	0.200	0.033
Bolivia	Mean	0.399	0.087	0.313	0.005
	Std. Dev.	0.009	0.034	0.034	0.031
Botswana	Mean	0.224	0.103	0.121	0.008
	Std. Dev.	0.240	0.122	0.224	0.130
Brazil	Mean	0.312	0.139	0.174	0.018
	Std. Dev.	0.076	0.065	0.081	0.053
Brunei	Mean	0.254	0.028	0.226	0.002
	Std. Dev.	0.084	0.058	0.071	0.015
Bulgaria	Mean	0.254	0.079	0.175	0.003
	Std. Dev.	0.160	0.082	0.137	0.028
Burkina Faso	Mean	0.306	0.119	0.216	0.008
	Std. Dev.	0.391	0.066	0.359	0.055
Burundi	Mean	0.555	0.218	0.404	0.022
	Std. Dev.	0.444	0.130	0.392	0.110
Côte d'Ivoire	Mean	0.097	0.121	0.015	0.001
	Std. Dev.	0.068	0.068	0.045	0.021
Cameroon	Mean	0.800	0.216	0.584	0.050
	Std. Dev.	0.000	0.099	0.099	0.124
Canada	Mean	0.052	0.040	0.013	0.000
	Std. Dev.	0.053	0.054	0.022	0.002
Central African Rep.	Mean	0.372	0.168	0.204	0.000
	Std. Dev.	0.103	0.088	0.119	0.000
Chile	Mean	0.252	0.066	0.186	0.005
	Std. Dev.	0.029	0.010	0.031	0.027
China	Mean	0.099	0.116	0.002	0.000
	Std. Dev.	0.073	0.092	0.014	0.002
Colombia	Mean	0.414	0.126	0.288	0.022
	Std. Dev.	0.209	0.068	0.202	0.112
Congo	Mean	0.231	0.191	0.040	0.000
	Std. Dev.	0.102	0.103	0.078	0.000
Costa Rica	Mean	0.425	0.059	0.366	0.009
	Std. Dev.	0.120	0.079	0.119	0.048
Croatia	Mean	0.064	0.068	0.011	0.000
	Std. Dev.	0.054	0.066	0.024	0.001
Czeck Republic	Mean	0.048	0.047	0.002	0.000
	Std. Dev.	0.062	0.062	0.011	0.000
Dominica	Mean	0.705	0.141	0.565	0.012
	Std. Dev.	0.327	0.168	0.275	0.078
Egypt	Mean	0.296	0.138	0.168	0.012
	Std. Dev.	0.673	0.612	0.307	0.249
El Salvador	Mean	0.359	0.070	0.289	0.007
	Std. Dev.	0.128	0.085	0.123	0.040
Estonia	Mean	0.091	0.030	0.063	0.000
	Std. Dev.	0.077	0.062	0.062	0.007
European Union	Mean	0.044	0.044	0.001	0.000
	Std. Dev.	0.044	0.044	0.008	0.002
Gabon	Mean	0.224	0.182	0.084	0.001
	Std. Dev.	0.167	0.095	0.128	0.012
Georgia	Mean	0.064	0.053	0.020	0.000
	Std. Dev.	0.058	0.056	0.039	0.002
Ghana	Mean	0.845	0.164	0.681	0.053
	Std. Dev.	0.264	0.094	0.244	0.160
Grenada	Mean	0.599	0.138	0.461	0.006
	Std. Dev.	0.229	0.093	0.231	0.047
Guatemala	Mean	0.415	0.063	0.352	0.015
	Std. Dev.	0.171	0.069	0.169	0.076
Guinea	Mean	0.164	0.129	0.067	0.000
	Std. Dev.	0.143	0.069	0.108	0.004
Guyana	Mean	0.555	0.096	0.460	0.001
	Std. Dev.	0.157	0.083	0.159	0.007
Honduras	Mean	0.309	0.067	0.242	0.002
	Std. Dev.	0.088	0.071	0.096	0.018

Country	Stat	Tariff bound	MFN applied	Tariff water	Useless water
Hungary	Mean	0.067	0.063	0.005	0.000
	Std. Dev.	0.082	0.077	0.023	0.004
Iceland	Mean	0.168	0.040	0.128	0.007
	Std. Dev.	0.205	0.063	0.187	0.064
India	Mean	0.441	0.222	0.225	0.039
	Std. Dev.	0.353	0.172	0.292	0.174
Indonesia	Mean	0.372	0.067	0.306	0.024
	Std. Dev.	0.123	0.086	0.123	0.081
Israel	Mean	0.204	0.042	0.162	0.033
	Std. Dev.	0.400	0.104	0.381	0.225
Jamaica	Mean	0.525	0.087	0.439	0.014
	Std. Dev.	0.224	0.111	0.205	0.067
Japan	Mean	0.031	0.032	0.001	0.000
	Std. Dev.	0.048	0.047	0.009	0.000
Jordan	Mean	0.169	0.151	0.040	0.000
	Std. Dev.	0.152	0.154	0.073	0.007
Kenya	Mean	0.941	0.209	0.733	0.064
	Std. Dev.	0.188	0.166	0.207	0.172
Korea	Mean	0.153	0.109	0.048	0.003
	Std. Dev.	0.356	0.336	0.081	0.045
Kyrgyzstan	Mean	0.064	0.038	0.029	0.000
	Std. Dev.	0.047	0.049	0.037	0.000
Latvia	Mean	0.078	0.038	0.041	0.000
	Std. Dev.	0.095	0.056	0.082	0.010
Lesotho	Mean	0.996	0.118	0.878	0.208
	Std. Dev.	0.631	0.119	0.642	0.385
Lithuania	Mean	0.066	0.038	0.031	0.000
	Std. Dev.	0.067	0.060	0.051	0.007
Madagascar	Mean	0.246	0.105	0.144	0.001
	Std. Dev.	0.066	0.068	0.078	0.008
Malawi	Mean	0.772	0.105	0.666	0.036
	Std. Dev.	0.397	0.099	0.356	0.103
Malaysia	Mean	0.150	0.086	0.067	0.002
	Std. Dev.	0.123	0.102	0.098	0.034
Mali	Mean	0.201	0.120	0.112	0.001
	Std. Dev.	0.214	0.065	0.185	0.016
Malta	Mean	0.493	0.057	0.435	0.005
	Std. Dev.	0.095	0.041	0.100	0.036
Mauritius	Mean	0.865	0.099	0.776	0.110
	Std. Dev.	0.491	0.166	0.465	0.197
Mexico	Mean	0.351	0.152	0.200	0.010
	Std. Dev.	0.046	0.094	0.090	0.041
Mongolia	Mean	0.184	0.044	0.141	0.000
	Std. Dev.	0.050	0.018	0.052	0.003
Morocco	Mean	0.403	0.248	0.178	0.007
	Std. Dev.	0.139	0.204	0.173	0.052
Namibia	Mean	0.255	0.111	0.144	0.012
	Std. Dev.	0.293	0.129	0.283	0.179
New Zealand	Mean	0.117	0.034	0.083	0.002
	Std. Dev.	0.116	0.044	0.080	0.014
Nicaragua	Mean	0.423	0.058	0.365	0.002
	Std. Dev.	0.099	0.074	0.096	0.026
Niger	Mean	0.428	0.130	0.316	0.023
	Std. Dev.	0.437	0.069	0.413	0.126
Nigeria	Mean	0.949	0.152	0.797	0.168
	Std. Dev.	0.516	0.210	0.459	0.311
Norway	Mean	0.033	0.013	0.022	0.000
	Std. Dev.	0.041	0.042	0.031	0.005
Oman	Mean	0.135	0.061	0.077	0.003
	Std. Dev.	0.172	0.085	0.116	0.046
Panama	Mean	0.232	0.081	0.153	0.002
	Std. Dev.	0.115	0.085	0.101	0.018
Papua New Guinea	Mean	0.333	0.040	0.293	0.003
	Std. Dev.	0.145	0.094	0.132	0.027
Paraguay	Mean	0.326	0.117	0.210	0.003
	Std. Dev.	0.067	0.068	0.086	0.022
Peru	Mean	0.302	0.096	0.206	0.007
	Std. Dev.	0.026	0.058	0.061	0.031
Philippines	Mean	0.248	0.055	0.194	0.009
	Std. Dev.	0.114	0.061	0.099	0.043
Poland	Mean	0.075	0.075	0.001	0.000
	Std. Dev.	0.112	0.113	0.008	0.000
Romania	Mean	0.044	0.084	0.002	0.000
	Std. Dev.	0.046	0.090	0.009	0.000
Rwanda	Mean	0.873	0.177	0.709	0.044
	Std. Dev.	0.283	0.111	0.280	0.132
Saint Kitss	Mean	0.818	0.141	0.677	0.011
	Std. Dev.	0.243	0.103	0.230	0.057
Saint Lucia	Mean	0.746	0.136	0.610	0.024
	Std. Dev.	0.350	0.121	0.328	0.082

Country	Stat	Tariff bound	MFN applied	Tariff water	Useless water
Saudi Arabia	Mean	0.107	0.063	0.051	0.001
	Std. Dev.	0.062	0.040	0.047	0.009
Senegal	Mean	0.299	0.125	0.174	0.001
	Std. Dev.	0.009	0.068	0.068	0.011
Singapore	Mean	0.070	0.000	0.070	0.001
	Std. Dev.	0.040	0.000	0.040	0.007
Slovakia	Mean	0.055	0.120	0.014	0.000
	Std. Dev.	0.070	0.151	0.048	0.014
Slovenia	Mean	0.123	0.073	0.058	0.001
	Std. Dev.	0.112	0.063	0.082	0.013
South Africa	Mean	0.195	0.085	0.110	0.012
	Std. Dev.	0.234	0.116	0.216	0.132
Sri Lanka	Mean	0.224	0.087	0.142	0.003
	Std. Dev.	0.193	0.133	0.134	0.029
Swaziland	Mean	0.242	0.115	0.127	0.004
	Std. Dev.	0.205	0.125	0.184	0.057
Tanzania	Mean	1.200	0.233	0.967	0.140
	Std. Dev.	0.000	0.160	0.160	0.254
Thailand	Mean	0.255	0.131	0.139	0.006
	Std. Dev.	0.139	0.145	0.119	0.042
Togo	Mean	0.800	0.169	0.631	0.006
	Std. Dev.	0.000	0.053	0.053	0.051
Trinidad and Tobago	Mean	0.577	0.085	0.492	0.015
	Std. Dev.	0.193	0.104	0.172	0.072
Tunisia	Mean	0.495	0.255	0.241	0.009
	Std. Dev.	0.317	0.246	0.235	0.075
Turkey	Mean	0.239	0.080	0.160	0.009
	Std. Dev.	0.270	0.177	0.190	0.071
Uganda	Mean	0.698	0.140	0.559	0.044
	Std. Dev.	0.158	0.145	0.154	0.129
United Arab Emirates	Mean	0.158	0.049	0.109	0.015
	Std. Dev.	0.240	0.057	0.213	0.139
United States	Mean	0.040	0.042	0.000	0.000
	Std. Dev.	0.122	0.122	0.003	0.000
Uruguay	Mean	0.315	0.128	0.188	0.004
	Std. Dev.	0.065	0.068	0.086	0.027
Venezuela	Mean	0.358	0.134	0.223	0.012
	Std. Dev.	0.133	0.070	0.136	0.057
Zambia	Mean	0.886	0.130	0.756	0.065
	Std. Dev.	0.411	0.109	0.353	0.169
Zimbabwe	Mean	0.633	0.186	0.485	0.106
	Std. Dev.	0.680	0.186	0.596	0.264

Source: World Bank's WITS at wits.worldbank.org, and Foletti et al. (2011) for the definition of water vapour.

Table 2: Descriptive statistics of trade elasticities

Country	Statistic	Import demand elasticity	Export supply elasticity	ROW export supply elasticity ($e^\star$)
Antigua and Barbuda	Mean	1.65	24.3	694
	Std. Dev.	2.13	54.7	1931
Argentina	Mean	1.52	27.0	99
	Std. Dev.	1.97	103.4	1082
Australia	Mean	1.64	27.0	35
	Std. Dev.	2.26	101.9	141
Bahrain	Mean	1.53	23.7	324
	Std. Dev.	1.84	63.3	733
Bangladesh	Mean	1.55	52.6	157
	Std. Dev.	2.08	151.6	468
Barbados	Mean	1.51	22.9	692
	Std. Dev.	1.83	56.8	2260
Belize	Mean	1.63	22.5	775
	Std. Dev.	1.96	56.6	2376
Benin	Mean	1.71	29.5	1135
	Std. Dev.	2.19	56.9	3942
Bolivia	Mean	1.54	22.8	463
	Std. Dev.	2.00	87.4	1619
Botswana	Mean	1.61	25.5	462
	Std. Dev.	2.08	93.6	1775
Brazil	Mean	1.58	26.7	51
	Std. Dev.	2.14	100.2	144
Brunei	Mean	1.59	26.2	363
	Std. Dev.	2.14	82.2	1853
Bulgaria	Mean	1.54	22.3	155
	Std. Dev.	1.97	72.0	515
Burkina Faso	Mean	1.81	22.4	683
	Std. Dev.	2.27	53.2	1743
Burundi	Mean	1.89	39.0	1569
	Std. Dev.	3.14	84.6	5562
Côte d'Ivoire	Mean	1.54	27.9	494
	Std. Dev.	2.07	79.0	1494
Cameroon	Mean	1.73	42.6	224
	Std. Dev.	2.11	90.1	371
Canada	Mean	1.68	27.0	16
	Std. Dev.	2.38	108.5	63
Central African Rep.	Mean	1.52	30.8	906
	Std. Dev.	2.00	55.1	3325
Chile	Mean	1.61	25.6	124
	Std. Dev.	2.15	92.0	1097
China	Mean	1.62	26.4	29
	Std. Dev.	2.27	99.9	106
Colombia	Mean	1.58	23.4	136
	Std. Dev.	2.12	84.1	784
Congo	Mean	0.84	70.7	367
	Std. Dev.	0.29	109.4	591
Costa Rica	Mean	1.53	26.9	239
	Std. Dev.	1.98	102.1	791
Croatia	Mean	1.64	26.9	176
	Std. Dev.	2.20	100.3	1856
Cyprus	Mean	1.52	27.6	251
	Std. Dev.	1.84	105.7	722
Czeck Republic	Mean	1.64	25.7	53
	Std. Dev.	2.26	98.0	206
Dominica	Mean	1.59	26.9	1053
	Std. Dev.	1.70	63.0	4084
Egypt	Mean	1.54	23.1	128
	Std. Dev.	2.00	89.8	341
El Salvador	Mean	1.56	25.5	274
	Std. Dev.	2.11	89.9	901
Estonia	Mean	1.64	26.7	238
	Std. Dev.	2.30	96.3	1661
European Union	Mean	5.51	47	4.64
	Std. Dev.	7.84	228	10.89
Gabon	Mean	1.54	23.6	498
	Std. Dev.	1.93	87.0	1463
Georgia	Mean	1.74	26.4	420
	Std. Dev.	2.51	70.8	1460
Ghana	Mean	1.76	45.4	153
	Std. Dev.	2.47	90.3	347
Grenada	Mean	1.80	24.6	1346
	Std. Dev.	2.28	49.7	5870
Guatemala	Mean	1.58	25.9	240
	Std. Dev.	2.13	101.3	765
Guinea	Mean	1.59	29.3	869
	Std. Dev.	1.90	69.1	2786
Guyana	Mean	1.55	20.7	579
	Std. Dev.	1.71	52.2	1771

Country	Statistic	Import demand elasticity	Export supply elasticity	ROW export supply elasticity ($e^{\star}$)
Honduras	Mean	1.63	27.3	383
	Std. Dev.	2.24	97.8	1477
Hungary	Mean	1.61	26.0	63
	Std. Dev.	2.19	94.7	243
Iceland	Mean	1.56	31.0	345
	Std. Dev.	2.21	116.7	1736
India	Mean	1.61	24.8	50
	Std. Dev.	2.22	101.8	165
Indonesia	Mean	1.65	26.4	77
	Std. Dev.	2.27	106.7	289
Israel	Mean	1.59	26.5	90
	Std. Dev.	2.33	100.2	611
Jamaica	Mean	1.61	23.7	346
	Std. Dev.	2.10	83.9	1189
Japan	Mean	1.59	24.5	13
	Std. Dev.	2.27	90.0	37
Jordan	Mean	1.60	24.5	265
	Std. Dev.	2.06	87.2	716
Kenya	Mean	1.68	59.3	226
	Std. Dev.	2.09	142.9	541
Korea	Mean	1.63	25.7	28
	Std. Dev.	2.28	95.1	94
Kyrgyzstan	Mean	1.64	26.8	461
	Std. Dev.	1.88	80.4	2022
Latvia	Mean	1.62	25.6	229
	Std. Dev.	2.24	83.2	740
Lesotho	Mean	1.81	25.2	305
	Std. Dev.	2.14	53.7	793
Lithuania	Mean	1.62	28.0	180
	Std. Dev.	2.18	107.4	638
Madagascar	Mean	1.58	27.0	574
	Std. Dev.	2.13	71.8	1384
Malawi	Mean	1.82	40.8	415
	Std. Dev.	2.65	96.2	1180
Malaysia	Mean	1.69	24.5	63
	Std. Dev.	2.42	88.0	243
Mali	Mean	1.73	22.9	532
	Std. Dev.	2.01	50.8	1272
Malta	Mean	1.54	25.0	415
	Std. Dev.	2.01	95.4	1194
Mauritius	Mean	1.60	32.9	337
	Std. Dev.	2.11	67.6	1427
Mexico	Mean	1.64	26.3	29
	Std. Dev.	2.32	99.7	92
Mongolia	Mean	1.68	23.7	531
	Std. Dev.	2.07	105.9	1560
Morocco	Mean	1.61	25.4	152
	Std. Dev.	2.19	93.9	428
Namibia	Mean	1.55	27.9	381
	Std. Dev.	2.02	97.6	973
New Zealand	Mean	1.61	28.1	100
	Std. Dev.	2.16	102.4	574
Nicaragua	Mean	1.52	24.1	475
	Std. Dev.	1.89	87.7	1131
Niger	Mean	1.65	23.7	830
	Std. Dev.	2.03	47.3	2713
Nigeria	Mean	1.97	39.4	66
	Std. Dev.	3.01	125.0	123
Oman	Mean	1.63	23.0	236
	Std. Dev.	2.15	69.1	758
Panama	Mean	1.51	24.4	301
	Std. Dev.	1.84	81.5	1440
Papua New Guinea	Mean	1.59	21.8	480
	Std. Dev.	2.02	59.2	1373
Paraguay	Mean	1.52	21.2	352
	Std. Dev.	2.01	56.5	1239
Peru	Mean	1.53	24.7	214
	Std. Dev.	2.02	91.4	1977
Philippines	Mean	1.68	27.7	115
	Std. Dev.	2.39	101.6	621
Poland	Mean	1.62	25.8	39
	Std. Dev.	2.21	102.0	183
Romania	Mean	1.62	26.6	79
	Std. Dev.	2.20	105.3	235
Rwanda	Mean	1.66	26.6	826
	Std. Dev.	2.06	74.5	2774
Saint Kitss	Mean	1.68	23.1	858
	Std. Dev.	1.96	55.2	2683

Country	Statistic	Import demand elasticity	Export supply elasticity	ROW export supply elasticity ($e^\star$)
Saint Lucia	Mean	1.52	24.7	771
	Std. Dev.	1.64	53.4	2168
Saudi Arabia	Mean	1.69	26.1	64
	Std. Dev.	2.40	102.4	176
Senegal	Mean	1.65	20.8	457
	Std. Dev.	2.00	53.6	1274
Singapore	Mean	1.62	31.0	42
	Std. Dev.	2.38	116.3	280
Slovakia	Mean	1.59	25.3	93
	Std. Dev.	2.15	87.0	337
Slovenia	Mean	1.60	27.8	151
	Std. Dev.	2.15	102.1	1361
South Africa	Mean	1.60	24.1	67
	Std. Dev.	2.13	88.3	273
Sri Lanka	Mean	1.72	34.1	208
	Std. Dev.	2.21	92.5	784
Swaziland	Mean	1.60	23.8	608
	Std. Dev.	1.89	65.5	2031
Tanzania	Mean	2.00	51.1	182
	Std. Dev.	3.10	99.2	327
Thailand	Mean	1.59	30.5	79
	Std. Dev.	2.10	120.2	448
Togo	Mean	1.53	41.7	341
	Std. Dev.	1.98	67.3	706
Trinidad and Tobago	Mean	1.56	24.2	415
	Std. Dev.	2.01	96.3	1893
Tunisia	Mean	1.65	26.8	131
	Std. Dev.	2.30	78.3	356
Uganda	Mean	1.97	41.5	330
	Std. Dev.	2.86	79.3	789
United Arab Emirates	Mean	1.72	22.8	55
	Std. Dev.	2.57	78.9	134
United States	Mean	1.41	28.7	3
	Std. Dev.	1.95	155.2	11
Uruguay	Mean	1.49	26.7	290
	Std. Dev.	1.81	91.2	659
Venezuela	Mean	1.59	23.9	125
	Std. Dev.	2.19	86.4	860
Zambia	Mean	1.95	39.4	236
	Std. Dev.	2.65	71.9	631
Zimbabwe	Mean	1.48	36.2	365
	Std. Dev.	1.71	82.8	953

Source: Authors' estimation and Kee et al. (2008) for import demand elasticities.

Table 3: External tests of the estimates of export supply elasticities faced by importers

	(1)	(2)	(3)	(4)
Log of Export supply elasticity of ROW	0.222^{**}			
(left-hand-side of equation (25))	(0.002)			
Log of world's export supply elasticity		0.024^{**}		
(right-hand-side of equation (25))		(0.003)		
Log of import demand elasticity of ROW		0.090^{**}		
(right-hand-side of equation (25))		(0.004)		
Log of import share		-0.370^{**}		-0.421^{**}
(right-hand-side of equation (25))		(0.002)		(0.003)
Log of Export supply elasticity of ROW			0.029^{**}	
(Broda et al. (2008) estimates)			(0.006)	
Log of GDP				-0.050^{**}
				(0.002)
Log of remoteness				-0.179^{**}
(inverse of distance-weigthed GDP of ROW)				(0.012)
R^2-adjusted	0.139	0.164	0.249	0.505
Number of observations	268240	268225	9378	196185
Number of countries	119	119	13	119
HS six-digit fixed effects	No	No	No	Yes
Country fixed effects	Yes	Yes	Yes	No

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

Table 4: Is market power used within tariff waters? OLS estimates

	(1)	(2)	(3)	(4)	(5)	(6)
Import Market Power	-6.88e-07					
$(1/e^*)$	(1.39e-05)					
Log of Import market Power		-0.0019**				
$(\log(1/e^*))$		(1.37e-04)				
Dummy for High and Medium Power			-0.0047**			
(within each country)			(0.0007)			
Dummy for High Power				-0.007**		
(within each country)				(0.001)		
Dummy for Medium Power				-0.0028**		
(within each country)				(0.0003)		
Dummy for High and Medium Power					-0.0071**	
(across all countries)					(0.0009)	
Dummy for High Power						-0.0129**
(across all countries)						(0.0018)
Dummy for Medium Power						-0.0049**
(Med in all sample)						(0.0004)
Water	-0.062**	-0.0481**	-0.0749**	-0.0753**	-0.0777**	-0.0789**
	(0.0097)	(0.0132)	(0.0063)	(0.0061)	(0.0061)	(0.0057)
Power∗water	-3.4e-05	0.0047**	0.0182**	0.0311**	0.0239**	0.0443**
(High in columns 4 and 6)	(5.86e-05)	(0.001)	(0.0051)	(0.0104)	(0.0061)	(0.0129)
Medium market Power∗water				0.0060**		0.0073**
(Medium in columns 4 and 6)				(0.0015)		(0.0016)
Uses power when water is $\geq$	-2.02p.p.	40.42p.p.**	25.82p.p.**	19.35p.p.**	29.71p.p**	29.12p.p.**
(High power in columns 4 and 6)	(2.06)	(7.09)	(3921)	(2.37)	(4.35)	(4.60)
Uses power when water is $\geq$				46.67p.p.**		67.12p.p**
(Medium in columns 4 and 6)				(8.52)		(11.45)

OLS estimates. All columns include year, HS six-digit and country x year x HS two-digit fixed effects. Robust standard errors in parenthesis: ** and * stand for 5 % and 10 % statistical significance. F-statistics indicate all regressions are significant at the 1 percent level. Number of observations in each specification is 1690909.

Table 5: Is market power used within tariff waters? IV estimates

	(1)	(2)	(3)	(4)	(5)	(6)
Import Market Power ($1/e^*$)	-0.0159** (0.0033)					
Log of Import market Power ($\log(1/e^*)$)		-0.0168** (0.0016)				
Dummy for High and Medium Power (within each country)			-0.0026 (0.0042)			
Dummy for High Power (within each country)				-0.0083* (0.0046)		
Dummy for Medium Power (within each country)				-0.0871** (0.0226)		
Dummy for High and Medium Power (across all countries)					-0.0821** (0.0049)	
Dummy for High Power (across all countries)						-0.059** (0.0191)
Dummy for Medium Power (Med in all sample)						-0.0285 (0.0439)
Water	-0.0614** (0.0064)	-0.6197* (0.3611)	-0.1005** (0.0142)	-0.129** (0.0165)	-0.153** (0.0138)	-0.1299** (0.0267)
Power$*$water (High in columns 4 and 6)	-0.0099 (0.0294)	-0.1616 (0.1062)	0.0630** (0.0232)	0.0902** (0.0268)	0.1336** (0.0207)	0.1034** (0.0258)
Medium market Power$*$water (Medium in columns 4 and 6)				0.1031** (0.0309)		0.1071** (0.0535)
Uses power when water is $\geq$ (High power in columns 4 and 6)	-160.61p.p. (484.25)	-10.39p.p. (7.66)	0 p.p (5.95)	9.09p.p.** (4.02)	61.45p.p** (8.21)	57.06p.p.** (12.07)
Uses power when water is $\geq$ (Medium in columns 4 and 6)				84.48p.p.** (23.4)		26.61p.p. (31.14)
Hansen's Orthogonality Test (p-value)	6.26 (0.01)	0.842 (0.36)	0.499 (0.48)	1.49 (0.47)	0.050 (0.823)	4.12 (0.13)
Kleibergen-Paap's Weak IV Test (pass 5 percent critical value?)	1.790 N	0.290 N	471.37 Y	10.38 Y	686.10 Y	4.62 Y

GMM variable estimates. All columns include year, HS six-digit and country x year x HS two-digit fixed effects. Standard errors in parenthesis: ** and $*$ stand for 5 % and 10 % statistical significance. Instruments for water and power include: water vapour, the average import demand elasticity in the rest-of-the-world for a given HS six-digit good and country, the interaction between water vapour and the average import demand elasticity in the rest-of-the-world, and between water vapour and the average across countries of the export supply elasticity from the point of view of exporters. Columns 3 to 6 use dummies derived from these variables as in Broda et al. (2008). High correspond to the top third of the distribution and Medium to the those in the middle of the distribution. Columns 3 and 4 calculate these dummies within each country elasticity distribution, whereas columns 5 and 6 calculate these dummies across all countries. F-statistics are not displayed but they suggest that all estimated models are statistically significant at the 1 percent level. Number of observations in each specification is 1562047.

Table 6: Market Power and Fear of Retaliation – IV estimates

	(1) - low fear	(2) - high fear	(3) - low fear	(4) - high fear
Log of Import market Power	-0.0087^{**}	-0.0064^{**}		
($\log(1/e^*)$)	(0.0015)	(0.0025)		
Dummy for High and Medium Power			-0.0153	-0.0742^{**}
(across all countries)			(0.0102)	(0.0078)
Water	0.2303	-0.3166^{**}	-0.0814^{**}	-0.139^{**}
	(0.1667)	(0.1329)	(0.014)	(0.0362)
Power∗water	0.0779^{*}	-0.0744^{*}	0.0273^{*}	0.0763
(High in columns 4 and 6)	(0.042)	(0.042)	(0.0151)	(0.0525)
Hansen's Orthogonality Test	2.585	7.231	0.255	25.23
(p-value)	(0.11)	(0.01)	(0.61)	(0.00)
Kleibergen-Paap's Weak IV Test	1.118	1.069	98.94	465.95
(pass 5 percent critical value?)	N	N	Y	Y

GMM variable estimates. All columns include year, HS six-digit and country x year x HS two-digit fixed effects. Standard errors in parenthesis: ** and $*$ stand for 5 % and 10 % statistical significance. Instruments for water and power include: water vapour, the average import demand elasticity in the rest-of-the-world for a given HS six-digit good and country, the interaction between water vapour and the average import demand elasticity in the rest-of-the-world, and between water vapour and the average across countries of the export supply elasticity from the point of view of exporters. F-statistics are not displayed but they suggest that all estimated models are statistically significant at the 1 percent level. Number of observations in columns 1 and 2 is 429469 and 557664, respectively. In the case of columns 3 and 4, the number of observations is 358669 and 675740, respectively.

Figure 1

Distribution of the inverse of export supply elasticities faced by importers

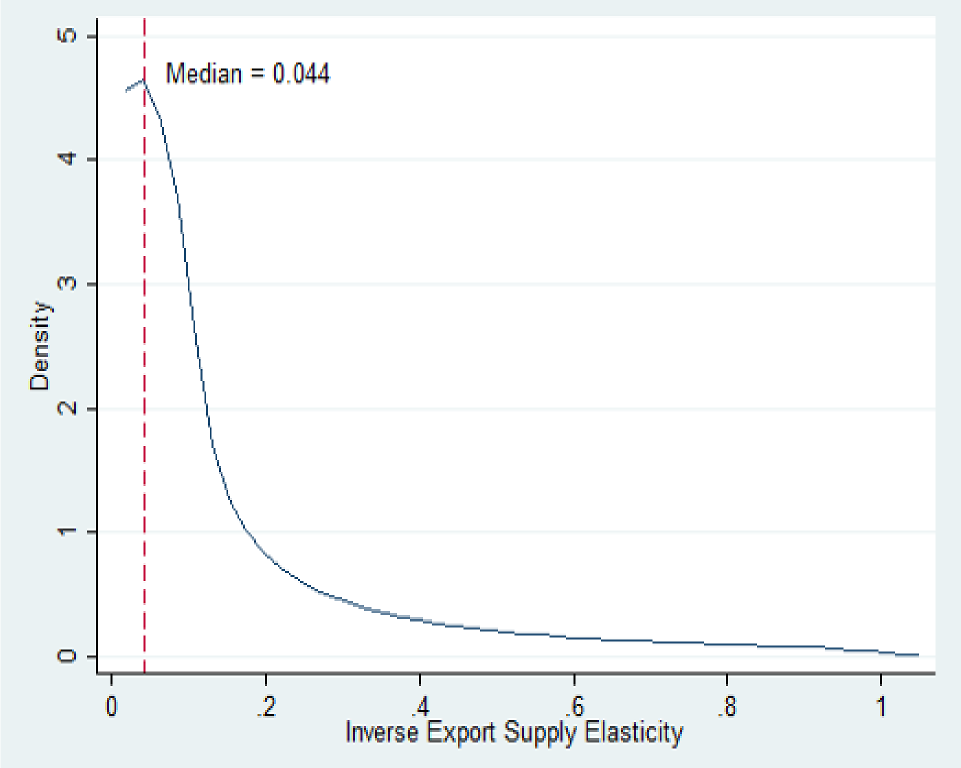

Figure 2
Correlation between the export supply elasticities faced by importers and those calculated using equation (25)