Cooperation in WTO's Tariff Waters*

Alessandro Nicita†
Marcelo Olarreaga‡
Peri Silva§

Incomplete draft

Abstract

With the help of a simple political economy model we show that when tariffs are set non-cooperatively, they are positively correlated to the importer's market power, whereas when tariffs are set cooperatively they are negatively correlated with the importer's market power. We use this result to identify the extent of cooperation reflected in WTO members' tariffs in the absence or presence of the flexibility offered by negotiated tariffs equal or above applied levels. We find that in the absence of flexibility, WTO members set tariffs cooperatively. However, in the presence of even small amounts of flexibility, non-cooperative tariff setting is observed among WTO members.
JEL classification numbers: F13
Keywords: Export supply elasticities, WTO cooperation, tariff water

*We are grateful to Kyle Bagwell, Mostafa Beshkar, Chad Bown, Matthieu Crozet, Anne-Célia Disdier, Michael Gasiorek, Sajal Lahiri, James Lake, Nuno Limao, Patrick Low, Rod Ludema, Giovanni Maggi, Anna Maria Mayda, Jaime de Melo, Christoph Moser, Thomas Osang, Santanu Roy, Subhash Sharmaand, José de Sousa, Bob Staiger, Akiko Suwa, Alan Winters, and seminar participants at Darmouth, ETH Zurich, Getulio Vargas, the Midwest Meetings at the University of Kansas, Oklahoma State, the RIEF in Orleans, the Paris School of Economics, Southern Illinois University, Southern Methodist University, and Sussex University for helpful comments and discussions. The views expressed here are those of the authors and do not necessarily reflect those of the institutions to which they are affiliated.

†United Nations Conference on Trade And Development, email: alessandro.nicita@unctad.org

‡University of Geneva and Centre for Economic Policy Research, email: marcelo.olarreaga@unige.ch.

§Kansas State University and Centro Studi Luca d'Agliano, email: pdasilva@k-state.edu.

1 Introduction

It has been long recognized that in the presence of market power, positive import tariffs can be optimal, and there is empirical evidence suggesting that non-members of the World Trade Organization (WTO) set tariffs to exploit their market power (Broda et al., 2008). If these optimal tariffs improve the terms-of-trade of importers, by definition, they deteriorate the terms of trade of their trading partners. This creates incentives for cooperation within a negotiating framework such as the WTO (Bagwell and Staiger, 1999). The recent empirical evidence suggests that WTO negotiations do facilitate cooperation in tariff setting, resulting in acceding members' tariff schedules that do not reflect any longer their market power in international markets (Bagwell and Staiger, 2011).

There is also recent evidence that even among WTO members tariffs may reflect their market power in spite of cooperation (Ludema and Mayda, 2013). This is explained by the fact that not all exporting countries necessarily participate in tariffs negotiations with all importers. This leads to some terms-of-trade externalities not being internalized and tariffs still partly reflecting importer's market power.

Another reason why WTO members' tariffs may reflect non-cooperative behavior is that a key aspect of the WTO process is the negotiation of tariff caps, or bound tariffs, rather than applied tariff levels. WTO members can apply tariffs below the bound. The difference between the tariff that a country applies at the border and the country's commitments to other WTO members is referred to as "tariff water", or "binding overhang". 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 room to set tariffs that reflect market power.[1]

In this paper we empirically explore the extent of tariff cooperation to internalize terms-of-trade externalities in the presence and absence of tariff water. To guide our empirical work, we consider a two-country model in which tariffs are driven by a terms-of-trade rationale, as well as political economy forces. The governments' politically motivated objective function when determining tariffs puts an extra-weight on the profits of firms in import and export-competing sectors. Countries set tariffs cooperatively when the costs of cooperation are not too large. Otherwise, a sufficiently high exogenous tariff bound is imposed allowing the importing country to implement a non-cooperative tariff within its tariff waters. In the presence of cooperation, the negotiated tariff maximizes the joint political function of the two countries, and no tariff water is observed. This dichotomy 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 Hoekman and Kostechi (2009).

The model predicts that in the absence of cooperation, one should observe the positive textbook relationship between importers' market power and their tariffs. On the other hand, in the presence of cooperation, the importing country's tariffs are inversely related to its market power. To understand the latter, note that exporters' profits also have an extra-weight in the government's objective function. Incentives for exporters to negotiate tariff reductions by trading partners are stronger the larger the importer's market power.

This second prediction is new and we use it to identify the presence of cooperation in WTO's member tariff schedules. In the absence of tariff water, we should observe a negative relationship between importers' market power and tariffs. In the presence of tariff water, the relationship between importers'

[1] The literature offers several explanations for the presence of tariff water. Amador and Bagwell (2012) explain its presence with a model where uncertainty and private information are present. Horn, Maggi and Staiger (2010) explain its presence in a model with uncertainty and contract costs. In practice, the rationale why countries often set their applied tariffs to levels below the bound tariffs remains an open question.

market power and tariffs should be positive.

We empirically test these predictions by exploring the correlation between applied most favoured nations (MFN) tariffs and market power (i.e., the inverse of the elasticity of export supply faced by each importer) in the presence and absence of tariff water. To implement the empirical test, we first need estimates of rest of the world's export supply elasticities. These are obtained building on the Kee et al. (2008) adaptation of Kohli's (1991) revenue function approach to the estimation of trade elasticities. In short, we estimate the revenue function of the rest of the world for each WTO member as a function of the rest of the world factor endowments and the price they face in the import market. The price parameter of the revenue function of the rest of the world can then be used to calculate the export supply elasticity of the rest of the world in the WTO member's market as in Kee et al. (2008). Our estimates of the rest of the world export supply elasticities suggest that the median optimal tariff for market power reasons is around 10 percent.

We then test our theoretical predictions and find evidence that in the absence of tariff water, tariffs are set cooperatively, as the importer's market power has a negative impact on tariffs. We also find that in the presence of tariff water the relationship between the importer's market power and tariffs becomes positive for small amounts of tariff water. This result is robust for controlling for the importance of preferential imports as well as for the degree of concentration of exporters faced by the importing country.

2 Optimal tariffs and the WTO

In a set-up where tariffs are determined by both market power and political economy forces, non-cooperative tariffs reflect both the terms-of-trade rationale and lobbying forces in the importing country.[2] In the presence of cooperation,

[2] See Grossman and Helpman (1995) and Bagwell and Staiger (1999).

the market power rationale vanishes as it captures inefficient transfers from the exporting country to the importing country that are internalized through cooperation. We should, therefore, expect no relationship between cooperative tariffs and market power.

However, this does not consider that the government in the exporting country may also be politically motivated and may have an objective function that gives additional weight not only to the profits of import-competing firms, but also to exporters. In this case, cooperative tariffs are negatively correlated with a measure of the importing country's market power, even though the terms-of-trade rationale has been internalized. Indeed, a tariff in the importing country imposes larger costs for politically organized exporters when their export supply elasticity is small, as the decline in their export price is larger. The cooperative tariff reflects this an ensure that tariffs are small when the export supply elasticity is small, i.e., when the inverse of the export supply elasticity which captures market power is large.[3]

We start developing a simple model to illustrate how the presence of cooperation changes the relationship between an importer's market power and tariffs. We then develop an empirical strategy to test the predictions of the model. We identify cooperative and non-cooperative tariff setting by the absence or presence of tariff water in the importer's schedule. The absence of tariff water signals that tariffs are set at the negotiated bound reflecting cooperation among WTO members. The presence of tariff water opens the door to non-cooperative tariff setting among WTO members.

Note that this assumes that the tariff bound is endogenously set when countries cooperate, but is exogenous in the absence of cooperation.[4] The latter describes well the setting of WTO tariff bounds in many developing countries.

[3]This is somehow equivalent to the negative relationship between cooperative tariffs and the import demand elasticity in the importing country. A more elastic import demand implies larger distortions in the importing country and therefore calls for a smaller optimal tariff.

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

As described in Croome (1995), an Australian proposal was adopted during the Uruguay Round to ensure that most countries would bind their tariffs by allowing each member to follow its own approach to tariff binding. This led many developing countries, in particular the smaller and poorer countries, to bind almost all of their previously unbound tariffs at arbitrarily high levels.[5] 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. The available data (see table 1) indicate that they have very little tariff water in their schedules, which suggests that their applied MFN tariffs are the outcome of trade negotiations.

2.1 Theoretical predictions

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

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

which describes the preferences in the home country (a similar expression de-

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

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

Perfect competition prevails. The numeraire 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.

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

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

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

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

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

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

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

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

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

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

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

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

We can now investigate the equilibrium tariff on good 1 that emerges when the two countries cooperate. We adopt the usual assumption that negotiated tariffs maximize the sum of the governments' political functions.[6] In this case, we represent the sum of the political functions by the global political function, which is represented by $G^w = G + G^\star$. Focusing on the equilibrium tariff for good 1, we can totally differentiate G^w to obtain:

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

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

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

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

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

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

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

Whether countries cooperate in tariff setting depends entirely on whether the gains from cooperation are larger than its costs, i.e., $(G^w\left(t_1^C\right) - G^w\left(t_1^N\right))$ needs to be greater than α. We follow Horn, Maggi and Staiger (2010) to obtain the sufficient condition for obtaining sufficiently large gains from cooperation. By definition, the function G^w is concave and $\frac{dG^w(t_1^C)}{dt_1} = 0$ since the cooperative tariff maximizes the global political function. Thus, a sufficient condition for large gains from cooperation is to have $\left|\frac{dG^w(t_1^N)}{dt_1}\right|$ large but this boils down to 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, and with the assistance of the market clearing condition, we can rearrange terms to derive the following sufficient condition in terms of relevant elasticities:

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

We can relate expression (7) to the discussion above about equilibrium tariffs. This sufficient condition indicates that countries are more likely to cooperate when the importing country has significant market power (low $e_1^\star$), or a tariff creates significant distortions in the importing country (high e_1), or foreign exporters are politically influential (high $\beta^\star$), or the two countries trade a great deal with each other (high m_1). If these conditions apply then countries cooperate and tariff water is not present since the bound and applied tariff are described by the cooperative tariff in (6). Otherwise, countries do not cooperate, water is present, and tariffs reflect the market power of the importing country. This is summarized in the following prediction:

Prediction 1 *If gains from cooperation described by expression (7) are large relative to negotiation costs, then there is no tariff water and tariffs are negatively related to the inverse of the export supply elasticity of the rest of the world. If gains from cooperation are relatively small, then there is tariff water and tariffs will reflect the market power of the importing country.*

Finally, note that the cooperative tariff necessarily implies side-payments from the foreign to the home government as t_1^C yields a lower value of the government's objective function than t_1^N. This side payments can take the form of market access concessions in terms of reductions in $t_2^\star$ which will necessarily increase the home government's objective function, or other monetary or non-monetary transfers in the spirit of Limão (2006 and 2007).

2.2 Empirical strategy

In order to empirically test the prediction developed in the previous section, we will use tariff data for 92 WTO members at the six-digit level of the HS classification,[7] and investigate the extent to which the importer's market power (i.e., the inverse of the export supply elasticity of the rest of the world) has a different relationship with tariffs in the presence and absence of tariff water. We estimate these two regimes using a sample split whenever tariff water is observed:

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

where $t_{c,p}$ is the applied tariff in country c in product p (defined at the six-digit level of the HS classification), $W_{c,p}$ is a dummy variable that indicates the presence of tariff water in country c in product p, α_p are product fixed effect defined at the six-digit level of the HS classification, and $\alpha_{c,2HS}$ are two-digit HS fixed effects that also vary by country. The different sets of fixed effects serve as controls for political economy determinants of tariffs, such as firm concentration and capital/labor intensity, as well as any other HS six-digit and country and HS two-digit unobserved heterogeneity.[8]

We expect $\alpha^{W} > 0$ as the relationship between market power and tariffs is positive in the presence of tariff water, and $\alpha^{1-W} < 0$, suggesting that in the absence of water, tariff are set cooperatively, and the the relationship between

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

[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.

applied tariffs and the inverse of the export supply elasticity of the rest of the becomes negative.

There are several issues regarding the estimation of (8). First, export supply elasticities of the rest of the world are measured with a lot of noise as suggested by Broda et al. (2008). We follow their strategy and use as an alternative the log of $1/e^{\star}$, as well as dummy variables that split the sample into high and low, as well as high, medium and low levels of market power across all countries and products. The latter two measures fit our analytical setup better, since it implies a discontinuity in the relationship between tariffs and market power above a certain level of market power that would yield cooperation gains larger than the negotiation costs.

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

$$\text{Water vapor}_{c,p} = \max\left\{0, t^{b}_{c,p} - t^{pr}_{c,p}\right\} \tag{9}$$

where $t^{b}_{p,c}$ stands for the bound tariff and $t^{pr}_{p,c}$ for the prohibitive tariff. So water vapor is tariff water above the prohibitive tariff.[9] After calculating water vapor for each product in each country, we use its presence to instrument for the presence of tariff water. Arguably, this instrument satisfies the exclusion and the inclusion restrictions as the level of the applied tariff should not depend on how much water vapor exists, and by construction, water vapor is correlated with tariff water as it is part of it.[10]

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

[10] To construct water vapor, we need a measure of prohibitive tariffs for every tariff line. These are not observable, but we use the approximation in Foletti et al. (2011), which with the help of import demand elasticities calculates the prohibitive tariff as the one that will lead to zero imports using a linear approximation around the observed level of imports. The prohibitive tariff is then given by:

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

The first four columns of table 1 provide summary statistics by country of applied and bound tariffs, as well as tariff water and water vapor.

The endogeneity of market power is addressed 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 the average across all countries of export supply elasticities measured from the exporters' point of view, and the average import demand elasticities in the rest of the world.[11] We have estimates of import demand elasticities at the six-digit level 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.[12] 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). In principle these two averages satisfy the exclusion restriction. We instrument the interaction of market power and the tariff water and no tariff water dummies with the interaction of these averages with dummies indicating the presence and absence of water vapor. To check the validity of these instruments we perform over-identification and weak instrumental variables' tests.

Finally, so far we have imposed on the data that the non-cooperative regime is observed as soon as there is some tariff water. This may be a strong assumption, but that can be easily relaxed. Using an unknown threshold model a la

where $e^m_{c,p}$ represents the import demand elasticity which varies by country and by product.

[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 the expression to obtain:

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

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.

[12] The methodology employed to measure all export supply elasticities is discussed in Section 3.

Hansen (2000) we can actually estimate the level of tariff water that is needed to observe a move from cooperative to non-cooperative tariff setting. We will therefore estimate (8) using an adaptation of Hansen (2000) to an instrumental variable setup by Caner and Hansen (2004), that we combine with Hansen (1999) estimator of threshold models with panel data to account for the country and product dimension in our dataset. Because we use HS 6-digit and country x HS 2-digit fixed effects in our main specification we first demean the left and right-hand side variables with respect to the HS 6-digit and the country x HS 2 digit means. As shown by Hansen (1999) the demeaning needs to take into account the fact that the sample is split into two regimes.

We then perform a grid-search for different values of the threshold depending on the level of tariff water using a two-stage least square procedure. The point estimate is given by the threshold that minimizes the sum of square residuals of the second stage as in Caner and Hansen (2004). The confidence interval for the estimated threshold is constructed using a LR-like statistic as in Hansen (2000).[13]

3 Estimating export supply elasticities

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

[13] Let's define $SSR^{\star}$ as the sum of square residuals for the threshold that minimizes the SSR. Then, any other threshold level is statistically different from the one used to obtain $SSR^{\star}$ at the 5 percent level if its SSR is such that: $(SSR - SSR^{\star}) / (SSR^{\star}/n) > 7.35$.

as well as some external tests.

3.1 Rest of the world export supply elasticities

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

We assume that the GDP function is common across all countries up to a constant term that accounts for productivity differences. The GDP function of each country, denoted $G^t(p^t, v^t)$, 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:

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

where all the translog parameters a, b and c_s when indexed by t allow for changes over time.[14] We also impose the necessary restrictions so that the GDP function

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

satisfies the homogeneity and symmetry properties of a GDP function.[15] 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 (10). Then, taking the derivative of $\ln G^t(p^t, v^t)$ 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,[16]

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

where s_n^t is the share of export good n in the rest of the world GDP, C_w is the total number of countries 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:[17]

[15] 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:

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

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

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

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

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

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

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

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

With an additive stochastic error term, μ_n^t, to capture measurement errors, equation (13) is the basis used for the estimation of own price effect, a_{nn}, and hence the export 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. Therefore, given that we assume that the GDP functions are common up to a constant, we pool the data together and estimate the common a_{nn} using both cross-country and time variations and introducing year and country-specific fixed effects that are all specific to each good n. The country-specific fixed effects (for each good n) will control, for example, for the level of trade restrictiveness in each importing country that may be correlated with the price received by exporters, as long as trade restrictiveness does not vary significantly across time. The year fixed effects (for each good n) will capture general shocks to good n's world market.

There are also several econometric problems. Unit prices can be endogenous or measured with error. There may also be selection bias due to the fact that some products may not be exported by the rest of the world to a particular country. Finally, there may be partial adjustments of exported quantities to changes in prices which may lead to serial correlation in the error term. To address all the econometric problems, we follow the procedure in Kee et al. (2008).[18]

[18] 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),

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

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

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

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

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

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

but only when the test they propose suggests that selection bias is a problem. We also test for serial correlation in the error term, and, when serial correlation is present, we then estimate a dynamic model by introducing a lagged dependent variable using the generalized methods of moments (GMM) system estimators developed by Arellano and Bover (1995). This estimation strategy corresponds to the Arellano and Bond (1991) difference GMM estimators, with a level equation added to the system to improve efficiency.

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:

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

We are facing the same econometric problems and data constraints as when estimating the export supply elasticities of the rest of the world, and we therefore follow the procedure described 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 United Nations Comtrade system at the six-digit level of the HS classification (around 4,600 products).[19] The HS classification was introduced in 1988. The basic data set consists of an unbalanced panel of exports of around 100 countries at the six-digit level of the HS classification for the period 1988-2007. The number of countries obviously varies across products and time 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 are constructed using the perpetual inventory method based on real investment data in WDI (2012).

3.4 Empirical Results

We have estimated a total of 212,888 rest of the world export supply elasticities corresponding to more than 100 importers at the six-digit level of the HS

[19]It is available at the World Bank through the World Integrated Trade Solution.

classification. The median export supply elasticity is around 10, which implies a median optimal tariff in the world based on market power at 10 percent. But there is quite a bit of variance in these estimates. At the top of the distribution, the 10 percent largest export supply elasticity of the rest of the world are larger than 377 which yields optimal tariffs below 0.2 percent. On the other hand, at the bottom of the distribution, the 10 percent smallest export supply elasticities are smaller than 0.8, which yields optimal tariffs above 125 percent.

The last column of table 1 provides the average and standard deviation of export supply elasticities faced by each importer in the sample used to estimate equation (8). It therefore excludes some countries for which we do not have applied or bound tariffs. The economies facing the lowest export supply elasticities and therefore having the strongest market power are the United States and the European Union, with average optimal tariffs above 14 percent. The countries facing the highest export supply elasticity, and therefore being close to price-taking behavior in international markets are Dominica, Central African Republic and Grenada with average optimal tariffs below 0.7 percent.[20]

We provide a few external tests of these estimates. First, as suggested in footnote 11, with information on import demand elasticities and export supply elasticities for each exporter, the rest of the world export supply elasticity faced by importer i can be approximated by:

$$e_i^\star = \frac{1}{m_i/x_w}\left(e^{x\star} + \sum_{c\neq i} e_c^m \frac{m_c}{x_w}\right) \tag{17}$$

where $e^{x\star}$ is the export supply of the entire world, which can be approximated by the weighted sum of export supply elasticities estimated from the exporter's point of view, and e_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

[20] There is a factor of 50 between the country with the highest average optimal tariff (the European Union) and the country with the lowest average optimal tariff (Madagascar).

country are given in the fifth column of table 1. The average could seem high, but it is important to remember that these export supply elasticities are estimated at the six-digit level of the HS classification keeping all prices constant, and among these prices that are kept constant there are some that are very close substitutes. For example, HS 010511 is the product code for live chickens under 185 grams, and HS 010512 is for live turkeys under 185 grams. Note that in order to derive equation (17) we assumed that the export supplies were not differentiated by importer, whereas our estimates of $e^{\star}$ described in section 3.1 assume that the export supply elasticities of the rest of the world are differentiated by destination. Thus, we do not expect the estimates in section 3.1 to be equal to the ones in obtained using equation (17).

In the first column of table 2 we provide estimates of the correlation between our estimate of the export supply elasticity faced by each importer, and its proxy using equation (17). In the second column we split equation (17) into its three elements, specifically: the world's export supply elasticity for each good which is 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. In the second column of table 2, as expected, when decomposing equation (17) 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 has 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 2 provides the correlation between the estimates of Broda et al. and our estimates. There is 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 constant elasticity of substitution demand structure, whereas our elasticities are derived from the supply side (the revenue function) and we make no assumptions on the demand side. Thus, we should not expect the elasticities to be equal, but positively correlated as they both capture the export supply elasticities faced by importers.

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

Finally, we have also estimated 66774 elasticities at the 4-digit of the HS by simply aggregating the six-digit raw data at the four digit-level and then implementing the same strategy as followed at the six-digit. The median elasticity is 8, which is slightly lower than the one obtained at the six-digit of the HS. This is to be expected as the aggregation of data into broader bundles leads to a less responsive supply. The last four columns of table 2 reproduce the same external tests undertaken for the estimates at the six-digit of the HS, but using elasticities estimated with the assistance of data at the 4-digit of the HS. They also confirm the different *a priori* expectations we had on these elasticities.[21]

[21] The correlation between estimates at the 4 and 6-digit levels is 0.9 when aggregated at

4 Cooperation in the WTO tariff waters?

To estimate the extent to which we observe cooperative behavior in the absence of tariff water, and non-cooperative behavior in the presence of tariff water, we estimate equation (8).[22]

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 an average difference between their bound and applied tariffs of 7 and 8 percentage points, respectively. On the other hand, most developing countries have more than 10 percentage points of tariff water in their tariff schedules, reaching over 40 percentage points in 27 countries (out of the 92 countries in the sample).

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

We estimate equation (8) using four different measures of market power. In the first specification we use our estimate of market power ($1/e^{\star}$). However, the data described in table 1 shows that there are important outliers given that the standard deviation is often several times larger than the average elasticity. For this reason, we follow Broda et al. (2008) in considering alternative nonlinear measures of market power. The second specification uses the log of $1/e^{\star}$. The third specification uses a dummy that takes a value of 1 for elasticities that are

the country level and 0.4 when aggregated at the 4-digit HS level.

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

above the median value in terms of market power across products and countries. The fourth specification uses a dummy that takes a value of 1 for goods that are in the top and middle thirds of the distribution of market power.

The first four columns of table 3 provide the ordinary least square estimates of equation (8). The last four columns provide the instrumental variable estimates. As discussed earlier we use as instruments a dummy indicating the presence of water vapor (i.e., tariff bounds above prohibitive tariffs), import demand elasticities in the rest of the world, and the interactions of the water vapor dummy with import demand elasticities in the rest of the world and with the world's export supply elasticity.

Results in the first row tend to confirm the prediction that in the absence of water, i.e., in the presence of tariff cooperation, the importer's market power is negatively correlated with applied tariffs. With the exception of the specifications in the first and fifth columns, all coefficients on the importer's market power are also statistically significant.

The ordinary least square results for the prediction that tariffs and market power are positively correlated in the presence of tariff water do not confirm our prediction with the exception of the specification in the first column. However, all the coefficients on market power are much smaller in the presence of water relative to the estimates with no tariff water. With the exception of the specification in the first column, all market power coefficients in the presence of tariff water are statistically smaller than the coefficients in the absence of tariff water. This suggests that in the presence of tariff water, countries may tend to set tariff less cooperatively than in the absence of tariff water.

Moreover, the ordinary least squares estimates may suffer from endogeneity bias as discussed in section 2. Interestingly, once we correct for endogeneity, the prediction that market power is positively correlated with tariffs in the presence of tariff water is also confirmed by all specifications in table 3. Only in the first specification, the coefficient is not statistically different from zero.

Note also that with the exception of column (5) we reject the null hypothesis that we are in the presence of weak instruments as indicated by the p-value of the Kleibergen-Paap test. Also only column (5) does not pass the Hansen overidentification test, suggesting that in the other columns the instruments are valid.

To sum up, the results in table 3 tend to confirm that tariffs are set co-operatively in the absence of tariff water, and that they tend to be set non-cooperatively in the presence of tariff water.

The economic importance of market power in cooperative and non-cooperative tariff setting is relatively large. Using our preferred specification in column (7) of table 3, which proxies market power with a dummy indicating whether market power is above or below the median, we have that a move from having low market power to having high market power leads to a tariff that is 16 percentage points lower in the absence of tariff water, and a tariff that is 18 percentage points higher in the presence of tariff water.

4.1 Robustness

We perform a series of robustness tests and results are provided in table 4. The robustness tests were performed over our preferred specification in column (3) of table 3, where market power is captured by a dummy that signals if the inverse of the export supply elasticity in the rest of the world is above or below the median across all countries and products.

Column (1) provides the results when the elasticities are estimated at the 4-digit of the HS to better address the large number of zeroes trade flows when estimated at the 6-digit of the HS. Column (2) introduces HS 4-digit x country fixed effects to account for unobserved heterogeneity instead of HS 2-digit x country fixed effects as in Table 2. Columns (3) and (4) explore differences between OECD and non-OECD countries. Columns (5) and (6) explore differences between GATT members and new WTO members. In column (7) we use elasticity estimates only if we did not have to impose the constraint in 14. In column (8) we use as additional controls the variables identified in Ludema and Mayda (2013), i.e., exporter's concentration, its interaction with market power and the share of preferential trade. Column (9) uses data on unbound tariffs.

All robustness tests tend to suggest that tariffs are negatively correlated with market power in the absence of tariff water and positively correlated with market power in the presence of tariff water. The instruments seem to pass the over and under-identification tests except perhaps in the sample of new WTO members where the first stage seems to perform relatively poorly, and in the estimates at the 4-digit of the HS where the Hansen overidentification tests suggest that the instruments may not be valid.

4.2 Estimating the "unknown" tariff water threshold

The model in section 2 suggests that the presence of tariff water, no matter how deep, leads to non-cooperative behavior by WTO members. When estimating equation (8) we have imposed this result on the data by allowing for a change in regime as soon as we depart from the absence of tariff water. Using an unknown threshold model à la Hansen (2000), we can estimate the level at which we have a change in regime in the data as a function of the level of tariff water.

Table 5 provides the estimates of the unknown threshold model which again tend to confirm that the measure of market power is positively correlated with tariffs when there is sufficiently large amounts of tariff water, and negatively correlated otherwise. But the threshold is estimated at 10 percent,[23] meaning that the change from cooperative to non-cooperative behavior only occurs when tariff water is above 10 percent. The threshold is also very precisely estimated and is statistically different form zero.

This is problematic as in our model non-cooperative behavior should be ob-

[23] Except in the first column where the first stage is particularly poor as indicated by the p-value of the Kleibergen-Paap test.

served as soon as we deviate from zero tariff water.[24] One potential explanation for this is that we have so far neglected the importance of preferential trade. As shown by Ludema and Mayda (2013) in the presence of preferential trade, market power can only be used on non-preferential exporters, which is likely to reduce the optimal MFN tariff.[25] This could explain why WTO members seem to impose cooperative tariffs in the presence of tariff water. It may simply be explained by the fact that in the presence of preferential trade the non-cooperative tariff is smaller than $1/e^{\star}$.

Let us then derive the optimal tariff when a share ϕ of imports enters preferentially at a zero tariff. The home country's government objective function becomes:

$$\begin{aligned} G\left(p_1,p_2\right) &= u_1\left(d_1\left(p_1\right)\right)-p_1d_1\left(p_1\right)+u_2\left(d_2\left(p_2\right)\right)-p_2d_2\left(p_2\right) \\ &\quad +\left[1-\phi_1\right]t_1m_1\left(p_1\right)+\left(1+\beta\right)\left[\pi_1\left(p_1\right)+\pi_2\left(p_2\right)\right] \end{aligned} \tag{18}$$

The optimal non-cooperative tariff on imports of good 1 is then obtained as before by differentiating expression (18) with respect to tariffs, and making the additional assumption that preferential exports are perfectly inelastic to obtain the first order condition of home's maximization problem:

$$\begin{aligned} \frac{dG}{dt_1} &= -d_1\left[\frac{dp_1^{\star}}{dt_1}+1\right]+\left[1-\phi_1\right]m_1+t_1m_1'\left[\frac{dp_1^{\star}}{dt_1}+1\right] \\ &\quad +\left(1+\beta\right)x_1\left[\frac{dp_1^{\star}}{dt_1}+1\right] \end{aligned} \tag{19}$$

As before $\frac{dp_1}{dt_1}=\frac{dp_1^{\star}}{dt_1}+1$, and we can solve for the non-cooperative tariff by

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

[25] In Ludema and Mayda (2013) the effect is actually ambiguous because importers may care about the reduction in trade diversion hurting their preferential partners as in Limão (2006 and 2007).

setting expression (19) equal to zero with the assistance of the market clearing condition, we obtain:

$$t_1^N = \frac{\beta z_1 p_1}{e_1} + \frac{1 - \phi \frac{e_1^\star + e_1}{e_1}}{e_1^\star} = \frac{\beta z_1 p_1}{e_1} + \frac{1}{e_1^\star} - \frac{\phi \frac{e_1^\star + e_1}{e_1}}{e_1^\star} \tag{20}$$

where t_1^N is the non-cooperative optimal tariff in the presence of preferential trade. The first two terms are identical to the non-cooperative tariff derived earlier under the assumption that there was no preferential trade. The third term is new. Note that when $\phi = 0$, i.e., there are no preferential imports, then we obtain the same non-cooperative tariff as before.

The equilibrium non-cooperative tariff displays the usual two motives for deviations from free trade under perfect competition: political economy and terms of trade. The first one is unchanged, but the terms of trade motive (the second term on the right) declines with ϕ, i.e., as the share of trade that goes preferential increases the incentives to impose a tariff for terms of trade reasons decline. This is due the fact that the decline in world prices induced by the tariff is only observed on non-preferential imports, as preferential imports do not pay the MFN tariff. It is also easy to show that under the above assumptions the cooperative tariff remains unchanged, as the terms-of-trade motive is internalized through negotiations.

In order to test this we need to add the additional term given by the third term on the right of (20) to the estimates of the unknown threshold in table 5. We proxy the share of preferential trade with Ludema and Mayda (2013) measure. It has the advantage of being measured in 1993 and therefore it is more exogenous that if we were to use the current level of preferential trade. We constraint the coefficient of this variable under the cooperative regime to be zero (by replacing its value by zero). Results in the last four columns of table 5 suggest that ....

5 Concluding Remarks

The paper explores the extent of cooperative and non-cooperative tariff setting in the WTO in the presence of a terms-of-trade rationale for cooperation. We exploit the extent of tariff water of WTO members to distinguish between the potential for cooperative and non-cooperative tariff setting. The absence of tariff water reflects cooperation, as tariffs cannot be legally increased to exploit the importer's market power. On the other hand, tariff water opens the door for non-cooperative tariff setting, as tariffs could be increased to further exploit market power without violating the importer's WTO commitments.

To guide our empirical study, we build a simple model where politically motivated governments put an extra-weight on profits of import-competing and exporting firms. Depending on the costs and gains from cooperation, tariffs are either set cooperatively or non-cooperatively. When the gains from cooperation are too small, an exogenous tariff bound is set, leading to tariff water in the importing countries' tariff schedules. We then show that when countries cooperate, tariffs are negatively correlated with the market power of the importer. The stronger the market power of the importer, the stronger are the incentives for exporters in the rest of the world to negotiate for lower tariffs. On the other hand, when tariffs are set non-cooperatively, we have the textbook positive relationship between importers' market power and tariffs.

To test this prediction, we first estimate the degree of market power (the inverse of the rest of the world export supply elasticity faced by each importer) at the tariff line level for more than 100 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 tariffs with and without tariff water. Because market power and tariff water may be endogenous we use an instrumental variable approach, where the extent of tariff water above the prohibitive tariff (water vapor), the average import demand elasticity in the rest of the world, and the export supply elasticity of the world are used as instruments.

Results are in line with the theoretical prediction. We find that in the absence of tariff water, importing countries' market power tends to be negatively correlated with applied tariffs, which is consistent with the cooperative tariff setting prediction of our model. On the other hand, in the presence of tariff water, the relationship between importers' market power and tariffs becomes positive, suggesting a tendency towards non-cooperative tariffs.

We then estimate the tariff water threshold at which tariffs move from a co-operative to a non-cooperative regime, instead of imposing that the shift occurs as soon as there is some water in the tariff schedules. We initially estimate the tariff water threshold at 10 percent, suggesting that in the presence of moderate levels of tariff water, WTO members tend to set their tariffs cooperatively.

This result is at odd with the model that we then extend to incorporate the presence of preferential trade. We first show that the optimal tariff in the non-cooperative regime is smaller in the presence of tariff water, and re-estimate our unknown threshold model. Results suggest after correcting for the presence of preferential trade......................

References

[1] Amador, Manuel, and Kyle Bagwell. 2012. "Tariff Revenue and Tariff Caps", *American Economic Review* 102(3): 459–65.

[2] Anderson, James and Peter Neary, 1996. "A New Approach to Evaluating Trade Policy", *Review of Economics and Statistics* 63, 107-125.

[3] Anderson, James and Peter Neary, 2003. "The Mercantilist Index of Trade Policy", *International Economic Review* 44, 627-649.

[4] Arellano, Manuel and Stephen Bond, 1991. "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations", *Review of Economic Studies* 58, 277-297.

[5] Arellano, Manuel and Olympia Bover, 1995. "Another look at the instrumental variable estimation of error-components models", *Journal of Econometrics* 68, 29-51.

[6] Bagwell, Kyle and Robert W. Staiger, 1999. "An Economic Theory of GATT", *American Economic Review* 89(1): 215-248.

[7] Bagwell, Kyle and Robert W. Staiger, 2011. "What Do Trade Negotiators Negotiate About? Empirical Evidence from the World Trade Organization", *American Economic Review* 101(4): 1238-73.

[8] Beshkar, Mostafa, Eric Bond, and Youngwoo Rho, 2015. "Tariff Binding and Overhang: Theory and Evidence", *Journal of International Economics* forthcoming.

[9] Bown, Chad P. and Meredith A. Crowley. 2013. "Self-Enforcing Trade Agreements: Evidence from Time-Varying Trade Policy" *American Economic Review* 103(2): 1071-90.

[10] Broda, Christian, Nuno Limão, and David E. Weinstein, 2008. "Optimal Tariffs and Market Power: The Evidence", *American Economic Review* 98(5): 2032-65.

[11] Caner, Mehmet, and Bruce Hansen, 2004. "Instrumental variable estimation of a threshold model", *Econometric Theory* 20(5): 813-843.

[12] Caves, Douglas W., Laurits R. Christensen, and Erwin Diewert, 1982. "Multilateral Comparisons of Output, Input, and Productivity using Superlative Index Numbers," *Economic Journal* 92(365), 73-86.

[13] Croome, John, 1995. Reshaping the World Trading System: a History of the Uruguay Round. World Trade Organization.

[14] Edgeworth, Francis, 1894. Theory of international values. *Economic Journal* 4, 606-638.

[15] Feenstra, Robert, 1995. "Estimating the Effects of Trade Policy", *Handbook of International Economics* vol. 3.

[16] Foletti, Liliana, Marco Fugazza, Alessandro Nicita and Marcelo Olarreaga, 2011. "Smoke in the (Tariff) Water", *The World Economy* 34(2): 248-264.

[17] Grossman, Gene M., and Elhanan Helpman, 1995. "Trade wars and trade talks", *Journal of Political Economy* 103(4): 675-708.

[18] Hansen, Bruce, 1999. "Threshold effects in non-dynamic panels: Estimation, testing, and inference", *Journal of Econometrics* 93(2): 345-368.

[19] Hansen, Bruce, 2000. "Sample splitting and threshold estimation", *Econometrica* 68(3): 575-603.

[20] Hoekman, Bernard and Michael Kostechi, 2009. *The Political Economy of the World Trading System,* Oxford University Press, Third Edition.

[21] Horn, Henrik, Giovanni Maggi and Robert Staiger, 2010. "Trade Agreements as Endogenously Incomplete Contracts", *The American Economic Review* 100(1), 394-419.

[22] Kee, Hiau Looi, Alessandro Nicita and Marcelo Olarreaga, 2008. "Import Demand Elasticities and Trade Distortions", *The Review of Economics and Statistics* 90(4): 666-682.

[23] Kohli, Ulrich, 1991. *Technology, Duality, and Foreign Trade: The GNP Function Approach to Modeling Imports and Exports,* The University of Michigan Press, Ann Arbor.

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

[25] Limão, Nuno, 2006. "Preferential Trade Agreements as Stumbling Blocks for Multilateral Trade Liberalization: Evidence for the United States", *American Economic Review* 96(3): 896–914.

[26] Ludema, Rodney and Anna-Maria Mayda, 2013. Do terms-of-trade effects matter for trade agreements? Theory and evidence from WTO countries. Quarterly Journal of Economics 128(4), 1837-1893.

[27] Olarreaga, Marcelo, Isidro Soloaga, and Alan Winters, 1999. "What's behind MERCOSUR's common external tariff?" Policy Research Working Paper Series 2231, The World Bank.

[28] Semykina, Anastasia and Jeffrey Wooldridge, 2010. "Estimating Panel Data Models in the Presence of Endogeneity and Selection: Theory and Application," *Journal of Econometrics* 157(2), 375-380.

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

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

Country	MFN Applied	Bound Tariff	Tariff Water	Vapor Water	Export elas. ($e^{x\star}$)	Import elas. (e)	ROW-exp elas. ($e^{\star}$)
China	0.095	0.097	0.002	0.000	88	1.580	24
	(0.071)	(0.071)	(0.014)	(0.003)	(162)	(2.269)	(72)
Colombia	0.124	0.407	0.283	0.016	79	1.512	57
	(0.071)	(0.193)	(0.186)	(0.093)	(133)	(2.011)	(122)
Costa Rica	0.059	0.425	0.366	0.008	81	1.459	78
	(0.076)	(0.125)	(0.123)	(0.053)	(149)	(1.836)	(154)
Côte d'Ivoire	0.124	0.100	0.018	0.001	88	1.413	96
	(0.067)	(0.074)	(0.056)	(0.018)	(188)	(1.546)	(167)
Croatia	0.053	0.065	0.014	0.000	87	1.589	63
	(0.057)	(0.054)	(0.026)	(0.001)	(179)	(2.094)	(129)
Cyprus	0.034	0.412	0.378	0.006	77	1.460	84
	(0.040)	(0.140)	(0.135)	(0.059)	(156)	(1.713)	(160)
Dominica	0.146	0.725	0.578	0.013	97	1.450	196
	(0.171)	(0.347)	(0.296)	(0.075)	(154)	(1.424)	(250)
Egypt	0.109	0.277	0.175	0.007	79	1.479	65
	(0.346)	(0.242)	(0.136)	(0.041)	(153)	(1.944)	(134)
El Salvador	0.065	0.365	0.300	0.005	85	1.513	83
	(0.075)	(0.121)	(0.114)	(0.031)	(163)	(2.032)	(157)
Estonia	0.044	0.088	0.047	0.000	87	1.576	77
	(0.049)	(0.076)	(0.064)	(0.006)	(174)	(2.169)	(151)
European Union	0.043	0.043	0.001	0.000	93	1.122	4
	(0.044)	(0.044)	(0.007)	(0.002)	(174)	(1.568)	(6)
Gabon	0.180	0.226	0.088	0.001	85	1.442	109
	(0.096)	(0.169)	(0.134)	(0.010)	(167)	(1.742)	(179)
Georgia	0.071	0.072	0.001	0.000	89	1.561	106
	(0.060)	(0.059)	(0.007)	(0.000)	(156)	(2.022)	(178)
Ghana	0.158	0.850	0.692	0.035	143	1.616	72
	(0.070)	(0.257)	(0.228)	(0.129)	(253)	(2.271)	(140)
Grenada	0.140	0.600	0.460	0.005	103	1.707	155
	(0.084)	(0.229)	(0.229)	(0.043)	(166)	(2.252)	(238)
Guatemala	0.059	0.412	0.353	0.013	78	1.537	77
	(0.064)	(0.174)	(0.173)	(0.074)	(145)	(2.136)	(153)
Guyana	0.122	0.587	0.465	0.000	88	1.567	114
	(0.109)	(0.189)	(0.177)	(0.004)	(177)	(1.947)	(189)
Honduras	0.064	0.310	0.246	0.001	74	1.547	91
	(0.068)	(0.087)	(0.095)	(0.011)	(121)	(2.144)	(176)
Hong Kong	0.000	0.000	0.000	0.000	102	1.522	27
	(0.000)	(0.000)	(0.000)	(0.000)	(199)	(2.032)	(76)
Iceland	0.041	0.168	0.127	0.006	80	1.445	82
	(0.062)	(0.203)	(0.188)	(0.064)	(159)	(1.856)	(161)
India	0.176	0.438	0.264	0.033	83	1.562	43
	(0.139)	(0.346)	(0.271)	(0.148)	(148)	(2.262)	(102)

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

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

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

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

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

	HS 6-digit estimates				HS 4-digit estimates			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log of ROW Export supply elasticity	0.404**				0.499**			
(left-hand-side of equation (17))	(0.003)				(0.005)			
Log of world's export supply elasticity		0.024**				0.061**		
(right-hand-side of equation (17))		(0.003)				(0.007)		
Log of ROW import demand elasticity		0.035**				0.019**		
(right-hand-side of equation (17))		(0.006)				(0.007)		
Log of import share		-0.418**		-0.400**		-0.448**		-0.485**
(right-hand-side of equation (17))		(0.003)		(0.003)		(0.005)		(0.004)
Log of ROW Export supply elasticity			0.021**				0.020**	
(Broda et al. (2008) estimates)			(0.008)				(0.008)	
Log of GDP				-0.032**				-0.026**
				(0.002)				(0.004)
Log of remoteness				-0.076**				-0.231**
(inverse of distance-weigthed GDP of ROW)				(0.013)				(0.022)
R^2-adjusted	0.535	0.135	0.051	0.544	0.635	0.234	0.078	0.621
Number of observations	202307	202307	8843	202307	63922	63922	8803	63922
Number of countries	100	100	14	100	100	100	14	100
Number of HS codes	4944	4944	1116	4944	1147	1147	1093	1147
HS fixed effects	Yes	No	No	Yes	Yes	No	No	Yes
Country fixed effects	Yes	Yes	Yes	No	Yes	Yes	Yes	No

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

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

	Ordinary Least Squares estimates				Instrumental Variables estimates			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$1/e^*$	$\log(1/e^*)$	$H = 1$	$H\&M = 1$	$1/e^*$	$\log(1/e^*)$	$H = 1$	$H\&M = 1$
Market Power × No Water	$-3E^{-5}$	-0.0022**	-0.0075**	-0.0117**	-0.016	-0.020*	-0.159**	-0.230**
	$(6E^{-5})$	(0.0003)	(0.0012)	(0.0017)	(0.020)	(0.010)	(0.027)	(0.037)
Market Power × Water	$5E^{-6}$	-0.0008**	-0.0018**	-0.0027**	0.018	0.033**	0.183**	0.144**
	$(1E^{-5})$	(0.0001)	(0.0005)	(0.0005)	(0.021)	(0.005)	(0.031)	(0.021)
# obs.	146,861	146,861	146,861	146,861	146,418	146,418	146,418	146,418
R^2	0.606	0.607	0.607	0.607	.	0.449	0.208	0.326
Hansen overid. (p-value)	NA	NA	NA	NA	0.011	0.125	0.632	0.633
Kleibergen-Paap (p-value)	NA	NA	NA	NA	0.786	0.000	0.000	0.000

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

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

	(1) HS4 aggreg.	(2) HS4×ctry f.e.	(3) Non OECD	(4) OECD	(5) Old GATT	(6) New WTO	(7) w/o $\epsilon^{\star}$ constred.	(8) L&M (2013)	(9) Unbound tariffs
Market Power × No Water	-0.510**	-0.089**	-0.197**	-0.072**	-0.169**	-0.136*	-0.156**	-0.208**	-0.493**
	(0.145)	(0.026)	(0.032)	(0.037)	(0.030)	(0.079)	(0.044)	(0.071)	(0.065)
Market Power × Water	0.146**	0.109**	0.239**	0.153**	0.173**	0.323*	0.084**	0.187**	0.185**
	(0.046)	(0.029)	(0.040)	(0.058)	(0.030)	(0.184)	(0.013)	(0.071)	(0.031)
Exporters Herfindhal (Herf)								0.142**	
								(0.049)	
Market Power × Herf								-0.038	
								(0.091)	
PTA share								-0.0577**	
								(0.005)	
# obs.	47,713	146,418	99362	47056	118,314	28,104	98837	67652	200,963
R^2	.	0.680	0.344	0.100	0.226	.	0.529	0.077	.
Hansen overid. (p-value)	0.074	0.244	0.686	0.906	0.679	0.823	0.510	0.434	0.568
Kleibergen-Paap (p-value)	0.000	0.000	0.000	0.001	0.000	0.222	0.000	0.000	0.000

We use a GMM estimator for the specification in column (7) of Table 3, as well as the same instrumental variables. In all regressions we use a six-digit and country × HS two-digit fixed effects, except for the first two columns. The first column has four digit and country × HS two-digit fixed effects, and the second column has six-digit and country × HS four-digit fixed effects. Standard errors in parenthesis: ** and $*$ stand for 5 % and 10 % statistical significance.

Table 5: Estimating the tariff water cooperation threshold with and without preferential trade

	Without preferential trade				With preferential trade			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$1/e^*$	$\log(1/e^*)$	$H=1$	$H\&M=1$	$1/e^*$	$\log(1/e^*)$	$H=1$	$H\&M=1$
Market Power × No Water	-0.005	-0.007	-0.091**	-0.104**				
	(0.221)	(0.008)	(0.017)	(0.020)				
Market Power × Water	-0.008	0.035**	0.194**	0.147**				
	(0.723)	(0.005)	(0.034)	(0.022)				
# obs.	146,418	146,418	146,418	146,418				
R^2	0.277	0.492	0.313	0.443				
Hansen overid. (p-value)	0.773	0.567	0.403	0.148				
Kleibergen-Paap (p-value)	0.990	0.000	0.000	0.000				
Threshold	0.100**	0.491**	0.100**	0.100**				

We use a Hansen (2000) estimator. All columns include HS six-digit and country × HS two-digit fixed effects. Standard errors in parenthesis: ** and ∗ stand for 5 % and 10 % statistical significance. Column (1) uses the inverse of ROW export supply elasticity as a measure of market power; column (2) uses the log of the inverse; column (3) uses a dummy that takes the value 1 if the inverse is above the within country median; and column (4) uses a dummy that takes a value of 1 if the inverse is above the within country two thirds of the distribution. We use the following instruments: a dummy for water vapor, the import demand elasticity in the ROW and the interaction of the dummy for water vapor with the import demand elasticity in the ROW, and with the export supply elasticity of the world.