RECONCILING OBSERVED TARIFFS AND THE MEDIAN VOTER MODEL

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This Draft: May 16, 2009

Abstract. The median voter theory of trade policy predicts positive tariffs in capital-abundant countries and negative tariffs in labor-abundant countries. This paper reconciles the median voter theory with observed protectionism across countries. Considering a large country median voter model, we show the optimal tariff is a sum of the median voter component and a positive terms of trade component. Consequently, positive terms of trade effects can overcome the negative median voter component in labor-abundant countries, leading to positive tariffs across countries. Testing the tariff prediction with cross-section and panel data, we provide evidence for each component in the 1990s.

Keywords. Median Voter, Trade Policy, Heckscher Ohlin, Terms of Trade, Threshold Regression.
JEL Classification Codes. F11, F13, F59

Acknowledgment. I am grateful to Bob Staiger for continued guidance. This paper has benefited from comments of Steven Durlauf, Charles Engel, Scott Gehlbach, Devashish Mitra, John Morrow, Alan Spearot and Ken West. Pushan Dutt and Michael Tomz kindly provided their datasets. The usual disclaimer applies.
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1. Introduction

Empirical studies show that factor ownership is associated with preferences over trade policy as predicted by the factor endowments model. Individuals with a relatively higher ownership of their country's abundant factor are more pro-trade and vice-versa.[1] In this paper, we examine whether individual preferences based on factor ownership are reflected in actual trade policies adopted across countries.

For this purpose, we consider the median voter factor endowments model of Mayer (1984). Mayer endogenizes trade policy in a factor endowments model to show how individual and aggregate trade policies are related to factor ownership. In the Mayer-Heckscher-Ohlin (MHO) setting, individuals own different shares of the aggregate capital in the economy. Consequently, a tariff affects each individual's income differently and tariff choices are related to shares of capital ownership, as found in empirical studies.

A natural question arises whether individual tariff choices translate into the adopted trade policy of a country. In a factor endowments framework, wages rise with a tariff on the labor-intensive good and fall with a tariff on the capital-intensive good. As a result, individuals with low capital shares prefer tariffs while individuals with high capital shares prefer import subsidies. With majoritarian voting, the MHO model predicts that the adopted trade policy reflects tariff preferences of the majority of individuals in a country. In particular, the adopted trade policy is the median capital owner's optimal tariff rate. When the median voter owns a small share of aggregate capital in the country, capital-abundant countries adopt tariffs while labor-abundant countries adopt import subsidies.

While individual trade policy preferences are empirically consistent with the MHO model, adopted trade policies are seldom in line with the model's prediction. Import subsidies are rarely observed so the level of tariff prediction is unrealistic. Consequently, this paper addresses the following question: Can Mayer's import subsidization result be reconciled with the lack of "pro-trade" bias across countries? This allows us to understand whether tariff levels observed across countries reflect the interests of the majority, as predicted by the median voter factor endowments model.

Taking our cue from the classic optimal tariff argument, we provide a "large" country level of tariff prediction to reconcile observed tariffs with the median voter model. According to the optimal tariff argument, a large country sets positive tariffs in order to improve its terms of trade. Recent work has

[1] See Scheve and Slaughter (2001), Mayda and Rodrik (2005) and O'Rourke and Sinnott (2001).

shown that even countries with small shares in world GDP or world imports are "large" as they set higher tariffs on account of terms of trade considerations.[2]

To tie in this insight, we consider a large country MHO model where countries have the ability to manipulate their terms of trade. World prices respond to domestic tariffs and large countries set higher tariffs to improve their terms of trade. Unlike the small country MHO model, optimal tariffs consist of a positive terms of trade component in addition to the standard median voter component. As a result, when a large labor-abundant country has sufficient market power, the positive terms of trade component dominates the negative median voter component. The optimal tariff is positive and there is no pro-trade bias.

Taking the large country level prediction to the data, we test for the median voter and terms of trade components in tariffs across countries during the last two decades. We consider two samples, a cross-section during the 1990s and a panel during 1995-2000 and 2000-2005. In line with our large country level prediction, we find the median voter component has a negative impact on tariffs in labor-abundant countries and a positive impact in capital-abundant countries using human capital. In each time period, we find strong empirical support for a positive terms of trade component in tariffs. Thus the empirical link between individual preferences and factor ownership is not at odds with the adopted tariff policies across countries. In fact, the observed absence of pro-trade policies can accommodate median voter considerations when terms of trade are considered.

During each time period, we find that the positive effect of terms of trade is higher among non-members of the GATT/WTO. As in the terms of trade theory of trade agreements (Bagwell and Staiger, 1999), we expect members to mutually negotiate and re-adjust their tariffs to reduce the terms of trade externality. In the limit, the terms of trade component would be completely eliminated among members. While we find evidence of a weaker terms of trade component among members, terms of trade concerns continue to exert an upward bias in tariffs of member countries. It remains to be seen whether future negotiations will eliminate the terms of trade component leading to pro-trade policies among labor-abundant member countries.

To summarize, we provide evidence for a terms of trade and a median voter component in tariffs. These empirical findings contribute to the limited work examining whether implemented trade policies

[2]Olarreaga et al. (1999) find that terms of trade considerations account for about 6 to 28 per cent of the explained variation in tariffs across commodities for MERCOSUR countries even though MERCOSUR's share in world imports is just one per cent. Broda et al. (2008) emphasize the role of regional market power and find that countries with small shares in world GDP (e.g. Algeria, Paraguay etc.) set higher tariffs on account of terms of trade considerations. Also see Blattman et al. (2003) and Williamson (2003) for historical evidence.

are in line with the median voter theory. In earlier work, Beaulieu and Magee (2004) use Political Action Committee (PAC) contribution data and find that the factor represented by the PAC is more important than industry in determining support for NAFTA and GATT in the US. This is consistent with the MHO model in that capital owners favor tariff reductions while labor owners favor tariff increases in a capital-abundant country.

On the other hand, Dutt and Mitra (2002) leave tariff levels aside and focus on variation in tariffs and inequality implied by the MHO model. The variation in tariffs prediction suggested by Dutt and Mitra states that higher inequality in capital ownership causes tariff rates to rise in capital-rich countries and to fall in capital-scarce ones. This precise relationship between tariffs and inequality is in contrast to other political economy models of trade policy.[3] Therefore, evidence of the variation prediction shows the median voter model explains trade policy patterns that cannot be attributed to other theories. Using adopted tariff rates, Dutt and Mitra found support for the variation prediction with physical capital and unskilled labor in the 1980s. We show that the large country MHO model preserves the variation prediction both theoretically and empirically.

The paper is organized as follows. Sections 2 and 3 contain the theoretical and empirical model respectively. Section 4 briefly summarizes the data while Section 5 lays out the empirical results. Section 6 concludes.

2. Theoretical Model

In this Section, we lay out the MHO theory and examine the tariff predictions for small and large countries. First we describe the production structure and resulting incomes. Then we discuss individual preferences and individual trade policy choices. Finally we determine how individual tariff choices translate into trade policy adopted in the economy. This gives us the large country level prediction which we test in a subsequent Section.

Production. We retain the basic MHO framework: There are two sectors (1 and 2) and two factors (labor L and capital K) in the economy. Labor and capital are needed to produce two goods, 1 and 2. Production functions for the two goods are homogeneous of degree one. Both factors are perfectly

[3]Dutt and Mitra (2002) remark that when a lobbying approach is used in a similar two-sector two-factor constant returns to scale framework such as Rodrik (1986), the opposite prediction follows. An increase in capital inequality results in lower protection in capital-rich countries and vice-versa. On the other hand, when a lobbying or median voter approach is used in a specific factors model, there is no clear cross-country prediction. The impact of an increase in inequality on trade barriers is highly sensitive to the costs of forming lobbies or the elasticity of substitution between mobile and specific factors (Feenstra, 2004, pp. 311-15).

mobile across these two industries. As a result, a unit of labor earns a wage rate (w) and a unit of capital earns a rental rate (r), irrespective of the industry of employment.

Income. There are L agents in the economy. Each agent (i) owns a unit of labor ($L^i = 1$) and a certain amount K^i of the capital stock in the economy. An agent who owns a unit of labor and K^i units of capital earns total factor income equal to $w + rK^i$. Thus individual i's share in national rewards from factor ownership is

$$\phi^i \equiv \frac{w + rK^i}{wL + rK}$$

In addition to factor earnings, agents receive a part of the national tariff revenue. Suppose the domestic country imports M units of good 1. Let t be the domestic import duty or tariff rate imposed on good 1 and π be the world relative price of good 1 in terms of good 2. Then the domestic country obtains national tariff revenue $T = t\pi M$. Mayer assumes tariff sharing is neutral with respect to the overall distribution of income. If agent i earns ϕ^i of the total factor rewards in the economy, then she receives ϕ^i of the total tariff revenue T. In other words, individual i receives $T^i = \phi^i T$ so her total income is $y^i = w + rK^i + T^i = \phi^i(wL + rK + T) = \phi^i Y$.

Preferences. On the demand side, all agents have identical and homothetic preferences over goods. Utility function are strictly concave. Both goods are normal and traded in competitive markets. Let the domestic price of good 1 in terms of good 2 be $p = \pi(1 + t)$. Individual i in the home country chooses a tariff level t^i that maximizes her indirect utility function U.

$$\max_{t^i} U^i\left(p(\pi, t^i), y^i\right) \qquad i = 1, ..., I$$

We allow for large countries so the world price π can be affected by changes in the domestic tariff rate t. In particular, a country is "large" if it has the ability to manipulate its terms of trade. Holding foreign tariff t^* constant, if the change in world price (π) with respect to a change in domestic tariff (t) is non-zero ($\pi_t \neq 0$) then the domestic country is "large". Following Bagwell and Staiger (1999), we assume an increase in domestic tariff of a large home country has a strictly negative impact on world relative price and vice-versa for tariff imposed by the foreign country (t^*).

Assumption (1). $\pi_t < 0 < dp/dt$ and $\pi_{t^*} > 0 > dp^*/dt^*$.

Individual Trade Policy Choices. When choosing a tariff rate, individual i takes into account how the tariff affects imports, her income share and her country's terms of trade, as shown below.

$$\frac{dU^i}{dt} = \left(\phi^i \frac{\partial U^i}{\partial y^i}\right)\left(\underbrace{t\pi\frac{dM}{dt}}_{\text{Tariff-weighted Imports}} + \underbrace{\frac{Y}{\phi^i}\frac{d\phi^i}{dt}}_{i\text{'s Income Share}} + \underbrace{-M\pi_t}_{\text{Terms of trade}}\right) = 0$$

While the change in tariff-weighted imports (first term in parenthesis) is negative for all individuals, the income share (second term in parenthesis) may rise or fall depending on an individual i's ownership of capital (as explained shortly). The terms of trade effect (third term in parenthesis) is an aggregate term that is positive in a large country. The standard MHO model assumes a small open economy implying that the terms of trade effect disappears (since $\pi_t = 0$). In a large country, the terms of trade effect is strictly positive since world price of the home country's imported good falls with a domestic tariff (i.e. $\pi_t < 0$).

Adopted Trade Policy. Having determined individual trade policy preferences, we now discuss the implications for adopted trade policies across countries. With single-peaked preferences, the median voter theorem implies the adopted tariff ($\tilde{t}$) corresponds to the median voter's optimal tariff ($\tilde{t}^{mv}$).

$$\tilde{t} = \tilde{t}^{mv} = \underbrace{\left(\frac{Y}{\pi(-dM/dt)}\right)\left(\frac{d\phi^{mv}/dt}{\phi^{mv}}\right)}_{\text{MV Component}} + \underbrace{\left(\frac{M\pi_t}{\pi dM/dt}\right)}_{\text{ToT Component}} \tag{2.1}$$

Equation (2.1) shows that the optimal tariff consists of two components, the median voter component and a terms of trade component. We discuss each of these components in turn.

As in the small country MHO model, the first term in Equation (2.1) is the median voter (MV) component. The sign of the MV component depends on how the median voter's income share is affected by a domestic tariff ($d\phi^{mv}/dt$). As shown below in Equation (2.2), the change in income share $d\phi^{mv}/dt$ in turn depends on two elements, the median voter's capital share relative to the nation ($K/L - K^{mv}$) and the relative factor intensity of the import industry which determines relative wage changes ($(1/w)(dw/dt) - (1/r)(dr/dt)$). From the factor ownership share $\phi^i = (w + rK^i)/(wL + rK)$, the change in income share of the median voter is

$$\frac{d\phi^{mv}}{dt} = \left[\frac{wL}{(wL + rK)^2}\right] r \underbrace{(K/L - K^{mv})}_{(+)} \underbrace{\left(\frac{1}{w}\frac{dw}{dt} - \frac{1}{r}\frac{dr}{dt}\right)}_{\text{Factor Intensity of M}} \tag{2.2}$$

In Equation (2.2), the first element $(K/L - K^{mv})$ is positive across countries since the median voter owns a lower fraction of the capital stock than the mean capital owner in all countries.[4] The sign of the second element $((1/w)(dw/dt) - (1/r)(dr/dt))$ depends on relative factor abundance of the country. In particular, the change in relative wage is positive in a capital-abundant country and negative in a capital-scarce country. An increase in tariff raises the domestic price of the imported good (p). By the Stolper-Samuelson theorem, this results in a higher income share for the agent if she is relatively well-endowed with the factor used intensively in the production of the imported good. From the Heckscher-Ohlin theorem, a capital-abundant country imports the labor-intensive good while a capital-scarce country imports the capital-intensive good. Consequently, in a capital-abundant country, an increase in the price of the imported labor-intensive good will lead to a higher factor reward for labor and a lower factor reward for capital. Thus, the relative factor reward of the median voter in a capital-abundant country increases with a rise in tariff. On the other hand, the relative factor reward of the median voter in a capital-scarce country falls with a rise in tariff. To summarize, trade barriers and income share of the median voter are positively related in a capital-abundant country ($d\phi^{mv}/dt > 0$) and negatively related in a labor-abundant country ($d\phi^{mv}/dt < 0$), leading to a positive median voter component of tariffs in a capital-abundant country and a negative median voter component in a labor-abundant country.

The second term in Equation (2.1) is a terms of trade (ToT) component. Let E^* denote the exports of foreign country to home country. Then the ToT component is a familiar inverse of the export supply elasticity of home country's imports of good 1, i.e. $\text{ToT} = 1/[(\pi/E^*)(d\pi/dE^*)] \equiv 1/\eta^*$. A small country faces a perfectly elastic export supply. As a result, in the small country MHO model, the ToT component in Equation (2.1) is zero. Tariffs only have a median voter component implying tariffs are positive in capital-abundant countries and negative in labor-abundant countries. This is the unrealistic import subsidization result of the MHO model.

In order to reconcile observed protectionism with the lack of import subsidies, we consider large countries that do not face a perfectly elastic export supply and hence have the ability to manipulate their terms of trade. In a large country, optimal tariff is a sum of the median voter component and a positive terms of trade component. As in the small country MHO model, the adopted tariff is positive in a capital abundant country (as both the median voter and the terms of trade components are positive). However, unlike the small country MHO model, the adopted tariff is positive in a sufficiently large

[4]We confirm this assumption in our empirical work. For further discussion, see Alesina and Rodrik (1994).

labor-abundant country due to the presence of terms of trade considerations. In particular, let $e_{\phi t}$ be the median voter's income share elasticity with respect to a domestic tariff and let $e_{\pi t}$ be the world price elasticity with respect to a domestic tariff. Then as long as the share of imports to GDP exceeds the ratio of median voter's factor share elasticity to world price elasticity ($\pi M/Y > e_{\phi t}/e_{\pi t}$), a labor-abundant country will impose positive tariffs on its imports. In this case, a labor-abundant country has sufficient market power in its import market implying that the positive terms of trade component outweighs the negative median voter component. The adopted tariff is positive and trade policies do not reflect a pro-trade bias. We summarize this result in a Proposition below.

> **Proposition: Large Country Tariff Levels.** *The optimal tariff is a sum of the median voter component and a terms of trade component. When a large labor-abundant country has sufficient market power, the positive impact of the terms of trade component outweighs the negative impact of the median voter component implying positive tariffs.*

Thus the unrealistic result of import subsidization is overturned while the relationship between tariffs and the median voter component is preserved. Olarreaga et al. (1999) remark that "the relevance of the "small" country assumption may be limited to a small number of cases, as MERCOSUR represents only 1 per cent of world markets, but terms-of-trade effects seem to be relatively important" (pp. 23). Thus it is likely that several countries across the world can be considered sufficiently large implying that the MHO level of tariff prediction may not be unrealistic after all.

From Equation (2.1), we find that the large country extension preserves the variation prediction tested by Dutt and Mitra (2002). Leaving the level of tariff prediction of the MHO model aside, Dutt and Mitra (DM hereafter) examined how adopted tariffs vary with a rise in inequality. Holding other things equal, the MHO model implies that higher inequality in capital ownership (i.e. a higher $K/L - K^{mv}$) causes tariff rates to rise in capital-rich countries and to fall in capital-scarce ones ($\partial\tilde{t}/\partial\text{Inequality} < 0$). Using cross-country variations in income inequality and adopted tariff rates, DM found support for the inequality-tariff implication during the 1980s. As mentioned earlier, this clear inequality-tariff relationship is unique to the MHO model and therefore provides suggestive evidence for its empirical validity (see Gawande and Krishna, 2003 for a discussion). It is therefore noteworthy that the large country MHO model preserves the inequality-tariff implication of the small country MHO model. Terms of trade considerations do not affect the individual-specific income effect of preferred tariffs. As a result, the large country extension maintains the relationship between tariffs and

inequality implied by the MHO model. Thus DM's findings regarding the validity of the inequality-tariff implication of the MHO model apply to the large country MHO model as well. For ease of reference, we summarize the variation and level prediction of a small and large country MHO model in Table 1.

TABLE 1. Level and Variation Prediction of the MHO Model

Country Type	Assumptions	MV	ToT	Level $\tilde{t}$	Variation $\partial\tilde{t}/\partial$Ineq
Small K-abundant	$\pi_t = 0$	(+)	0	(+)	(+)
Small L-abundant	$\pi_t = 0$	(-)	0	(-)	(-)
Large K-abundant	$\pi_t < 0 < \frac{dp}{dt}$	(+)	(+)	(+)	(+)
Large L-abundant	$\pi_t < 0 < \frac{dp}{dt}$	(-)	(+)	(+/-)	(-)
	$\frac{\pi M}{Y} > \frac{e_{\phi t}}{e_{\pi t}}$	(-)	(+)	(+)	(-)

3. Empirical Model

In this Section, we provide an empirical model to test the level of tariff prediction. We start with the cross-sectional test as it closely parallels the work of Dutt and Mitra (2002).

From Equation (2.1), the optimal tariff can be written as:

$$\tilde{t} = \text{MV Component} + \text{ToT Component} = \theta_{mv}\text{MV} + \text{ToT}$$

where $\theta_{mv} = \left(\frac{dw}{dt} - \frac{w}{r}\frac{dr}{dt}\right)/|\pi dM/dt|$ is the median voter coefficient which switches signs depending on factor-abundance. The median voter term can be written in terms of capital inequality as follows:

$$\text{MV} = \frac{Y}{Y-T}\frac{r(K/L - K^{mv})}{w + rK^{mv}}L$$

MV captures the shortfall in the median voter's capital ownership relative to the average voter. It is the population-weighted percentage deviation of the median voter's capital earnings after adjusting for tariff revenue. Finally ToT $= 1/\eta^*$ is the inverse of the export supply elasticity of the home country. We are interested in examining whether the median voter component is negative (positive) in labor (capital) abundant countries and whether the terms of trade component is positive, as predicted by the large country level prediction.

For brevity, let $k \equiv K/L$ denote the mean capital-labor ratio and k^* denote the threshold capital-labor ratio that divides countries into capital-scarce and capital-abundant categories. Then the level of tariff prediction implies that majority considerations exert a negative influence on tariffs in capital-scarce countries and a positive influence in capital-abundant countries. In other words, $\theta_c^{mv} < 0$ for all

countries with $k_c < k^*$ and $\theta_c^{mv} > 0$ for all countries with $k_c > k^*$. The large country level prediction implies that terms of trade considerations exert a positive influence on tariffs in all large countries.

In order to test these predictions, we follow Dutt and Mitra (2002) and consider the following linear regression:[5]

$$\tilde{t}_c = \theta_1 \mathrm{MV}_c + \theta_2 \mathrm{MV}_c \cdot k_c + \theta_3 k_c + \theta_{tot} \mathrm{ToT}_c + Z_c'\zeta + \varepsilon_c \tag{3.1}$$

where Z and ε denote a vector of controls and error terms respectively while θ and ζ are parameters to be estimated. We explain each RHS variable in turn. The interaction term $(\mathrm{MV} \cdot k)$ in Equation (3.1) allows the coefficient on the median voter term $(\theta_1 + \theta_2 k_c)$ to vary across subgroups of countries so we get an endogenous split in the sample that groups countries into categories of high and low capital stock. In particular, if $\theta_1 < 0$ and $\theta_2 > 0$ then we obtain a critical capital-labor ratio (k^*) defined by $\theta_1 + \theta_2 k^* = 0$. The threshold k^* implies capital-scarce countries have a negative median voter component ($[\theta_1 + \theta_2 k_c]\mathrm{MV}_c < 0$ for $k_c < k^*$) while capital-abundant countries have a positive median voter component ($[\theta_1 + \theta_2 k_c]\mathrm{MV}_c > 0$ for $k_c > k^*$). The capital per worker term (k_c) is included as a RHS variable in Equation (3.1) to allow the sign of the interaction term coefficient (θ_2) to differ from the sign of the capital per worker coefficient (θ_3).

The ToT component increases adopted tariffs in all large countries. However, in the absence of cross-country export supply elasticities, we do not have measures for ToT in Equation (3.1). Consequently, we use demand and supply relationships to construct the ToT variable from available data and expect its impact on tariffs (θ_{tot} in Equation 3.1) to be positive for all large countries.[6] We consider two distinct methods for constructing ToT measures. First, we provide a method of constructing a ToT measure based on import elasticity data. Second, we consider the import share proxy proposed by Olarreaga et al. (1999).

Elasticity Method. Following Chacholiades (2006), we use the equilibrium relation between exports and imports to express export supply elasticities in terms of import demand elasticities. In equilibrium, the value of exports of a foreign country j equals the values of its imports, $\pi E_j^* = M_j^*$. Let η_c^* be the elasticity of export supply to home country c and $e_j^* = (\pi/M_j^*)(dM_j^*/d\pi)$ be the elasticity of import demand of a foreign country j. For brevity, we denote the share of goods imported by home country

[5]Dutt and Mitra examined if $\gamma_1 < 0$ and $\gamma_2 > 0$ in the equation $\tilde{t}_c = \gamma_1 \mathrm{Inequality} + \gamma_2 \mathrm{Inequality} k_c + \gamma_3 k_c + Z_c'\xi + \epsilon_c$, as implied by the tariff-inequality relationship of the Mayer median voter model.

[6]We do not have elasticity and import data for all countries in the world. So the ToT variable will vary by the same amount for all countries in the sample. Hence, we do not expect to obtain a slope parameter equal to one for the ToT term.

from foreign country j by $\lambda_j \equiv M_j^*/\sum_k M_k^*$. Then using $\pi E_j^* = M_j^*$, the export supply elasticity is

$$\eta_c^* = \frac{\pi}{\sum_j E_j^*} \frac{d\sum_j E_j^*}{d\pi} = -(1 + \sum_j \lambda_j e_j^*)$$

Consequently, the terms of trade component of tariffs is $\text{ToT}_c = 1/\eta_c^* = -1/(1+\sum_j \lambda_j e_j^*)$. As a result, we can use data on imports and import elasticities to construct the terms of trade component.

Import Share Method. As mentioned earlier, we use an alternative method to construct the ToT variable. Formally, let W denote the entire world and M_j^* denote the import demand of a foreign country j. Then in equilibrium, the total supply of imported good E_c^* to country c is $E_c^* = E_W^* - \sum_j M_j^*$. Denoting country j's share of world imports by $\lambda_j^W \equiv M_j^*/E_W^*$ and differentiating the equilibrium relationship with respect to world price yields the export supply elasticity η_c^* faced by country c as a function of its import share λ_c^W.

$$\eta_c^* = \frac{1}{\lambda_c^W} \left(\eta_W^* - \sum_j \lambda_j^W e_j^* \right)$$

Using this equation, Olarreaga et al. (1999) argue that a "preferred" proxy for the terms of trade component $(1/\eta_c^*)$ is the import share of country c in world markets λ_c^W since it avoids availability and measurement problems associated with trade elasticities. We use import shares as a proxy for ToT to supplement the first method which uses elasticity data to construct a ToT proxy.

Having constructed the ToT variable, we estimate Equation (3.1) and test whether signs on the key variables agree with those predicted by the large country MHO model (as summarized in Table 2).

TABLE 2. Large Country Level Prediction Test

Variable	Coef.	Exp. Sign
MV	θ_1	(-)
$MV \cdot k$	θ_2	(+)
ToT	θ_{tot}	(+)

4. Data Sources and Description

Using cross-country variation in tariffs, inequality and factor endowments, we test the optimal tariff prediction of Equation (2.1). To estimate Equation (3.1), we need measures of trade barriers $\tilde{t}$, median voter (MV) and terms of trade effects (ToT) and capital-labor ratios k. A brief summary of these variables is provided below (see Appendix for details).[7]

[7]We use the largest possible set of observations but the intersection of countries with data on tariffs and its components is limited.

As the dependent variable $\tilde{t}$, we use trade restrictiveness indices (TRIs) estimated by Kee et al. (2009) for the period 1993-2004. The TRIs are composite measures of trade protection which account for tariffs, duties and non-tariff barriers (see Anderson and Neary, 2003). Data on tariffs for the TRIs are from 2000 onwards while most non-tariff barriers are from 1995 onwards (see Kee et al., 2009 for details).

For the RHS, we construct the median voter component MV using data on labor shares, taxes and inequality. As in DM, we use shares of the third quintile in national income as a measure of the median voter's capital ownership. In our sample, the median voter term is highest in Norway and lowest in Madagascar. To proxy for capital-labor ratio k in the Mayer model, we use human capital from Baier et al. (2006). Individual-level studies using survey data find that skill or human capital is related to trade policy preferences of voters. As a result, human capital is our preferred measure of capital in the MHO setting. In our sample, human capital is low in Ethiopia and Madagascar and high in USA and Canada.

We construct the ToT variable using data on imports and import elasticities. Import demand elasticity is lowest in Nicaragua and highest in USA (in absolute terms). It is noteworthy that import demand elasticities are less than -1 for all countries, implying that the ToT variable is positive across all countries in the sample.[8] Elasticities were estimated by Kee et al. (2008) using data for the period 1988-2002. Consequently, we use averages over the same period for all explanatory variables. Summary statistics for key variables are provided in Table 3.

As a robustness check, we consider a first differencing estimation to minimize country effects arising from other factors. Our sample consists of thirty different countries during the five-year periods between 1996-2005. We proxy for trade barriers $\tilde{t}$ by world-trade weighted average tariff rates (ATRs). Importantly, we use a direct measure of capital inequality to construct the median voter term. In particular, human capital ginis are used instead of income inequality measures, bringing the theory closer to empirics (see Castelló and Doménech, 2002 for details on the human capital ginis). For this extended sample, we do not have import elasticities. As a result, we proxy for terms of trade effects by import shares in the world market.

[8]We compared the constructed ToT variable with the direct export supply elasticity estimates of Broda et al. There are twelve common countries (out of 15 in their sample): Algeria, Belarus, Bolivia, China, Czech Republic, Lebanon, Latvia, Lithuania, Oman, Paraguay, Saudi Arabia and Ukraine. The correlation between the ToT variable and median estimates for low, medium and high inverse export supply elasticities are 0.4, 0.5 and 0.67. Own correlation between median estimates of low, medium and high inverse export supply elasticities are 0.6 (low, high), 0.77 (low, medium) and 0.9 (medium, high). Thus the constructed ToT variable captures the export supply elasticity relationship well.

TABLE 3. Summary Statistics

Variable		Obs	Mean	S.D.	Min	Max
$\tilde{t}$	TRI	35	0.17	0.1	.045	.465
MV	(w/Income Q3)	35	0.012	0.013	.0003	0.054
ToT	Elasticity Method	35	10.97	0.075	10.9	11.23
	Imports	35	596	1,700	6.25	9,920
e_j^*		35	-1.1	0.065	-1.33	-1.03
k	Human Capital	35	1.5	0.289	0.878	1.988
$\tilde{t}$	ATR	99	0.14	0.1	0	0.53
MV	(w/k Ginis)	99	0.022	0.036	.0001	0.226
ToT	Import Share	99	0.013	0.023	.0001	0.14
k	Schooling Years	99	6.01	2.38	0.876	11.85

Notes: ATR refers to world trade weighted average tariff rates. Imports are reported in billion dollars. Import Shares are imports as a percentage of world imports. Schooling refers to average years of schooling of the population aged 15 years and over.

5. Empirical Results

We examine the validity of the large country level prediction (Equation 2.1) by testing whether the median voter component is negative in labor-abundant countries but positive in capital-abundant countries and whether the terms of trade component has an expected positive association with tariffs. The first part of this Section contains results for the baseline model of Equation (3.1) while the second part discusses an alternative first differencing specification to test the level of tariff prediction.

5.1. **Baseline Results.** Results from estimation of Equation (3.1) are provided in Table 4. Column (a) of Table 4 contains results for the small country version (without the ToT term) while columns (b) and (c) contain results for the large country version of the level prediction. In both the small and large country tests of Table 4, the median voter variable and the interaction term are statistically significant and have the expected signs. This implies the median voter component is negative in all countries with human capital lower than k^* but positive in all countries with human capital higher than k^*. The critical k^* is similar across the small and large country tests (Columns a and b) implying the same categorization of countries by human capital abundance. The list of countries and estimated median voter component by human capital index is presented in Table 5 and Figure 5.1. In a large country, the level of tariff contains a terms of trade component. Inclusion of ToT increases the R^2 from 0.28 (Column a) to over 0.33 (Column b). As expected, the terms of trade variable (ToT) is positive and significant (Column b) implying that market power increases tariff levels across countries.

While we use lagged values of the RHS variables, the estimates may suffer from endogeneity bias arising due to the effects of trade policy on the median voter term (through inequality), human capital

accumulation or terms of trade variables (through imports). Consequently, we follow the approach taken by Li et al. (1998) and used in DM to test for endogeneity bias. The suspected endogenous variables are MV, MV·k, k and ToT. As in DM, we use instrumental variables - population growth rates, saving rates (measure of credit requirements), ratio of money (M2) to GDP (measure of financial development) and civil liberties (measure of political factors as a structural variable) as instruments for our suspected endogenous variables (MV, MV·k, k). In order to account for the effect of tariffs on ToT, we include GDP and population as instruments reflecting the market power of a country in world markets (see Broda et al., 2008 for evidence). We do not encounter any endogeneity problems so results for the endogeneity tests are reported along with the OLS results. The Hausman test statistic, Endog χ^2, for each regression is statistically insignificant (at the 10 per cent level or lower). For completeness, we report the instrumental variable (IV) results when only ToT is suspected to be endogenous. As expected, the OLS and IV estimates are similar so that the large country level prediction continues to be valid under IV estimation reported in Column (c) of Table 4.[9] Similar results hold using the import share method for ToT (see Table 8 in Appendix).

As a check of consistency, we present results for the tariff-inequality relationship tested by DM in Column (d) of Table 4. The median voter model implies that a fall in inequality is positively associated with trade barriers in labor-abundant countries and vice-versa. Using the third quintile's share in national income, we find that the tariff-inequality relationship is empirically valid in our sample. In fact, estimates from the tariff-inequality relationship yield the same categorization of countries by human capital as the large country level of tariff prediction. Consequently, our results are in line with the variation in tariff prediction of Dutt and Mitra (2002).

Robustness Checks. We check the robustness of the baseline results of Table 4. First, we augment the specification to account for differences in terms of trade effects across members and non-members of the World Trade Organization (WTO). Our time period covers the formation of the WTO so members may have engaged in a mutual re-adjustment of their tariffs to overcome the ToT externality (see Bagwell and Staiger, 2006 for evidence). Consequently, we include an interaction term for WTO members and ToT. Tariff bindings lower the ability to manipulate terms of trade so we expect a negative coefficient on the interaction term for members. Members of the WTO may engage in tariff adjustment for reasons

[9]The correlation between TRI and (GDP, Population) is (0.01, 0.29). The correlation between ToT through the elasticity and import share methods and (GDP, Population) is (0.7,0.66) and (0.97,0.52) respectively. Unfortunately we cannot use threshold regressions (Hansen, 2000) due to our small sample and the lack of results for IV estimation without a convergence assumption (which requires that the difference between the parameters across regimes converges to zero as the sample size gets infinitely large).

TABLE 4. Variation and Level Test: Trade Restrictiveness Indices (TRIs)

	Level of TRI			TRI and Inequality	
	(a) OLS	(b) OLS	(c) IV		(d) OLS
MV	-15.619**	-16.758**	-17.239**	Q3	0.109†
	(3.521)	(3.698)	(3.513)		(0.062)
MV·k	10.061**	10.950**	11.326**	Q3·k	-0.071†
	(2.264)	(2.386)	(2.254)		(0.038)
ToT (Elasticity)		0.322‡	0.458*		
		(0.201)	(0.219)		
k	-0.288**	-0.314**	-0.324 *	k	0.997†
	(0.077)	(0.083)	(0.079)		(0.569)
Intercept	0.635**	-2.863	-4.340†	Intercept	-1.349
	(0.141)	(2.192)	(2.396)		(0.901)
k^*	1.55	1.53	1.522	k^*	1.535
N	35	35	35	N	35
R^2	0.283	0.335	0.326	R^2	0.166
Endog χ^2	0.461 (All)	0.557 (All)	0.595 (ToT)	Endog χ^2	0.821 (All)
Endog N	34	34	35	Endog N	34

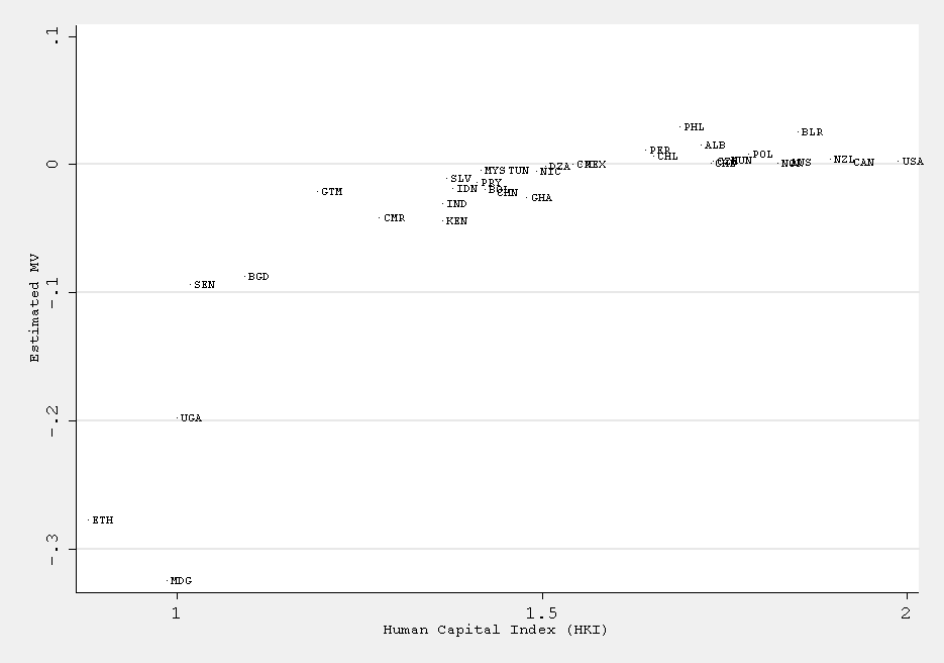
Notes: **, *, † and ‡ denote 1, 5, 10 and 15 per cent significance levels respectively. Endogeneity tests refer to MV, MV·k, k in Column (a), MV, MV·k, k, ToT in Column (b), only ToT in Column (c) and Q3, Q3·MV·k and k in Column (d). Durbin-Wu-Hausman statistics (or C-statistic in Column c) are reported for endogeneity tests.

TABLE 5. Countries by Human Capital Index (k^*)

Human Capital Scarce		Human Capital Abundant	
Ethiopia	Indonesia	Costa Rica	Norway
Madagascar	Paraguay	Mexico	Australia
Uganda	Malaysia	Peru	Belarus
Senegal	Bolivia	Chile	New Zealand
Bangladesh	China	Philippines	Canada
Guatemala	Tunisia	Albania	United States
Cameroon	Ghana	Switzerland	
India	Nicaragua	Czech Republic	
Kenya	Algeria	Hungary	
El Salvador		Poland	

other than terms of trade externalities (e.g., to solve time-consistency or commitment problems as in Staiger and Tabellini, 1987 and Maggi and Rodriguez-Clare, 2007 respectively). As a result, we include a dummy for WTO membership as well. The member dummy is categorized as one for countries that were members of the WTO during the time period 1995-2002. As expected, we find a negative and statistically significant association between tariffs and ToT of WTO Members but the membership coefficient is positive and statistically significant (Column b of Table 6). Following Rose (2004), when a polity variable (civil liberties) is used as an instrument for membership, we cannot reject the null that

FIGURE 5.1. Countries by Human Capital Abundance (HKI* = 1.53)



endogeneity of Member, Member·ToT and ToT is not severe. The test statistic is 0.42 in a sample of 34 countries which is statistically insignificant at the 15 per cent level. As expected, the coefficient on the ToT dummy is larger in magnitude than the coefficient on the interaction Member·ToT.[10] However, the membership coefficients require cautious interpretation since we have only three non-members in the sample, Algeria, Ethiopia and Belarus. Of these three non-members, Algeria may be considered a "de facto" member as pointed out by Tomz et al. (2007).

In Column (c) of Table 6, we include a dummy for de facto membership and focus on the overall effect of WTO membership. The overall effect of WTO membership is negative and statistically significant. De facto membership is positive and statistically significant but it acts like a dummy variable for Algeria so we cannot interpret it as a membership effect. Following DM, Column (c) controls for oil export status, political rights and regional effects (through region-specific dummies). The large country level prediction continues to hold with inclusion of these controls. In addition, we find that oil exporters tend to have lower tariffs while the effect of political rights on tariffs is statistically insignificant in our sample. Finally, we control for total tax revenue (as a percentage of GDP). It has been argued

[10]The difference between the coefficients is statistically significant at the one per cent level. During the 1990s, developing and least developed member countries did not have to bind their tariffs to the extent required of the developed member countries. Including a dummy for developing/least developed members (Dev) and an interaction Dev·ToT does not change our key results. As expected, the coefficient on Dev is negative and the coefficient on Dev·ToT is positive but both are statistically insignificant (Available on request).

in the public finance literature that tariffs may be preferred to other forms of taxation as they can be collected more easily. So our results may be driven by the differential ability of high-income and low-income countries in finding alternative sources of revenue.[11] However, controlling for these RHS variables does not alter our qualitative results for the level prediction.

TABLE 6. Level Test: Trade Restrictiveness Indices (TRIs)

	Without Controls	With Controls	
	(a) OLS	(b) OLS	(c) OLS
MV	-16.758**	-19.078**	-21.029*
	(3.698)	(3.721)	(8.098)
MV·HKI	10.950**	13.063**	13.004*
	(2.386)	(2.426)	(5.658)
ToT (Elasticity)	0.322‡	5.458**	0.466**
	(0.201)	(0.915)	(0.148)
Member·ToT		-5.092**	
		(0.940)	
Member		55.578**	-0.101**
		(10.285)	(0.034)
HKI	-0.314**	-0.302**	-0.281
	(0.083)	(0.085)	(0.176)
Oil Exporter			-0.180**
			(0.025)
Pol. Rights			-0.005
			(0.012)
De Facto Member			0.142**
			(0.045)
Tax Revenue %			0.003
			(0.002)
Intercept	-2.863	-58.951**	-4.233*
	(2.192)	(10.118)	(1.616)
Regional Effects			YES
HKI*	1.53	1.46	1.61
N	35	35	35
R^2	0.335	0.556	0.796

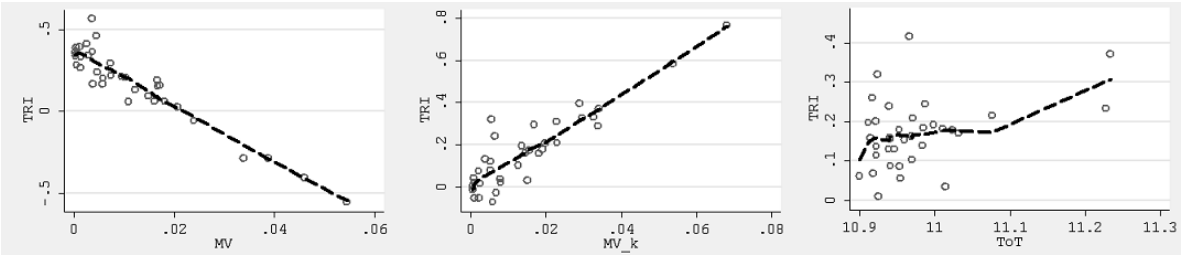
Notes: **, *, † and ‡ denote 1, 5, 10 and 15 per cent significance levels respectively.

Finally, we change the estimation method from OLS to a local linear regression. Using locally weighted least squares smoothing for Equation (3.1), we find the relationship between trade barriers and the key variables has the signs predicted by the large country MHO model (see Figure 5.2). Figure 5.2 plots the smoothed TRIs and their values for each key variable adjusting for other explanatory variables (MV, MV·k, k, ToT). The local TRI-MV curve is negatively sloped (left panel) while the TRI-MV·k curve is positively sloped (middle panel). The TRI-ToT curve is positively sloped (right

[11]See Baunsgaard and Keen (2005) and Gehlbach (2006) for discussion and empirical evidence.

panel). The right panel seems to be driven by the two countries with the highest ToT levels. We note that dropping these two countries (USA and India) from the sample does not affect the qualitative results reported in Tables 4 and 6.

FIGURE 5.2. Local Estimates for TRI, MV and ToT



N = 35, $R^2 = 0.41$

5.2. **First Differences Estimation.** In the remaining part of this Section, we control for country effects by considering a first differences regression of trade barriers on median voter and terms of trade considerations. The large country level prediction states that $\tilde{t}_c = \theta_{mv}\text{MV}_c + \theta_{tot}\text{ToT}_c$ where $\theta_{mv} \gtreqless 0$ for $k_c \gtreqless k^*$ and $\theta_{tot} > 0$ for all c. Consider two distinct time periods t and $t+1$ and let $\triangle x_t \equiv x_{t+1} - x_t$. Taking differences between time period $t+1$ and t, the level prediction in differences is $\triangle\tilde{t}_c = \theta_{mv}\triangle\text{MV}_c + \theta_{tot}\triangle\text{ToT}_c$. As earlier, we can estimate the following equation to examine whether the parameters $\theta_1 < 0$, $\theta_2 > 0$ and $\theta_{tot} > 0$ as predicted by the median voter model.

$$\triangle\tilde{t}_c = \theta_1(\triangle\text{MV}_c) + \theta_2(\triangle\text{MV}_c)\cdot k_c + \theta_{tot}\triangle\text{ToT}_c + \epsilon_c \tag{5.1}$$

The data to test this first differences specification varies from that for the baseline results. We do not have any TRIs for more than one period. Consequently, world-trade weighted average tariff rates are used to measure trade barriers over the two 5-year periods between 1996 to 2005. For these 5-year periods, we have data on human capital ginis (for the population aged 15 years and over) with which we construct the median voter term. Thus we now have a direct measure of capital inequality, bringing theory and empirics more in line with each other. Human capital is proxied by average years of schooling for the population aged 15 years and over.

Estimating Equation (5.1), we find that support for the level prediction is remarkably strengthened. Column (a) of Table 7 shows a negative relationship between median voter considerations and tariffs in labor-abundant countries and a positive relationship between median voter considerations and tariffs in capital-abundant countries. We note that the magnitude of the estimates reported here differ from

the cross-sectional estimates since we are using average years of schooling and import shares instead of human capital indices and elasticity based ToT measures.

In this expanded sample, we have eleven non-members of the GATT/WTO in our sample so we can be more confident of the interpretation of the membership coefficients.[12] As expected, we find that members have lower tariffs relative to non-members. Importantly, the membership dummy is negative but statistically insignificant while the interaction between ToT and membership is negative and highly significant. Additionally, the coefficient on the interaction term is reasonable as it does not exceed the coefficient on the ToT term. The results for the interaction between membership and ToT lend support to the terms of trade theory of trade agreements and are consistent with empirical evidence provided by Broda et al. (2008) and Bagwell and Staiger (2006). The key results are not sensitive to inclusion of changes in political rights and tax revenue. Similar results hold with inclusion of an intercept and/or human capital on the RHS (Available on request).[13]

TABLE 7. Robustness: Average Tariff Rates (△ATR)

	(a) First Diff	(a) First Diff	(b) First Diff
△MV	-93.369**	-102.321**	-95.626**
	(20.566)	(19.795)	(19.708)
(△MV)·HKI	15.997**	17.471**	16.436**
	(3.269)	(3.145)	(3.134)
△ToT	0.123**	0.208**	0.213**
	(0.040)	(0.040)	(0.040)
△(ToT)·Member		-0.131*	-0.123*
		(0.051)	(1.363)
△Membership		-0.005	0.004
		(0.014)	(0.017)
△Political Rights			-0.008‡
			(0.005)
△Tax Revenue %			0.001
			(0.002)
N (Differences)	48	48	48
R^2	0.48	0.534	0.546
N (Levels)	99	99	99

Notes: **, *, † and ‡ denote 1, 5, 10 and 15 per cent significance levels respectively.

[12]Since our sample covers the time period before and after the formation of the WTO, we define a country to be a member of the GATT/WTO if it was a "formal" or "informal" member in the 5-year period before the year of the tariffs (see Tomz et al., 2007 for details). For example, a country that was not a member of the GATT but becomes a member of the WTO in 1995 is considered a "non-member" in the period 1991-95 but a member in the period 1996-2000.

[13]In the results reported here, we drop two observations from the original sample (India and Pakistan which are clear outliers). Adding the two observations gives qualitatively similar but imprecise estimates. Using robust regression techniques (instead of simple OLS) on the full sample strongly supports the level prediction and yields estimates similar to those reported here.

Thus during the last two decades, we find strong evidence for both the Mayer median voter hypothesis and the terms of trade argument for tariff-setting. Capital-abundant countries tend to have higher tariffs while labor-abundant countries tend to have lower tariffs on account of general interest politics. Terms of trade considerations exert a positive influence on tariff levels across countries.

6. Conclusion

This paper considers a large country median voter model to examine whether majority concerns and terms of trade considerations play a role in tariff-setting across countries. We show that tariff in a large country is a sum of the median voter component and a positive terms of trade component. The median voter component has a negative impact on tariffs in labor-abundant countries and a positive impact in capital-abundant countries. The terms of trade component has a positive effect on tariffs across all large countries. Thus the import subsidization result of Mayer (1984) is overcome for large labor-abundant countries.

We test the large country level prediction and find support for it during the last two decades. At even our highly aggregate cross-country level, we find a positive terms of trade component in tariffs. As expected, the terms of trade component of tariffs is lower among members of the GATT/WTO. In line with the median voter theory of trade policy, we find a negative median voter component in tariffs of countries with scarce human capital and a positive median voter component in tariffs of countries with abundant human capital. The results reveal that labor-abundant countries set lower tariffs while capital-abundant countries set higher tariffs on account of majority considerations. Thus labor-abundant countries tend to be "pro-trade" while capital-abundant countries tend to be "protectionists" as predicted by the median voter theorem.

It remains to be tested whether our level test results generalize to additional countries and time periods. Future work in this regard can shed more light on the importance of general interest and terms of trade considerations in determining the direction of tariffs adopted across countries.

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Appendix A. Data and Results

Table 8. Level Test: TRIs and Import Share Method for ToT

	Level of TRI	
	(a) OLS	(b) IV
MV	-14.683**	-14.653**
	(3.109)	(2.904)
MV·k	10.288**	10.220**
	(2.215)	(2.106)
ToT	0.015†	0.014‡
	(0.008)	(0.009)
k	-0.286**	-0.283**
	(0.073)	(0.069)
Intercept	0.339*	0.357 *
	(0.164)	(0.168)
k^*	1.427	1.434
N	39	39
R^2	0.285	0.285
Endog χ^2	0.236 (All)	0.429 (ToT)
Endog N	34	35

Notes: **, *, † and ‡ denote 1, 5, 10 and 15 per cent significance levels respectively.
Endogeneity tests refer to MV, MV·k, k and ToT in Column (a) and only ToT in Column (b).

Data Sources and Description. To estimate Equation (3.1), we use the following variables:

(1) TRI is defined as the uniform tariff that would maintain imports of the country at the same level as the existing tariff structure. TRIs are taken from Kee et al. (2009).

(2) The median voter component is MV $= \frac{r(K/L - K^{mv})}{\phi^{mv}} \frac{LY}{(Y-T)^2}$. Data on GDP, labor, total tariff revenue and third quintile's share in national income are from the World Development Indicators (WDI) 2006.

(3) For ToT, import elasticities (e_j^*) and import values are from the Trade and Production Database of the World Bank. Import elasticities have been estimated using data for the period 1988-2002 (Kee et al., 2008). To construct the ToT term, we use data on all available countries including those which are not in the regression due to lack of data on other variables. We use logs of imports as ToT in Table 8 to prevent extreme values from driving the results.

(4) Human capital is an average of 1990 and 2000 values taken from Baier et al. (2006). Following DM, we use logs of human capital.

(5) Data on instruments, saving rate, population growth rate, money (M2/GDP), GDP and population are from the WDI 2006. Unlike DM, we do not use land ginis as an instrument due to several missing values.

(6) Political rights and civil liberties scales are available from the Freedom House.

(7) Tax revenue (as a percentage of GDP) is from WDI 2006 while oil export status and de facto membership status are from Dutt and Mitra (2002) and Tomz, Goldstein and Rivers (2007) respectively.

(8) Regional dummies correspond to the categorization of Baier et al. (2006) which separates countries into Western Countries, Southern Europe, Eastern Europe, NICs, Asia, Sub-Saharan Africa, Latin America, Middle East and Northern Africa.

To estimate Equation (5.1), we use data on countries for which both tariffs and human capital ginis are available. These are Algeria, Brazil, Canada, China, Ecuador, Egypt, Ghana, Guatemala, Indonesia, India, Iran, Jordan, Japan, Kenya, Korea, Mexico, Mauritius, Malaysia, Nicaragua, Pakistan, Peru, Philippines, Papua New Guinea, Sri Lanka, Switzerland, Tunisia, Uruguay, Venezuela, Zambia, Zimbabwe. About half of the observations (22 out of 48) is from the time period 1996-2000 while the others are from 2000-2005. The variables to estimate Equation (5.1) are as follows.

(1) World-trade weighted average tariff rates are computed using tariffs and world imports from the UNCTAD-TRAINS database (available through the WITS utility). An average over each five-year period between 1996 to 2005 is taken.

(2) For MV, data on GDP, labor and total tariff revenue are from WDI 2007 while human capital ginis are from Castelló and Doménech (2002).

(3) For ToT, import shares (as a percentage of world imports) are from WDI 2007. We use import percentages in logarithmic form.

(4) Human capital is proxied by average years of schooling for persons 15 years and over taken from Castelló and Doménech (2002). To convert into logs, we first scaled the years by hundred. Similar results hold when average months of schooling are used instead.

(5) Political rights are from the Freedom House (compiled by Professor Pippa Norris and available on her website) while tax revenue is from WDI 2007.

(6) All countries that were "out" of the GATT/WTO according to Tomz, Goldstein and Rivers (2007) were coded as non-members. Only three countries in the sample changed their membership status (from non-members to members), Guatemala, Tunisia and Venezuela.

(7) We use lagged values (corresponding to the previous 5-year period) for each RHS variable. Averages of all available years over the 5-year period are taken.