Re-examination of the Mayer Median Voter Model of Trade Policy

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Abstract. This paper examines the empirical validity of the Mayer-Heckscher-Ohlin (M-H-O) model. We test the inequality-tariff relationship studied by Dutt & Mitra (2002) as well as a large country version of Mayer's model. Dutt and Mitra (2002) found support for the inequality-tariff implication of the model for a cross-section of countries in the 1980s, using physical capital and labor as the two factors in the M-H-O model. Our results suggest that this finding is not robust. Instead, we find that when human capital and (unskilled) labor are taken as relevant factors, the Mayer implication is validated in the 1980s. Using cross-sectional country data, we also find that the Mayer implication holds for the 1990s with either physical capital or human capital. We discuss possible explanations for the different findings in the two periods.

We extend the model to a large country and obtain tariff levels which are a function of the median voter component and a terms of trade factor. For the 1990s, the positive impact of terms of trade considerations on tariff levels across countries is validated. Using human capital, we find that the median voter component has a negative impact on tariffs in labor-abundant countries and a positive impact in capital-abundant countries.

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1. Introduction

> "If, by an overwhelming consensus among economists, trade should be free, then why is it that nearly everywhere we look, and however far back, trade is in chains?"
>
> Gawande & Krishna (2005)

For decades, theorists have been putting forward ideas to explain the existence of protectionism, leading to a large body of theories that endogenize trade policy.[1] Two major categories are special interest group theories and the direct democracy approach. The former has been empirically examined by Goldberg & Maggi (1999) and Gawande & Bandyopadhyay (2000) in a small country setup and by Gawande & Li (2005) in a large country setup. Within the direct democracy category, an implication of the Mayer median voter theory of trade policy (Mayer, 1984) has been empirically tested by Dutt & Mitra (2002) for the 1980s. Their findings are consistent with the model. This paper re-examines the empirical validity of the Mayer hypotheses with data from the 1980s as well as the 1990s. We test the inequality-tariff relationship studied by Dutt & Mitra (2002) as well as a large country version of Mayer's model.

The Mayer hypothesis asserts that "each factor owner has an optimal tariff whose value is uniquely related to the individual's factor ownership. In the special case of majority voting with no voting costs, it is the median factor owner's optimal tariff rate that will be chosen to become the actual tariff rate" (Mayer, 1984, pp. 971). Since the median voter owns a small share of aggregate capital in the country, this yields a *level of tariff* prediction for her country. In the Mayer-Heckscher-Ohlin (M-H-O) setting, the optimal tariff is negative for a labor-abundant country and positive for a capital-abundant country.

Several papers have examined the validity of the tariff-factor ownership link and found support for it as well as the Stolper-Samuelson effect which drives the predictions of the Mayer model. Balistreri (1997) finds support for HOV in the voting preferences of Canadians regarding Canadian-US Free Trade Agreement (1989). Scheve and Slaughter (2001), Mayda and Rodrik (2005) and O'Rourke and Sinnott (2001) use survey data to confirm that individual preferences over trade policy depend on factor ownership.

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 M-H-O model in that "capital groups consistently back representatives supporting trade liberalization while labor groups favor protectionists" (pp. 163). So, at a more aggregate level than individual data, there is some evidence which supports the level prediction that capital owners favor tariff reductions and vice-versa. But, when we consider trade policies across countries, we rarely observe a "pro-trade" bias.[2] Thus, Mayer's *level of tariff* prediction seems unrealistic. However, the model can be salvaged by two key extensions.

The first extension was proposed by Dutt and Mitra (2002). Leaving the level prediction aside, they examined a comparative static result that follows from the M-H-O framework. Mayer's model predicts that higher inequality in factor ownership would cause tariff rates to rise in capital-rich countries and to fall in capital-scarce ones. Dutt and Mitra (DM hereafter) tested this *variation in tariffs* prediction using data from the 1980s. They found evidence of the tariff-inequality relationship. Their empirical results are important not only because they provide some "tentative"[3] support for the median voter model, but also because the tariff-inequality relationship does not have a clear theoretical answer.

Mayer's precise implication for tariffs and inequality is in contrast to other political economy models of trade policy. In particular, DM explain that when a lobbying approach is used in a similar two-sector two-factor constant returns to scale setup 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 model with specific factors is used, there are no clear cross-country predictions since the impact of an increase in inequality on trade barriers is highly sensitive to the costs of forming lobbies in each country (Feenstra (2003), pp. 311-15). The relationship between inequality and tariff levels is an empirical question that can also shed light on the appropriateness of alternative theoretical models. Viewed

[1] See Gawande & Krishna (2005) for a survey of the literature on political economy of trade policy.
[2] Dutt and Mitra (2002), pp. 109.
[3] Gawande & Krishna (2005), pp. 11.

in this context, Feenstra comments that DM's finding of a "systematic" relationship between inequality and protection is even more "remarkable" (Feenstra (2003), pp. 314).

We use DM's approach of examining the variation prediction and extend their analysis to the 1990s. Our time period covers the liberalization of several countries (at least 13, which includes some major developing countries) (Greenaway et al, 1997). Further, we use new measures of trade restrictiveness following Anderson and Neary (2003). Our results reveal an interesting difference - in the 1980s, the Mayer implication does not find strong empirical support when it is tested for physical capital and unskilled labor but, it cannot be rejected when we compare skilled labor with unskilled labor. In the 1990s however, the Mayer implication cannot be rejected when either physical capital or human capital is used.

The relevance of human capital is consistent with previous empirical work on the median voter theory of trade policy. Other than DM, all the papers mentioned earlier compare trade preferences of unskilled versus skilled labor rather than physical capital. Thus, they corroborate our finding regarding suitability of human capital as the second factor in Mayer's framework.[4] But, they use a direct micro-level approach to explore the trade preference-factor ownership link. We are interested in finding out whether the preference of the median voter actually manifests itself in the form of her country's adopted trade policy, so we use DM's approach.

The results from DM's variation method lend support to the M-H-O model. So, we can take the next step by addressing the level prediction. The key question that we ask is - how can Mayer's import subsidization result be reconciled with the lack of "pro-trade" bias across countries? To answer this, we extend the model to the case of a large country. In the M-H-O setting, the optimal tariff for a large country has two components - the Mayer median voter component and a terms of trade component. Thus, if a large labor-abundant country has sufficient market power, then the positive terms of trade component dominates the negative median voter component and the optimal tariff is positive. Hence, this simple extension overcomes the import subsidization result for large labor-abundant countries.

We extend the model to a large country framework because it is more appropriate for addressing tariff-setting issues. Previous work on tariff levels has found evidence that even countries with very small shares in world GDP have the ability to influence their terms of trade. So, an overwhelming number of countries can actually be considered "large" implying that terms of trade considerations play a decisive role in tariff-setting. Broda et al (2006) find that countries with higher market power set higher tariffs, at both the aggregate and disaggregate levels. Similarly, 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 share in world imports is just one per cent. However, both papers include a commodity-level analysis of tariffs so the chosen political economy variables are those implied by special interest group theories. Our paper considers a general interest large country model, instead.

In a large country framework, trade agreements that conform to reciprocity can increase welfare levels of each participating country via reciprocal trade liberalization (Bagwell and Staiger, 1999). Our time period covers the formation of the World Trade Organization (WTO). So, we expect WTO members to engage in a mutual re-adjustment of their tariffs. We incorporate this insight into our empirical framework by controlling for membership status while testing the extended *level of tariffs* prediction for the period 1988-2002.

The extended level of tariff prediction finds empirical support during the 1990s. We find that the median voter component has a negative impact on tariffs in labor-abundant countries and a positive impact in capital-abundant countries. Thus, labor-abundant countries tend to be "pro-trade" while capital-abundant countries tend to be "protectionists", as predicted by the median voter theorem. We find strong empirical evidence for the positive influence of the terms of trade component. At even our highly aggregate cross-country level, the *optimal tariff argument* (which postulates that tariffs are inversely proportional to the export supply elasticity of a country) is empirically validated.

As mentioned earlier, the variation test supports the M-H-O model as well. In the 1980s and 1990s, we find strong empirical support for a positive relationship between tariffs and inequality for high human capital countries and a negative relationship for low human capital countries. This relationship holds in the 1990s when it is tested for physical capital and unskilled labor but, not in the 1980s. Our results suggest that human capital is the relevant variable for Mayer's hypothesis in the 1980s. On the other hand, in the 1990s,

[4] Beaulieu and Magee (2004) segregate PACs into corporate PACs and labor PACs so there is no clear distinction between physical and human capital in their paper.

both human capital and physical capital yield similar results. Thus, both the variation and level predictions of the M-H-O model are empirically validated in the 1990s.

To lay out these results, we start with the theoretical foundations of the small-country model and its implications in Section 2. In Section 3, we set up the empirical model for the variation prediction. Section 4 explains our data sources while Section 5 contains a summary of the data used in the paper. Section 6 comprises of our results for the variation prediction. First, we contrast our findings with those of DM's for the 1980s. Then, we test the Mayer hypothesis using data on both human capital and physical capital in the 1990s. We discuss the results and their robustness. In Section 7, we extend Mayer's model to a large country followed by the empirical model to test the large country level prediction. We lay out the results for the large country level prediction. Finally, we present our conclusions in Section 8.

2. Theoretical Model: Small Country

In his model, Mayer uses a 2-sector, 2-factor small open economy to illustrate the dependence of tariff rates on factor ownership distribution and voter eligibility and participation. Here, we will lay out the hypotheses for a small open economy as in Mayer (1984).

We retain all the assumptions of Mayer (1984). There are two factors - labor (L) and capital (K). Each agent (i) owns a unit of labor ($L^i = 1$) and a certain fraction (σ^i) of the total capital stock in the economy (so $K^i = \sigma^i K = k^i$ is person i's capital stock). 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 mobile within these two industries. So, 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. 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:

$$\phi^i = \frac{w + rK^i}{wL + rK} \tag{1}$$

In addition to factor earnings, agents receive a part of the national tariff revenue as well. Suppose the domestic country imports M amount of good 1. Let t be the domestic import duty or tariff rate imposed on good 1. Let π denote the world relative price of good 1 in terms of good 2. Then the domestic country obtains national tariff revenue worth $T = t\pi M$. Mayer assumes that tariff sharing is neutral with respect to the overall distribution of income. This implies that 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, the amount of tariff revenue received by individual i is $T^i = \phi^i T$. Thus, individual i's total income (y^i) can be expressed as a fraction (ϕ^i) of the total national income (Y) because:

$$y^i = w + rK^i + T^i = \phi^i(wL + rK + T) = \phi^i Y$$

On the demand side, Mayer assumes that all agents have identical and homothetic preferences over goods. Both goods are normal and traded in competitive markets. So, $p = \pi(1 + t)$ is the domestic price of good 1 in terms of good 2. Individual i chooses the tariff level that maximizes her utility subject to her budget constraint. Thus, the optimization problem of individual i can be expressed in terms of her indirect utility function (U^i) as follows:

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

Consumers have strictly concave utility functions. So, using Roy's identity and homotheticity of the utility function, we find that the optimal tariff for individual i satisfies:

$$\frac{dU^i}{dt} = \frac{\partial U^i}{\partial y^i}\left(\phi^i t^i \pi \frac{dM}{dt} + Y\left(\frac{d\phi^i}{dt}\right)\right) = 0$$

The first term in brackets represents the change in tariff-weighted values of imports. The second term denotes the change in individual's income share. Using the above equation, agent i's optimal tariff choice is:

$$\tilde{t}^i = \left(-\frac{Y}{\pi \frac{dM}{dt}}\right)\left(\frac{\frac{d\phi^i}{dt}}{\phi^i}\right) \tag{2}$$

Thus, in equilibrium, each voter has an optimal tariff rate that is unique to her factor ownership ratio. According to the median voter hypothesis with single-peaked preferences, the adopted policy is determined by the median voter's (mv) preference $(\tilde{t}^{mv})$. So, the adopted trade policy in the domestic country is:

$$\tilde{t} = \tilde{t}^{mv} = \left(-\frac{Y}{\pi \frac{dM}{dt}}\right)\left(\frac{\frac{d\phi^{mv}}{dt}}{\phi^{mv}}\right) \tag{3}$$

Now, using 1 and Jones' hat algebra, we can write,

$$\frac{d\phi^{mv}}{dt} = \left[\frac{wL}{(wL + rK)^2(1+t)}\right]\frac{r(k - k^{mv})(\hat{w} - \hat{r})}{\hat{p}}$$

where $k = \frac{K}{L}$ is the mean capital-labor ratio in the country. This equation implies that the individual-specific income effect depends on two elements - person's income share relative to the nation $(k - k^{mv})$ and the relative factor intensity of the import industry (which determines $\frac{\hat{w}-\hat{r}}{\hat{p}}$). The first element is assumed to be negative across countries (i.e. $k^{mv} < k$).[5] But the second element depends on factor abundance of the country. An increase in tariff raises the domestic price. So by the Stolper-Samuelson theorem, this results in a higher income share for the agent if she is relatively well-endowed with the factor that is used intensively in the production of the import good. On an economy-wide scale, by the Heckscher-Ohlin theorem, 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, making $\frac{(\hat{w}-\hat{r})}{\hat{p}}$ positive. This implies that the derivative is positive for a capital-abundant country and negative for a capital-scarce country.

Putting this together in the expression for $\tilde{t}^{mv}$, we obtain the following result.

Proposition 2.1. *Small Country Level Prediction:*

The median voter in a small capital-abundant country supports tariffs on imports, while the median voter in a small capital-scarce country supports subsidies on imports. Thus, by the median voter theorem, small capital-abundant countries support tariffs on imports, while small capital-scarce countries support subsidies on imports.

Import subsidies are rarely observed in practice. So, DM leave this level prediction aside and ask a different question: What happens to trade barriers, if inequality increases, i.e., $\sigma^{mv} = \frac{k^{mv}}{K}$ falls? Using equation 2 and holding other things constant,

$$\frac{\partial t}{\partial \sigma^{mv}} = -A\frac{(\hat{w} - \hat{r})}{\hat{p}} \tag{4}$$

where,

$$A = \left(\frac{-Y}{\pi \frac{dM}{dt}}\right)\left[\frac{wL}{(wL + rK)(1+t)}\right]\frac{rK(w + rk^{mv} + r(k - k^{mv}))}{(w + rk^{mv})^2} > 0$$

This equation yields the following prediction for variation in tariffs across countries.

Proposition 2.2. *Variation Prediction:*

Higher inequality would cause tariff rates to rise in capital-rich countries and to fall in capital-scarce ones.

Thus, as pointed out by DM, we can use cross-country data on variations in trade barriers (instead of their actual levels) to assess the impact of differences in inequality on differences in trade policy. This would provide an indication of the empirical validity of Mayer's model.

[5] We confirm this assumption for the countries in our sample. Also see Alesina and Rodrik for a discussion.

3. Empirical Model: Variation Prediction

We start this section with DM's test for the variation prediction. DM used equation 4 as a testable implication of the Mayer model. They assumed a linear form for their analysis and used an interaction term to allow for difference in signs between sub-groups of capital-abundant and capital-scarce countries. These two features lead to estimating equation 5.

$$t_c = \gamma_0 + \gamma_1 \sigma_c^{mv} + \gamma_2 \sigma_c^{mv} k_c + \gamma_3 k_c + X_c^{'} \delta + \epsilon_c \tag{5}$$

where t_c refers to trade barriers in country c, X_c are control variables, $\Gamma = (\gamma_0, \gamma_1, \gamma_2, \gamma_3, \delta)$ are parameters to be estimated and ϵ refers to the vector of error terms. The specification implies that

$$\frac{\partial t_c}{\partial \sigma_c^{mv}} = \gamma_1 + \gamma_2 k_c$$

Our aim is to test whether $\gamma_1 > 0$ and $\gamma_2 < 0$. With $\gamma_1 > 0$ and $\gamma_2 < 0$, we obtain a critical capital-labor ratio (k^*) such that $\frac{\partial t_c}{\partial \sigma_c^{mv}} \gtrless 0 \, for \, k_c \lessgtr k^*$. The interaction term in 5 allows the sign of $\frac{\partial t_c}{\partial \sigma_c^{mv}}$ to vary across the subgroups of countries so we get an endogenous split in the sample that groups countries into categories of high and low aggregate capital stock. Thus, the test implies that countries with lower k_c ratios (those less than the turning point ratio), reveal a positive (negative) relationship between equality (inequality) and trade restrictiveness. On the other hand, countries with higher capital-labor ratios, show a negative (positive) relationship between trade restrictiveness and equality (inequality).

Capital-labor ratio (k_c) is included as a separate variable to allow $\frac{\partial t_c}{\partial k_c}$ to differ in sign from γ_2. However, we suspect an endogeneity problem between trade policy and capital accumulation since trade policy could affect the production structure of the economy, which in turn would have an impact on accumulation and the steady state level of capital. Endogeneity yields inconsistent OLS estimates so we follow the approach taken by Li et al (1998) and used in DM to test for endogeneity bias. The suspected endogenous variables are σ^{mv}, $\sigma^{mv} k$ and k. As in DM, we use instrumental variables - saving and population growth rates (Solow growth model parameters), land gini (measure of initial distribution of land), ratio of money (M2) to GDP (measure of financial development), civil liberties (measure of political factors as a structural variable) and the exogenous variables in the regression equation for auxiliary regressions of our suspected endogenous variables. The residuals are then used as right-hand side variables and tested for their joint significance. In our sample, we do not encounter any endogeneity problems so all results are reported in Appendix B (Table 17). DM do not report instrumental variable regression results for the Summers-Heston and Easterly-Levine datasets. But using the Nehru-Dhareshwar dataset, they find endogeneity in only one regression using tariffs.

The specification in 5 suffers from some problems. First, it assumes a linear form which is not implied by the theoretical model. Second, it has the disadvantage that the turning point is sensitive to countries included in the sample. As a result, countries close to the turning point ratio could switch categories. However, two issues work in favor of this specification. First, we find in our results that the bulk of countries in the sample continue to be in the same relationship category across regressions using different control variables and different countries in the sample. Second, other approaches involving splitting of the sample into high and low capital ownership countries suffer from being rather ad hoc in determining the value at which the split is made.[6] Thus, we continue to use the DM specification.[7]

4. Data Sources

Our data sources can be divided into two parts. Part 1 pertains to the 1980s. Part 2 pertains to the time period 1988-2002.

[6] We experimented with the World Bank's categorization of high-income and low-income countries to split the sample (assuming that countries with higher income levels have higher capital and vice-versa). We find that the trade-inequality correlation is as predicted by the Mayer hypothesis. Please see Appendix B for detailed results.

[7] Note that DM use (K/L) in logarithmic form. This is exactly the approach that we use for both physical capital and human capital. Also, using different lags of right-hand side variables does not change our qualitative results. All unreported results are available from the author upon request.

Part 1. To compare our results with those of DM's, we use their original dataset for all variables (including capital-labor ratios). Data on inequality - income ginis and share of third quintile in national income - are from DM's original dataset. In the absence of asset inequality measures, income inequality measures are used as proxies for capital inequality as in DM. We use DM's data on tariff and import duties as measures of trade restrictiveness. *Tariff* is an average of tariffs and charges imposed on imports and weighted by the share of world trade of each good. *Import duties* refer to the total import duties collected as a percentage of aggregate imports.[8] For other regressions, we use data on capital-labor ratios and human capital available in Baier et al (2006).

Part 2. For part 2, we use trade restrictiveness indices (TRIs) estimated by Kee et al (2006) for the period 1993-2002.[9] The TRI is based on Anderson and Neary (2003) and has the advantage of being a composite measure of trade protection which accounts for tariffs, duties and non-tariff barriers. Further, it does not suffer from underestimation problems unlike the import-weighted average tariff.

Human capital and physical capital estimates for part 2 are from Baier et al (2006). For robustness check, we use human capital stock estimated by Cohen and Soto (2001). Gini coefficients and quintile shares of income in part 2 are taken from the World Income Inequality Database (WIID2), which is a corrected and updated version of the Deininger & Squire income inequality database.

Data on the instruments in part 2 - population growth rates, saving rates, M2/GDP and GDP are from World Development Indicators 2005 and on land ginis from Dutt and Mitra (2002) dataset. Polity variables (political rights and civil liberties) of part 2 are from the Freedom House Gastil Index.

For the level test, data on imports, GDP, labor and tax revenue are from World Development Indicators 2006. The WTO dummy is categorized as zero for countries that were not members of the WTO during the time period 1995-2002. Import elasticities, import quantities, import values and distance were taken from the Trade and Production Database of the World Bank. For each variable in our analysis, averages of all available years from 1988 to 2002 were taken so that the effects of explanatory variables on trade barriers could be accounted for.

5. Data Description

Before laying out the empirical results, we briefly discuss the data used in the empirical tests.

Part 1. Key variables used in the empirical test for the 1980s are tariff, import duty, gini index, median quintile's share in national income (Q3), physical capital-labor ratio (K/L) and human capital index (HKI).

We use three different measures of physical capital-labor ratios. The physical capital-labor ratio ranges from 170 to 166,476 for our largest dataset (Baier et al, 2006). The most capital-scarce country is Madagascar while the most capital-abundant country is Kuwait. The K/L ratios are similar across the three datasets for countries that do not export oil. But, there is substantial discrepancy in the K/L ratios of oil-exporting nations. For instance, K/L estimates for Nigeria range from 1,000 to 3,960 and for Venezuela from 20,500 to 47,500. DM used a dummy to indicate oil-exporting countries. We have confirmed the validity of our key results using a dummy for oil-exporting countries (See Appendix B). However, to avoid bias in the estimates of key coefficients and the turning point due to the discrepancy in K/L data, we have excluded all oil-exporting nations in our regressions. This amounts to dropping two to three observations in each regression.

Tariff ranges from 0.01 to 1.32 across countries. However, India is a clear outlier since the maximum tariff across all countries excluding India is 0.41. Import duty ranges from 0.06 to 41.38 when India is included in the sample. But, the maximum import duty falls to 35.7 when India is excluded. Summary statistics for the entire sample of countries are presented below.

[8] DM used two other measures of trade protection (X+M)/GDP (share of trade in GDP) and coverage ratio of quotas. However, both these measures are unsatisfactory and results using these measures cannot be taken as evidence for or against the Mayer hypothesis. The former is usually higher in smaller countries and is known to suffer from causality issues. And the latter, as pointed out by DM in their paper, suffers from severe measurement error. Thus, we will not be using these two measures in this paper.

[9] See Appendix B for formal definition. These indices are not available for the 1980s so for part 1, we use DM's data on tariff and import duties.

Variable	Obs.	Mean	Std. Dev.	Min	Max
Tariff	86	0.18	0.17	0.01	1.32
Import Duty	86	12.1	8.45	0.01	41.38
Q3	69	14.4	2.43	9.2	18.5
Gini	56	42	9	26.43	62.62
K/L	102	21,018	23,339	170	166,476
HKI	102	4.14	1.26	2.13	7.14

K/L refers to Baier et al (2006) capital-labor ratios

Human capital index ranges from 2.13 to 7.14 (USA) with Niger having the lowest HKIs. Q3 shares are lowest in South Africa while Gini is highest in Lesotho. The highest Q3 shares and lowest Gini indices are in Western Europe and the Czech Republic. Countries showing the lowest political rights ranking are Ethiopia, Guinea, Pakistan and Bolivia.

Part 2. For the variation prediction of time period 1988-2002, key variables are the trade restrictiveness index (TRI), gini index, Q3, K/L and HKI. Summary statistics of these variables for the entire sample of countries are presented below.

Variable	Obs.	Mean	Std. Dev.	Min	Max
TRI	80	0.17	0.1	0.02	0.55
Q3	41	15.48	2.27	11.3	21.13
Gini	80	40.41	10.39	24.82	65
K/L	80	23,515	23,076	128	80,294
HKI	80	4.8	1.35	2.3	7.3

TRI is lowest in Estonia and greater than 0.4 in three countries (Tanzania, Algeria and Nigeria). Our results in the subsequent sections are robust to exclusion of these countries. Inequality measured by Gini is lowest in the Czech Republic and European Union countries. It is highest in Zimbabwe. Once again, Western Europe is the region with highest physical capital while USA is the most skill-abundant. As earlier, Madagascar has the lowest K/L ratio. The most skill-scarce countries are Mali and Ethiopia. Countries with the lowest political rights are Laos, Cameroon, Vietnam and China.

6. Results: Variation Prediction

For the specification in 5, we use TRI (overall trade restrictiveness index) as a measure of t_c in the 1990s and tariffs & import duties in the 1980s. As in DM, we use Income Gini coefficients as well as Q3 (median quintile's share in national income) as proxies for capital inequality.[10]

Comparison with DM results (1980s): First, we present DM's results for the 1980s using the Summers-Heston (S-H) and the Easterly-Levine (E-L) capital data and compare them with our findings.[11] In their paper, DM reported two key regressions - reduced regression (without control variables) and controlled regression (with five control variables). We use the same dataset and sample of countries as DM. We are able to replicate DM's results but find that their results are highly sensitive to the countries included in the sample. Each of their regressions includes India which is a clear outlier. For instance, in the case of tariffs, for a sample of 92 countries excluding India, the mean tariff is 0.16 and the maximum is 0.48. India on the other hand has a tariff of 1.32. This is reflected in the high values of studentized residuals in each regression. The studentized residuals for India range from 8.8 to 14 for tariff regressions and from 4 to 6 for import duty regressions. Thus, India is an outlier in each regression. Given the small sizes of samples, this poses an acute problem which can be exacerbated when another influential observation is present in the sample. We find that two of the eight regressions have an influential observation (Sierra Leone) which has absolute DFbeta values in excess of 2 for at least one of the key variables. Exclusion of India and Sierra Leone (when it is an influential observation) from regression samples has a dramatic effect on six out of eight of DM's regression results. The coefficient values for two key variables (inequality measure and interaction term)

[10]For robustness check, we used human capital ginis from the Castello-Domenech dataset (Castello and Domenech, 2002) for the human capital regressions in both time periods. The results support the variation and level tests and are available from the author upon request.

[11]DM used the Nehru-Dhareshwar (ND) capital-labor ratios for their main regressions. We do not report these results due to inconsistencies in the ND dataset which have been confirmed by DM in a personal communication.

change and their significance levels drop so drastically that we can no longer reject the null hypothesis that these coefficients are zero.[12] Results for tariffs are presented in Table 1.

Table 1. Dependent Variable: Tariff - Using Summer-Heston's (K/L) ratio

	(a) DM	(b) W/o outliers		(c) DM	(d) W/o outliers
Gini	-0.144**	-0.046	Q3	0.324***	0.021
	(0.06)	(0.04)		(0.09)	(0.08)
Gini * (K/L)	0.014**	0.005	Q3 * (K/L)	-0.034***	-0.004
	(0.01)	(0.00)		(0.00)	(0.01)
(K/L)	-0.938***	-0.288†	(K/L)	0.275**	-0.037
	(0.26)	(0.17)		(0.13)	(0.12)
Schooling	0.035†	0.013	Schooling	0.005	0.004
	(0.02)	(0.01)		(0.02)	(0.01)
Pol. Rights	-0.006	-0.002	Pol. Rights	-0.051*	-0.023
	(0.03)	(0.02)		(0.03)	(0.02)
SS Africa	-0.345*	0.127	SS Africa	-0.206*	-0.072
	(0.13)	(0.13)		(0.12)	(0.07)
East Asia	-0.257*	0.046	East Asia	-0.126	0.006
	(0.14)	(0.09)		(0.13)	(0.07)
Oil	0.208†	0.146*	Oil	-0.039	0.027
	(0.13)	(0.08)		(0.18)	(0.10)
Constant	9.274***	2.583†	Constant	-2.245*	0.812
	(2.41)	(1.69)		(1.20)	(1.11)
N	31	30	N	33	31
R^2	0.7	0.62	R2	0.54	0.64
(K/L)*	10.3		(K/L)*	9.4	
# of obs excluded	0	1 (India)	# of obs excluded	0	2 (India, Sierra Leone)
Studentized Res.	11			8.8	
Compare w/DM	Same	Different	Compare w/DM	Same	Different

Note: Absolute DFbeta values for Sierra Leone range from 1.8-2.2.
Significance Levels: *** 1 percent, ** 5 percent, * 10 percent, † 15 percent.

It is clear that the coefficient values and significance levels are very sensitive to the countries used in the sample. However, the insignificance of key variables cannot be taken as evidence against the Mayer implication because our estimates suffer from a classic symptom of multicollinearity - large standard errors of individual variables and high R-squared coefficients. The bivariate correlation of the inequality term (gini or q3) and the corresponding interaction terms ranges from 0.86 to 0.91. We tested for the joint significance of the first two variables gini (q3) and gini*(K/L) (q3*(K/L)), but our results are inconclusive. For some of the regressions, the null hypothesis of joint insignificance can be rejected but for others it cannot. Further, the results are extremely sensitive to dropping of one or two observations. We tried centering the data on gini and q3 but the problem persisted. For detailed results, see Appendix B.

Results for four other regressions - using tariffs or import duties and Easterly-Levine capital-labor ratios - are similar so they are reported in Tables 11 and 13 in Appendix B. In the remaining two regressions using import duties and Summers-Heston capital-labor ratios, DM's qualitative results do not change when India is dropped from the sample. However, we detect an endogeneity problem here and cannot reject the null hypothesis of zero coefficients when DM's instrumental variables are used (See Table 12, Appendix B).

Overall, the results from DM's controlled regressions using physical capital to test the variation prediction are not robust.

[12]We used a robust estimation technique - MM-estimator - to cross-check the sensitivity of our results. Using the MM-estimator, DM's qualitative results are rejected in five out of eight cases. For the reduced regressions, we can reject the variation prediction for physical capital in three out of four cases. For reduced regressions using human capital, we cannot reject the variation prediction in any regression.

Cross-check with Reduced Specification of DM Regressions (1980s): In the regression above, DM used five control variables - schooling, political rights, oil and two location dummies for sub-Saharan Africa and East Asia. We argue that some of these control variables are inappropriate. First, using schooling as a control variable has little theoretical justification. It is highly correlated with human capital which is a separate factor (correlation coefficient of 0.9). Treating it as a control variable that accounts for development or "people's ability to figure out the dead-weight costs of distortionary government policies favoring special interest groups"[13] does not seem compelling. Further, the correlation between schooling, K/L and political rights may explain the insignificance of some of these variables.

Second, while controlling for political rights and oil could be justified (See Appendix A for a formal argument), we think that exclusion of countries with low political rights and oil exports has greater merit. As mentioned earlier, exclusion of oil countries is on account of a data issue. However, our key results are robust to using a dummy variable for oil-exporting countries (Appendix B, Tables 20 and 21).

Exclusion of countries with low political rights is appropriate due to two reasons. First, Mayer is concerned with countries which have majoritarian voting. Second, it can be argued that individuals who have low capital endowment in countries with very low political rights are likely to be disenfranchised. So, the median voter among the set of effective voters of a low political right country has a higher income level than would be the case if the country had a better political rights situation. In our dataset, the political rights variable (PR) takes on values from 1 to 7, with 1 indicating the highest level of political rights. We present results for all our regressions using the entire sample as well as a sub-sample of countries with political rights (PR) less than five. The subset of countries with PR less than five corresponds to the top 75 per cent of countries in terms of political rights in our entire sample.

We report the results of the reduced regressions using our largest dataset (Baier et al, 2006) in Table 2. Results for import duties are in Table 13 of Appendix B.[14]

Table 2. Dependent Variable: Tariff

	(a)	(b) Pol. Rights < 5		(c)	(d) Pol. Rights < 5
Gini	-0.011	Too	Q3	0.026	0.103†
	(0.02)	few		(0.06)	(0.07)
Gini * (K/L)	0.001	obs.	Q3 * (K/L)	-0.004	-0.011†
	(0.00)			(0.01)	(0.01)
(K/L)	-0.115		(K/L)	0.012	0.084
	(0.08)			(0.10)	(0.11)
Constant	1.164†		Constant	0.238	-0.611
	(0.80)			(0.99)	(1.08)
N	42		N	47	30
R^2	0.5		R^2	0.44	0.7
F-statistic for joint test			F-statistic for joint test		
(Gini and Gini*(K/L))	1.28		(Q3 and Q3*(K/L))	1.77	1.28

We find the key terms (inequality and interaction) to be individually significant in only one regression using tariffs. But, for the corresponding regression using import duties, we get the unexpected signs on our key estimates. But, once again there is a multicollinearity problem. The R-squared coefficients for the regressions of inequality, interaction term and capital-labor ratios on each other are over 0.95 in each case. We are able to reject the joint significance of our two key variables in all regressions. However, this has little meaning in the case of Q3 regressions since all three variables are highly correlated so we cannot separate the effect of the first two.

Therefore, using physical capital as the relevant factor in Mayer's framework in the 1980s, we can at best say that the test is inconclusive and at worst say that the Mayer implication can be rejected.

[13] Dutt and Mitra (2002), pp. 124.

[14] While DM do not report the reduced regressions using the S-H and E-L datasets, we have checked that including the two to three influential countries in the sample would yield results that support the Mayer implication. However, when these influential observations are dropped, the results once again lead to a rejection of the Mayer hypothesis.

So, the natural question is: Since, we do not find strong evidence regarding the Mayer implication in the 1980s, should we abandon the Mayer hypothesis as an explanation for trade protection in this time period? Rejecting the hypothesis would be inconsistent with results from other papers that have found an explicit link between trade preferences and factor ownership of voters and their representatives. Previous work has compared preferences of skilled and unskilled labor so it guides us to regard human capital as the relevant capital variable in equation 4. And, this indeed supports the Mayer hypothesis.

Human Capital and Trade Barriers: We use two different measures of human capital - Cohen & Soto indices (C-S) and Baier et al indices. The C-S dataset has the advantage of greater conformity to national censuses. However their dataset does not cover many former USSR countries. The Baier et al dataset (2006) on the other hand covers more countries and uses the World Development Reports and the Mitchell datasets. It is also based on theoretical foundations and reduces the problem inherent in use of measures such as average years of schooling. So we use this dataset for our main regression and cross-check the results with the Cohen-Soto dataset, presented in Appendix B (Table 18).

Human Capital and Trade Barriers (1980s): Using human capital measures, we are unable to reject the Mayer implication. The results are reported in Tables 3 and 4 below.

TABLE 3. Dependent Variable: Tariff

	(a)	(b) Pol. Rights < 5		(c)	(d) Pol. Rights < 5
Gini	-0.031***	Too	Q3	0.071*	0.148***
	(0.01)	few		(0.04)	(0.05)
Gini * HKI	0.022***	obs.	Q3 * HKI	-0.056**	-0.1***
	(0.01)			(0.03)	(0.03)
HKI	-1.109***		HKI	0.662†	1.222**
	(0.31)			(0.43)	(0.50)
Constant	1.784***		Constant	-0.622	-1.612**
	(0.48)			(0.61)	(0.71)
N	42		N	47	32
R^2	0.5		R^2	0.4	0.6
HKI*	1.42		HKI*	1.27	1.49

HKI* = Critical HKI Value

TABLE 4. Dependent Variable: Import Duty

	(a)	(b) Pol. Rights < 5		(c)	(d) Pol. Rights < 5
Gini	-1.596**	-1.662*	Q3	3.887**	4.793†
	(0.672)	(0.931)		(1.91)	(1.91)
Gini * HKI	1.2***	1.185*	Q3 * HKI	-2.97**	-3.441*
	(0.457)	(0.601)		(1.32)	(1.99)
HKI	-61.614***	-61.49***	HKI	32.533†	32.515
	(17.575)	(23.373)		(20.24)	(28.98)
Constant	95.256***	98.35***	Constant	-30.022	-31.608
	(26.767)	(37.54)		(28.31)	(44.13)
N	42	31	N	56	33
R^2	0.57	0.6	R^2	0.4	0.6
HKI*	1.33	1.4	HKI*	1.31	1.39

Not only are the results statistically significant and robust, but they also have the expected theoretical interpretation. We find that the net effect of inequality on tariffs and import duties is positive in countries with higher levels of human capital and negative in countries with scarce human capital resources. So, we find considerable support for the M-H-O model in the 1980s.

Human Capital, Physical Capital and Trade Barriers (1990s): Our next step is to check the link between trade restrictions and inequality in factor ownership in the 1990s. For this time period, we have a larger dataset and superior measures of trade restrictiveness for our purposes. We use both physical capital and human capital as relevant factors in separate regressions presented in Tables 5 and 6.[15]

TABLE 5. Dependent Variable: Trade Restrictiveness Index

	(a)	(b) Pol. Rights < 5		(c)	(d) Pol. Rights < 5
Gini	-0.017**	-0.014**	Q3	0.13***	0.13**
	(0.01)	(0.01)		(0.05)	(0.06)
Gini * (K/L)	0.002**	0.002**	Q3 * (K/L)	-0.014***	-0.014**
	(0.00)	(0.00)		(0.005)	(0.006)
(K/L)	-0.088***	-0.071**	(K/L)	0.19***	0.195**
	(0.03)	(0.03)		(0.07)	(0.076)
Constant	0.952***	0.78***	Constant	-1.67**	-1.7**
	(0.31)	(0.31)		(0.67)	(0.762)
N	72	61	N	37	30
R^2	0.15	0.15	R^2	0.24	0.23
(K/L)*	8.9	8.7	(K/L)*	9.3	9.5

(K/L)* = Critical Physical Capital-Labor Ratio

TABLE 6. Dependent Variable: Trade Restrictiveness Index

	(a)	(b) Pol. Rights < 5		(c)	(d) Pol. Rights < 5
Gini	-0.014**	-0.011**	Q3	0.13**	0.175***
	(0.01)	(0.01)		(0.055)	(0.061)
Gini * HKI	0.009**	0.008**	Q3 * HKI	-0.08**	-0.108***
	(0.00)	(0.00)		(0.03)	(0.036)
HKI	-0.451***	-0.364**	HKI	1.12**	1.466***
	(0.03)	(0.15)		(0.468)	(0.491)
Constant	0.848***	0.691***	Constant	-1.584**	-2.19***
	(0.25)	(0.25)		(0.762)	(0.803)
N	72	61	N	37	30
R^2	0.2	0.2	R^2	0.36	0.41
HKI*	1.5	1.44	HKI*	1.6	1.62

The results are remarkably similar - the gini (Q3) term in each case is negative (positive) and significant and the interaction term is positive (negative) and significant. Our results are robust to exclusion of countries with low political rights. The key results are unaltered when we use the Cohen-Soto human capital index as well. Moreover, the split in the sample does not show any anomalous categorization (Figure 6.1) and the results clearly reflect the difference in tariff-inequality relationship across the two categories of human-capital endowment (Figure 6.2).

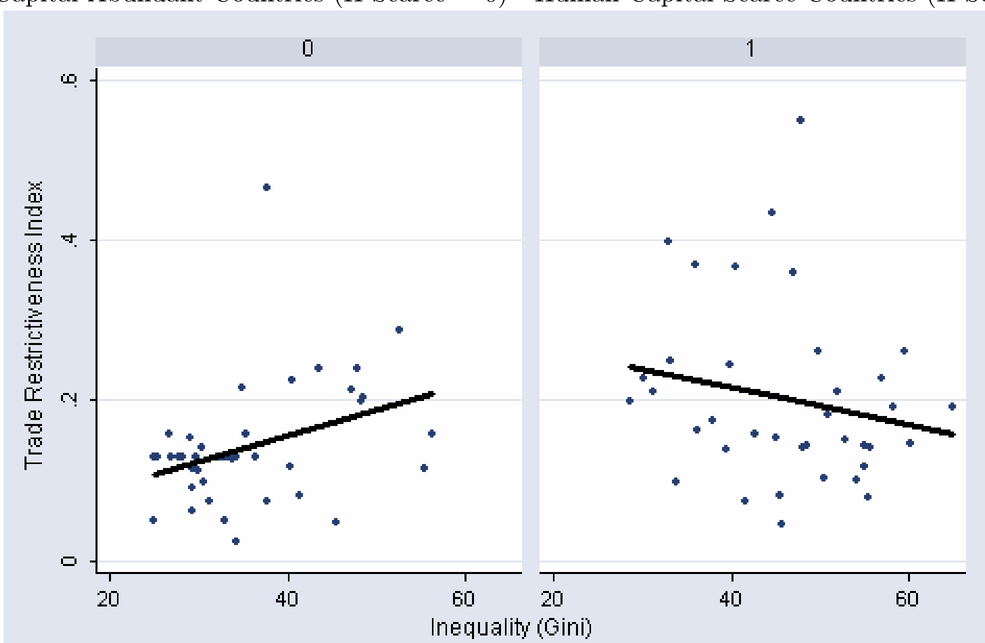
These results imply that higher inequality is associated with greater protectionism in countries with higher levels of physical capital and/or human capital, and with less restrictiveness in countries with lower levels of physical capital and/or human capital. Thus, we conclude that evidence supports the Mayer implication regarding trade preferences and ownership of physical capital and/or human capital strongly in the 1990s. In the 1980s, this is true for ownership of human capital but the same cannot be said about physical capital.

[15]Our results are robust to treatment of European Union member countries as one observation.

Figure 1. Countries by Human Capital Index (Corresponds to Table 8, HKI* = 1.5)

Countries with high human capital			Countries with low human capital		
Albania	Finland	Nicaragua	Bangladesh	Kenya	Thailand
Argentina	France	Norway	Bolivia	Kyrgyzstan	Tunisia
Australia	Germany	Peru	Brazil	Laos	Uganda
Austria	Greece	Philippines	Cameroon	Madagascar	Vietnam
Belarus	Hungary	Poland	Central Afr. Rep.	Malawi	Zambia
Belgium	Ireland	Portugal	China	Malaysia	Zimbabwe
Canada	Italy	Romania	Colombia	Mali	
Chile	Latvia	Spain	El Salvador	Mozambique	
Costa Rica	Lithuania	Sweden	Ethiopia	Nepal	
Czech Republic	Mexico	Switzerland	Ghana	Pakistan	
Denmark	Moldova	United Kingdom	Guatemala	Papua N. Guinea	
Ecuador	Netherlands	United States	Honduras	Paraguay	
Estonia	New Zealand	Uruguay	India	Tanzania	

Figure 2. TRI-Inequality Relationship by Human Capital Scarcity (H-Scarce), 1990s
Human Capital Abundant Countries (H-Scarce = 0) Human Capital Scarce Countries (H-Scarce = 1)



Discussion. A possible explanation for the finding could be simply that data on human capital (H) is better than data on physical capital (K). Therefore, we get inconclusive results with the latter in the 1980s. However, greater dissatisfaction has been expressed with data on human capital (see de la Fuente and Doménech (2002) for a review), so this does not seem plausible.

It can be also argued that countries with higher human capital endowment also had a higher physical capital stock in the 1980s. So for the 1980s, H is a better measure of total capital stock (TK) because it not only accounts for skills, but also implicitly takes into account ownership of physical capital (K). If this is the case, then H is clearly the correct measure to be used, since it robustly captures a link between factor ownership and policy that physical capital measures fail to do.

One approach to resolve this is to combine H and K to obtain a single measure for TK. But, this poses some problems. Theoretically, aggregation of different forms of capital implicitly assumes that they are perfect substitutes or complements (See Balassa, 1979, pp. 260). We do not have such explicit knowledge of the relationship between H and K across countries. In fact, in the specific case of US trade, Branson and

Monoyios (1977) find that the correlation of net exports across commodities is negative and only "marginally significant" with physical capital but, is positive and significant for human capital and negative and significant for labor (pp. 113 and 117). So, they advise against aggregation of physical and human capital measures.

Even if aggregation is theoretically justified in our case, it is difficult because of the nature of available data. Physical capital data is available in value terms while human capital is in an index form. So, simple aggregation is infeasible.[16] To ensure that the discreteness of human capital measures (as opposed to the continuous value form of physical capital) was not responsible for the difference in results across these two forms of capital in the 1980s, we used an index of physical capital instead but, that did not satisfy the Mayer hypothesis in the 1980s either.

Given our limited success with physical capital in the 1980s, another reason, and one that agrees with previous literature can be advanced in favor of the results of this paper. Becker (1980) stresses that "small investments in human capital" yield "considerably higher payoffs than those in physical capital", so one would expect a greater share of small endowments to be placed in human capital.[17] Hornstein et al (2005) use data from the US and report that returns to education rose dramatically in the 1980s and then grew at a slower pace in the 1990s.

> "The return to post-college education doubled from 1970 to 1990...The returns to experience increased in the 1970s and the 1980s and leveled off in the 1990s." (Hornstein et al, 2005, pp. 1283-85).

So, viewed in the context of the Mayer model, voters had an incentive to invest in human capital in the 1980s. This would imply that K is much more unequally distributed than H during the 80s. Thus, the median voter's trade preference is largely determined by the impact of trade policy on relative wages of skilled and unskilled labor, rather than on rents from ownership of physical capital. Hence, during this time period, H is the primary factor of interest for the Mayer hypothesis and not K. Hornstein et al (2005) report further that in the 1990s, the growth of returns to education had dampened in the US, but equipment-embodied productivity growth was increasing substantially (pp. 1283 and 1293). This would imply that the median voter had an incentive to invest in K as well. So, both factors K and H assume a comparable level of importance in the Mayer framework.[18]Though these findings are limited to the US, they suggest a possible role for private investment decisions which can be incorporated within the M-H-O framework to reconcile our different results regarding the validity of the Mayer implication in the 1980s and the 1990s.

7. Large Country

Theoretical Model. Since the variation prediction is empirically validated in both time periods, we can now take the next step to test the M-H-O model. In this section, we extend Mayer's model to the case of a large country that has the ability to influence its terms of trade. We retain the original M-H-O framework. But, when a country is large, world prices respond to changes in its tariffs. So, we need to make some additional assumptions regarding the impact of tariffs on prices.

Suppose, as earlier, that the domestic country imposes a tariff t on its imports of good 1. Similarly, let t^* be the tariff imposed by the foreign country on its imports of good 2. Then world prices can be expressed as a function of tariff levels, i.e., $\pi = \pi(t, t^*)$. Domestic and foreign prices of good 1 with respect to good 2 are $p = (1+t)\pi(t, t^*)$ and $p^* = \frac{\pi(t,t^*)}{1+t^*}$ respectively.

Now, let $\pi_t = \frac{d\pi(\cdot,t^*)}{dt}$ be the change in world relative price with respect to the domestic tariff, given t^*. Similarly, let $\pi_{t^*} = \frac{d\pi(t,\cdot)}{dt^*}$ denote the change in world relative price with respect to the foreign tariff, given t . We define a "small" country as one that does not have the ability to manipulate its terms of trade. In

[16]We tried to combine H and K through two different methods. In the first one, we used the Cobb-Douglas production coefficients for human and physical capital as weights to construct a measure of total capital. This index did not support the Mayer hypothesis. In the second case, we used the stock definition of total capital in Balassa (1979) to aggregate H and K. This required using the discounted difference between skilled and unskilled wages as a proxy for human capital per worker. However, using the Freeman-Oostendrop dataset for wages, we were left with very few observations and could not implement this approach. Lack of data also prevented us from using expenditure on schooling across countries to convert the human capital indices into value form.

[17]See Becker (1980), pp. 130-33.

[18]DM recognize the importance of human capital in their paper as well (pp. 112). But, they argue that in the 1980s, physical capital is a good proxy for total capital and therefore, it reflects ownership of human capital as well. However, our results reveal otherwise - H, rather than K is the correct measure to be used in the Mayer framework.

other words, the domestic country is small if $\pi_t = 0$. On the other hand, the domestic country is "large" if $\pi_t \neq 0$. Following Bagwell and Staiger (1999), we make some standard assumptions regarding changes in prices with respect to tariffs. In particular, we assume that for large domestic and foreign countries,

$$\pi_t < 0 < \frac{dp}{dt} \text{ and } \pi_{t^*} > 0 > \frac{dp^*}{dt^*}$$

Thus, a change in domestic tariff of a large home country has a strictly negative impact on world relative price.

Under the assumptions made earlier and given t^*, individual i in the domestic country chooses a tariff level that maximizes the following objective function:

$$\max_{t^i} U\left(p\left(\pi(t^i, t^*), t^i\right), y^i\right)$$

As earlier, using Roy's identity and homotheticity of the utility function, we find that the optimal tariff for individual i satisfies:

$$\frac{dU^i}{dt} = \frac{\partial U^i}{\partial y^i}\left(\phi^i t^i \pi \frac{dM}{dt} + Y\left(\frac{d\phi^i}{dt}\right) + (-\phi^i M \pi_t)\right) = 0$$

The first term in brackets represents the change in tariff-weighted values of imports, the second term denotes the change in individual's income share and the third term denotes the ability to effect a terms of trade improvement.

Using the balance of trade condition (whereby the quantity of good 1 imported by the home country M must equal the quantity of good 1 exported by the foreign country E^*), agent i's optimal tariff choice is:

$$\tilde{t^i} = \left(-\frac{Y}{\pi \frac{dM}{dt}}\right)\left(\frac{\frac{d\phi^i}{dt}}{\phi^i}\right) + \frac{1}{\eta^*}$$

where η^* is the export supply elasticity of good 1, i.e., $\eta^* = \frac{\pi}{E^*}\frac{dE^*}{d\pi}$.

With single-peaked preferences, the median voter theorem implies that the adopted policy in a large domestic country is:

$$\tilde{t} = \tilde{t}^{mv} = \left(-\frac{Y}{\pi \frac{dM}{dt}}\right)\left(\frac{\frac{d\phi^{mv}}{dt}}{\phi^{mv}}\right) + \frac{1}{\eta^*} \tag{6}$$

where

$$\frac{d\phi^{mv}}{dt} = \left[\frac{L}{(wL + rK)^2}\right](k - k^{mv})\left(r\frac{dw}{dt} - w\frac{dr}{dt}\right)$$

As in Mayer's small country model, the first component of the optimal tariff is positive in a capital-abundant country and negative in a labor abundant country. But, unlike the small country model, there is a non-zero second term which is positive for all large countries. So, if a capital-scarce country has sufficient market power in its import market i.e., $(-\pi_t)\frac{M}{Y} > \frac{1}{\phi^{mv}}\left(-\frac{d\phi^{mv}}{dt}\right)$, then the positive impact of the terms of trade component outweighs the negative impact of the median voter component. In this case, the median voter in a large capital-scarce country supports tariffs on imports. Moreover, the magnitude of the first component increases with a fall in the median voter's capital ownership. Thus, capital ownership inequality and tariff levels are positively related in capital-abundant countries and negatively related in labor-abundant countries. So, labor-abundant countries with high import share and market power vis-a-vis inequality in capital ownership do not subsidize imports.

In other words, as long as the share of imports to GDP ($\frac{\pi M}{Y}$) in a labor-abundant country exceeds the ratio of median voter's factor share elasticity ($e_{\phi^{mv}t}$) to world price elasticity ($e_{\pi t}$) with respect to domestic tariffs, a labor-abundant country will impose positive tariffs on its imports. This gives us the following proposition.

Proposition 7.1. *Large Country Level Prediction:*

The optimal tariff in a large country is a sum of the median voter component and a terms of trade factor.

Under standard assumptions, the median voter in a capital-abundant country supports tariffs on imports because both the median voter and the terms of trade components are positive.

Under standard assumptions, the terms of trade component in large labor-abundant countries is positive while the median voter component is negative. If the share of imports to GDP and market power are large enough so that $\frac{\pi M}{Y} > \frac{e_{\phi^{mv}t}}{e_{\pi t}}$*, then the positive impact of the terms of trade component outweighs the negative impact of the median voter component. Under this condition, the median voter in a large capital-scarce country supports tariffs on imports.*

Thus, the unrealistic result of import subsidization in a capital-scarce country does not hold if the country is sufficiently engaged in the world market. 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). Therefore, it is likely that most countries across the world can be considered sufficiently large. This implies that the level prediction may not be unrealistic after all.

We combine the results from the small and large country propositions to get the following set of Mayer hypotheses that form the basis of our empirical tests.

TABLE 7. Mayer Hypotheses

Country Type	Assumptions	$r\frac{dw}{dt} - w\frac{dr}{dt}$	$\frac{d\phi^{mv}}{dt}$	η^*	$\tilde{t}$	$\frac{d\tilde{t}}{d\sigma^{mv}}$
1a) Small K-abundant	$\pi_t = 0$	+	+	0	+	-
1b) Small L-abundant	$\pi_t = 0$	-	-	0	-	+
2a) Large K-abundant	$\pi_t < 0 < \frac{dp}{dt}$	+	+	+	+	-
2b) Large L-abundant	$\pi_t < 0 < \frac{dp}{dt}$	-	-	+	?	+
	$\frac{\pi M}{Y} > \frac{e_{\phi^{mv}t}}{e_{\pi t}}$	-	-	+	+	+

It is noteworthy that the large country extension preserves the variation prediction. The expression for $\frac{\partial t}{\partial \sigma^{mv}}$ is the same, irrespective of the size of a country. Thus, our results from the previous section are valid for both small and large countries.

Empirical Model: Large Country Level Prediction. The variation prediction is unchanged when we consider large countries. So, this section contains the empirical model to test the level prediction for the large country case. We test whether the median voter component has a negative impact on tariff levels in low capital countries and a positive impact on tariff levels in high capital countries. We evaluate the role of terms of trade considerations in tariff-setting.

From the optimal tariff equation 6, we know that the equilibrium tariff level is a sum of the median voter component ($\tilde{MV}$) and a terms of trade factor (ToT). Thus, the optimal tariff can be written as:

$$\tilde{t} = \tilde{MV} + ToT = \frac{Y}{(Y-T)^2}(1-\sigma^{mv})K\left[\frac{1}{\phi^{mv}}\left(-\frac{1}{\pi\frac{dM}{dt}}\right)\left(r\frac{dw}{dt} - w\frac{dr}{dt}\right)\right] + ToT$$

We do not have data on the terms in square brackets in the above equation. So, we cannot construct tariff levels predicted by the median voter model for comparison with actual tariff levels. Instead, we account for as much variation in the median voter component as possible with available data. In particular, let

$$MV_c = \frac{Y_c}{(Y_c - T_c)^2}(1-\sigma_c^{mv})K_c = \left[\frac{1}{\phi^{mv}}\left(-\frac{1}{\pi\frac{dM}{dt}}\right)\left(r\frac{dw}{dt} - w\frac{dr}{dt}\right)\right]_c^{-1}\tilde{MV}_c$$

So, MV_c increases the absolute value of the median voter component. But, $\left[\frac{1}{\phi^{mv}}\left(-\frac{1}{\pi\frac{dM}{dt}}\right)\left(r\frac{dw}{dt} - w\frac{dr}{dt}\right)\right]_c^{-1}$ is negative in labor-abundant countries and positive in capital-abundant countries. Thus, MV_c decreases tariff levels in labor-abundant countries and increases tariff levels in capital-abundant countries.

Now we consider the ToT component. In the absence of cross-country export supply elasticity estimates, we need to impose more structure on the import demand and export supply curves before proceeding to empirics. We adopt the assumptions made in Bagwell and Staiger (2006). In particular, demand for good

1 in the home country is given by $D_1 = a_1 - b_1 p$ while supply of good 1 in the foreign country is given by $S_1^* = A_1^* + B_1^* \pi$. Thus, $\frac{dM}{dt} = -(b_1 + B_1)\frac{dp}{dt}$ and $\frac{dE^*}{dt} = (b_1^* + B_1^*)\pi_t$ which implies that

$$\pi_t = \frac{-\pi(b_1 + B_1)}{(b_1^* + B_1^*) + (b_1 + B_1)}$$

Hence, equation 6 can be expressed as follows:

$$\tilde{t} = \tilde{MV} + \left(\frac{1}{-\pi \frac{dM}{dt}[(b_1^* + B_1^*) + (b_1 + B_1)]} \right) (\pi M(b_1 + B_1)) \tag{7}$$

The third term in brackets is positive. We have data on the import weighted elasticity of imports for the home country (e) as well as the foreign countries (e^*) at the 3-digit ISIC level. So, we can construct the last term in brackets by using data on imports and import-weighted elasticities.

Using this version of equation 6, we now obtain a linear estimating equation:

$$t_c = \theta_1 MV_c + \theta_2 MV_c k_c + \theta_3 ToT_c + Z_c^{'} \zeta + \varepsilon_c \tag{8}$$

where, Z_c denotes a vector of control variables, $\Theta = (\theta_1, \theta_2, \theta_3, \zeta)$ is a vector of parameters to be estimated and ε denotes a vector of errors.

As earlier, we use an interaction term to allow for the sign change across sub-groups of high and low capital countries. So, it follows that when $\theta_1 < 0$ and $\theta_2 > 0$, we obtain a critical capital-labor ratio (k^*) such that $\theta_1 MV_c + \theta_2 MV_c k_c \gtreqless 0 \ \forall k_c \gtreqless k^*$. Hence, high capital endowment countries favor positive tariffs while low capital endowment countries favor negative tariffs, on account of the median voter component.[19]

On the other hand, we expect a positive coefficient on ToT_c across all countries because it denotes the terms of trade component of tariff levels. We use the product of imports and weighted elasticities ($m \cdot e$) as a proxy for ToT_c.[20] But, this formulation leads us to a potential inconsistency of OLS estimates. OLS estimates will be inconsistent if tariff levels during the period affect the amount of imports in that period or if there is a severe measurement error associated with elasticity estimates. Therefore, we report estimates from instrumental variables regressions. Following a gravity equation approach, we use GDP as an instrument for $m \cdot e$. The correlation between t and GDP is -0.02.

We use four control variables - an intercept, capital per worker (k_c) and WTO membership.[21] An intercept is included to avoid sensitivity arising due to use of a proxy for ToT_c and the impact of WTO membership. Capital per worker (k_c) is included as a separate variable to allow the sign of its coefficient to differ from the sign of the interaction term coefficient (θ_3). We include a dummy indicating WTO members because the terms of trade theory of trade agreements implies that members will re-adjust their tariffs to overcome the ToT externality. We expect the coefficient on WTO to be negative since tariff bindings tend to lower the ability to manipulate terms of trade.

We estimate equation 8 and then test whether the signs on the key variables agree with those predicted by the extended M-H-O model (last column of Table 8).

TABLE 8. Level Test

Variable	Coefficient	Expected Sign
MV_c	θ_1	(-)
$MV_c k_c$	θ_2	(+)
ToT_c	θ_3	(+)

[19]Since $(1 - \sigma_c^{mv})k_c$ is a measure of inequality, by the variation prediction, we must obtain another critical ratio determined by $\frac{\partial t_c}{\partial (1-\sigma_c^{mv})k_c} = \theta_1 + \theta_2 k^{**} = 0$. But $(1 - \sigma_c^{mv})$ is positive across countries, so both turning points are equal, i.e., $k^* = k^{**}$. Thus, the split obtained from k^* is enough to guarantee that the median voter component and the tariff-inequality relationship are negative in countries with $k_c < k^*$and positive in countries with $k_c > k^*$. The variation and level predictions are consistent with each other.

[20]There are some extreme observations for imports so we use the product of imports and weighted elasticities in logarithmic form.

[21]Note that we do not have any de facto members of the GATT in our sample.

Level Test: Data. Cross-country export supply elasticity estimates are not available. So, we construct two forms of ToT as mentioned earlier. Summary statistics for import-weighted elasticities, imports, share in world imports ($\frac{Value\, of\, Imports\, of\, country\, c}{Value\, of\, World\, Imports}$) and the median voter term (MV) are provided below.

Variable	Obs.	Mean	Std. Dev.	Min	Max
MV	35	1.2	1.35	0.03	5.4
e	35	1.1	0.065	1.03	1.33
m	35	671	1,732.8	8.68	9,225.7
Import Share (%)	68	0.7	2.14	0.007	16.21

In our sample, the median voter term is highest in Norway and lowest in Madagascar. Elasticity is lowest in Nicaragua and high in USA and India. Imports are measured in billion units. None of the countries in our sample have zero imports. Imports are lowest in Madagascar and highest in USA. Import shares range from 0.014 per cent (Malawi and Mali) to 16.3 per cent (USA).

Level Test: Results. Results of the level test using q3 data for the period 1988-2002 are given below. Column (a) of Table 9 contains results for the small country version of Mayer's model while columns (b) and (c) contain results from specification 7.

Table 9. Dependent Variable: Trade Restrictiveness Index

	$ToT = 0$	ToT: Log$(m \cdot e)$	
	(a)	(b)	(c)
	OLS	OLS	IV
MV	-14.52***	-16.05***	-16.1***
	(3.32)	(3.31)	(3.07)
MV*HKI	9.77***	11.18***	11.27***
	(2.24)	(2.33)	(2.22)
HKI	-0.262***	-0.313***	-0.318***
	(0.073)	(0.081)	(0.077)
ToT		0.017**	0.019*
		(0.008)	(0.01)
WTO		-0.075***	-0.078***
		(0.018)	(0.02)
Constant	0.58***	0.3	0.25
	(0.131)	(0.205)	(0.24)
N	34	34	34
R^2	0.32	0.41	0.41
HKI*	1.49	1.44	1.44

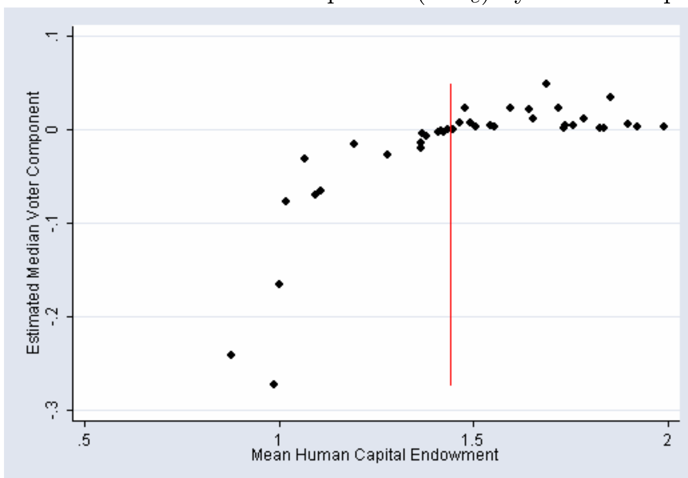
The median voter variable and the interaction term are both statistically significant and have the expected signs. This implies that the median voter component is positive in all countries with human capital greater than 1.44 and vice-versa (See Figure 7.1). The critical HKI* is similar to the turning point from the variation test (Table 6(a)). Thus, the categorization of countries is fairly consistent across the variation and level tests. Inclusion of terms of trade variables increases the R^2 from 0.32 to 0.41. The terms of trade component is positive and significant indicating that market power increases tariff levels across countries (See Figure 7.2). The WTO dummy has the expected negative sign so we find evidence of lower terms of trade manipulation among WTO members.

Robustness Check: We use value of imports instead of units of imports in the specification above and find no change in the qualitative results (Appendix B, Table 19). The results are not sensitive to use of import-weighted distance and population as instruments.

Next, we use an alternative expression for equation 6:

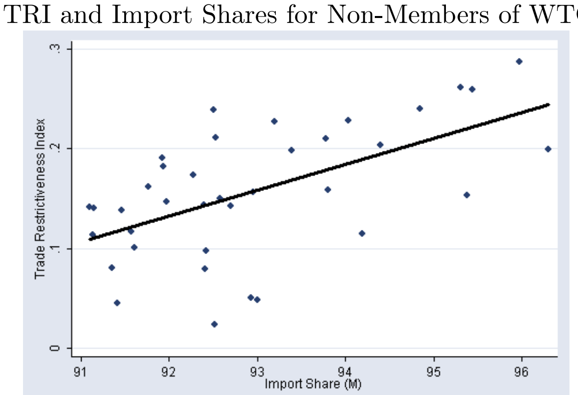
$$\tilde{t} = \left(-\frac{MV_c}{(b_1 + B_1)_c}\right)\left[\frac{1}{\phi^{mv}}\left(r\frac{dw}{dt} - w\frac{dr}{dt}\right)\right] + \left(\pi^{-1}\right)\left(\frac{M}{(b_1^* + B_1^*)}\right) \quad (9)$$

FIGURE 3. Estimated Median Voter Component ($\tilde{MV_c}$) by Human Capital Endowment



Estimated $\tilde{MV_c} \lesseqgtr 0 \, for \, HKI \lesseqgtr 1.44$
Corresponds to Table 9 (b)

FIGURE 4. TRI and Import Shares for Non-Members of WTO, 1988-2002



Once again, we can construct the first and last terms in brackets with available data. So, we obtain another estimating equation as follows:

$$t_c = \theta_1' \frac{MV_c}{(b_1 + B_1)_c} + \theta_2' \frac{MV_c}{(b_1 + B_1)_c} k_c + \theta_3' ToT_c' + Z_c' \zeta' + \varepsilon_c'$$

where once again, we expect $\theta_1' < 0$, $\theta_2' > 0$ and $\theta_3' > 0$. Results from specification 9 are qualitatively very similar and induce similar categorizations (Appendix B, Table 19).

Thus, during the 1990s, we find evidence of 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 considerations. Terms of trade considerations exert a positive influence on tariff levels while WTO membership tends to lower tariff levels.

8. Conclusion

We have tested the Mayer variation prediction using physical capital and labor as well as human capital and labor. Our results show that the Mayer implication holds for human capital, but not for physical capital in the 1980s. However, in the 1990s, the Mayer implication is supported using either factor. Our findings suggest that voters' decisions regarding choice of investment are relevant issues which need to be explored in future research.

We extend the Mayer theorem to large countries and test the predictions. Results for the large country level test support the Mayer framework. The ability to manipulate world prices through domestic tariffs influences tariff choice in large countries. We find that the median voter's factor ownership exerts pressure to lower tariffs in labor-abundant countries and to increase tariffs in capital-abundant countries. Thus, general interest motivations and terms of trade considerations are important determinants of the direction of tariffs adopted across countries.

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Appendix A: Disenfranchisement

Here we present a formal explanation for why countries with low political rights will tend to bias results based on the median voter theorem. In order to do this, we will need some terms, and within a country let W stand for wealth and let $f_W(w)$ denote the distribution of wealth in terms of population frequency. We will denote the maximum observed wealth as $\overline{w}$, so for example, per capita wealth is given by

$$\int_0^{\overline{w}} w f_W(w) dw$$

In order to capture the effect of political rights in a country, r, we introduce the idea of *disenfranchisement.* In the UN's terminology,

"rights derive from the inherent dignity of the human person"

for our purposes, this is in opposition to

"rights derived from status, privilege, and influence associated with wealth"

In accordance with the UN's terms, consider a country where all individuals are equal in terms of their voice in governance. Then we should expect that a group of individuals with wealth in $[w_1, w_2]$ should have "effective voting mass" equal to their "population mass", namely

$$\text{"effective voting mass"} \quad \approx \quad \int_{w_1}^{w_2} f_W(w) dw$$

However, in a country with low political rights we should expect that those with great wealth have a voice in governance disproportionate to their population mass.[22] In other words

$$\text{"effective voting mass of wealthy"} \quad > \quad \int_{\text{wealthy}} f_W(w) dw$$
$$\text{"effective voting mass of poor"} \quad < \quad \int_{poor} f_W(w) dw$$

A natural way to introduce *disenfranchisement* is then to weight the population mass by a function of wealth and rights, say $e(w, r)$ (for *enfranchisement)* where we assume that:

(1) $e(w, r)$ is normalized for each r, or rather

$$\int_0^{\overline{w}} e(w, r) f_W(w) dw \quad = \quad 1 \ \forall r$$

(2) For rights r, less political rights $r' < r$ magnifies *disenfranchisement* in the sense that

$$r' < r \text{ implies } \quad \tfrac{e(w,r')}{e(w,r)} \quad \text{is strictly increasing in } w$$

It turns out these conditions imply that when $r' < r$ that for "low" w we have

$$e(w, r') \quad < \quad e(w, r)$$

and for "high" w that

$$e(w, r') \quad > \quad e(w, r)$$

so that 2 does in fact capture the idea that as rights decrease, the poor have increasingly less "effective votes" and the wealthy have increasingly more "effective votes".

Given population weights $e(w, r)$ we may then define the *effective median voter* m as

$$m \quad \equiv \quad \int_0^m e(w, r) f_w(w) dw = \frac{1}{2} \tag{10}$$

Regarding the effective median voter and rights, we have the following result:

Proposition. *(Rights) Lowering political rights increases the wealth level of the effective median voter.*[23]

[22] Or, at least relative to those countries with higher political rights. Our formal definition cares only about relative differences.

[23] We will also assume the following regularity conditions:

(1) f_W and $e(\cdot, r)$ are continuous in w and > 0 on $[0, \overline{w}]$.

Proof. Fix some level of rights r and suppose $r' < r$. The effective median voter at the two rights levels, say m_r and m_r', are given by 10, specifically

$$\begin{aligned} m_r &\equiv \int_0^{m_r} e(w,r) f_w(w) dw = \frac{1}{2} \\ m_{r'} &\equiv \int_0^{m_{r'}} e(w,r') f_w(w) dw = \frac{1}{2} \end{aligned}$$

and we intend to show that $m_{r'} > m_r$. Define $h(w)$ by

$$h(w) \equiv \frac{e(w,r')}{e(w,r)}$$

and since each e is continuous in w and and > 0 on $[0, \overline{w}]$, so is h. From 2, h is also strictly increasing in w. Now define

$$\begin{aligned} g(z) &\equiv \int_0^{z} e(w,r) f_W(w) dw - \int_0^{z} e(w,r') f_W(w) dw \\ &= \int_0^{z} e(w,r) f_W(w) dw - \int_0^{z} h(w) e(w,r) f_W(w) dw \\ &= \int_0^{z} e(w,r) f_W(w) [1 - h(w)] dw \end{aligned} \tag{11}$$

Clearly g is continuous and it follows from 1 that

$$g(0) = g(1) = 0 \tag{12}$$

Examining 11, since $h < 1$ implies $g(1) > 0$ and $h > 1$ implies $g(1) < 0$ there exist w_1, w_2 with

$$h(w_1) > 1 > h(w_2)$$

so by continuity of h there exists a w^* s.t. $h(w^*) = 1$. Since in addition h is strictly increasing, this w^* is unique and again examination of 11 shows that

$$\begin{aligned} g(z) &\quad \text{is strictly increasing on} \quad [0, w^*] \\ g(z) &\quad \text{is strictly decreasing on} \quad [w^*, \overline{w}] \end{aligned}$$

Together with 12, this implies that $g > 0$ on $(0, \overline{w})$. Now in particular, we have

$$\begin{aligned} g(m_r) &= \int_0^{m_r} e(w,r) f_W(w) dw - \int_0^{m_r} e(w,r') f_W(w) dw \\ &= \frac{1}{2} - \int_0^{m_r} e(w,r') f_W(w) dw \\ &> 0 \end{aligned}$$

so that

$$\int_0^{m_r} e(w,r') f_W(w) dw < \frac{1}{2}$$

which implies $m_{r'} > m_r$ as desired. □

Appendix B

World Bank Categorization. After splitting the sample into low-income and high-income countries, we check for the correlation between trade restrictiveness and inequality. Inequality is positively correlated with trade restrictiveness in high-income countries and negatively correlated in low-income countries.

Table 10. Correlation between TRI and Gini Index (1988-2002)

Countries	Correlation coefficient	Number of Observations
High-Income	0.31	26
Low-Income	-0.21	51

Trade Restrictiveness Index. The TRI is defined as the uniform tariff that would maintain imports of the country at the same level as the existing tariff structure i.e.,

$$TRI_c | \sum_n m_{c,n}(TRI_c) = \sum_n m_{c,n}(t_{c,n}) = m_c^0$$

where, $m_{c,n}$ is the import of good n by country c, m_c^0 is its existing import bundle and $t_{c,n}$ is its current protection level (tariffs, duties, tariff equivalents of NTBs) for each import good n. It captures the trade "distortions imposed by each country's trade policies on its import bundle". (Kee et al, 2006). If we totally differentiate the above equation, we get that

$$TRI_c = \frac{\sum_n \left(\frac{dm_{c,n}}{dp_{c,n}}\right) t_{c,n}}{\sum_n \left(\frac{dm_{c,n}}{dp_{c,n}}\right)}$$

where $p_{c,n}$ is the price of good n in country c. So, TRI_c is a weighted average of trade restrictions in country c.

Additional Empirical Results. This part contains results that correspond to regressions reported in the main body of the paper. All regressions in this appendix have been estimated using OLS.

DM Results. Tables 11, 12 and 13 compare our results with those of DM's. They reveal the sensitivity of the DM results to exclusion of outliers in the dataset.

TABLE 11. Dependent Variable: Tariff - Using Easterly-Levine's (K/L) ratios

	a) DM	b) W/o outliers		c) DM	d) W/o outliers
Gini	-0.151†	0.005	Q3	0.295**	0.166
	(0.10)	(0.04)		(0.13)	(0.14)
Gini * (K/L)	0.015†	0.0003	Q3 * (K/L)	-0.032**	-0.02
	(0.01)	(0.00)		(0.01)	(0.02)
(K/L)	-0.961**	-0.037	(K/L)	0.349*	0.296
	(0.39)	(0.19)		(0.19)	(0.23)
Schooling	0.036†	0.005	Schooling	0.002	-0.005
	(0.02)	(0.01)		(0.03)	(0.01)
Pol. Rights	-0.002	0.002	Pol. Rights	-0.031	0.001
	(0.03)	(0.02)		(0.03)	(0.01)
SS Africa	-0.334†	0.189*	SS Africa	-0.013	0.08
	(0.20)	(0.10)		(0.18)	(0.08)
East Asia	-0.249†	0.069	East Asia	-0.009	0.111*
	(0.15)	(0.07)		(0.18)	(0.06)
Oil	0.224†	0.134**	Oil	-0.031	-0.004
	(0.15)	(0.06)		(0.23)	(0.08)
Constant	9.579**	0.121	Constant	-2.907+	-2.326
	(3.71)	(1.86)		(1.81)	(2.25)
N	28	27	N	30	28
R^2	0.7	0.66	R^2	0.44	0.7
(K/L)*	10.18		(K/L)*	9.2	
# of obs. excluded	1 (m/s)	2 (IND, m/s)	# of obs. excluded	1 (m/s)	2 (IND, SLE, m/s)
Studentized Res.	14			14	
Compare w/DM	Similar	Different	Compare w/DM	Similar	Different

* Notes: IND = India, SLE = Sierra Leone, m/s = missing, SS = Sub-Saharan. In this case, there is a missing country in our dataset. Despite the missing observation, we are able to get very close to DM's results for these regressions. Absolute DFbeta values for Sierra Leone range from 1.9-2.1.

Table 12. Dependent Variable: Import Duty - Using Summer-Heston's (K/L) ratios

	a) DM	b) W/o outliers		c) DM	d) W/o outliers
Gini	-6.268***	2.2	Q3	10.703***	0.36
	(1.88)	(6.55)		(3.02)	(11.6)
Gini * (K/L)	0.666***	-0.136	Q3 * (K/L)	-1.226***	-0.41
	(0.20)	(0.67)		(0.33)	(1.04)
(K/L)	-37.33***	5.37	(K/L)	12.763***	4.99
	(8.44)	(28.78)		(4.41)	(9.09)
Schooling	1.291*	0.571	Schooling	-0.434	0.359
	(0.75)	(0.787)		(0.74)	(1.33)
Pol. Rights	0.288	-0.785	Pol. Rights	-2.561***	-3.97**
	(1.18)	(1.46)		(0.96)	(1.77)
SS Africa	-5.59		SS Africa	3.981*	11.21
	(6.20)			(4.00)	(10)
East Asia	-6.68	3.02	East Asia	-0.85	7.09
	(4.96)	(6.61)		(4.60)	(8.81)
Oil	10.034**	8.43	Oil	-2.215	-4.45
	(4.45)	(6.7)		(6.13)	(5.5)
Constant	354.976***	-83.34	Constant	-88.082*	19.023
	(78.97)	(285.21)		(41.30)	(113.26)
N	31	28	N	35	29
R^2	0.73	0.5	R^2	0.66	0.43
(K/L)*	9.4		(K/L)*	8.7	
Studentized Res.	4.5			5	
Endogeneity F-st.	2.47*		Endogeneity F-st.	5.63***	
Compare w/DM	Same	Different	Compare w/DM	Same	Different

*Note: India is excluded from these two regressions. Other countries have been excluded due to lack of data availability on instrumental variables.

Table 13. Dependent Variable: Import Duty - Using Easterly-Levine's (K/L) ratios

	a) DM	b) W/o outliers		c) DM	d) W/o outliers
Gini	-6.462**	-2.043	Q3	9.844***	2.803
	(2.46)	(2.00)		(3.42)	(2.49)
Gini * (K/L)	0.675**	0.256	Q3 * (K/L)	-1.14***	-0.471*
	(0.26)	(0.21)		(0.36)	(0.26)
(K/L)	-37.524***	-12.614	(K/L)	11.502**	6.36*
	(10.51)	(9.29)		(5.15)	(3.40)
Schooling	1.249†	0.466	Schooling	-0.399	-0.419
	(0.77)	(0.57)		(0.81)	(0.52)
Pol. Rights	0.396	0.387	Pol. Rights	-2.265**	-1.038†
	(1.22)	(0.87)		(1.03)	(0.69)
SS Africa	-4.894	7.488	SS Africa	2.235	5.836*
	(6.38)	(5.29)		(5.00)	(3.24)
East Asia	-6	1.533	East Asia	-0.107	3.837
	(5.24)	(4.07)		(5.04)	(3.28)
Oil	10.526**	8.675	Oil	-2.011	-0.715
	(4.74)	(3.38)		(6.41)	(4.08)
Constant	361.69***	108.459	Constant	-75.818†	-22.072
	(100.47)	(90.88)		(48.77)	(32.39)
N	28	27	N	31	30
R^2	0.75	0.76	R^2	0.67	0.77
(K/L)*	9.6		(K/L)*	8.6	
# of obs. excluded	0	1 (IND)	# of obs. excluded	0	1 (IND)
Studentized Residual	5.4			5.8	
Compare w/DM	Same	Different	Compare w/DM	Similar	Different

Table 14 reports results for the reduced regression using import duties in the 1980s. The test for joint significance of key variables does not support the Mayer hypothesis.

Table 14. Dependent Variable: Import Duty

	a)	b) Pol. Rights < 5		c)	d) Pol. Rights < 5
Gini	-0.573	-1.905	Q3	1.8	-1.308
	(0.73)	(1.65)		(2.07)	(3.26)
Gini * (K/L)	0.077	0.204	Q3 * (K/L)	-0.242	0.077
	(0.08)	(0.16)		(0.22)	(0.33)
(K/L)	-7.572**	-13.193*	(K/L)	0.802	-6.247
	(3.07)	(6.89)		(3.25)	(5.07)
Constant	76.366**	136.019*	Constant	9.335	78.908†
	(29.89)	(71.13)		(30.35)	(49.02)
N	42	31	N	56	33
R^2	0.65	0.7	R^2	0.46	0.77
F-statistic for joint test (Gini and Gini*(K/L))	1.94	1.83	F-statistic for joint test (Q3 and Q3*(K/L))	1.75	1.56

Since multicollinearity is still a problem in the reduced regressions of Tables 2 and 14, we drop capital-labor ratios from the right hand side of the regression equation to check the results. Tables 15 and 16 contain these results for tariffs and import duties respectively.

TABLE 15. Dependent Variable: Tariff

	a)	b) Pol. Rights < 5		c)	d) Pol. Rights < 5
Gini	0.018***	0.027***	Q3	0.019†	0.055***
	(0.00)	(0.00)		(0.01)	(0.01)
Gini * (K/L)	-0.002***	-0.003***	Q3 * (K/L)	-0.003***	-0.006***
	(0.00)	(0.00)		(0.00)	(0.00)
Constant	0.035	0.054	Constant	0.35***	0.179**
	(0.07)	(0.08)		(0.11)	(0.08)
N	42	30	N	47	32
R^2	0.49	0.7	R^2	0.44	0.73
(K/L)*	11.38	10.8	(K/L)*	5.8	9.5

TABLE 16. Dependent Variable: Import Duty

	a)	b) Pol. Rights < 5		c)	d) Pol. Rights < 5
Gini	1.178***	1.231***	Q3	1.306***	2.601***
	(0.16)	(0.20)		(0.51)	(0.76)
Gini * (K/L)	-0.107***	-0.104***	Q3 * (K/L)	-0.189***	-0.325***
	(0.02)	(0.03)		(0.03)	(0.05)
Constant	3.182	0.033	Constant	16.74***	18.76***
	(4.13)	(4.60)		(4.56)	(4.60)
N	42	31	N	56	33
R^2	0.6	0.65	R^2	0.46	0.76
(K/L)*	11.1	11.8	(K/L)*	6.9	8

When we exclude capital-labor ratios as an explanatory variable in the reduced regression, we get individually significant terms with a positive coefficient on the gini and Q3 terms and a negative coefficient on the interaction terms in each case. This implies that if gini index is taken as a measure of inequality, then the Mayer implication can be rejected, since our results imply that trade restrictiveness and inequality are positively correlated in countries with low capital ownership and negatively correlated in countries with high capital ownership. On the other hand, if Q3 is considered to be a better measure of inequality, then our results appear to validate the Mayer implication. But, there is a caveat here. The correlation between the interaction term Q3*(K/L) and (K/L) is 0.83 (as opposed to -0.3 for gini*(K/L) and (K/L)), so it may simply be working as a proxy for K/L in this regression. We have no reason to believe that data on Q3 is better than that on gini indices. Further, our subsequent regressions for the 1980s and 1990s validate the Mayer implication using both measures of inequality.

Endogeneity. We report the results for endogeneity tests in the tables below.

Table 17. Results for Endogeneity Tests

Table Number	N	F-statistic
2 (a)	30	0.4
2 (c)	33	1.35
3 (a)	34	1.25
3 (c)	33	1.65
4 (a)	34	0.49
4 (c)	38	1.73
5 (a)	35	1.12
5 (c)	30	1.32
6 (a)	35	0.87
6 (c)	30	1.35
9 (b)	34	0.34
14 (a)	32	1.59
14 (c)	37	1.5
19 (a)	34	0.6
19 (c)	31	0.39
19 (e)	31	0.49

In 19 (c) and 19 (e), we use instruments for the median voter terms as well since these are multiplies with elasticities too.

Robustness check: Cohen-Soto Index. The Mayer hypothesis is validated. The gini coefficient is negative and significant, while the interaction term is positive and significant. (Note: The Cohen-Soto index ranges from 0 to 15, while the Baier et al index ranges from 0 to 7).

Table 18. Dependent Variable: Trade Restrictiveness Index - Using Cohen-Soto HKI

	a)	b) Pol. Rights < 5		c)	d) Pol. Rights < 5
Gini	-0.007**	-0.008**	Q3	0.044**	Too few obs.
	(0.00)	(0.00)		(0.02)	
Gini * HKI	0.001**	0.001***	Q3 * HKI	-0.005**	
	(0.00)	(0.00)		(0.00)	
HKI	-0.048***	-0.052***	HKI	0.062**	
	(0.02)	(0.02)		(0.03)	
Constant	0.568***	0.568***	Constant	-0.409	
	(0.17)	(0.18)		(0.30)	
N	51	38	N	30	
R^2	0.16	0.25	R^2	0.33	
(HKI)*	7.85	7.51	(HKI)*	9.35	

Robustness Check: Level Prediction. The results for log of import shares are presented in columns (a) and (b) of Table 19 while the results from specification 9 are presented in columns (c) and (d). All qualitative results are similar when population is used as an instrument.

Note: vm implies value of imports.

All key coefficients are significant and have the expected signs. The IV estimates are similar to OLS estimates due to rejection of endogeneity/measurement error in each regression.

Oil Exporting Countries. Qualitative results do not change when a dummy variable is used for oil-exporting countries, as in DM.

Table 19. Dependent Variable: Trade Restrictiveness Index

	ToT: Log$(vm \cdot e)$			ToT: Log$(m \cdot e^*)$		ToT: Log$(vm \cdot e^*)$	
	(a)	(b)		(c)	(d)	(e)	(f)
	OLS	IV		OLS	IV	OLS	IV
MV	-16.87***	-16.85***	$\frac{MV}{(b_1+B_1)}$	-17.24***	-17.29***	-18.12***	-18.13***
	(3.48)	(3.19)		(3.57)	(3.32)	(3.74)	(3.45)
MV*HKI	11.95***	11.93***	$\frac{MV}{(b_1+B_1)}$*HKI	11.86***	11.97***	12.69***	12.71***
	(2.52)	(2.37)		(2.42)	(2.33)	(2.61)	(2.5)
HKI	-0.336***	-0.335***	HKI	-0.314***	-0.32***	-0.337***	-0.34***
	(0.088)	(0.081)		(0.081)	(0.078)	(0.088)	(0.083)
ToT	0.018*	0.018*	ToT	0.016**	0.019*	0.018**	0.018*
	(0.009)	(0.01)		(0.008)	(0.01)	(0.009)	(0.01)
WTO	-0.077***	-0.077***	WTO	-0.075***	-0.079***	-0.077***	-0.078***
	(0.02)	(0.013)		(0.018)	(0.021)	(0.019)	(0.02)
Constant	0.42***	0.43***	Constant	0.23	0.16***	0.35***	0.34***
	(0.158)	(0.163)		(0.23)	(0.287)	(0.18)	(0.2)
N	34	34	N	34	34	34	34
R^2	0.42	0.42	R^2	0.41	0.4	0.41	0.41
HKI*	1.41	1.41	HKI*	1.44	1.44	1.43	1.43

Table 20. Dependent Variable: Tariff

	a)		b)		c)		d)
Gini	-0.008	Q3	0.01	Gini	-0.028**	Q3	0.064*
	(0.021)		(0.063)		(0.012)		(0.04)
Gini * (K/L)	0.001	Q3 * (K/L)	-0.003	Gini * HKI	0.02**	Q3 * HKI	-0.051**
	(0.002)		(0.007)		(0.008)		(0.027)
(K/L)	-0.105	(K/L)	-0.009	HKI	-1.038***	HKI	0.575
	(0.08)		(0.104)		(0.319)		(0.424)
Oil	0.084**	Oil	0.023	Oil	0.038	Oil	-0.007
	(0.041)		(0.047)		(0.041)		(0.048)
Constant	1.057	Constant	0.469	Constant	1.666***	Constant	-0.497
	(0.805)		(0.99)		(0.5)		(0.607)
N	49	N	53	N	49	N	53
R^2	0.51	R^2	0.42	R^2	0.51	R^2	0.39
(K/L)*		(K/L)*		(HKI)*	1.4	(HKI)*	1.26

Table 21. Dependent Variable: Import Duty

	a)		b)		c)		d)
Gini	-0.944	Q3	2.356	Gini	-1.543**	Q3	3.964*
	(1.194)		(2.183)		(0.694)		(2.095)
Gini * (K/L)	0.129	Q3 * (K/L)	-0.293	Gini * HKI	1.203*	Q3 * HKI	-2.981**
	(0.124)		(0.23)		(0.471)		(1.451)
(K/L)	-7.873*	(K/L)	1.466	HKI	-60.23***	HKI	33.254†
	(4.72)		(3.435)		(18.234)		(22.17)
Oil	2.363	Oil	4.019	Oil	0.372	Oil	2.942
	(2.414)		(2.785)		(2.342)		(3.024)
Constant	73.601†	Constant	2.128	Constant	90.693***	Constant	-31.834
	(46.241)		(32.05)		(27.807)		(31.03)
N	48	N	61	N	48	N	61
R^2	0.5	R^2	0.45	R^2	0.53	R^2	0.35
(K/L)*		(K/L)*		(HKI)*	1.3	(HKI)*	1.3