DISCUSSION PAPER SERIES

No. 7695

DO TERMS-OF-TRADE EFFECTS MATTER FOR TRADE AGREEMENTS? EVIDENCE FROM WTO COUNTRIES

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INTERNATIONAL TRADE AND REGIONAL ECONOMICS

Centre for Economic Policy Research

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Available online at: **www.cepr.org/pubs/dps/DP7695.asp**

ISSN 0265-8003

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Discussion Paper No. 7695
February 2010

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CEPR Discussion Paper No. 7695

February 2010

ABSTRACT

Do terms-of-trade effects matter for trade agreements? Evidence from WTO countries

In the literature on the economics of international trade institutions, a key question is whether or not terms-of-trade effects drive international trade agreements. Recent empirical work addressing terms-of-trade effects has been restricted to non-WTO countries or accession countries, which differ markedly from existing WTO members and account for only a tiny fraction of world trade. This paper investigates whether MFN tariffs set by existing WTO members in the Uruguay round are consistent with the terms-of-trade hypothesis. We present a model of multilateral trade negotiations featuring free riding on MFN that leads the resulting tariff schedule to display terms-of-trade effects. Specifically, the model predicts that the level of the importer's tariff resulting from negotiations should be negatively related to the product of exporter concentration, as measured by a Herfindahl-Hirschman index (sum of squared export shares), and the importer's market power, as measured by the inverse elasticity of export supply, on a product-by-product basis. We test this hypothesis using data on tariffs, trade and production across more than 30 WTO countries and find strong support. We estimate that the internalization of terms of trade effects through WTO negotiations has lowered the average tariff of these countries by about 20% compared to its non-cooperative level.

JEL Classification: F13
Keywords: free riding, mfn clause and terms-of-trade effects

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Submitted 04 February 2010

We thank Meredith Crowley, Peter Egger, Luigi Guiso, Andreas Haufler, Giovanni Maggi, seminar participants at Ente Einaudi, the University of Munich, the University of Geneva, the University of Michigan and conference participants at the EITI conference in Tokyo, at the ETSG conference in Rome and at the “Political Economy of the WTO” conference in South Korea. Finally, we thank Justin Pierce and Anastasiya Denisova for excellent research assistance and the NSF (#SES-0649468, Project title: "Free Riding and the Most-Favored Nation Clause") for financial support. This Paper is produced as part of the CEPR project 'Politics, Economics and Global Governance: The European Dimensions' funded by the European Commission under its Seventh Framework Programme for Research (Collaborative Project) Contract no. 217559.

1. Introduction

International agreements between countries are often established for the purpose of discouraging beggar-thy-neighbor policies. A growing body of literature, led by Bagwell and Staiger (2002), argues that international trade agreements, like the WTO, can be understood in these terms. Specifically, governments acting unilaterally will tend to overuse tariffs and other trade restrictions, to the extent that these policies shift the cost of protecting a domestic industry onto foreign producers by altering the terms of trade. Conversely, WTO rules cause countries to internalize the terms-of-trade effects of their policies and thus lead to efficient policy choices. As compelling as this theory is, its empirical verification is hampered by its own logic, for if the WTO actually does this, then we should observe no relationship between a WTO member's tariff schedule and its ability to affect the terms of trade (i.e., its market power); however, this would also be true of any alternative theory in which the terms of trade plays no role. Recent papers have sought to surmount this problem by focusing on special cases: Broda, Limao and Weinstein (2008) examine the tariff schedules of non-WTO countries; Bagwell and Staiger (2009) consider changes in the tariff schedules of recent accession countries; and Bown (2004) studies WTO disputes. All produce findings consistent with the terms-of-trade theory. As yet, however, the theory has not been empirically tested on the tariff schedules of existing WTO members, which cover the vast majority of world trade.

This paper investigates whether MFN tariffs set by existing WTO members in the Uruguay round are consistent with the terms-of-trade hypothesis. To do this, we exploit what is arguably a flaw in the WTO, which is that multilateral trade negotiations over MFN tariffs are susceptible to free riding. Intuitively, if not all countries participate in the negotiations over an MFN tariff, then the negotiators may not fully internalize the terms-of-trade effects of reducing that tariff, and thus the negotiated tariff may continue to bear the imprint of market power. The trick is to reliably predict which countries and which products are most susceptible to this problem. For this we draw on the model of MFN free riding due to Ludema and Mayda (2009), which predicts that only the largest exporters of each product will participate in negotiations with a given importer[1] and therefore the level of the importer's tariff resulting from negotiations should be negatively related to exporter concentration, as measured by the Herfindahl-Hirschman index (sum of squared export shares) on a product-by-product basis. Moreover, because it is driven by the terms of trade, this negative relationship should be proportional to the importer's market power, as measured by the inverse elasticity of export supply. Thus, the model predicts that the MFN tariff rate is an inverse function of exporter concentration multiplied by importer market power. We test this hypothesis using data on tariffs, trade and production across more than 30 WTO countries and find strong support. We estimate that the internalization of terms of trade effects through WTO negotiations has lowered the average tariff of these countries by about 20% compared to its non-cooperative level.

To conduct the empirical analysis, we construct two data sets on MFN applied tariffs and multilateral and bilateral trade flows. The first data set is disaggregated to the 6-digit HS level and uses data from COMTRADE and UNCTAD's TRAINS. The second data set also includes information on production levels by sector but is more aggregated as it follows the 4-digit ISIC classification. In particular, the second data set is based on the World Bank Trade and Production database (WBTPD) (Nicita and Olarreaga 2001), which contains the necessary data for a small sample of mostly low and middle-income countries. We expand and update the WBTPD adding data for several high and middle-income countries.

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[1] This prediction accords with the WTO negotiating convention known as the "principal supplier rule," as well as with anecdotal evidence on free riding found in earlier work, such as Finger (1979).

In both datasets, we consider various measures of an importer's market power over a given product. One is simply country size as measured by GDP. Another is a measure of the inverse elasticity of export supply that varies by importer and product, based on direct estimates from Broda, Greenfield and Weinstein (2006). A third is the product's degree of differentiation, according to the Rauch index (Rauch, 1999). This measure is motivated by the fact, also found in Broda, Limão and Weinstein (2008), that product differentiation is significant in explaining the inverse elasticity of export supply (the true measure of market power).

Our findings confirm that not only do the MFN tariffs of WTO countries depend on market power but this dependence diminishes as tariff negotiations internalize a greater proportion of the terms-of-trade externality. In our view, this is the clearest evidence to date in favor of the hypothesis that trade agreements are intended to neutralize the terms-of-trade motive for trade policy.

In addition to making a clear contribution to the literature on the economics of trade agreements generally, this paper makes a contribution to the literature on MFN per se. The MFN free rider hypothesis is an old idea that rests on the observation that, because MFN commits a country to treat all of its trade agreement partners equally, the trade concessions it exchanges with any one partner must automatically be extended to all the others, who thereby get a free ride. Thus, MFN could create a *free rider problem*, wherein countries "deliberately refrain from making concessions … in order [to] avoid the obligation of extending such concessions to other countries" (Viner, 1924, p. 105). Today, the MFN clause is one of the pillars of the GATT/WTO system – any trade policy measure that a WTO country applies to the products of another WTO country must be applied equally to the same products of all WTO countries.[2]

[2] An exception is made for preferential trade agreements, such as free trade areas or customs unions under GATT Article XXIV.

Previous literature has been divided about the importance of the MFN free rider problem. While formal models of the problem exist (e.g., Caplin and Krishna, 1988), recent theoretical literature casts doubt on its relevance to the GATT/WTO system (e.g., Ludema, 1991, Bagwell and Staiger, 2002). On the empirical side, early work by Finger (1979) and Lavergne (1983) find evidence suggestive of an MFN free rider problem in US tariffs. This is confirmed by Ludema and Mayda (2009), which finds evidence of a significant free-rider effect of the MFN clause for US tariffs following both the Tokyo and Uruguay Rounds. On the other hand, Bagwell and Staiger (2009) find no evidence of MFN free riding in the tariffs of countries recently acceding to the WTO.

A notable limitation of these previous empirical studies is that they do not make use of market power information in estimating the MFN free rider effect. For a country like the US, with market power in a broad array of products, this may be a minor problem; however, when considering a broad spectrum of countries, some of which are small and developing, attention to the variation in inverse export elasticities is likely to be crucial. The novelty of this paper is in exploiting the relationship between terms-of-trade effects and MFN free riding to make possible the empirical estimation of both effects across a broad spectrum of countries. Our empirical findings confirm that indeed the MFN free rider problem is widespread and closely connected to terms-of-trade effects. The empirical specifications we test are closely related to the theoretical model and take into account institutional details, such as the timing of negotiations. In addition, we check the robustness of our results by using data at different levels of disaggregation, by controlling for additional variables (outside of the theoretical model) and by addressing endogeneity issues with an instrumental variable estimation strategy.

The remainder of this paper is as follows. Section 2 presents a sketch of the theory. Section 3 describes the cross-country data sets used. Section 4 discusses the empirical strategy and main results of the analysis. Finally, Section 5 concludes.

2. Theory

In this section, we present a simple, stylized model of the MFN free rider problem to motivate our empirical analysis. The model is based on the "competing exporters" framework, originally developed by Bagwell and Staiger (1998) and used extensively in the literature on MFN (e.g., Saggi, 2009). There are $C > 2$ countries, a single numeraire good, and a large set Γ of non-numeraire goods. Each non-numeraire good $g \in \Gamma$ is imported by a single country, and exported by the other countries. These goods are produced with sector-specific capital and a common factor, labor, under conditions of perfect competition and constant returns to scale. The numeraire is produced with labor alone. Each country has a representative consumer with a quasi-linear utility function.

All countries are assumed to be members of the WTO and therefore entitled to either MFN or FTA treatment. In particular, suppose a subset of the exporters of a particular good *g* are members of a free-trade agreement with the importer of *g*, country *c*, and thus face no impediments to trade on that good, while the rest are subject to country *c*'s MFN tariff. Let τ_{cg} denote one plus the MFN ad valorem tariff rate of the importer. Let Φ_{cg} denote the share of country *c*'s total imports of *g* from FTA partners. Let the non-FTA exporters be indexed by $i = 1, 2, \ldots, N_g$, and let θ_{ig} denote the exports of country *i* of good *g* as a share of country *c*'s total non-FTA imports. For simplicity, assume these export shares are independent of τ_{cg}.[3]

[3] This would be true, for example, if all non-FTA exporters share a common elasticity of export supply.

Each country seeks to maximize a weighted welfare function of the form,

$$
\begin{aligned}
w_c = \sum_{g\in\Gamma} s_{cg}(p_{cg}) + \sum_{g\in\Gamma_c}(1+\lambda_{cg})\pi_{cg}(p_{cg}) + \sum_{g\in\Gamma\setminus\Gamma_c}\pi_{cg}(p_g^*) \\
+ \sum_{g\in\Gamma_c}(p_{cg} - p_g^*)M_{cg}(p_{cg}) + \sum_{g\in\Gamma_c}\phi_{cg}\sum_{c'\in FTA_c} w_{c'}
\end{aligned} \qquad (1)
$$

The first term in (1) is the sum of consumer surplus over all goods, which is a function of domestic prices p_{cg}. The second term is the weighted sum of producer surplus of import-competing sectors, where Γ_c denotes the set of all goods imported by country *c*. The extra weight λ_{cg} represents the political clout of import-competing sector *g* in country *c*. We do not model the exact political mechanism behind this weight, though it is consistent with a variety of political economy models (Baldwin, 1987). The third term is the sum of producer surplus of country *c*'s export sectors, which is a function of world prices p_g^*. For simplicity, we assume export sectors receive no extra weight.[4] The fourth term is tariff revenue, which is non-negative for all import sectors, as we consider only non-negative import tariffs. The final term measures country *c*'s concern about the interests of its FTA partners on products it imports. We have in mind that FTA partners may apply diplomatic pressure on the importing country to preserve their preferential market access. While we prefer not to digress into a complete model of this FTA interaction, we believe it is potentially important enough (see, for example, Limão, 2007) to warrant the inclusion of an exogenous parameter ϕ_{cg} to capture this effect.

A key aspect of the MFN free rider problem is that countries are free to decide whether to participate or not in negotiations for the reduction of MFN tariffs. In keeping with item-by-item, request-and-offer method that has been GATT's most common form of negotiation over the

[4] That trade regimes are biased toward import-competing sectors is well known (Rodrik, 1995). We should point out, however, that our theoretical model can easily accommodate politically influential exporters. The main reason we leave this aspect aside is practical: no data is available to measure exporter political influence. Thus, in this short sketch of our model, we focus only on the components for which we have data.

years, we allow these participation decisions to be made on a good-by-good basis.[5] We assume that if the importer decides not to participate in negotiations over a particular good, the tariff on that good remains at its original level, which we fix at the non-cooperative optimal tariff. If an exporter decides not to participate, this exporter cannot be made to "pay" for any tariff reductions that occur in that good. To capture this, we assume that the exporters have access to transfers by which to compensate the importer for its tariff reduction, but non-participants make no such transfers, directly or indirectly. In equilibrium, it may be that the transfers given and received by a country balance out across all goods, but we do not impose this constraint.[6]

As each negotiation is effectively separate from every other by assumption, we can drop the subscripts c and g and consider the negotiations over a generic good. Suppose the participants in these negotiations consist of the importer and a set $A \subseteq N$ of non-FTA exporters. The membership of A is endogenous, but for now take it as given. We assume the outcome of this negotiation is an MFN tariff that is Pareto efficient for the participants. In this setting, Pareto efficiency for participants is equivalent to maximizing the sum of the payoffs of the importer and the members of A. Using (1), it can be shown that the tariff that maximizes this sum (the "negotiated tariff") satisfies,

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[5] In the Uruguay round, many countries, including the US, used the item-by-item approach, while others, most notably the EU, used a formula approach, whereby each country cuts tariffs across-the-board according to a certain formula agreed to at the outset. In fact, however, countries deviated considerably from the formula cuts on an item-by-item basis, and many countries ignored the formula entirely (Hoda, 2001, pp. 30-32). Negotiations over these deviations took place on an item-by-item basis between principal suppliers. According to Hoda (2001, p. 47), "Thus a linear or formula approach did not obviate the need for bilateral negotiations: they only gave the participants an additional tool to employ in the bargaining process."

[6] A constraint of this type could be interpreted as a form of reciprocity, though it is not exactly the same as the reciprocity emphasized by Bagwell and Staiger (2002). Imposing such a constraint would introduce linkages across the various negotiations that would make our model far more complex. While this would be an interesting direction for future research, it is beyond the scope of this section, which is intended to provide a tractable model for estimation. We do attempt to control for reciprocity considerations in our empirical work but only in reduced form.

$$\tau^n(A) = \frac{1 + \frac{1}{\xi}\left(1 - \Theta_A\right)}{1 - \frac{\lambda}{\tilde{\mu}}\frac{X}{M} + \frac{(1-\phi)}{\tilde{\mu}}\Phi} \tag{2}$$

where M denotes total imports and X domestic production of the importing country, $\tilde{\mu}$ and ξ are the elasticities of demand for, and supply of, exports from non-FTA countries, respectively,[7] and $\Theta_A \equiv \Sigma_{i\in A}\theta_i$ is the cumulative export share of participants (as a share of non-FTA imports).

Equation (2) reflects three different channels affecting the negotiated tariff. The numerator captures the MFN free rider effect: the larger the market share of non-participants $1 - \Theta_A$, the higher is the tariff. This is because, when participants negotiate a tariff reduction, non-participants gain improved market access to the importing country without paying for it – they are free riders. The negotiated tariff level reflects the fact that only a fraction Θ_A of a tariff reduction's total benefit to non-FTA exporters is internalized by participants. Moreover, the total benefit to non-FTA exporters depends on how much the tariff affects their terms of trade, as measured by $1/\xi$, the importing country's inverse elasticity of export supply from non-FTA sources. Thus, the MFN free rider effect is proportional to the terms-of-trade effect of the tariff. In the extreme case of no participants ($\Theta_\varnothing = 0$), the numerator of (2) is just the standard optimal tariff formula. If all countries participate ($\Theta_N = 1$), then the terms-of-trade effect is fully internalized by participants and the numerator becomes unity. This would imply free trade but for some terms in the denominator.

The two terms in the denominator of (2) reflect the power of domestic producers and FTA partners, respectively. The domestic political pressure term is familiar from the literature. Helpman (1997) shows that the equilibrium tariff is proportional to X/M, the inverse import-

[7] The elasticity of demand for non-FTA exports can be decomposed as $\tilde{\mu} \equiv \mu + \xi_F \Phi$, where μ is the importing country's elasticity of total import demand, and ξ_F is the elasticity of export supply from FTA members.

penetration ratio, in a wide variety of political economy models. For example, in the model of Grossman and Helpman (1994, 1995), $\lambda = (I_L - \alpha_L)/(a + \alpha_L)$, where I_L is an indicator of whether or not the sector is organized into a lobby, α_L is the fraction of the electorate represented by a lobby, and *a* measures the government's concern for welfare relative to lobby contributions. Empirical work by Goldberg and Maggi (1999) and Gawande and Bandyopodhayay (2000) have estimated this model and confirmed that the sign of the effect of X/M on NTBs varies by sector, depending on the sectors' political organization. According to our model, we would expect the same to be true of tariffs. The FTA term takes into account that tariff reductions by the importing country erode the preferential access enjoyed by FTA partners. If the importing country does not fully internalize this negative externality on its FTA partners ($\phi < 1$), it will cut tariffs more the larger is the FTA share of total trade. Alternatively, if maintaining the preference margin is a high priority, it could be that $\phi > 1$, in which case the tariff would increase with FTA share.[8]

The goal of the empirical analysis is to properly measure the numerator of equation (2), the MFN free rider term, and estimate its effect on MFN tariffs, controlling for domestic political pressure and FTA effects as represented by the denominator of equation (2). The main obstacle is that we do not directly observe the set of participants involved in negotiating any given tariff; therefore we cannot construct the variable Θ_A. For this reason, we need a theory of participation. Developing such a theory allows us to investigate the root cause of the MFN free rider problem in addition to its effects on tariffs.

[8] Limão (2007) provides a model in which the importer uses the preference margin as a means to induce its FTA partner to provide a regional public good. His model effectively delivers ϕ > 1. He finds tariffs increase with preferential trade share in the US, whereas Estevadeordal et. al. (2008) find the opposite for Latin America.

To this end, assume that participation is voluntary and that countries play the following two-stage game: in the first stage, all countries decide to participate or not in the negotiations; in the second stage, participants negotiate a tariff according to equation (2). Suppose A is an equilibrium set of participating exporters. Each member $i \in A$ knows that by refusing to participate it will increase the resulting negotiated tariff from $\tau^n(A)$ to $\tau^n(A \setminus i)$. On the other hand, if the importer refuses to participate the tariff increases from $\tau^n(A)$ to $\bar{\tau} \equiv \tau^n(\emptyset)$. Thus, the total surplus available to allocate between the importer and members of A is,

$$\Omega(A) \equiv \sum_{i \in A} w_i(\tau^n(A)) - w_i(\tau^n(A \setminus i)) - [w_c(\bar{\tau}) - w_c(\tau^n(A))] \tag{3}$$

It follows that there exists an allocation of the surplus between the importer and members of A that supports A as an equilibrium set of participants, if and only if, $\Omega(A) \geq 0$.

For purposes of illustration, consider the following approximation of (3):

$$\Omega(A) \approx \sum_{i \in A} \theta_i^2 \omega(A) - [w_c(\bar{\tau}) - w_c(\tau^n(A))] \tag{3'}$$

where $\omega(A) \equiv -(\Sigma_{i \in N} w_i')^2 / \left[w_c'' + \Sigma_{i \in A} w_i''\right] > 0$. This approximation is accurate if the export shares are small. Note that the available surplus depends on the sum of the squared export shares of the participants. This is because the impact of an exporting country's participation decision on the negotiated tariff is proportional to its export share (from equation (2)). Moreover, the amount an exporting country gains from a tariff change is also proportional to its export share. Thus, a participant's contribution to the surplus (which is the difference between what it gets by participating and not participating) depends on the product of the two effects, both proportional to the export share. Summing these over all participants gives the sum of squared export shares.

At this point, we can state our first main conclusion, which is that full participation ($\Theta_N = 1$) is possible if and only if the Herfindahl-Hirschman index of non-FTA export shares,

$H \equiv \Sigma_{i \in N} \theta_i^2$, is sufficiently high. While we shall not prove this result here,[9] the necessary part can be seen immediately from (3') evaluated at A = N. Full participation requires that $0 \leq \Omega(N) \approx H\omega(N) - w_c(\bar{\tau}) + w_c(\tau^n(N))$. If H is too low, $\Omega(N)$ will be negative and full participation cannot be sustained. Intuitively, a high H means that the cumulative surplus from participation for all exporters is sufficient to compensate the importer for choosing tariff $\tau^n(N)$, which is the Pareto efficient tariff for the world as a whole.

Although the condition $\Omega(A) \geq 0$ narrows the set of possible equilibria considerably, it does not generally produce a unique outcome. What is needed is a rule, or bargaining protocol, to determine how the surplus is divided among any given set of participants. Suppose the WTO (the collection of all countries, participants and free riders alike) has as its objective to maximize the total payoff of its members, while respecting the right of each member to voluntarily participate (or not) in negotiations and allowing those who do participate to negotiate the tariff that is Pareto efficient for them. This calls for a rule that selects from the sets satisfying $\Omega(A) \geq 0$ those with the minimum $\tau^n(A)$.

Ludema and Mayda (2009) show that two conclusions follow from this assumption. First, in the search for optimal sets of participants, we can restrict attention to sets satisfying the Principal Supplier Rule (PSR), with minimal loss of generality. The PSR simply says that the set of participants should include all exporters above a certain size, as measured by export share. Second, under PSR and less-than-full participation, if the distribution of export shares is geometric, then any increase in H increases the cumulative market share of the optimal set of participants and thereby decreases the equilibrium tariff.[10] In other words, higher H should be

[9] All proofs can be found in Ludema and Mayda (2009).

[10] Actually, this conclusion holds for any class of distributions that can be ranked according to first-order stochastic dominance.

associated with higher Θ_A and therefore with a lower tariff. In addition, from equation (2) we see that this effect is modulated by $1/\xi$, the importer's monopoly power in trade. This is the main empirical prediction of the model.

3. Cross-country data

To carry out the cross-country empirical analysis, we need information for a multitude of importing countries on MFN tariffs, trade and production levels, and import and export elasticities. Obtaining internationally comparable data for all these variables according to a common classification and level of aggregation is almost impossible. Thus, we have chosen to construct two complementary datasets, which differ in the number of variables available, level of aggregation and country coverage. The results turn out to be the same using both datasets.

The first dataset contains applied MFN tariff rates, multilateral and bilateral trade flows for 36 countries[11], comprising a wide range of income levels, according to the 6-digit Harmonized System (HS) classification. The data set covers the period from 1993 to 2000. This period of time includes the final years of the Uruguay round – which took place in 1986-1994 – and its implementation period. We constructed the data set by combining information collected from COMTRADE and UNCTAD's TRAINS. Data on the individual members of the European Union were combined, so as to create, in effect, a single country called the EU. This is because the EU maintains a common external tariff and negotiates as a bloc.[12]

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[11]The countries are (the date of entry into GATT/WTO is in parentheses): Argentina (1967), Australia (1948), Belize (1983), Bolivia (1990), Brazil (1948), Canada (1948), Chile (1949), Colombia (1981), Dominica (1993), Ecuador (1996), European Union (varies by country), Gabon (1963), Grenada (1994), Guatemala (1991), Hungary (1973), Iceland (1968), India (1948), Indonesia (1950), Japan (1955), Korea (1967), Madagascar (1963), Malaysia (1957), Mauritius (1970), Mexico (1986), Morocco (1987), New Zealand (1948), Nicaragua (1950), Norway (1948), Peru (1951), Romania (1971), Saint Kitts & Nevis (1994), Saint Vincent & the Grenadines (1993), Sri Lanka (1948,) Thailand (1982), Tunisia (1990), United States (1948).

[12] The European-Union (EU) includes the following countries (date of entry into the EU in parentheses): Belgium (1958), Luxembourg (1958), Netherlands (1958), Germany (1958), France (1958), Italy (1958), Denmark (1973),

The main advantage of the 6-digit HS dataset is its very fine level of disaggregation (more than one thousand sectors per country with upwards of four thousand sectors for several of them) and the extensive country coverage. The main disadvantage is that this dataset lacks production data, which prevents the construction of import penetration, an important factor in controlling for domestic political economy determinants of protection. To address this problem we construct a second dataset, which includes 31 countries. Twenty countries overlap with the 6-digit HS dataset, including nearly all of the developed countries. This second dataset contains information on applied MFN tariff rates, multilateral and bilateral trade flows, and production for 81 (or fewer) manufacturing industries at the 4-digit level of the International Standard Industrial Classification (ISIC Rev. 2). The data set covers the period from 1993 to 1999. All bilateral and multilateral import and export data are from the World Bank's Trade and Production Database (WBTPD) (Nicita and Olarreaga 2001). The WBTPD is also the source of data on domestic production and applied MFN tariff rates for 18 countries in the sample, mostly middle and low-income countries.[13][14] We have augmented this initial dataset with data for 13 additional countries by collecting production and tariff data from the UNIDO INDSTAT4 (2006) Industrial Statistics Database and UNCTAD's TRAINS, respectively.[15] Drawing data from these additional sources

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Ireland (1973), United Kingdom (1973), Cyprus (1973), Greece (1981), Portugal (1986), Spain (1986), Austria (1995), Finland (1995), and Sweden (1995); Turkey joined the customs union in 1996. To construct the EU data, we averaged the EC tariffs reported by TRAINS and summed together the production and trade data across members (netting out intra-EU trade flows). To obtain representative EU-wide elasticity estimates, we used the average of Germany, France, Italy and the UK.

[13] The WBTPD derives from several sources: UNCTAD Trains, UN Comtrade, and UNIDO Industrial Statistics are the sources of MFN tariffs, trade flows and production data, respectively.

[14] The 18 countries covered by the World Bank data set are (date of entry into GATT/WTO is in parenthesis): Bolivia (1990), Canada (1948), Chile (1949), Colombia (1981), Costa Rica (1990), Ecuador (1996), Egypt (1970), Guatemala (1991), Honduras (1994), Indonesia (1950), India (1948), Korea (1967), Mexico (1986), Malaysia (1957), Philippines (1979), Turkey (1951), United States (1948), and Venezuela (1990).

[15] Production and tariff data from these sources is used for the following 13 countries (date of entry into GATT/WTO is in parenthesis): Australia (1948), Bangladesh (1972), European Union (varies by country), Japan (1955), Morocco (1987), New Zealand (1948), Norway (1948), Pakistan (1948), Panama (1997), Peru (1951), Romania (1971), South Africa (1948) and Thailand (1982).

is particularly important because it allows us to expand the analysis to include a greater number of high-income, high-trade countries, including the EU.

To construct MFN tariff rates at the 4-digit ISIC level, the WBTPD uses the simple average of the tariff lines within each product category. The benefit of simple averages, instead of trade-weighted averages (revenue divided by dutiable imports), is that they are invariant to changes in trade flows. The drawback is that a few highly protected tariff lines within a sector can seriously affect the average. To mitigate the effect of outliers, we restrict our ISIC sample to tariff averages less than 50% ad valorem.[16]

The 6-digit HS and 4-digit ISIC datasets are augmented with information from secondary sources. Information on GATT/WTO membership is drawn from Rose (2004). Estimates of export supply and import demand elasticities are derived from Broda, Greenfield and Weinstein (2006) and kindly provided by David Weinstein. These vary by country and product (but not time) at the 3-digit HS level. Information about the degree of product differentiation is from Rauch (1999) and varies by product, according to the 4-digit SITC classification. The Rauch product classification divides goods into those that are sold on organized exchanges, those for which reference prices can be found in trade journals, and others. Products in the third category are interpreted as differentiated products. We use concordances to map the elasticity estimates and the Rauch classification to the 6-digit HS and 4-digit ISIC classifications.[17]

[16] This amounts to less than 5% of our observations. Our main results are not sensitive to this threshold, though overall fit diminishes if outliers are not excluded. Note that, as the 6-digit HS level is the tariff-line level for almost all WTO countries, we do not censor tariffs in the 6-digit HS dataset.

[17] Since 4-digit ISIC is more aggregated than 3-digit HS and 4-digit SITC, concording the data to ISIC required some care. To concord the elasticities, we took the median of the 3-digit HS values within each 4-digit ISIC. We used the median, rather than the mean, to diminish the effect of outliers, as the elasticity estimates had large standard errors. For the Rauch classification, we created a continuous measure (*diffshare*) equal to the share of the 4-digit SITC codes within each 4-digit ISIC category that were classified as differentiated according to Rauch's liberal definition.

Our datasets have three dimensions: importing country, product and time. The period of time they cover allows us to pay attention to the timing of the negotiation and implementation of tariff agreements. This is important in the empirical analysis given that one might expect tariffs observed during the implementation period to be affected more by conditions prevailing during the negotiation period than by contemporaneous conditions. Thus, our dependent variable will be the applied MFN tariff rate averaged over 1995-2000 (or 1995-1999), while the independent variables are drawn from 1993, which was the final and most critical year of the Uruguay Round negotiations. With the time dimension collapsed in this way, our estimation exploits cross-commodity and cross-country variation.

Note that we use *applied* MFN tariff rates, averaged over several years, as opposed to bound rates.[18] In practice, the difference between the two tariff rates in many countries like the US is quite small, though the gaps can be large for developing countries. Our choice to use applied as opposed to bound rates is based on two sets of considerations. First, an important institutional feature is that applied tariffs are not immediately subject to the bound rates negotiated in a Round but are phased-in in stages, with more politically sensitive products phased-in as late as possible. This feature would be lost if we used only final bound rates. Second, while our theoretical model makes no distinction between bound and applied rates, Bagwell and Staiger (2005) provide a theory that accounts for the difference, based on private information about political pressure. In their model, the bound rate is chosen to ensure the incentive compatibility of applied rates, whereas applied rates fluctuate but on average maximize the expected welfare of the negotiating parties. Accordingly, the average applied rate is the more appropriate measure of our efficient tariff.

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[18] In GATT/WTO negotiations, countries negotiate tariff bindings, i.e. they do not explicitly agree to tariff levels but instead to tariff ceilings (bound rates) that tariff levels must not exceed.

Summary statistics of the main variables used in the empirical analysis are presented in Appendix Tables 1 and 2.

4. Empirical Analysis

A. Empirical Strategy

In the empirical analysis, we use a specification that is closely related to the theoretical model but also takes into account institutional details, such as the timing of negotiations. To make the link from our model, which assumes importer-specific goods, to the data, which are organized by product categories common to all countries, we partition the set of goods Γ into K "products", with every partition *k* containing a good imported by each country in our sample.[19] The tariff τ_{ck} is interpreted as country *c's* tariff on the good it imports from product *k*, and we assume it is the outcome of a negotiation as previously modeled. Note that the negotiated tariff in equation (2) is equal to 1 (free trade) if there is full participation, no domestic political pressure and negligible FTA share. Taking a first-order Taylor approximation of (2) around this point, and adding an error term, we obtain the following estimating equation for sector *k* and importing country *c*:[20]

$$\tau_{ck} - 1 = \frac{1}{\xi_{ck}}\left(1 - \Theta_{A_{ck}}\right) + \frac{\lambda_{ck}}{\mu_{ck}}\frac{X_{ck}}{M_{ck}} - \frac{1-\phi_c}{\mu_{ck}}\Phi_{ck} + \varepsilon_{ck}. \tag{4}$$

The first challenge is to measure $1/\xi_{ck}$, the inverse elasticity of foreign export supply of product *k* to country *c*, which captures country *c*'s market power. Finding an accurate measure

[19] Product categories are either a 6-digit HS codes or 4-digit ISIC codes, depending on the dataset. We shall use the terms products and sectors interchangeably to refer to these product categories. We use the term "industry" to refer to a higher level of aggregation than products. In the HS dataset, industries refer to HS sections. In the ISIC dataset, industries are defined as 3-digit ISIC codes.

[20] Note that the import demand elasticity μ_{ck} appears in equation (4) instead of the FTA-augmented elasticity found in (2). This is because our approximation occurs around the point of zero FTA share, where the two elasticities are the same.

has long been a problem in the international trade literature. Although the elasticity estimates of Broda, Greenfield and Weinstein (2006) are the most comprehensive available in terms of country and product coverage, they are very imprecise. We deal with this issue in two different ways. One is to follow Broda, Limão and Weinstein (2008) and create a categorical variable, "High inverse export elasticity" (HIEE), which is equal to 1 if the inverse export elasticity estimate is in the top two thirds of all products' estimates within the same country and zero otherwise. The second approach is to use proxy measures that are both theoretically plausible determinants of market power and are also correlated with the inverse elasticity estimates. The proxies we consider are the log of GDP, which varies by country, and the Rauch classification, which varies by product. To justify using log of GDP, we note that textbook treatments of optimal tariffs attribute market power to large countries and indeed, in the data (see footnote 21 below), countries with larger GDP face lower export elasticities on average. As for the Rauch classification, product differentiation is normally associated with a low elasticity of substitution in consumption between varieties. When a country imposes a tariff, it decreases its demand for imported varieties and thereby drives down their world prices; however, with a low substitution elasticity, there is less of a tendency for consumers in other countries to substitute towards those varieties and thereby mitigate the price decline. Thus we expect that products classified as differentiated by the Rauch classification should have lower export elasticities (i.e., higher importer market power) than homogenous products. This is too borne out in the data, as the export supply elasticity estimates are much lower for products classified as differentiated.[21]

[21] Broda, Limão and Weinstein (2008) investigate the correlation between inverse export elasticity and several market power variables, including log GDP, the Rauch index and the importing country's share of world imports by product, for a group of non-WTO countries. They find the same results for log GDP and the Rauch index as we do for WTO countries. We find a positive correlation between HIEE and the indicator of product differentiation. We also estimate a positive correlation between the inverse export elasticity and log GDP – controlling for product fixed effects – although this correlation is less robust. Broda, Limão and Weinstein (2008) also find that an importing

The second challenge is to measure $\Theta_{A_{ck}}$, which captures how much of the terms-of-trade effect of the tariff is internalized by the participants in negotiations over each product. In particular, $\Theta_{A_{ck}}$ measures importing country *c*'s imports from participants in GATT/WTO negotiations over product *k* as a fraction of its imports from all countries that are entitled to MFN treatment and are not its FTA partners. While we cannot measure the market share of participants directly[22], our theory tells us that it should be positively related to the Herfindahl-Hirschman index (HHI). In our calculation of the HHI, we must account for the presence of non-GATT countries that receive MFN treatment and exclude each importing country's FTA partners and other countries that do not receive MFN treatment. Thus, we measure the HHI as:

$$H_{ck} = \frac{\sum_{i \in GATT_c} M_{ick}^2}{\left(\sum_{i \in MFN_c} M_{ick}\right)^2}, \tag{5}$$

Here MFN_c is the set of all countries that are granted MFN treatment by importing country *c*, excluding *c*'s FTA partners, while $GATT_c$ is the subset of MFN_c consisting of members of the WTO (these countries are therefore potential participants in the multilateral negotiations). We have data on MFN treatment only for the United States, which grants MFN treatment to all but a few, small, isolated countries.[23] We therefore exclude these same countries from MFN_c for all countries in our sample. M_{ick} is the value of importing country *c*'s imports of product *k* from country *i*. Thus the HHI so defined equals the sum of squared shares of exports to importing country *c* by all potential (non-FTA) participants in multilateral negotiations.

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country's share of world imports is correlated with inverse export elasticity by product (although this result does not survive controlling for log GDP). We find no such correlation among WTO countries, thus we do not use the importing country's share of world imports as a proxy of market power.

[22] There is yet no dataset on countries' participation decisions in negotiations product by product.

[23] From 1996 onwards, the only countries that were not granted MFN treatment by the United States were Afghanistan, Cuba, Laos, North Korea, Iran, Vietnam, Serbia and Montenegro. Before then, the US granted unconditional MFN to all other countries, except Communist countries.

The third challenge is to measure λ_{ck}, which captures the degree of domestic political pressure in sector *k* of country *c*. Lacking internationally comparable data on political variables, we take an indirect approach, as explained in detail in the following two sections. Finally, we also control for the FTA market share[24] – which captures the third term in (4) – and add country fixed effects.

B. Estimation based on the 6-digit HS dataset

We shall begin our estimation by investigating the role of country size. Ludema and Mayda (2009) estimate the average effect (across products) of MFN free riding on U.S. tariffs, ignoring cross-sector variation in market power. In this section, we conduct a similar exercise for all importing countries in our sample to see if this effect depends on market size. If larger countries have greater market power in general, we should expect their tariff schedules to be more sensitive to variation in the market share of participants and thus the HHI. To test this, we estimate country-specific regressions of the average MFN tariff rate (over the years 1995-2000) on the 1993 HHI.[25] For each of these regressions, we consider the estimated coefficient on the HHI – which is indeed negative for most countries in the sample – and plot it against the country's log GDP (Figure 1). We estimate the fitted regression line with weighted least squares (WLS) using as weights the inverse of the standard errors of the HHI coefficient estimates. The slope of the regression line is negative (-0.1678), which is consistent with the proposition that the MFN free-rider problem (as evidenced by a negative average effect of the HHI on the tariff) is

[24] We use the definition of Article XXIV to determine FTA status. Countries that may have received preferential treatment through other means, such as the Generalized System of Preferences, are treated as MFN non-FTA countries. We take this approach mainly because of the inconsistent coverage and conditional nature of these preferences.

[25] We also control for the 1993 FTA market share and HS section dummy variables, both divided by the import demand elasticity. The rationale for these controls is explained below.

more severe for larger countries. However, it is only significant at the 19% level (the robust standard error is 0.1260).

It should come as no surprise that the country-specific regressions produce weak findings, particularly for developing countries. The coefficients on the HHI for many developing countries in the sample are not statistically significant, whereas most of the OECD countries have significant coefficients of the correct sign. These estimates are consistent with the contrasting findings of Ludema and Mayda (2009) and Bagwell and Staiger (2009), as discussed earlier, and highlight the importance of exploiting the cross-sector heterogeneity in market power that is present in our data. While developing countries may have little market power on average, the tariffs in sectors where they *do* have market power should exhibit the MFN free-rider problem if our theory is correct.

We next estimate regressions with data pooled across countries. Incorporating the considerations of Section 4.A, we derive the following specification:

$$\tau_{95-00,ck} - 1 = \alpha + \beta_1 H_{93,ck} + \beta_2 H_{93,ck} MP_{ck} + \beta_3 MP_{ck} + \sum_l \eta_l \frac{I_l}{\mu_{ck}} + \nu \frac{\Phi_{FTA\,93,ck}}{\mu_{ck}} + \sum_c \gamma_c I_c + \varepsilon_{ck} \quad (6)$$

where $\tau_{95-00,ck} - 1$ is the *ad-valorem* MFN tariff rate on product *k* of importing country *c* averaged over the years 1995-2000, MP_{ck} is one of our two proxies for product-specific market power (*diff* or HIEE), μ_{ck} is importing country *c*'s import demand elasticity in sector *k* and $\Phi_{FTA\ 93,ck}$ is importing country *c's* imports from FTA partners as a share of its total imports of product *k* in 1993.

As mentioned before, our 6-digit HS dataset lacks information on production and therefore on the inverse import-penetration ratio. Thus, in the HS regressions, we let the industry (HS section) dummies (I_l) absorb the effect of both political power and inverse import-penetration ratio at the industry level. On the other hand, we can control for the product and country-specific import demand elasticities. Thus, we interact industry dummies and FTA shares with the inverse import demand elasticities (see second and third terms of equation (4)).

Given that MP_{ck} and $H_{93,ck}$ serve as *proxies* for the true inverse export supply elasticity and the market share of participants, respectively, we should not expect the coefficients on MP_{ck} and $H_{93,ck}MP_{ck}$ to be equal to 1 and -1, respectively, as in equation (4). Nevertheless, the theoretical model pins down expected signs. We expect β_1 to be zero or slightly negative, since β_1 captures the effect of the HHI when $MP_{ck} = 0$, i.e. zero or low market power. On the other hand, the effect of the HHI on tariffs should be negative and more pronounced in sectors where the importing country has high market power, and thus β_2 should be negative. In addition, we expect $\beta_3 > 0$, as this captures the effect of the importing country's market power (MP_{ck}) when $H_{93,ck} = 0$, which is when free riding is complete and the negotiated tariff is equal to the non-cooperative optimal tariff. As in the optimum tariff theory, the higher importing country *c*'s market power in sector *k*, the higher the tariff it sets. The coefficient on the FTA share is theoretically ambiguous. A negative coefficient would indicate that the importing country does not fully internalize the effect of its tariff on its FTA partners (i.e., $\phi < 1$), while the opposite interpretation is true for a positive coefficient.

Table 1 shows the results of estimating equation (6). Note that standard errors reported in these and all the following regressions in the paper are robust – to address heteroskedasticity – and clustered by country – to account for correlation of observations within a country. The first column contains OLS estimates and uses the Rauch proxy for market power. Specifically, the categorical variable *diff* is equal to 1 if the product is differentiated and zero otherwise. The second column uses HIEE as the measure of market power. The OLS results for the two specifications (regressions (1)-(2)) show that β_2 is negative and significant. Thus, a country's MFN tariff is decreasing in the HHI for products over which it has high market power. The direct effect of market power β_3 is positive and significant, while the direct effect of HHI (β_1) is positive and insignificant. All these results are exactly consistent with our expectations. Finally, the effect of the FTA share variable is insignificant, which provides evidence for neither of the interpretations above.

Columns (3) and (4) address the issue of potential endogeneity of the HHI using an IV approach. It is possible that other domestic political-economy determinants of a country's MFN tariff rates, not captured in the theoretical model, are correlated with the HHI. We construct an instrument for the HHI for each country *c* by finding the three countries in our sample with HHI most highly correlated with that of *c* and using the average of their HHI as an instrument for *c*'s HHI.[26] The reason for averaging is to avoid data loss resulting from cross-country variation in the number of observations.[27] We do not instrument for the market power variables, as we regard the elasticity estimates and product classification to be exogenous. The results in columns (3) and (4) are qualitatively the same as in the OLS regressions, although the interaction coefficient β_2 is larger in absolute value and the direct effect of the HHI (β_1) is now negative (and weakly significant when HIEE is used as the measure of market power). Finally, the direct effect of market power on the tariff β_3 is still positive and significant at the one percent level in both specifications. We take these results to be strong evidence of a free rider problem of the MFN clause driven by the terms-of-trade effect.

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[26] As far as the first stage is concerned, the correlation coefficient between the instrument and the HHI is 0.50 (significant at the 1% level) in the 6-digit HS data set and 0.48 (significant at the 1% level) in the 4-digit ISIC data set. As for the exclusion restriction, it is unlikely a country's political-economy dynamics are influenced by other countries' HHI.

[27] To see this, consider the following example: the EU has 4691 observations for the HHI, while the country whose HHI is most correlated with that of the EU is Norway, with 3572 observations. If we use Norway's HHI alone as an instrument for the EU's HHI, we lose a quarter of our EU data.

Based on the coefficient estimates in regression (3), which measures market power according to the Rauch classification, we find that a 10 percentage points increase in the Herfindahl-Hirschman index reduces the importing country's MFN tariff rate by 0.8 percentage points (this change is not small given that the mean of the dependent variable in that regression is 13 percentage points). Remarkably, based on regression (4), we get exactly the same magnitude of the effect of an increase in the HHI by 10 percentage points – i.e., a reduction of the MFN tariff rate by 0.8 percentage points – when the sector is characterized by high inverse export elasticity.

Another way to gauge the magnitude of our results is to consider the counterfactual of setting the HHI equal to zero. This produces an estimate of what the tariff would be in the absence of negotiations, because a zero HHI corresponds to such extreme free riding that none of the terms of trade effects of a country's tariff reduction would be internalized among the participants. For each 6-digit product, we compare the predicted cooperative tariff (corresponding to the actual HHI) with the predicted non-cooperative tariff (corresponding to HHI = 0). Next we take the average of these differences across products and countries. Based on this measure, using the HIEE measure of market power, we estimate that the internalization of terms of trade effects through WTO negotiations has lowered tariffs by about 22% compared to the non-cooperative level. It is 19% using the Rauch measure. Figure 2 breaks this down by HS section. While the two measures of market power give different results, they agree on the main points: food, textiles and clothing are predicted to experience the smallest tariff reductions, while machines, transport equipment and instruments are predicted to experience the largest. This is driven by the combination of HHI and market power differences across sections.

Note that these effects may be a lower bound of the true effects. For example, it could be that a market with few foreign suppliers (and thus high HHI) is also less competitive domestically, i.e. the HHI of export shares is likely to be positively correlated with domestic (firm) concentration. In that case, the tariff might reflect rent shifting motives (i.e., strategic trade policy considerations) or a disproportionate political influence from concentrated domestic producers. Alternatively, it could be that a high tariff itself weeds out the smaller foreign suppliers and increases the HHI directly.[28] Although both of these stories should be addressed by our IV strategy, they would in any event suggest a positive correlation between the HHI and the tariff, which may cloak the full negative effect of the HHI.

Table 2 tests the robustness of our findings. Here we add, as controls, the share of each importing country's total exports (i.e., of all products) to the top five exporters of each product to that country (*share of IC's exports to top 5 exporters*) and *non-GATT market share*. In considering the impact of these two controls, we account for cross-product variation in monopoly power by interacting them with the market power variables. The reason for the first control is reciprocity. Our theory assumes that exporting countries reciprocate with transfers, while in practice countries exchange trade barrier concessions of various kinds. In such a world, it could be that importing country *c* is more inclined to swap concessions with countries that represent a large market for its exports. One might be concerned that the products principally supplied by such countries have high HHI, thus causing a negative correlation between the HHI and the MFN tariff rate unrelated to MFN. The *share of IC's exports to top 5 exporters* thus represents a

[28] If, as discussed in footnote 3, all non-FTA exporters have the same export supply elasticity, then the HHI would be invariant to the tariff. Otherwise, the tariff can affect the HHI but in a generally ambiguous way. If an increase in the tariff causes larger (smaller) exporters to gain market share, then the HHI would increase (decrease).

measure of importing country *c*'s overall export dependence on the principal suppliers of each product it imports.[29]

The logic behind *non-GATT market share* is that we include non-GATT countries receiving MFN treatment (e.g., China) in the denominator of the HHI but exclude them from the numerator, because they are not potential participants in the negotiations. Therefore, the higher the non-GATT market share, the lower our measure of the HHI. Therefore, by controlling for the non-GATT market share, we can check whether the negative impact of the HHI is mostly driven by countries that cannot participate in negotiations (because they are not GATT-WTO members) as opposed to being driven by countries that decide not to (although they are members of the GATT-WTO system). Our results on the two additional control variables are for the most part insignificant; however, and most importantly, none of our main findings changes. Thus, our findings are driven entirely by the sectoral variation in concentration among GATT-WTO members.

Table 3 adds industry (HS section) fixed effects in addition to the HS section dummy variables interacted with the inverse import demand elasticities present in the previous regressions. In our model, industry effects enter only through the domestic political economy term, which is why we have only considered industry dummies interacted with the inverse import demand elasticities to this point. More generally, however, there may be industry-level effects that lie outside of our model, such as alternative domestic political determinants or possibly foreign political pressure. The results based on adding the industry fixed effects are very similar to our previous findings.

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[29] Bown (2004) uses essentially the same measure. He finds that the greater a country's export dependence on the principal suppliers of a given product, as measured by the share of its worldwide exports (of all products) sold to those suppliers, the less likely it is to implement protection (safeguards and safeguard-like measures) on that product.

C. Estimation based on the 4-digit ISIC dataset

Recall that the main advantage of the 4-digit ISIC dataset is that it contains information on production levels by sector, which enables us to control explicitly for the inverse import penetration ratio and thus capture a key domestic political economy determinant of the negotiated tariff in our theory. Using this data set, we follow the same steps as in the previous section.

We first investigate the role of country size. We estimate country-specific regressions of the average MFN tariff rate (over the years 1995-1999) on the 1993 HHI.[30] The estimated coefficient on the HHI is indeed negative for most countries in the sample. It is plotted against the country's log GDP in Figure 3. The slope of the fitted line – estimated using WLS – is negative (-0.7443), but unlike before it is highly significant (at the 1% level, with robust standard error of 0.2384). The reason for this difference may be the country sample, which contains fewer very small countries or poor countries. Nonetheless, the regression confirms that the negative impact of the HHI on the MFN tariff rate – driven by the free riding effect of the MFN clause – is more pronounced for larger countries.

We next estimate the model pooling the data across countries. The specification we use resembles equation (6):

$$\tau_{95-99,ck} - 1 = \alpha + \beta_1 H_{93,ck} + \beta_2 H_{93,ck} MP_{ck} + \beta_3 MP_{ck} + \sum_l \eta_l I_l \frac{X_{93,ck}}{M_{93,ck}} + \beta_4 \Phi_{FTA\ 93,ck} + \sum_c \gamma_c I_c + \varepsilon_{ck} \qquad (7)$$

where $\tau_{95-99,ck} - 1$ is the *ad-valorem* MFN tariff rate on product k of importing country c averaged over the years 1995-1999, MP_{ck} is one of our two proxies for product-specific market

[30] We also control for the 1993 FTA market share and the interaction of industry dummy variables with the inverse import penetration ratio to control for political economy factors. We justify this approach below.

power (*diffshare* or HIEE), $X_{93,ck}/M_{93,ck}$ is the inverse import-penetration ratio in 1993 (ratio of domestic total output to imports) and $\Phi_{FTA\ 93,ck}$ is importing country *c's* imports from FTA partners as a share of total imports of product *k* in 1993. Equation (7) differs from equation (6) in a few respects. First, we control explicitly for the inverse import penetration ratio. However, we are unable to include import demand elasticities in the ISIC analysis without an unacceptable drop in sample size. Thus, the industry dummy variables (I_l) in the political-economy term capture the impact of each industry's political power and import demand elasticity, which are assumed to be constant across all sectors within an industry and the same across importing countries.[31] In addition, the FTA share variable is not divided by the import demand elasticity. Therefore the coefficients on the political economy and FTA terms are not comparable in magnitude across the HS vs. ISIC regressions. The last difference between the two specifications is that the Rauch proxy for market power used in the ISIC regressions is *diffshare*, i.e. the share of the 4-digit SITC products – within each 4-digit ISIC category – classified as differentiated.

Tables 4 through 6 present the estimates using the 4-digit ISIC dataset. These results are qualitatively very similar to the 6-digit HS findings. Regressions (1)-(2) in Table 4 agree on the main point: β_2 is negative and significant. Thus, a country's MFN tariff is decreasing in the Herfindahl-Hirschman index for products over which it has high market power. The direct effect of market power β_3 is positive, which is consistent with our expectations; however, it is significant only in the first specification. Contrary to expectations, the direct effect of HHI is also positive and marginally significant in the first regression, but this is not robust to the measure of

[31] To relax the assumption that each industry's political power and import demand elasticity are the same across importing countries, we also consider – in additional regressions – country-specific industry dummy variables.

market power. The effect of *FTA share* is now strongly negative.[32] The interpretation of this result is that importing countries do not fully internalize the effect of their tariffs on their FTA partners (i.e., $\phi < 1$). In particular, the higher the FTA share, the smaller the terms-of-trade gain for an importing country from setting a high tariff (as the price of products coming from FTA partners equals the domestic price), and therefore the lower the MFN tariff.

The IV regressions (columns (3) and (4)) in Table 4 give a similar picture.[33] The only difference relative to the OLS estimates is that the positive direct effect of market power is now larger and more significant. Tables 5 and 6 present the estimates for the 4-digit ISIC data adding controls and industry fixed effects, respectively. There are few differences between these results and those of the previous tables. Finally, in additional regressions (not shown), we estimate a modified version of equation (7) where we replace the industry dummy variables with importing-country-specific industry dummy variables. We find very similar results.

To conclude, we believe we found remarkably robust evidence of a free rider problem of the MFN clause driven by the terms-of-trade effect. Our results are even stronger in light of the following consideration. Participants in the negotiations may try to constrain the MFN externality via reciprocity and their determination to do so might be greater when MFN free-rider issues are more severe (i.e., the HHI is low). This would imply that when the HHI is low (and our model predicts that the tariff should be high, assuming high market power), endogenous mitigation of the MFN externality should reduce the incentive for free riding, thereby lowering the tariff relative to our prediction. In other words, the presence of this effect should bias the coefficient on the interaction $H_{93,ck}MP_{ck}$ towards zero. The fact that we find a negative and

[32] Note that, while *FTA share* could be endogenous due to reverse causality, this is likely to create a positive bias in the estimate of the coefficient, as higher MFN tariff rates should increase import shares from FTA partner countries.
[33] Note that the instrument for the HHI is slightly different from the one used in the 6-digit HS regressions. For each country *c*, we find the other country in our sample with HHI most highly correlated with that of *c* and use its HHI as an instrument for *c*'s HHI.

significant coefficient tells us that, whatever the importance of this effect, the MFN free rider problem driven by the terms-of-trade effect persists to some degree.[34]

6. Conclusion

The main findings of this paper are twofold. First, the MFN tariffs of WTO countries are higher in the presence of market power, controlling for factors affecting domestic politics and international negotiations. This result generalizes to WTO countries the evidence on optimal tariffs found by Broda, Limão and Weinstein (2008) who use a sample of non-WTO countries. Second, and arguably more important, we find a country's MFN tariff is decreasing in the Herfindahl-Hirschman index for products over which it has high market power. This generalizes the evidence on the MFN free rider problem found by Ludema and Mayda (2009) using U.S. data and provides clear evidence that the free rider problem is driven by terms-of-trade effects, as suggested by the theory. Moreover, by establishing that MFN free riding occurs and operates through the terms of trade, we generalize to WTO countries the findings of Bagwell and Staiger (2009) for accession countries that indeed trade agreements are affected by terms-of-trade considerations.

The broader implications of these findings are also threefold. First, if terms of trade drive trade agreements, then the principles of reciprocity and nondiscrimination on which so much of the WTO seemingly depends are indeed valuable, and the attempts of economists and legal scholars to understand the WTO in these terms should prove fruitful. Second, if the MFN free

[34] Another exercise we carry out to test the robustness of our results – in particular, the fact that the effect of the HHI on MFN tariff rates is indeed driven by the MFN clause – focuses on the US (for data availability reasons). In particular, we estimate the effect of our covariates on US tariffs and non-tariff barriers (NTBs). The logic is that tariffs and NTBs share many common determinants but not the MFN free rider problem. Thus, if the HHI negatively affects NTBs, as it does tariffs, it would call into question whether the HHI is really capturing the MFN free rider effect. We find no significant correlation between the HHI and NTBs in the US case (Ludema and Mayda 2009).

rider problem exists and is widespread, as we have shown, then it suggests that the principle of nondiscrimination is not without its drawbacks. There are many benefits to MFN discussed in the literature, so it would be premature to advocate the elimination of MFN based on our results. The solution to the MFN free rider problem is to provide greater inducements for participation and/or isolate free riders from the benefits of liberalization. The principal supplier rule, reciprocity, the use of formula negotiations and the single undertaking can all be seen as attempts to combat the MFN free rider problem along one or both of these dimensions. At this point, all we know is that they haven't eliminated the problem. More study is required to determine what effects these approaches have had and to suggest preferable alternatives.

Finally, developing countries have long complained that the WTO has produced too little trade liberalization on products they predominantly export. Indeed, addressing this imbalance was one of the top priorities of the Doha Development Round. This paper sheds some light on this controversy. In particular, our estimates show that food, textiles and clothing experience the smallest tariff reductions, while machines, transport equipment and instruments experience the largest. This is driven by the combination of HHI and market power differences across industries. Thus, the root of the problem (and hopefully the clue to its solution) may not be the callous indifference of developed countries to the concerns of the poor or even a lack of developing-country bargaining power but the MFN free rider problem, which is part of the underlying structure of the WTO itself.

Bibliography

Bagwell, Kyle and Staiger, Robert W., 1998. Regionalism and multilateral tariff cooperation. In John Pigott and Alan Woodland, eds., *International Trade Policy and the Pacific Rim*, London: Macmillan.

Bagwell, Kyle and Staiger, Robert W., 2002. *The Economics of the World Trading System,* Cambridge, MA: MIT Press.

Bagwell, Kyle, Staiger, Robert W., 2005. Enforcement, private, political pressure and the GATT/WTO escape clause. *Journal of Legal Studies* 34, 471–514.

Bagwell, Kyle and Staiger, Robert W., 2009. "What do trade negotiators negotiate about? Empirical evidence from the World Trade Organization," forthcoming *American Economic Review*.

Baldwin, Richard, 1987. "Politically realistic objective functions and trade policy PROFs and tariffs," *Economics Letters* 24(3), 287-290.

Bown, Chad, 2004. "Trade Disputes and the Implementation of Protection under the GATT: An Empirical Assessment." *Journal of International Economics*, *62*(2), 263-294.

Broda, Christian, Greenfield, Joshua and Weinstein, David, 2006. "From Groundnuts to Globalization: A Structural Estimate of Trade and Growth," NBER working paper #12512.

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

Caplin, Andrew and Krishna, Kala. "Tariffs and the Most-Favored-Nation Clause: A Game Theoretic Approach," *Seoul Journal of Economics*, 1988, *1*, 267-289.

Estevadeordal, Antoni, Freund, Caroline and Ornelas, Emanuel, 2008. "Does Regionalism Affect Trade Liberalization towards Non-Members?" *Quarterly Journal of Economics*, 123(4), 1531-1575.

Feenstra, Robert C., 1997. "NBER Trade Database, Disk 3: U.S. Exports, 1972-1994, with State Exports and Other U.S. Data," NBER Working Paper no. 5990.

Finger, J. Michael, 1979. "Trade Liberalization: A Public Choice Perspective," in Amacher, Ryan C.; Haberler, Gottfried, and Willet, Thomas D., Eds., *Challenges to a Liberal International Economic Order*. Washington, DC: American Enterprise Institute.

Gawande, Kishore and Bandyopadhyay, Usree, 2000. "Is Protection for Sale? Evidence on the Grossman-Helpman Theory of Endogenous Protection," *The Review of Economics and Statistics*, 82(1), 139-152.

Goldberg, Pinelopi K. and Maggi, Giovanni, 1999. “Protection for Sale: An Empirical Investigation,” *American Economic Review*, *89*(5), 1135-1155.

Grossman, Gene M. and Helpman, Elhanan, 1994. “Protection for Sale,” *American Economic Review*, *84*(4), 833-850.

Grossman, Gene M. and Helpman, Elhanan, 1995. “Trade Wars and Trade Talks,” *Journal of Political Economy*, *103*(4), 675-708.

Helpman, Elhanan, 1997. “Politics and Trade Policy”, in D. M. Kreps and K. F. Wallis (eds.), *Advances in economics and econometrics: Theory and applications*, Volume II. Cambridge, U.K., Cambridge University Press.

Horn, Henrik and Mavrodis, Petros C., 2001. “Economic and Legal Aspects of the Most-Favored-Nation Clause,” *European Journal of Political Economy*, *17*(2), 233-279.

Lavergne, Real P., 1983. *The Political Economy of U.S. Tariffs*. New York: Academic Press.

Limão, Nuno. 2007. “Are Preferential Trade Agreements with Non-trade Objectives a Stumbling Block for Multilateral Liberalization?” *Review of Economic Studies*, 74(3), 821-855.

Ludema, Rodney D., 1991. “International Trade Bargaining and the Most-Favored-Nation Clause,” *Economics and Politics*, *3*(1), 1-20.

Ludema, Rodney D. and Mayda, Anna Maria, 2009. “Do Countries Free Ride on MFN?,” *Journal of International Economics* 77, 135-150.

Nicita, Alesandro and Olarreaga, Marcelo, 2001. “Trade and Production, 1976-99,” Documentation of Trade and Production Database: www.worldbank.org/research/trade, World Bank.

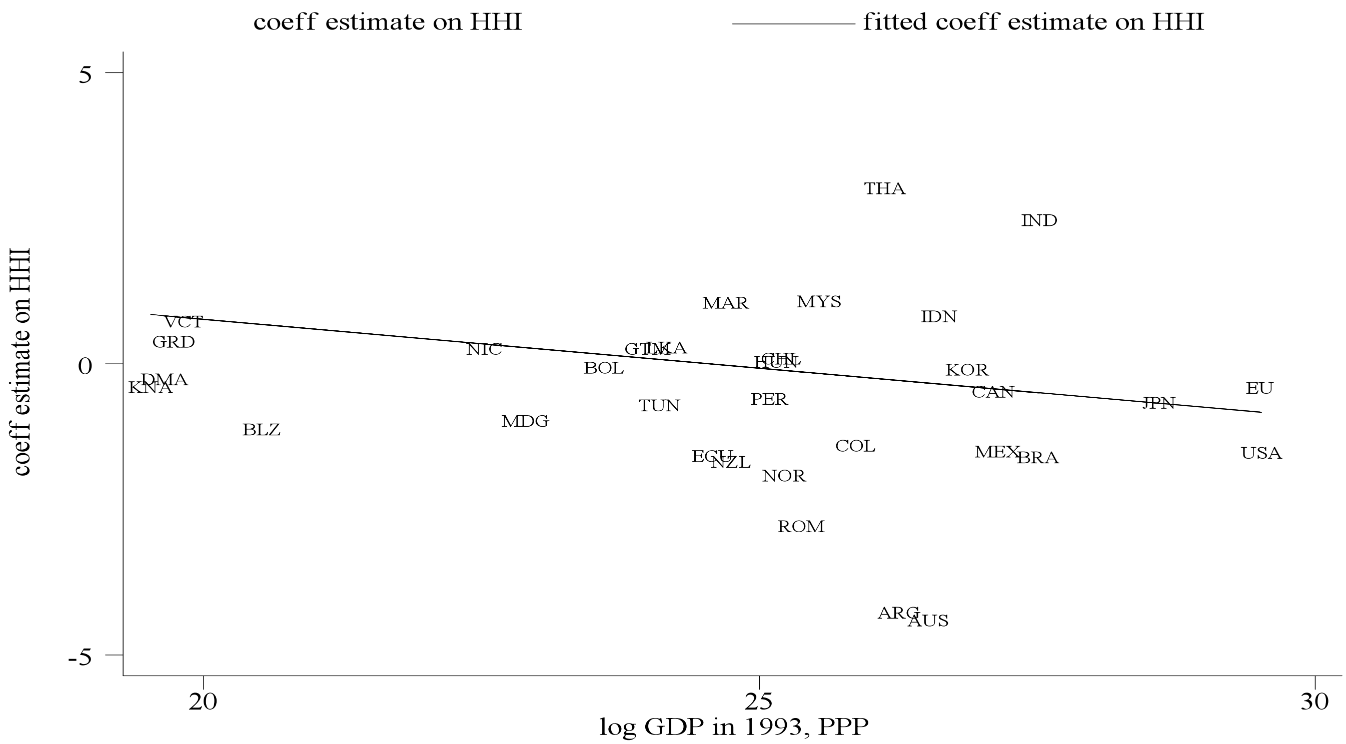
Rauch, James E., 1999. “Networks versus markets in international trade,” *Journal of International Economics* 48, 7-35.

Rose, Andrew K., 2004. “Do We Really Know That the WTO Increases Trade?” *American Economic Review*, *94*(1), 98-114.

Saggi, Kamal, 2009. “The MFN Clause, Welfare, and Multilateral Cooperation between Countries of Unequal Size,” *Journal of Development Economics*, 88(1), 132-143.

Viner, Jacob, 1924. “The Most-Favored-Nation Clause in American Commercial Treaties,” *Journal of Political Economy* 32(1), 101-129.

Figure 1: The coefficient estimate on the HHI as a function of GDP of the importing country (HS6)



Data source: 6-digit HS data set. The slope of the line is -0.1678, significant at the 19% level (robust standard error of 0.1260). The regression line is estimated with weighted least squares (WLS) using as weights the inverse of the standard errors of the coefficient estimates (on the HHI) from the first stage. WLS puts more weight on countries with smaller variance of the estimated coefficients. Three outliers are dropped from the graph: Iceland, Gabon, Mauritius.

Table 1: Free-riding and MFN tariff rates *across countries* (6-digit HS data)

	1	2	3	4
Method	**OLS**	**OLS**	**IV**	**IV**
Dependent variable	**Average MFN tariff rate (1995-2000)**			
Herfindhal-Hirschman index (1993)	0.35	0.35	-1.72	-2.92
	0.57	0.65	1.75	1.54+
Herfindhal-Hirschman index (1993)*diff	**-1.47**		**-6.07**	
	0.68*		**2.44***	
diff	3.03		5.37	
	0.68**		1.68**	
Herfindhal-Hirschman index (1993)*High Inverse Export Elasticity		**-1.7**		**-5.06**
		0.53**		**1.69****
High Inverse Export Elasticity		2		3.72
		0.57**		1.28**
FTA share (1993)/import demand elasticity	1.95	2.15	2.22	2.4
	1.47	1.53	1.45	1.52
Constant	12.5	12.95	13.8	15.04
	0.64**	0.73**	1.22**	1.18**
HS section dummy variables/import demand elasticity	yes	yes	yes	yes
Observations	120483	120668	118303	118303
R-squared	0.39	0.38	0.38	0.37

Source: WITS plus additional data sources (see text). Robust standard errors, clustered by importing country, under each estimated coefficient. + significant at 10%; * significant at 5%; ** significant at 1%. Importing country fixed effects are included in each regression. For each sector, the *Herfindhal-Hirschman index* equals the sum of squared import shares from each exporting country to each importing country. The *Herfindhal-Hirschman index* is calculated excluding countries which are part of a preferential trade agreement with the importing country and excluding countries without MFN treatment. Countries which do not belong to the WTO but receive MFN treatment by the importing country are included in the denominator of the *Herfindhal-Hirschman index*, but not in the numerator.

Diff is an indicator of goods which are classified as differentiated according to Rauch. The *High Inverse Export Elasticity* is equal to 1 if the inverse export elasticity of the product is above the 33rd percentile of elasticities of that country. The *FTA Share* gives the overall import share (by sector) from countries which are part of a preferential trade agreement with the importing country. EC countries are considered as one block. In regressions (3)-(4), we instrument the *Herfindahl-Hirschman index*: For each country c, we find the three other countries in our sample with Herfindahl-Hirschman index most highly correlated with that of c and use the average of their Herfindahl-Hirschman indices as an instrument for c's Herfindahl-Hirschman index.

Figure 2. Percentage difference between the cooperative and non-cooperative tariff

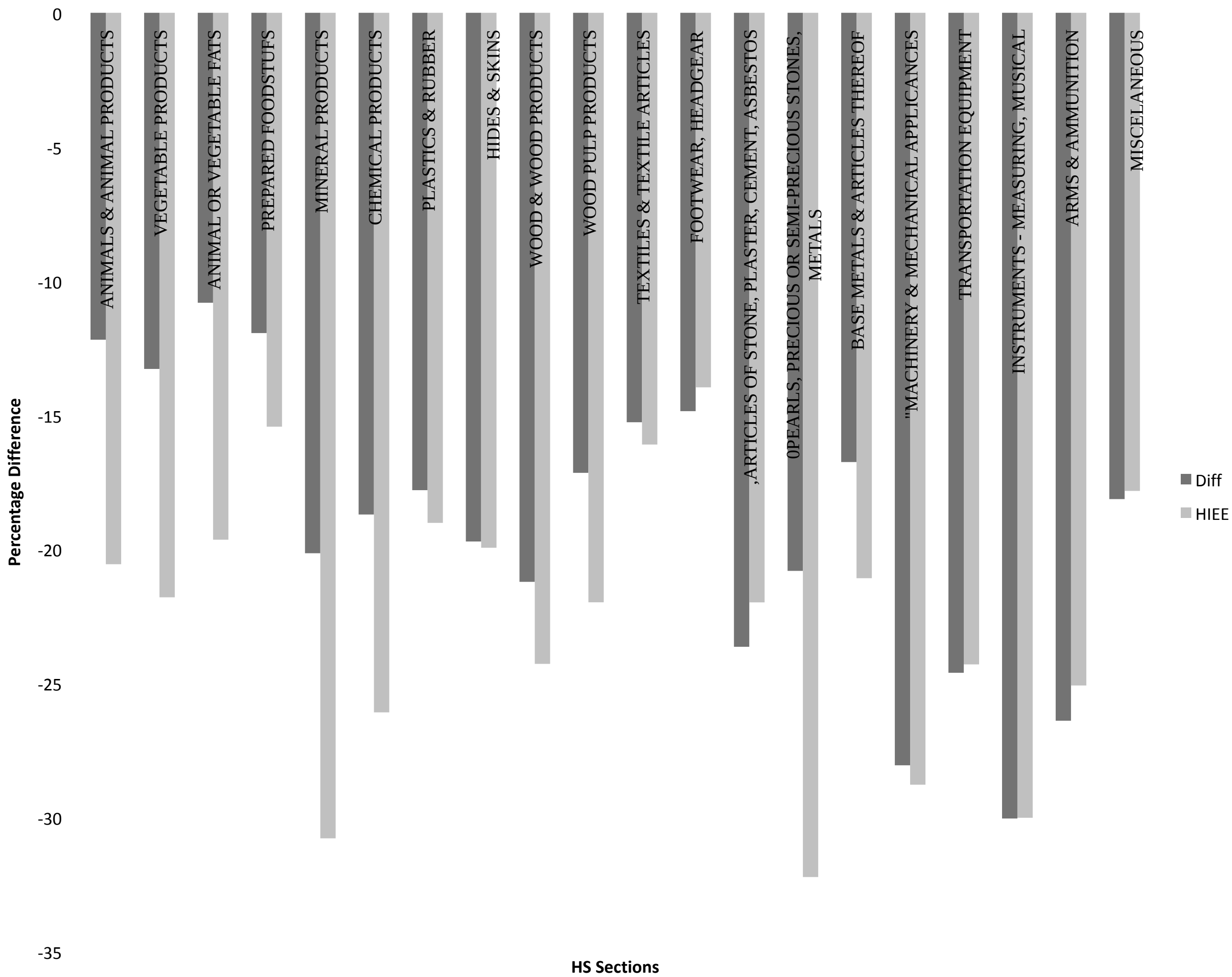


Table 2: Free-riding and MFN tariff rates *across countries* controlling for additional determinants (6-digit HS data)

	1	2	3	4
Method	**OLS**	**OLS**	**IV**	**IV**
Dependent variable	**Average MFN tariff rate (1995-2000)**			
Herfindhal-Hirschman index (1993)	0.41	0.43	-2.73	-3.41
	0.56	0.66	2.3	1.74+
Herfindhal-Hirschman index (1993)*diff	**-1.42**		**-5.31**	
	0.71+		**2.86+**	
diff	3.24		4.95	
	1.21*		2.44+	
Herfindhal-Hirschman index (1993)*High Inverse Export Elasticity		**-1.63**		**-4.92**
		0.58**		**1.81***
High Inverse Export Elasticity		2.9		4.57
		0.96**		1.66**
share of IC's exports to top 5 exporters (1993)	0.55	2.39	-1.48	0.21
	1.38	1.35+	1.49	1.44
non-GATT market share (1993)	0.25	0.11	-1.11	-0.18
	0.28	0.1	1.28	0.25
share of IC's exports to top 5 exporters (1993)*diff	-0.41		-0.06	
	1.89		2.08	
non-GATT market share (1993)*diff	-0.09		1.05	
	0.26		1.23	
share of IC's exports to top 5 exporters (1993)*HIEE		-2.42		-2.38
		1.9		2.01
non-GATT market share (1993)*HIEE		0.08		0.08
		0.08		0.14
FTA share (1993)/import demand elasticity	1.28	1.22	2.42	2.44
	1.43	1.53	1.46	1.55
Constant	12.21	11.98	14.79	15.01
	0.96**	0.96**	1.92**	1.52**
HS section dummy variables/import demand elasticity	yes	yes	yes	yes
Observations	114204	114389	112319	112319
R-squared	0.39	0.39	0.38	0.38

Source: WITS plus additional data sources (see text). Robust standard errors, clustered by importing country, under each estimated coefficient. + significant at 10%; * significant at 5%; ** significant at 1%. Importing country fixed effects are included in each regression. For each sector, the *Herfindhal-Hirschman index* equals the sum of squared import shares from each exporting country to each importing country. The *Herfindhal-Hirschman index* is calculated excluding countries which are part of a preferential trade agreement with the importing country and excluding countries without MFN treatment. Countries which do not belong to the WTO but receive MFN treatment by the importing country are included in the denominator of the *Herfindhal-Hirschman index*, but not in the numerator. See the definition of the additional variables and of the instrument for the *Herfindhal-Hirschman index* (regressions (3)-(4)) at the end of Table 1.

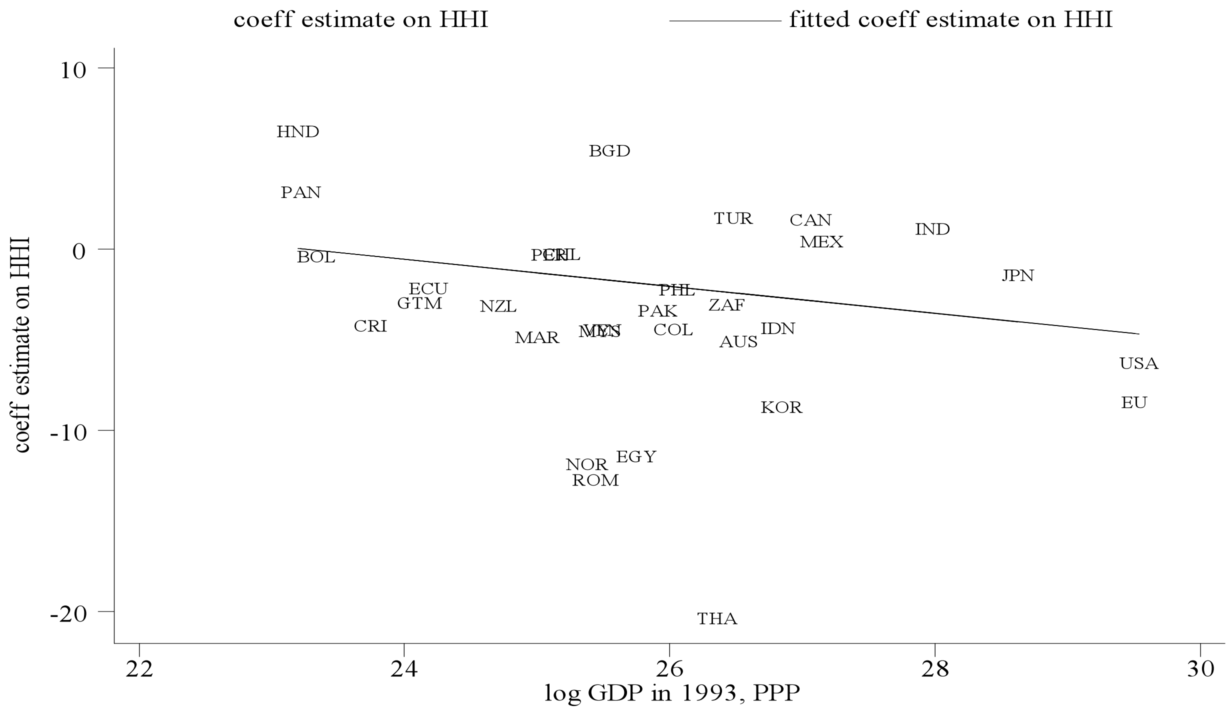
Table 3: Free-riding and MFN tariff rates *across countries* (6-digit HS data)
(controlling for section dummy variables)

	1	2	3	4
Method	**OLS**	**OLS**	**IV**	**IV**
Dependent variable	**Average MFN tariff rate (1995-2000)**			
Herfindhal-Hirschman index (1993)	0.13	0	-2.07	-3.48
	0.53	0.63	1.78	1.56*
Herfindhal-Hirschman index (1993)*diff	**-1.19**		**-5.12**	
	0.66+		**2.56+**	
diff	3.24		5.19	
	0.71**		1.71**	
Herfindhal-Hirschman index (1993)*High Inverse Export Elasticity		**-1.31**		**-4.11**
		0.54*		**1.76***
High Inverse Export Elasticity		1.69		3.15
		0.51**		1.19*
FTA share (1993)/import demand elasticity	2.3	2.98	2.44	3.04
	1.42	1.57+	1.39+	1.55+
Constant	17.9	18.16	19.1	20.41
	2.38**	2.35**	2.98**	2.69**
HS section dummy variables/import demand elasticity	yes	yes	yes	yes
Observations	120483	120668	118303	118303
R-squared	0.4	0.4	0.39	0.39

Source: WITS plus additional data sources (see text). Robust standard errors, clustered by importing country, under each estimated coefficient. + significant at 10%; * significant at 5%; ** significant at 1%. Importing country fixed effects are included in each regression. Each regression also controls for HS section dummy variables. For each sector, the *Herfindhal-Hirschman index* equals the sum of squared import shares from each exporting country to each importing country. The *Herfindhal-Hirschman index* is calculated excluding countries which are part of a preferential trade agreement with the importing country and excluding countries without MFN treatment. Countries which do not belong to the WTO but receive MFN treatment by the importing country are included in the denominator of the *Herfindhal-Hirschman index*, but not in the numerator.

Diff is an indicator of goods which are classified as differentiated according to Rauch. The *High Inverse Export Elasticity* is equal to 1 if the inverse export elasticity of the product is above the 33rd percentile of elasticities of that country. The *FTA Share* gives the overall import share (by sector) from countries which are part of a preferential trade agreement with the importing country. EC countries are considered as one block. In regressions (3)-(4), we instrument the *Herfindhal-Hirschman index*: For each country c, we find the three other countries in our sample with Herfindahl index most highly correlated with that of c and use the average of their Herfindahl indices as an instrument for c’s Herfindahl index.

Figure 3: The coefficient estimate on the HHI as a function of GDP of the importing country (ISIC)



Data source: 4-digit ISIC (Rev.2) data set. The slope of the line is -0.7443, significant at the 1% level (robust standard error of 0.2384). The regression line is estimated with weighted least squares (WLS) using as weights the inverse of the standard errors of the coefficient estimates (on the HHI) from the first stage. WLS puts more weight on countries with smaller variance of the estimated coefficients.

Table 4: Free-riding and MFN tariff rates *across countries* (ISIC Rev.2 data)

	1	2	3	4
Method	**OLS**	**OLS**	**IV**	**IV**
Dependent variable	**Average MFN tariff rate (1995-1999)**			
Herfindhal-Hirschman index (1993)	3.75	1.5	9.07	1.85
	2.07+	1.8	3.90*	3.43
Herfindhal-Hirschman index (1993)*diffshare	**-7.54**		**-17.88**	
	2.42**		**3.65****	
diffshare	1.89		5.06	
	0.82*		1.24**	
Herfindhal-Hirschman index (1993)*High Inverse Export Elasticity		**-4.43**		**-11.32**
		1.94*		**2.83****
High Inverse Export Elasticity		0.62		2.57
		0.61		0.88**
FTA share (1993)	-4.37	-4.94	-3.92	-5.19
	1.15**	1.44**	0.89**	0.93**
Constant	8.79	9.7	7.05	9.57
	0.63**	0.49**	1.23**	1.09**
inverse import penetration ratio (1993)*industry DVs	yes	yes	yes	yes
Observations	2417	1932	2417	1932
R-squared	0.56	0.55	0.55	0.54

Source: World Bank's Trade & Production Database plus additional data sources (see text). Robust standard errors, clustered by importing country, under each estimated coefficient. + significant at 10%; * significant at 5%; ** significant at 1%. Importing country fixed effects are included in each regression. Outliers (MFN tariff rates higher than 50) are excluded. MFN tariff rates (in percentage points) are simple averages at the 4 digit level ISIC. Industries are defined as 3-digit ISIC codes. For each sector, the *Herfindhal-Hirschman index* equals the sum of squared import shares from each exporting country to each importing country. The *Herfindhal-Hirschman index* is calculated excluding countries which are part of a preferential trade agreement with the importing country and excluding countries without MFN treatment. Countries which do not belong to the WTO but receive MFN treatment by the importing country are included in the denominator of the Herfindhal-Hirschman index, but not in the numerator.
The *diffshare* is the share of 5-digit US SIC products in each 4-digit ISIC category that are classified as differentiated according to Rauch. The *High Inverse Export Elasticity* is equal to 1 if the inverse export elasticity of the product is above the 33rd percentile of elasticities of that country. The inverse import penetration ratio equals the ratio of output value to imports in each sector. The *FTA Share* gives the overall import share (by sector) from countries which are part of a preferential trade agreement with the importing country. EC countries are considered as one block. In regressions (3)-(4), we instrument the *Herfindhal-Hirschman index*: For each country c, we find the other country in our sample with Herfindahl index most highly correlated with that of c, and we use that value as an instrument for c’s Herfindahl index.

Table 5: Free-riding and MFN tariff rates *across countries* controlling for additional determinants (ISIC Rev.2 data)

	1	2	3	4
Method	**OLS**	**OLS**	**IV**	**IV**
Dependent variable	**Average MFN tariff rate (1995-1999)**			
Herfindhal-Hirschman index (1993)	4.9	2.52	10.86	2.54
	2.11*	2.13	4.62*	4.76
Herfindhal-Hirschman index (1993)*diffshare	**-5.35**		**-17.81**	
	2.46*		**5.22****	
diffshare	0.49		5.2	
	0.83		2.12*	
Herfindhal-Hirschman index (1993)*High Inverse Export Elasticity		**-2.6**		**-11.46**
		2.21		**3.35****
High Inverse Export Elasticity		-0.59		2.57
		0.85		1.07*
share of IC's exports to top 5 exporters (1993)	-4.86	-8.74	-7.03	-7.78
	7.38	14.1	8.14	15.8
non-GATT market share (1993)	2.87	1.94	7.13	1.8
	2.67	2.53	4.8	3.54
share of IC's exports to top 5 exporters (1993)*diffshare	24.64		26.63	
	15.13		16.52	
non-GATT market share (1993)*diffshare	4		-4.52	
	3.48		5.69	
share of IC's exports to top 5 exporters (1993)*HIEE		21.13		21.64
		16.1		18.03
non-GATT market share (1993)*HIEE		4.27		-1.13
		3.56		3.07
FTA share (1993)	-2.55	-3.25	-2.98	-4.87
	1.6	1.88+	1.51+	1.50**
Constant	8.6	9.51	6.24	9.28
	0.66**	0.71**	1.64**	1.54**
inverse import penetration ratio (1993)*industry DVs	yes	yes	yes	yes
Observations	2417	1932	2417	1932
R-squared	0.56	0.56	0.56	0.54

Source: World Bank's Trade & Production Database plus additional data sources (see text). Robust standard errors, clustered by importing country, under each estimated coefficient. + significant at 10%; * significant at 5%; ** significant at 1%. Importing country fixed effects are included in each regression. Outliers (MFN tariff rates higher than 50) are excluded. MFN tariff rates (in percentage points) are simple averages at the 4 digit level ISIC. Industries are defined as 3-digit ISIC codes. EC countries are considered as one block. See the definition of the additional variables and of the instrument for the *Herfindhal-Hirschman index* (regressions (3)-(4)) at the end of Table 4.

Table 6: Free-riding and MFN tariff rates *across countries* (ISIC Rev.2 data)

(controlling for industry dummy variables)

	1	2	3	4
Method	**OLS**	**OLS**	**IV**	**IV**
Dependent variable	**Average MFN tariff rate (1995-1999)**			
Herfindhal-Hirschman index (1993)	1.11	0.82	4.29	1.19
	2.04	1.85	4.35	4.41
Herfindhal-Hirschman index (1993)*diffshare	**-2.86**		**-8.36**	
	2.36		**4.30+**	
diffshare	3.92		5.74	
	0.91**		1.54**	
Herfindhal-Hirschman index (1993)*High Inverse Export Elasticity		**-2.05**		**-6.98**
		2.04		**3.17***
High Inverse Export Elasticity		1.57		2.98
		0.66*		1.00**
FTA share (1993)	-2.42	-2.9	-2.23	-3.12
	0.57**	0.90**	0.52**	0.76**
Constant	12.42	12.79	11.44	12.72
	0.89**	1.01**	1.40**	1.53**
inverse import penetration ratio (1993)*industry DVs	yes	yes	yes	yes
Observations	2417	1932	2417	1932
R-squared	0.69	0.67	0.68	0.67

Source: World Bank's Trade & Production Database plus additional data sources (see text). Robust standard errors, clustered by importing country, under each estimated coefficient. + significant at 10%; * significant at 5%; ** significant at 1%. Importing country fixed effects are included in each regression. Each regression also controls for industry dummy variables. Outliers (MFN tariff rates higher than 50) are excluded. MFN tariff rates (in percentage points) are simple averages at the 4 digit level ISIC. Industries are defined as 3-digit ISIC codes. For each sector, the *Herfindhal-Hirschman index* equals the sum of squared import shares from each exporting country to each importing country. The *Herfindhal-Hirschman index* is calculated excluding countries which are part of a preferential trade agreement with the importing country and excluding countries without MFN treatment. Countries which do not belong to the WTO but receive MFN treatment by the importing country are included in the denominator of the Herfindhal-Hirschman index, but not in the numerator.

The *Market Share* is the importing country's share in world imports of a particular good. The *diffshare* is the share of 5-digit US SIC products in each 4-digit ISIC category that are classified as differentiated according to Rauch. The *High Inverse Export Elasticity* is equal to 1 if the inverse export elasticity of the product is above the 33rd percentile of elasticities of that country. The inverse import penetration ratio equals the ratio of output value to imports in each sector. The *FTA Share* gives the overall import share (by sector) from countries which are part of a preferential trade agreement with the importing country. EC countries are considered as one block. In regressions (3)-(4), we instrument the *Herfindhal-Hirschman index*: For each country c, we find the other country in our sample with Herfindahl index most highly correlated with that of c, and we use that value as an instrument for c's Herfindahl index.

Appendix Table 1: Summary Statistics of variables by GDP (6-digit HS data)

GDP in 1993	Variable	N	mean	sd	min	max
smaller than 25th percentile	**MFN tariff rate (1995-2000)**	25159	13.9373	13.6775	0.0000	154.1600
	Herfindahl-Hirschman index (1993)	27436	0.7039	0.2807	0.0000	1.0000
	FTA Share (1993)	27436	0.1047	0.2456	0.0000	0.9996
	import demand elasticity	27436	9.1049	25.2820	1.1025	759.9526
	diff	27436	0.6947	0.4605	0.0000	1.0000
	High Inverse Export Elasticity	27436	0.6935	0.4611	0.0000	1.0000
	share of IC's exports to top 5 exporters (1993)	27436	0.3674	0.2073	0.0000	0.9313
	non-GATT market share (1993)	24423	0.1282	1.7239	0.0000	118.8776
between 25th and 50th percentile	**MFN tariff rate (1995-2000)**	36468	14.3064	13.5755	0.0000	416.0833
	Herfindahl-Hirschman index (1993)	36687	0.5997	0.3184	0.0000	1.0000
	FTA Share (1993)	36687	0.1483	0.3123	0.0000	0.9999
	import demand elasticity	36687	9.2268	91.2461	1.1576	16808.0400
	diff	36687	0.6239	0.4844	0.0000	1.0000
	High Inverse Export Elasticity	36687	0.6947	0.4605	0.0000	1.0000
	share of IC's exports to top 5 exporters (1993)	32818	0.3352	0.1777	0.0000	0.7594
	non-GATT market share (1993)	36687	0.0999	0.2095	0.0000	0.9999
between 50th and 75th percentile	**MFN tariff rate (1995-2000)**	29728	11.7447	13.4192	0.0000	644.8800
	Herfindahl-Hirschman index (1993)	29796	0.4784	0.2789	0.0000	1.0000
	FTA Share (1993)	29796	0.0283	0.1235	0.0000	0.9996
	import demand elasticity	29796	4.5569	8.0214	1.1530	131.5013
	diff	29611	0.5912	0.4916	0.0000	1.0000
	High Inverse Export Elasticity	29796	0.6566	0.4749	0.0000	1.0000
	share of IC's exports to top 5 exporters (1993)	29796	0.3185	0.1599	0.0000	0.6391
	non-GATT market share (1993)	29796	0.1084	0.2040	0.0000	0.9998
greater than 75th percentile	**MFN tariff rate (1995-2000)**	29313	10.8112	12.4335	0.0000	299.5900
	Herfindahl-Hirschman index (1993)	29545	0.5209	0.2973	0.0000	1.0000
	FTA Share (1993)	29545	0.1800	0.2965	0.0000	1.0000
	import demand elasticity	29545	5.4088	11.1955	1.0743	195.9547
	diff	29545	0.5859	0.4926	0.0000	1.0000
	High Inverse Export Elasticity	29545	0.6816	0.4659	0.0000	1.0000
	share of IC's exports to top 5 exporters (1993)	29545	0.4004	0.3000	0.0000	0.9059
	non-GATT market share (1993)	29545	0.1161	0.2956	0.0000	25.6835

Source: WITS plus additional data sources (see text). For each sector, the *Herfindahl-Hirschman index* equals the sum of squared import shares from each exporting country to each importing country. The *Herfindahl-Hirschman index* is calculated excluding countries which are part of a preferential trade agreement with the importing country and excluding countries without MFN treatment. Countries which do not belong to the WTO but receive MFN treatment by the importing country are included in the denominator of the *Herfindahl-Hirschman index*, but not in the numerator. *Diff* is an indicator of goods which are classified as differentiated according to Rauch. The *High Inverse Export Elasticity* is equal to 1 if the inverse export elasticity of the product is above the 33rd percentile of elasticities of that country. The *FTA Share* gives the overall import share (by sector) from countries which are part of a preferential trade agreement with the importing country.

Appendix Table 2: Summary Statistics of variables by GDP (ISIC Rev.2 data)

GDP in 1993	Variable	N	mean	sd	min	max
smaller than 25th percentile	**MFN tariff rate (1995-1999)**	567	10.5416	5.8584	0.0000	37.1632
	Herfindahl-Hirschman index (1993)	567	0.3221	0.1744	0.0000	1.0000
	FTA Share (1993)	567	0.0000	0.0000	0.0000	0.0000
	Inverse Import Penetration Ratio (1993)	566	31.6449	266.1269	0.0000	4478.4400
	diffshare	567	0.6901	0.4079	0.0000	1.0000
	High Inverse Export Elasticity	391	0.7059	0.4562	0.0000	1.0000
	share of IC's exports to top 5 exporters (1993)	567	0.0078	0.0238	0.0000	0.2806
	non-GATT market share (1993)	566	0.0890	0.1341	0.0000	0.9094
between 25th and 50th percentile	**MFN tariff rate (1995-1999)**	636	14.7060	9.4812	0.0000	39.1100
	Herfindahl-Hirschman index (1993)	636	0.2534	0.2368	0.0000	1.0000
	FTA Share (1993)	636	0.1698	0.3169	0.0000	0.9951
	Inverse Import Penetration Ratio (1993)	635	136.1782	1999.0600	0.0000	48437.6300
	diffshare	636	0.6990	0.4035	0.0000	1.0000
	High Inverse Export Elasticity	542	0.7380	0.4401	0.0000	1.0000
	share of IC's exports to top 5 exporters (1993)	636	0.0061	0.0290	0.0000	0.4460
	non-GATT market share (1993)	635	0.1031	0.1432	0.0000	0.9607
between 50th and 75th percentile	**MFN tariff rate (1995-1999)**	586	16.0416	12.3428	0.0000	49.8450
	Herfindahl-Hirschman index (1993)	586	0.3071	0.2024	0.0022	1.0000
	FTA Share (1993)	586	0.0099	0.0489	0.0000	0.8494
	Inverse Import Penetration Ratio (1993)	584	91.7362	1143.9070	0.0000	26992.7800
	diffshare	586	0.6944	0.4058	0.0000	1.0000
	High Inverse Export Elasticity	376	0.7261	0.4466	0.0000	1.0000
	share of IC's exports to top 5 exporters (1993)	586	0.0069	0.0196	0.0000	0.2065
	non-GATT market share (1993)	586	0.1233	0.1451	0.0000	0.9309
greater than 75th percentile	**MFN tariff rate (1995-1999)**	634	11.8860	11.0020	0.0000	48.6937
	Herfindahl-Hirschman index (1993)	634	0.2870	0.2066	0.0000	0.9794
	FTA Share (1993)	634	0.1164	0.2271	0.0000	0.9834
	Inverse Import Penetration Ratio (1993)	632	86.3822	1119.4340	0.0000	26971.6300
	diffshare	634	0.7016	0.4016	0.0000	1.0000
	High Inverse Export Elasticity	625	0.7328	0.4429	0.0000	1.0000
	share of IC's exports to top 5 exporters (1993)	634	0.0070	0.0187	0.0000	0.1949
	non-GATT market share (1993)	633	0.1367	0.1616	0.0000	0.9704

Outliers (MFN tariff rates higher than 50) are excluded. MFN tariff rates (in percentage points) are simple averages at the 4 digit level ISIC. For each sector, the *Herfindhal-Hirschman index* equals the sum of squared import shares from each exporting country to a given importing country.

The *Herfindhal-Hirschman index* is calculated excluding countries which are part of a preferential trade agreement with the importing country and excluding countries without MFN treatment. Countries which do not belong to the WTO but receive MFN treatment by the importing country are included in the denominator of the *Herfindhal-Hirschman index,* but not in the numerator. The *FTA Share* gives the overall import share (by sector) from countries which are part of a preferential trade agreement with the importing country. The *inverse import penetration* ratio equals the ratio of output value to imports in each sector. The *Market Share* is the importing country's share in world imports of a particular good. The *diffshare* is the share of 5-digit US SIC products in each 4-digit ISIC category that are classified as differentiated according to Rauch. The *High Inverse Export Elasticity* is equal to 1 if the inverse export elasticity of the product is above the 33rd percentile of elasticities of that country.

The *share of IC's exports to top 5 exporters (1993)* gives the fraction of total exports of each importing country going to the five principal suppliers of each product. The *non-GATT market share (1993)* is exports to each importing country by countries which are granted MFN treatment by that importing country but are not GATT/WTO members, as a fraction of total imports of that importing country from non-FTA countries which receive MFN treatment.