ABSTRACT

Title of dissertation: THE THREE FACES OF TRADE
                                      LIBERALIZATION: UNILATERAL,
                                      PREFERENTIAL, AND MULTILATERAL

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       There is a growing number of studies that investigate the effect of trade
liberalization on productivity and nearly all assume that trade policy is independently
determined of productivity, hence it is exogenous. I show that this assumption is
generally invalid both theoretically and empirically. In Chapter 1, I demonstrate that
under a standard political economy model of trade protection, productivity directly
influences tariffs. Moreover, this productivity-tariff relationship partly determines the
extent of liberalization across sectors even in the presence of a large exogenous unilateral
liberalization shock that affects all sectors. In Chapter 2, I examine total factor
productivity (TFP) estimates obtained at the firm level for Colombia between 1983 and
1998 and find that more productive sectors receive more protection within this period. In
estimating the effect of productivity on tariffs, I control for the endogeneity of the inverse
import penetration to import demand elasticity ratio and productivity. Finally, I use a
system of equations to illustrate that the positive impact of liberalization on productivity
grows somewhat stronger when corrected for the endogeneity bias.

In Chapter 3, which is joint with Nuno Limão, we analyze the effect of preferential trade agreements (PTAs) on multilateral trade liberalization (MTL). PTAs are characterized by liberalization with respect to only a few partners and thus can potentially retard multilateral trade liberalization (MTL). Despite this important concern, there is almost no systematic evidence as to whether PTAs actually affect MTL or not. We model the effect of PTAs on MTL and show that PTAs slow down MTL unless they involve a common external tariff and allow for internal transfers. Next, we use detailed data on product-level tariffs negotiated by the European Union (EU) in the last two multilateral trade rounds to structurally estimate our model. We confirm the main prediction–the EU's PTAs have clashed with its MTL–and find that the effect is quantitatively significant. Moreover, we also confirm several auxiliary predictions of the model and provide new evidence on the political economy determinants of MTL in the EU.

THE THREE FACES OF TRADE LIBERALIZATION:
UNILATERAL, PREFERENTIAL, AND MULTILATERAL

by

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Dedication

To my loving wife Guliz Kalender

and

the memory of my father Ceyhan Karacaovali

Acknowledgements

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List of Abbreviations

ACP	African, Caribbean, and Pacific States
AFS	Austria, Finland, Sweden
AMS	Annual Manufacturers Survey
CEC	Central and East European Countries
CET	Common External Tariff
CU	Customs Union
DNP	National Planning Department
EFTA	European Free Trade Association
EFTX	European Free Trade Association Members Excluding Austria, Finland, and Sweden
ERP	Effective Rate of Protection
EU	European Union
FOC	First Order Condition
FTA	Free Trade Agreement
GATT	General Agreement on Tariffs and Trade
GDP	Gross Domestic Product
GMM	Generalized Method of Moments
GSP	Generalized System of Preferences
GSPL	Generalized System of Preferences for Least Developed Countries
GTAP	Global Trade Analysis Project
HOLS	Heteroskedastic Ordinary Least Squares
ISIC	International Standard Industrial Classification
IV	Instrumental Variables
LBD	Learning-by-Doing
MED	Mediterranean Countries
MFN	Most-favored Nation
MTL	Multilateral Trade Liberalization
NTB	Non-Tariff Barriers
OLS	Ordinary Least Squares
PTA	Preferential Trade Agreement
SIC	Standard Industrial Classification
SPG	Spain, Portugal, Greece
TFP	Total Factor Productivity
TRAINS	Trade Analysis and Information System
UNCTAD	United Nations Conference on Trade and Development
UR	Uruguay Round
US	United States
WDI	World Development Indicators
WTO	World Trade Organization
2SLS	Two-Stage Least Squares
3SLS	Three-Stage Least Squares

Introduction

The effect of trade policy on productivity is a major issue in development and international trade economics. The interest in this issue is not new and the papers on this issue date back to the 1950s (e.g. Johnson 1955).[1] We recently see an increased interest in the topic through the ever-growing number of empirical studies testing the effect of trade liberalization on productivity (e.g. Tybout and Westbrook 1995, Pavcnik 2002, Schor 2004). Many developing countries (for example, Brazil, Colombia, Chile, India, Mexico, and Turkey) have aggressively pursued trade liberalization in the late 1980s and the early 1990s, in part, to boost productivity. So, does trade liberalization really increase productivity? Recent micro-level empirical findings indicate that the answer is "Yes." However nearly all these studies fail to recognize that trade policy might be endogenous with respect to productivity. And, even if they acknowledge the existence of this endogeneity, most do not control for it. I show, theoretically in Chapter 1 and empirically in Chapter 2, that productivity directly affects trade policy. Thus, a concern for the endogeneity bias is well-founded. Moreover, when we account for the bi-directional causality between trade policy and productivity, the positive effect of trade reform on productivity may become stronger.

In Chapter 3, which is joint with Nuno Limão, we look at the effect of preferential trade agreements (PTAs) on multilateral trade liberalization (MTL). Over 130 PTAs were formed in the last ten years–more than in the previous 50 years combined. Nearly all countries are currently members of at least one PTA and nearly a third of world trade is carried out under such agreements. Although most economists favor MTL, there is no such consensus on the desirability of preferential liberalization. The original concern with PTAs was their ambiguous effect on welfare: positive if the preferential partner is more efficient than the rest of the world but negative otherwise (Viner 1950). During the late 1980s and early 1990s, MTL was stalled while the United States and the European Union pursued PTAs,

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[1] A detailed historical review of the papers that are concerned with the effects of trade on industrial performance appears in Pack (1988). He suggests that the early evidence is rather mixed.

generating much debate on whether PTAs are a "building block" or a "stumbling block" towards MTL (Bhagwati 1991). This issue is also prominent in the current multilateral round since several developing countries fear that MTL will erode the preferences provided to them.[2]

An important source of concern with PTAs is that they can hurt non-members. One direct channel by which this occurs is if the PTA members divert their import demand away from the non-members and this effect is large enough to reduce non-members' export prices. There is evidence of trade diversion and also some direct evidence that PTAs do lower export prices for non-members.[3] This and other costs to the non-members due to discrimination disappear if the preference is fully eroded by MTL. Thus, it is crucial to determine if PTAs hold back MTL and entrench these costs, particularly given that two thirds of world trade is still not covered by any preferences. After much debate there is still no theoretical consensus about and scant empirical evidence of a "clash of liberalizations". We provide evidence of such a clash during the last multilateral trade round by using product-level protection data to estimate a model of the interaction of preferential and multilateral liberalization.

In Chapter 1, I provide a theoretical model of tariff policy determination for a small open economy. I show that under my political economy of protection, the sectoral tariffs depend positively on the industry production (size) and hence, on the sectoral productivity if these sectors are organized and lobby for protection.[4] The intuition for this result is that

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[2]The latest round was launched in 2001 and according to a recent article in the leaders section of the *Economist* magazine, a key factor that may lead to its collapse is that "Poor countries with preferential access to rich world markets want to make sure that freer trade will not reduce these preferences" ("Talking the Talk", July 17th 2004, p.14). However, the *possibility* that these preferences would reduce MTL is not new: it was a concern raised when the generalized system of preferences to developing countries was originally proposed (Johnson 1967, p. 166).

[3]Chang and Winters (2002) find that Mercosur caused lower export prices for non-members. Romalis (2004) provides evidence of trade diversion for the North American Free Trade Area and its predecessor between the US and Canada.

[4]This is a modified result (as I explain later in the text) from the, now standard, political economy models such as Grossman and Helpman (1994). The results from Grossman and Helpman (1994) have been widely tested and confirmed. Also Ferreira and Facchini (2005), who find that more concentrated sectors receive more protection, share a similar view with my paper in the sense that the industry characteristics matter for trade policy.

more productive sectors have got more to gain from lobbying and the potential to generate more protection. More specifically, the marginal benefit of a tariff, hence a higher domestic price is greater when it applies to more units and more productive processes.[5]

It is often argued that trade reform may be used as an exogenous change and this uniform shift in policy helps identify the effect of trade policy on productivity without worrying too much about its endogeneity. In order to account for this argument, I model a unilateral trade liberalization shock which is common across sectors. I find that under such a common exogenous shock, the reduction in tariffs is lower for sectors that experience a higher productivity gain (or a lower productivity decline) as compared to other sectors in the presence of political economy. Initially, I keep the additional channel simple making sure that it is clearly the political economy consideration that is driving the results. Next, I give more structure to the extra channel of protection and to the way the liberalization shock manifests itself by allowing for an infant industry argument.[6] This argument led to the widespread use of import substitution policies in most developing countries until the mid-1980s and its dismissal was the source of much unilateral trade liberalization since then.

In my two period model, the government initially believes that there exists a learning-by-doing (LBD) process and decides about the current tariffs by considering both political economy effects and the effect of these tariffs on the future welfare through LBD. In the second period, the government realizes that LBD does not actually exist and it is a false perception, and thus initiates a trade reform. Given that political economy forces still determine tariffs, the extent of liberalization differs across sectors (due to political economy) despite this common shock across sectors. The implication from the models I present is that,

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[5]I focus on the effect of productivity on trade policy due to political economy motivations. However, there are other plausible channels that could actually lead to more protection (not less) for less productive sectors as I discuss in Chapter 1. My purpose of using this standard model as the starting point is to create a tractable setup for the effect of productivity on tariffs and then, having accounted for an economy-wide trade reform, to ultimately obtain structural equations to test econometrically.

[6]For example, the infant industry argument is mentioned as an important motive for protection in Grossman and Horn (1988).

assuming cross-sectional differences in trade policy to be independent of cross-sectional differences in productivity is incorrect.

In Chapter 2, I employ Colombian data for the 1983-1998 period to empirically test my theory. Colombia has been used in various studies (for example, Roberts 1996; Fernandes 2003; Melendez, Seim and Medina 2003) given that it provides a great natural experiment environment. Colombia experienced a drastic trade reform in the early 1990s and had a stable economy in this period without major crises. Given the existence of other studies using the same country, I get the chance to test my predictions with a comparable dataset.

I analyze the effect of productivity[7] on trade protection by closely following my theory. I confirm that (4-digit ISIC level) sectoral tariffs are inversely related to the import penetration ratio and import demand elasticity, whereas they are positively related to total factor productivity. The results also indicate that the sectors with more productivity gain (or less productivity decline), as compared to the other sectors, are liberalized less.

In the estimations, I account for the extra channels which I mention above and more specifically, I account for their elimination which leads to a big decline in tariffs. For this purpose, I allow for a shift in the common terms across sectors over time. I tackle the potential endogeneity of the right-hand-side variables, namely inverse import penetration to import demand elasticity ratio and productivity, by using instrumental variables. The instruments are capital to output ratio, materials prices, a measure of scale economies (value added/number of firms), and the TFP of the upstream industries which I confirm to be valid based on a test of overidentifying restrictions and also explain intuitively in Chapter 2. Finally, I estimate a system of equations for illustrative purposes. In the system, I correct for the endogeneity of tariffs and show that the positive effect of trade liberalization on productivity can be underestimated when endogeneity bias is not accounted for.

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[7]My productivity estimates come from Eslava, Haltiwanger, Kugler and Kugler (2004) and they are originally calculated at the firm-level which are then aggregated to the 4-digit ISIC level using production shares of each firm. The dataset has the great advantage of using plant level input and output prices. This enables obtaining good estimates with smaller bias as compared to the majority of the studies which need to employ non-parametric estimations and sector level price deflators due to lack of data.

In Chapter 3, we develop a model which builds on Limão (2002) and captures the key features of the multilateral system and of recent PTAs. We generate several specific predictions to test. The main one is that multilateral tariffs are higher on products that a country imports duty-free from preferential partners (PTA good, henceforth) than on an otherwise similar good (non-PTA good). The basic intuition for this result is the following. Suppose the European Union (EU) offers preferential duty-free access in a set of products to a certain country. The latter benefit from facing a lower tariff than their competitors and the fact that the EU signs the PTA indicates that its member governments value it at given multilateral tariffs. If the EU eliminated its multilateral tariff on that same set of products, it would effectively eliminate the PTA that it valued. We show that this additional cost of MTL is only present for the subset of PTA goods and affects multilateral tariff levels only when the preferential tariff is already zero since otherwise, the preferential tariff can be reduced to maintain the preferential margin. The model also predicts that, if there is a common external tariff and the ability for direct cash transfers–generally present when there is a common tariff–then no stumbling block effect appears. This occurs because the EU can now offset any reduction in preferential margins due to MTL through a direct transfer to the preferential partner.

We estimate the model's structural equation for the equilibrium trade policy using detailed data, at the level used in the negotiations, for thousands of products imported by the EU. There are several compelling reasons for focusing on the EU to analyze whether there is a clash of liberalizations. First, a key concern with PTAs is their potential to harm non-members. Given that the EU is the world's largest trader, its trade policy surely affects non-members. Second, the EU's preferential agreements are quite diverse, which allows us to theoretically derive and test a rich set of predictions. Finally, although the EU accounts for a fifth of world trade, there is hardly any empirical evidence on the formation of the EU's trade policy in general and none that analyzes how its PTAs affect its MTL.[8]

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[8]Constantopoulos (1974) and Riedel (1977) examine determinants of industry level protection of individual members before accession to the EU. Tavares (2001) analyzes the determinants of the EU's common

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We find that the EU's PTAs generated a stumbling block for MTL in the last trade round. More specifically, the EU reduced its multilateral tariffs on goods not imported under PTAs by almost twice as much as on its PTA goods, as predicted by the model. We ensure that the results are robust to reverse causation and other possible sources of endogeneity by employing an IV-GMM estimator and testing for the exogeneity of different variables and the validity of their instruments. The stumbling block effect we estimate is stronger for goods that were exported by all of the EU's PTA partners. Moreover, the effect is not present for goods with a positive preferential tariff and in agreements with a common external tariff and transfers, which are two important auxiliary predictions from our model. Various robustness tests provide further support for the baseline estimates.

The results are also economically significant. The estimates imply that the average price effect due to the EU's multilateral tariff changes was only about half for PTA goods relative to other goods. Moreover, according to the theoretical model, our estimate represents not only the current wedge in the tariffs between PTA and non-PTA goods but also what the actual tariff wedge for this set of PTA goods would be relative to the counterfactual where the EU has no preferences for that *same* set of goods. That wedge is about 1.4 percentage points whereas the current average tariff for PTA goods in our sample is 4.7 percent. This evidence along with the stumbling block effect estimated for the US in Limão (2006) suggest that we should be concerned about a "clash of liberalizations".[9]

Reciprocity is a key feature not only of our model but also of the leading economic

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external tariff, also at the industry level. We are not aware of any paper that either estimates the determinants of protection for the EU at the product level or does so structurally.

[9]It is possible that, in other countries, PTAs lead to lower protection against non-members. Foroutan (1998) finds lower average MFN tariffs for Latin American countries with PTAs after the Uruguay Round. She agrees that no causality can be drawn from such a correlation because those countries were moving away from import substitution during the 90's, which implied considerable unilateral liberalization independently of any effects from PTAs. This issue of causation is partially addressed by Bohara, Gawande and Sanguinetti (2004) who estimate that the Argentine unilateral tariffs were lower in *industries* where the value of imports from Mercosur to value added in Argentina was highest. Neither paper models MTL in the context of a trade round so, even if we set causation issues aside, there is no systematic evidence that PTAs lead to more MTL. Even if such evidence is found for Latin American and some other countries, it will be difficult to overturn the concern that PTAs slow down MTL because the current evidence supports this conclusion for two of the largest traders, the EU and the US, which have generally been the focus of the controversy.

theory of the GATT (Bagwell and Staiger 1999). Although reciprocity is supposed to be an important principle in multilateral negotiations, some economists question whether it is followed in practice (Finger, Reincke, and Castro 1999). We empirically model the multilateral negotiation process and address the endogeneity issue associated with reciprocal tariff reductions. Our estimates indicate that reciprocity was followed: the EU's tariff reductions were largest for products exported by countries that provided greater increases in market access. Finally, we model and provide novel evidence of the EU's internal political economy determinants of trade policy. The EU places some, but not much, additional weight on producer than consumer welfare. In this respect our findings are similar to structural estimates of the Grossman-Helpman (1994) model that also find small values for the US.[10]

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[10]See Goldberg and Maggi (1999) and Gawande and Bandyopadhyay (2000).

1 Productivity Matters for Trade Policy: The Theory

1.1 Basic Model

The output and factor markets are perfectly competitive. The numeraire good, $i = 0$, is produced with labor only, using a constant returns to scale process, whereas the non-numeraire goods, $i = 1, ...n$, are produced using labor and one sector-specific factor. The production function for the non-numeraire goods is $X_i(p_i) = A_i Q_i(p_i)$,[11] where A_i stands for the Hicks-neutral total factor productivity (TFP). The international prices for all goods $i = 0, ..., N$, denoted by p_i^w, are normalized to one. Furthermore, assuming a large enough aggregate supply of labor, the wage rate is also tied at one–the marginal revenue productivity of labor in the numeraire sector.

The numeraire good is traded freely, hence its domestic price is equal to the world price of one. The owners of each specific factor organize into lobbies, and ask for government protection in their own sector only since they are assumed to constitute a negligible share of the total population. The consumers cannot overcome the free-rider problem and are not organized as discussed in Olson (1965). For simplification, export subsidies are not allowed and only tariffs are available for trade protection.[12] Maintaining the small country assumption and the world prices normalized to 1, the domestic price of the remaining goods are given by $p_i = 1 + \tau_i$, where τ_i denotes both the specific and the advalorem tariff rate.[13] The government, then, sets its trade policy by maximizing the following political support function

$$G \equiv L + \sum_{i=1}^{N} \left(\int_{1+\tau_i}^{\infty} D_i(\tau_i) d\tau_i + \omega \int_{0}^{1+\tau_i} A_i Q_i(\tau_i) d\tau_i + \tau_i M_i(\tau_i) \right) \qquad (1)$$

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[11]In Chapter 2, I give $Q_i(p_i)$ more structure. Here, it just indicates part of the production function independent of productivity.

[12]The trade with the rest of the world is balanced through movements of the numeraire good.

[13]Note that the domestic price for a small economy is related to the world price and tariff rates with $p_i = (p_i^w + \textit{specific tariff}) = p_i^w(1 + \textit{advalorem tariff})$ but the assumption that $p_i^w = 1$ makes the specific and advalorem rates equal under this case.

where L is the aggregate labor supply and income; $D_i(\tau_i)$ is the aggregate demand, $X_i(\tau_i) = A_i Q_i(\tau_i)$ is the aggregate supply, and $M_i(\tau_i) = D_i(\tau_i) - A_i Q_i(\tau_i)$ is the aggregate import demand for good i. Thus, G is a weighted sum of the aggregate consumer and producer suplus, as well as labor income and tariff revenue.[14] The weight, $\omega \geq 1$, represents the relative importance given to the producer surplus with respect to the rest of the social welfare.[15]

Given the additive separability of the government objective, we can obtain the optimal tariff rate for sector i by maximizing equation (1) with respect to τ_i. Consequently, the equilibrium specific and advalorem tariff rates for sector i are implicitly defined as[16]

$$\tau_i = (\omega - 1)\frac{A_i Q_i(\tau_i)/M_i(\tau_i)}{\varepsilon_i(\tau_i)} \tag{2}$$

where $\varepsilon_i(.)$ stands for the elasticity of import demand.[17] This expression is a standard one obtained in various political economy models (Helpman 1997). Accordingly, the tariff rate for sector i is an increasing function of the extra political economy weight provided to producers, whereas it is a decreasing function of the import demand elasticity, ε_i, and import penetration ratio, $M_i/A_i Q_i$. A tariff is a tax on imports, so just like a tax on a non-traded good, the deadweight loss created is lower the more inelastic the (import) demand is. Thus, a smaller value of ε_i allows for higher tariffs to be applied. In addition, a relatively larger market for imports creates a greater price distortion potential which should be avoided by the government. Finally, the marginal benefit of a tariff is higher when it applies to more units and more productive processes.

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[14]The tariff revenue, $\sum_{i=1}^{N} \tau_i M_i(.)$, is fully rebated back to the public in a lump-sum manner.

[15]This setup can be easily interpreted as a reduced form of a model where lobbying is given microfoundations such as in Grossman and Helpman (1994). I prefer to take a shortcut here to keep the focus on the main subject matter: trade policy and productivity link in the presence of unilateral liberalization.

[16]Again note that the specific (first term) and advalorem (second term) tariff rates are equivalent since the international prices are normalized to one. See the appendix section A for the derivation of equation (2).

[17]Here, the import demand elasticity is defined as $\varepsilon_i \equiv -M_i' p_i^w/M_i$, so it differs from the standard definition which is evaluated at the domestic price. I account for this in the empirical estimations as explained in the appendix section B.1.

Partially and implicitly differentiating equation (2) with respect to A_i, we obtain the following relationships between tariff protection and productivity

$$
\begin{align}
\frac{\partial \tau_i}{\partial A_i} &= -(\omega - 1)\frac{Q_i(\tau_i)}{M_i'(\tau_i)} > 0 \tag{3a} \\
\frac{d\tau_i}{dA_i} &= -\frac{(\omega - 1)Q_i(\tau_i)}{M_i'(\tau_i) + (\omega - 1)A_iQ_i'(\tau_i)} > 0 \tag{3b}
\end{align}
$$

I assume that $Q_i(\tau_i)$, $D_i(\tau_i)$ and hence, $M_i(\tau_i)$ are linear for ease of exposition (i.e. $Q_i''(\tau_i) = D_i''(\tau_i) = 0$).[18] Although initially $\omega \geq 1$ is the only restriction on the value of ω, I further assume it to be bounded above such that $\omega < 2 - \frac{D_i'(.)}{A_iQ_i'(.)}$ based on the observations from the empirical political economy literature. For example, Goldberg and Maggi (1999) estimate ω to be equal to 1.014 for the United States, whereas Karacaovali and Limão (2005b) estimate it to be between 1.0025 and 1.0039 for the European Union. Although these estimates might be a bit small, they more than support my parameter restriction as a plausible one. If ω were so high to exceed $2 - \frac{D_i'(.)}{A_iQ_i'(.)}$[19], then more productivity would call for less protection. Under our political economy setup, this would be counterintuitive given that a high ω together with a high A_i only indicate a stronger lobby and require more protection, not less.

The main result is that, based on a standard political economy model, we expect an organized sector with higher productivity to receive more protection because it has got more to gain for a marginal increase in the tariff rate, hence the domestic price level. Thus, this is a slight modification of the size effect identified by the influential work of Grossman and Helpman (1994) which has been tested and confirmed in various papers (like Gawande and Bandyopadhyay 2000, Goldberg and Maggi 1999, Mitra et al. 2002 and so on). More importantly, this basic observation naturally raises doubts about the assumption of exogeneity of trade policy with respect to productivity in the earlier empirical literature.

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[18]I have the same assumption throughout the text. This is not a necessary condition for the inequality in equation (3b) to hold or the other results to follow.

[19]Note that $D_i'(.) < 0$.

Before I extend this basic setup by introducing common shocks, I should note that we could potentially have a channel working in the opposite direction. That is, one can plausibly expect a less productive sector to obtain more protection. One way to model this is by allowing the political economy weight to differ across sectors based on certain sectoral characteristics as in Karacaovali and Limão (2005a).[20] For example, a sector with a higher share of employment is likely to have a higher weight given that it generates more political votes (Caves 1976). Or, sectors with lower wages may have a higher weight due to government and society-wide sympathy with their situation or simply because low wage workers have a lower opportunity cost of lobbying (Magee et al. 1989). Typically, low wage and labor intensive sectors are less productive so this could potentially reverse the results. I exclude such concerns from my model because I want to focus on the effect of productivity on tariffs in the presence of a big trade reform shock that affects all sectors and accounting for further sector characteristics would only complicate this analysis. Furthermore, I would like to obtain a tractable parsimonious econometric model from this theoretical setup. For example, I allow for such differences across sectors that could lead to different initial tariff rates by considering fixed effects in my estimations (Chapter 2).

1.2 Trade Reform

Nearly all the papers examining the trade reform-productivity linkage involve a period of unilateral liberalization which is usually considered to be an exogenous shock independent of productivity and common across sectors. Then, the exogeneity of the liberalization shock is used to defend the argument that we should not be worried about the endogeneity of trade policy. Therefore, I provide room for a unilateral liberalization motive common across sectors in order to create a similar setup and analyze its effects. We would like to see whether such a common shock does indeed produce a proportional, non-selective decline in tariffs.

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[20] In Grossman and Helpman (1994) we get a constant weight, such as the one I have.

In order to capture this common and exogenous shock argument, I simply augment the baseline government objective function, G, with an additional term, $\Sigma(\boldsymbol{\tau}) = \alpha \sum_{i=1}^{N} \sigma_i(\boldsymbol{\tau}_i)$. This extra term does not create a different economic structure, that is we still have consumers with quasilinear utility functions, a constant returns to scale production with no spillovers and so on. The government objective function can now be expressed as

$$\Gamma \equiv G + \alpha \sum_{i=1}^{N} \sigma_i(\boldsymbol{\tau}_i) \tag{4}$$

where G is the same as in equation (1), $\sigma_i(.)$ is increasing in $\boldsymbol{\tau}_i$ (and concave), and $\alpha > 0$ is a constant. $\Sigma(\boldsymbol{\tau})$ is meant to capture the government perceived benefit of using protective trade policy and would call for protection even in the absence of lobbying. One can think of the perceived benefit as a government view that favors import substitution or as an unquestioned historical legacy of trade protectionism. Initially, I use this approach to be able to clearly show that the tariff changes and levels depend on the productivity changes and levels even under the simplest setup of trade reform. However, in the next sub-section, I put more structure on the way liberalization manifests itself by modeling an infant industry argument, which is known to be a crucial protection motive for developing countries.

The equilibrium tariff rate obtained by maximizing equation (4) is given by[21]

$$\tau_i = (\omega - 1)\frac{A_i Q_i(\tau_i)/M_i(\tau_i)}{\varepsilon_i(\tau_i)} + \frac{\alpha \sigma_i'(\tau_i)}{M_i(\tau_i)\varepsilon_i(\tau_i)} \tag{5}$$

The first part of the expression in equation (5) is essentially the same as equation (2). The additional σ_i' term, on the other hand, captures the marginal perceived benefit of tariffs, again weighted by imports and import demand elasticity. I assume that the σ_i' terms are identical across sectors in order to get a uniform effect, that is $\sigma_i' = \sigma_j'$ for $i \neq j$. As I show

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[21]The derivation is similar to the one for equation (2), so it is omitted.

in the appendix section A, tariffs increase in the coefficient of perceived benefit

$$\frac{d\tau_i}{d\alpha} > 0 \tag{6}$$

Many developing countries, including Colombia, have gone through significant unilateral trade liberalization in the late 1980s through early 1990s. Moreover, it is often argued that such liberalization episodes can be interpreted as an exogenous shock mostly uniform across sectors. Thus, empirical researchers regress productivity on tariffs by exploiting this variation over time maintaining an exogeneity assumption. Now, I model such a unilateral liberalization shock as a dramatic decline in the parameter α, say, all the way down to zero.[22] Note that, this shock is modeled to be common across sectors on purpose and it does not depend on any industry characteristics. Yet, as we will see below, the political economy motives still affect tariffs so that the reduction in tariffs for a sector depends on the change in its level of production or size and hence, its productivity.

$$\Delta\tau_{it+1} \equiv \tau_{it+1}|_{\alpha=0} - \tau_{it}|_{\alpha>0} \tag{7}$$
$$= -\frac{(\omega-1)A_{it+1}Q_{it+1}(\tau_{it+1})}{M'_{it+1}(\tau_{it+1})} + \frac{(\omega-1)A_{it}Q_{it}(\tau_{it})}{M'_{it}(\tau_{it})} + \frac{\alpha\sigma'_i(\tau_{it})}{M'_{it}(\tau_{it})}$$

Then, using the linearity of M_i,[23] equation (7) can be re-expressed as

$$\Delta\tau_{it+1} = -(\omega-1)\frac{(\Delta A_{it+1})Q_{it}(\tau_{it}) + A_{it+1}(\Delta Q_{it+1})}{M'_i} + \frac{\alpha\sigma'_i(\tau_{it})}{M'_i} \tag{8}$$

The partial effect of A_{it} on τ_{it} is the same as given in equation (3a). Now, we also obtain

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[22]This change could be due to a contingent loan from the IMF or a policy recommendation from the World Bank which require certain stabilization and liberalization policies from our "small" country. Or it could be due to a change in the paradigm having observed the success of other comparable liberalizing countries and a new international consensus degrading import substitution type policies. For example, Edwards (1997) analyzes the role of the World Bank in its effect on trade liberalization reforms and acknowledges its contribution through research and policy dialogue.

[23]I assume that the paramaters do not change over time, and combining with the earlier linearity assumption we get $M'_{it+1}(.) = M'_{it}(.) = M'_i(.)$.

the following relationships between tariffs and productivity in levels and changes

$$\frac{d\tau_{it}}{dA_{it}}\Big|_{\alpha \geq 0} = -\frac{(\omega - 1)Q_{it}(\tau_{it})}{M'_{it}(\tau_{it}) + (\omega - 1)A_{it}Q'_{it}(\tau_{it}) + \alpha \sigma''_i(\tau_{it})} > 0 \qquad (9a)$$

$$\frac{d\Delta\tau_{it+1}}{d\Delta A_{it+1}}\Big|_{\tau_{it}, A_{it}} = -\frac{(\omega - 1)Q_{it+1}(\tau_{it+1})}{M'_i(.) + (\omega - 1)A_{it+1}Q'_{it+1}(\tau_{it+1})} > 0 \qquad (9b)$$

Equation (9a) is obtained by implicitly differentiating the first part of equation (5) (specific tariff) with respect to A_{it} whereas, equation (9b) is obtained by implicitly differentiating $\Delta\tau_{it+1}$ as expressed in equation (8) with respect to ΔA_{it+1} for given initial levels of τ_{it} and A_{it}.[24]

We see that a sector with higher productivity is expected to receive more protection and a sector with a bigger increase (or a lower decline) in productivity is expected to have lower reduction in tariffs despite an exogenous shock common across sectors. Thus, we have reasons to worry about the endogeneity of tariffs with respect to total factor productivity. Accordingly, in the empirical studies where the sector level productivity is regressed on the sector level tariffs that are assumed to be exogenous, there will be a direct reverse causality problem. In the case of the firm level productivity being regressed on the sector level tariffs, this problem will be smaller. However, to the extent that the firm level productivities of a sector differ commonly from the firm level productivities of the other sectors or the more correlated the firm level productivities are with the sector level productivities, the worse the endogeneity problem will be. In Chapter 2, I use productivity estimates obtained at the firm level that are then aggregated to the sector level using production shares as weights to arrive at representative productivity values for each sector.

Finally, notice that the productivity-tariff linkage above is completely driven by the political economy channel. If political economy is not a concern for the determination of tariffs for a given sector, that is, if the extra political economy weight is null ($\omega - 1 = 0$), then productivity has no effect on the tariffs. On the other hand, again because of political

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[24]Naturally, we also have $\partial\tau_{it}/\partial A_{it} > 0$ and $\partial\Delta\tau_{it+1}/\partial\Delta A_{it+1} > 0$.

economy, the reduction in tariffs varies across sectors based on productivity differences regardless of the common shock.

1.3   Government Perceived Learning-by-Doing

In this sub-section, I provide more structure for the liberalization process and the government perceived benefit of protection by introducing an infant industry argument. In developing countries, learning-by-doing and infant industry arguments have been a major motivation for protection which should be accounted for. Grossman and Helpman (1995) provide a comprehensive survey of the literature on technology and trade and indicate that "some countries might wish to use trade or industrial policies to alter their patterns of specialization... The short-run income loss for such a country would be small, while the policy would generate a permanent boost to its productivity growth..." (p. 1297). However, it should be noted that import substitution policies and infant industry protection have been largely abandoned especially after the 1980s and some critics have indicated that the infants actually never seem to grow (see, e.g., Krueger and Tuncer 1982). In this spirit, the trade liberalization episodes in the developing countries can be seen as a result of the disillusion about the infant industry argument. That is, the governments go from strongly believing in the argument to understanding that it does not work. I would like to examine the effect of such a shift in the government beliefs on the structure of liberalization. Therefore, I model a learning-by-doing (LBD) process which is merely a perception by the government.[25] Although there is no LBD, the government believes that there is some and thus sets its tariffs accordingly until it changes its view by realizing that this is a false perception and then embarks upon a trade reform.[26]

More specifically, the government believes that producing more today has a positive

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[25]I gratefully acknowledge Nuno Limão for his suggestions here.

[26]Edwards (2001) notes that César Gaviria (President of Colombia 1990-1994) "developed from early on a critical view regarding CEPAL's import substitution development strategies, then in vogue in most of Latin America."

impact on tomorrow's productivity and hence takes this relationship into account while determining its current trade policy. On the other hand, the firms decide about their production by simply reacting to the prices determined by the government trade policy and their decisions do not depend on any LBD process. For simplicity, I assume that the government has a two-period policy setting horizon.[27] This assumption is not only computationally convenient but also helps us partially capture the real experience in Colombia[28] which I study in Chapter 2.

In this setup, I aim to provide a plausible explanation for the way unilateral liberalization is introduced. The liberalization shock is common across sectors as in the basic model but the government's perceived benefit of the protection now has a specific reasoning based on a LBD process.

I model the government objective in equation (1), but now the government has the following belief about the form of the supply function

$$X_{it}(\tau_{it}) = A_{it}(\phi_{it}, \lambda_{it})Q_{it}(\tau_{it}) \tag{10}$$

$A_{it}(.)$, like before, denotes the total factor productivity, $\lambda_{it} = \lambda(X_{it-1}, X_{it-2}, ...)$ represents the learning-by-doing process, and ϕ_{it} stands for the determinants of TFP that are independent of LBD. The government believes that $\lambda(.)$ is an increasing function of past production within the same sector, that is $\lambda'(.) > 0$. Note that the true supply function is actually $X_{it}(\tau_{it}) = A_{it}(\phi_{it})Q_{it}(\tau_{it})$. Each period, the government sets tariffs considering their current effects on the weighted social welfare as discussed in the previous section but now it additionally considers the perceived future effects of current tariffs via learning-by-doing.

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[27]One can think that the government sets trade policy quite infrequently such that tariffs are first determined when the government believes that there exists a strong learning-by-doing process at play and later when this perception is discarded because productivity gain is not observed or the process reaches its terminal point. Alternatively, this might be a short lived government that expects to be in power for two periods only.

[28]This is a feature shared by many other developing countries such as Turkey, Brazil, and India that experienced significant amounts of liberalization around the 1983-1985, 1991-1996, and 1990-1993 periods, respectively.

The equilibrium tariffs for period t can be obtained as

$$\hat{\boldsymbol{\tau}}_t \equiv \arg\max_{\tau_t}[G_t + \delta E_t(G_{t+1}|\iota_t)] \tag{11}$$

where the G_j terms are defined as in equation (1) but with time subscripts and $X_{it}(.)$ takes the form in equation (10). ι_t denotes the information set of the government in period t, and $\delta < 1$ is the time discount factor. At period t the government knows that TFP has some baseline value $A_{it}(.) = \phi_{it}$ and believes that the future expected TFP is given by $E_t(A_{it+1}(.)) = E_t(\phi_{it+1}\lambda_{it+1}) = \overline{\phi}_{it+1}\lambda(\phi_{it}Q_{it}).$[29]

Solving backwards, we obtain the tariffs for period $t + 1$. The realized values of these tariffs are set after the government observes A_{it+1} and finds out that there is actually no LBD. Therefore, the actual period $t+1$ tariff rate is equal in its form and actual value to the one in equation (2). On the other hand, in order to determine the tariffs set in period t, the government needs to compute the future expected welfare which depends on the expected period $t + 1$ tariffs. Given that there are two periods, the expected tariffs for period $t + 1$ have the standard form similar to equation (2); however, due to the LBD process, each of its components, hence itself is expected to depend on period t tariffs

$$E_t(\tau_{it+1}) = \tau_{it+1}^e(\tau_{it}) = (\omega - 1)\frac{\overline{\phi}_{it+1}\lambda(X_{it}(\tau_{it}))Q_{it+1}(X_{it}(\tau_{it}))/M_{it+1}(X_{it}(\tau_{it}))}{\varepsilon_{it+1}(X_{it}(\tau_{it}))} \tag{12}$$

As I show in Section A in the appendix, the equilibrium tariff rate for period t is obtained from equation (11) such that the tariffs now include the perceived learning-by-doing motive in addition to the political economy channel.

$$\tau_{it} = (\omega - 1)\frac{\phi_{it}Q_{it}(\tau_{it})/M_{it}(\tau_{it})}{\varepsilon_{it}(\tau_{it})} + \delta\omega\frac{\Lambda_i/M_{it}(\tau_{it})}{\varepsilon_{it}(\tau_{it})} \tag{13}$$

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[29]Note that the government is not taking expected values over alternative values of ϕ_{it+1}. Instead it expects ϕ_{it+1} to be equal to $\overline{\phi}_{it+1}$ with probability 1.

The variable Λ_i stands for the LBD effect and it is defined as

$$\Lambda_i \equiv \left(\frac{\lambda'(\phi_{it}Q_i(\tau_{it}))}{\lambda(\phi_{it}Q_i(\tau_{it}))} \phi_{it}Q'_{it} \right) \int_0^{1+\tau_{it+1}^e} \overline{\phi}_{it+1}\lambda(\phi_{it}Q_{it})Q_{it+1}d\tau_{it+1} > 0 \qquad (14)$$

Thus, Λ_i measures the government perceived growth in productivity due to the LBD process multiplied by the responsiveness of current supply to tariffs and weighted by the future producer surplus. The tariff rate is increasing in the additional LBD term since the government considers the positive effect of increased production through protection today on tomorrow's welfare.

Let's consider the following functional form for the LBD process[30]

$$\lambda_{it+1} = \lambda(X_i(\tau_{it})) = [\phi_{it}Q_i(\tau_{it})]^n, \, n < 1 \qquad (15)$$

Next, in order to see the effect of productivity on tariffs, we plug equation (15) in equation (13) and, as I show in the appendix section A, obtain

$$\frac{d\tau_{it}}{d\overline{\phi}_{it+1}} > 0 \qquad (16a)$$

$$\frac{\partial\tau_{it}}{d\phi_{it}} > 0 \qquad (16b)$$

$$\frac{d\tau_{it}}{d\phi_{it}} > 0 \qquad (16c)$$

Thus, assuming that ϕ_{it}, the part of the government perceived productivity that is independent of the LBD process, and $\overline{\phi}_{it+1}$, its future expected value, are positively correlated with the actual underlying determinants of TFP, the tariff rate increases in the current and expected future productivity. This might be one of the reasons why we need to worry about using lagged tariff rates as a way to get around the endogeneity problem while regressing productivity on tariffs. More importantly, the positive effect of productivity on tariffs

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[30]I assume $\lambda(.)$ is concave. Otherwise, in the multi-period case, tariffs could be raised unboundedly which is quite unrealistic.

confirms the main result in my basic model in this richer setup.

Next, I also confirm that the change in tariffs is positively related to the change in productivity as in the previous section[31]

$$\frac{d\Delta\tau_{it+1}}{d\Delta\phi_{it+1}}|_{\tau_{it},\phi_{it}} > 0 \tag{17}$$

We see that, introducing a government perceived LBD process adds a new channel of protection and a structure for the onset of the unilateral trade liberalization. However, the productivity to tariff linkages, as established in the basic political economy model, prevail.

As a final note, I acknowledge that in several empirical studies, declining industries such as textiles, clothing, footwear, and steel receive more protection in industrialized nations. Therefore, these studies naturally look at developed countries and especially US for evidence (see for example Baldwin 1985, and Marvel and Ray 1983). On the theory side, two recent papers that build up on Grossman and Helpman (1994) are worth noting: Baldwin (2002) uses a monopolistic competition model with sunk entry costs and random Markov process demand shocks; whereas, Tovar (2004) introduces loss aversion in preferences. One implication from these papers is that less productive sectors could receive more protection. However, none of the models on declining industries specifically account for unilateral liberalization or focus on establishing a link from productivity to trade policy. The models I presented in this and previous sections intend to show this link in the presence of unilateral liberalization which is taken to be an exogenous shock and hence used as the working assumption to identify the effects of tariffs on productivity in the earlier literature. Yet, the common denominator of my models and implications from these is that productivity matters for trade policy. Thus, how productivity specifically affects tariffs needs to be tested and documented empirically as I do in the next chapter.

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[31]Apart from the supposedly temporary nature of protection due to the infant industry argument, I assume that in period $t + 1$ the government actually realizes that the LBD process is not working. See the appendix section A for the derivation.

2 Productivity Matters for Trade Policy: The Evidence

2.1 Empirical Literature Overview

In this section I discuss the existing empirical literature to the extent that it relates to this paper. Tybout (1991) briefly reviews the literature that contains implications for the linkages between trade and productivity, and he indicates that the net effect of a liberalization episode is ambiguous. Therefore, a majority of the studies that appear in the last decade remain empirical and do not test any particular theory.[32,33]

Nearly all researchers take a two-step approach, where they first estimate (total factor) productivity usually at the firm level (and some at the sector level), and then regress this productivity estimate on trade policy measures such as import penetration or tariffs for a single country (e.g., Fernandes 2003, Schor 2004, and Tybout and Westbrook 1995). Another strand of the literature focuses on the effect of imperfect competition in estimation and seeks to analyze the change in price-cost margins after liberalization (Harrison 1994, Krishna and Mitra 1998 and so on).[34]

Although nearly all studies neglect the endogeneity issue, Fernandes (2003) is one exception. She uses lagged tariff rates instead of current ones due to her worry with the endogeneity problem. She also considers the variables from Trefler's (1993) non-tariff barrier (NTB) equation as instruments for tariff rates as a robustness check. Using lagged tariff rates is not appropriate if the true model relates them in the same period. Then a better so-

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[32]The motivation for the micro-level liberalization impact studies is based on two basic conjectures. First, trade liberalization may produce a productivity growth for the firm and the industry through economies of scale, improved access to foreign technology, and elimination of X-inefficiencies. Second, liberalization may reallocate resources from the less efficient to the more efficient firms after the less efficient ones exit, hence provide a rise in the average productivity.

[33]There are also ex-post theoretical studies that provide an explanation for some of the results found in the recent empirical research. For example, in an influential paper, Melitz (2003) shows how industry productivity may grow due to reallocation between firms after an exogenous trade reform shock.

[34]In this paper, I focus on the single-country micro studies and relate my results directly to these. However, there is also a related group of empirical papers where authors analyze cross-country growth regressions (as summarized in Harrison 1996) linking openness to output growth. Such studies miss the micro variation, which is crucial in distinguishing among various channels of productivity changes, in the data. A recent criticism of these studies appears in Rodriguez and Rodrik (2001) who are in turn criticized by Srinivasan and Bhagwati (2001).

lution could be to use the lagged tariff rates as an instrument to current ones. Moreover lagged tariff rates might not get around the endogeneity problem, because trade policy might differ across sectors due to persistent factors related to productivity. For instance, productivity might be autocorrelated, or tariffs may be influenced by anticipated changes in productivity as predicted by one of my theoretical results. What is more, the validity of the instruments initially used by Trefler (1993) for a different study is debatable since some of the instruments (like import penetration or regional concentration) could very well be influenced by productivity, and hence be endogenous themselves.[35] Muendler (2004) is another exception in trying to control for the endogeneity of trade policy. He regresses the growth rate of productivity on both tariffs and import penetration at the same time. He considers certain components of the real exchange rate as instruments for the trade policy measures.[36] However, both nominal and real exchange rates lack sectoral variation and cannot explain why tariff rates differ across sectors.[37]

Harrison (1994) uses time dummies for capturing trade liberalization but these do not account for firm/industry level variation in policy. She also considers tariff changes and import penetration in her estimations by interacting the trade policy measures with the relevant mark-up variable. These estimations invariably suffer from the same endogeneity problems I discussed above.

Pavcnik (2002) takes yet another approach and compares productivity changes in tradable versus non-tradable sectors around a trade liberalization period, finding that import sectors experienced a larger increase in productivity relative to non-tradable sectors but results are inconclusive for export-oriented sectors.[38] This methodology does not account

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[35]Fernandes (2003) acknowledges that these robustness results are not reliable, as some of her instruments are clearly correlated with productivity.

[36]The measures are the nominal dollar exchange rate, the average sector-specific European and US-Canadian producer price indices, and the Brazilian consumer price index. Muendler (2004) recognizes that the domestic prices can be correlated with the productivity of firms so does not consider this as one of his baseline instruments but rather keeps it as a component of the real exchange rate.

[37]Note that, I show in my theoretical model and the corresponding estimations that tariffs directly depend on import penetration as well as import penetration depends on tariffs in a systematic way so this might further create multicollinearity problems in Muendler's (2004) estimations.

[38]Ozler and Yilmaz (2003) use the same approach to analyze the effect of trade liberalization on produc-

for the sectoral variations in policy as well. Furthermore, Tybout (1996) notes that firms usually self-select their trade-orientation and if more productive firms are more likely to become an exporter, then one must use caution in asserting a casual relationship from policy to performance. Pavcnik (2002) also regresses productivity on tariffs and import penetration as a robustness check, and she does not control for the endogeneity of trade policy.

In the next section, I discuss the trade policy in Colombia during the sample period of 1983 through 1998, and describe how we can rule out a uniform change in tariffs across sectors. Then in the remaining part of this chapter, I explore more structural evidence and make an empirical analysis based on the predictions from my theory using Colombian data for the 1983-1998 period.

2.2 Trade Policy in Colombia

Colombia is a perfect example of a developing country that went through phases of heavy trade protection prior to the mid-1980s and finally a dramatic unilateral trade liberalization in the early 1990s, as can be seen in Figure 1. Therefore, it is no surprise that Colombia has been used as the case study of several papers to examine the impact of trade reform on productivity (for example, Roberts 1996; Fernandes 2003; Melendez, Seim and Medina 2003).

The barriers were first lowered during the 1977-1981 period in response to an increase in coffee prices, increased foreign borrowing, and drug trafficking (Fernandes 2003). On the other hand, the Latin American debt crisis and worsening terms of trade led to an increase in protection in the first half of the 1980s (Edwards 2001). President Virgilio Barco Vargas started the initial movement towards a real trade reform after he took office in 1986. He was succeeded by President César Gaviria who completed the trade reform swiftly in two years (1991 and 1992).[39]

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tivity in Turkey.

[39]The factor markets were also liberalized during this period. For example, the labor costs are estimated to be reduced by approximately 60% to 80% (Kugler 1999) due to the labor market reform. These additional

I focus on protection through tariffs in my empirical estimations which directly follows from my theory (Chapter 1) and is consistent with the productivity studies in the literature. Note that import licenses were also commonly used in conjunction with the tariffs prior to the trade reform. On the other hand, the trade reform not only rolled back the tariff rates but also almost eliminated the import licenses (Edwards 2001). Thus, a reduction in one form of protection was not replaced with another. Moreover, the tariff rates tend to be better measured and they are positively correlated with the import licenses. However, I also have access to the effective rate of protection (ERP) data which I use to augment my results with tariffs. The effective rates take into account the tariffs on inputs, and they are based on value added. They are considerably higher than nominal rates but show a similar pattern with tariffs as can be observed from Figure 1. Amiti and Konings (2005) find that in Indonesia, the reduction in input tariffs have a stronger positive effect on productivity gains so it is important to address how this measure of protection also depends on productivity.

As I mentioned above, nearly all studies in the trade reform and productivity literature neglect the endogeneity of trade policy. Although some authors (e.g., Pavcnik 2002 for Chile; Ferreira and Rossi 2003 for Brazil) acknowledge the potential for endogeneity, they argue that it may not be such an issue in their studies given that tariffs were reduced uniformly or proportionally across sectors. This is not true at least for Colombia; the liberalization was not uniform. Edwards (2001) notes that the trade liberalization reform of Colombia ("*La Apertura*") was "announced during the presidential campaign [of Cesar Gaviria] as a 'gradual' and 'selective' process." As can be observed from Figures 2 through 4, there is quite some variation in the tariff reductions across sectors.[40] Moreover, the Spearman's rank correlations of tariffs in Table 1 indicate that the correlations reduced over time, implying a selective process as opposed to a uniform one in liberalization. Otherwise, the ranking of sectors in terms of their protection rate would not change.

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reforms facilitate reallocation between firms and could potentially complement the productivity-enhancing effects of the trade reform if anything. However, the trade reform is still the most dramatic of all, by both Latin American and world standards (Edwards 2001).

[40]Note that the reductions are computed as percentages to account for the variation in the initial tariffs.

The average advalorem tariff rates in my sample of 4-digit ISIC industries declined from 43% in 1983 to about 14% in 1992 and stayed around that rate in the following years (Table 2). The dispersion of tariffs across sectors also declined (Table 2). If we just look at the standard deviations, the decline appears markedly higher. However, we need to take into account the differences in magnitude and the coefficient of variation[41] is a better measure for that matter. The decline in dispersion is notably lower when we use the coefficient of variation. However, this outcome does not indicate that political economy is no more a factor in tariffs after reform. The decrease in dispersion is predicted by my models (Chapter 1) given the fact that the liberalization occurs through the elimination of some extra channels other than political economy.

Next, I aim to empirically show that the reduction in tariffs was a selective process due to political economy. More particularly, I would like to test my theory which predicts that tariffs depend on productivity, and liberalization across sectors differs based on productivity changes despite a common exogenous shock.

2.3   Econometric Model

In Chapter 1, I present two similar models of tariff policy where political economy is the common determinant. Moreover, the government has some positive perception about using tariffs which serves as the extra channel for protection. Both models imply protection even in the absence of political economy. A large negative shock, which is common across sectors, appears through these channels and serves as the source of trade liberalization.

In the estimations, I intend to capture the common features of protection and liberalization implied by my models. According to the political economy channel, tariffs are inversely related to import penetration (that is Imports/Domestic Production) and import demand elasticity. Recall that the production function is denoted as $X_{it} = A_{it}Q_{it}$ where A_{it} stands for total factor productivity (TFP) and we have the following definition: *In-*

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[41]Coefficient of variation is the mean divided by the standard deviation of a given group.

verse Import Penetration/Import Demand Elasticity$= \frac{A_{it}Q_{it}/M_{it}}{\varepsilon_{it}}$. The additional source of tariff protection causes a major unilateral liberalization when it vanishes. This occurs after the paradigm changes as discussed in Section 1.1, or after learning-by-doing is realized to be a false perception as in Section **??**. I model the additional channels of protection under both models with a combination of overall and sector specific constants. Then, the trade reform that occurs due to the disappearance of such motives is a shift in the intercept terms (constants) of the tariff determination rule. Given the parsimonious nature of the models, the sector-specific effects also help to control for the other determinants of tariffs that may not be already considered.

As illustrated in Figure 1, tariffs in Colombia declined drastically starting in 1990 and liberalization continued until 1992. Based on the theory, I first start out by assuming that liberalization is a major, once and for all shift in tariffs and relax this assumption afterwards. I capture the shift with a dummy variable, $UNILIB_t$, that takes the value one for 1990 and onwards, and zero otherwise. The basic econometric model[42] can then be expressed as

$$\log \tau_{it} = \alpha + \beta_1 \log(Q_{it}/M_{it}\varepsilon_{it}) + \beta_2 \log A_{it} + \beta_3 UNILIB_t + \mu_i\beta_4 + u_{it} \qquad (18)$$

where τ_{it} is the advalorem tariff rate for sector $i = 1, ..., N$ at period $t = 1, ..., T$. Note that the effect of A_{it} (TFP) on tariffs is taken in isolation with the use of logarithms. $Q_{it}/M_{it}\varepsilon_{it}$, together with A_{it}, are measures of the main political economy channel.[43] μ_i is a $1 \times (N-1)$ vector of industry dummy variables and depicts sector-specific effects. $UNILIB_t$ serves as an intercept-shifter with the interpretation I described above. According to the theory, we expect positive estimates of β_1 and β_2. On the other hand, the estimate of β_3 should be naturally negative by definition (it is a unilateral liberalization).[44]

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[42] I am assuming no autocorrelation in the error terms, and no spatial correlation between the sectors but heteroskedasticity which I test and confirm in the next section.

[43] Q_{it} is not directly observable but it is estimated by dividing X_{it} by the estimate of A_{it}.

[44] α, β_1, β_2, and β_3 are scalars, whereas β_4 is an $(N-1) \times 1$ vector of coefficients.

In my theory outlined in Chapter 1, the liberalization shock results in a one time permanent decline in tariffs although it is not necessarily how a real reform progresses. By looking at Figure 1, we can distinguish three periods with plausibly different intercept terms: 1983-1989 (pre-reform), 1990-1992 (reform), and 1993-1998 (post-reform). What is more, there exists considerable variation within the pre-reform and reform periods.[45] Therefore, I estimate two different versions of equation (18). In the first version, I replace $\beta_3 UNILIB_t$ with $\rho_1 REF_t + \rho_2 POSTREF_t$, where REF_t is a dummy variable which equals one for 1990-1992 and zero otherwise. Similarly, $POSTREF_t$ is equal to one for 1993-1998 and zero otherwise.[46] Both control for the shift in tariffs in their respective periods relative to the constant term, α. In the second version, I replace $\beta_3 UNILIB_t$ with $\theta_t \gamma$ where θ_t is a $1 \times (T-1)$ vector of year dummies that capture the yearly common variation in tariffs and further relaxes the assumption of a one time overall tariff reduction.[47]

Next, to eliminate the fixed effects, I use a first-differenced model based on the basic equation (18)

$$\Delta \log \tau_{it} = \beta_1 \Delta \log(Q_{it}/M_{it}\varepsilon_{it}) + \beta_2 \Delta \log A_{it} + \beta_3 \Delta UNILIB_t + v_{it} \qquad (19)$$

where the error term is $v_{it} = \Delta u_{it}$ and it is essentially autocorrelated so I correct for autocorrelation in my estimations. Given the definition of $UNILIB_t$, $\Delta UNILIB_t$ becomes just a year dummy for 1990. This may not be adequate to capture the action in the actual data. When we take first differences, the differenced data for 1983, 1985, and 1988 automatically gets dropped given the gaps in the sample. Moreover, the trade liberalization took place gradually between 1990 and 1992. I consider this downward trend in the reform years by employing a different version of equation (19), where I replace $\beta_3 \Delta UNILIB_t$ with φREF_t. REF_t is a dummy variable for 1990-1992 as above, and φ is a scalar. I

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[45]Tariffs actually increase between 1982 and 1984 and then start to decline in 1985. The sample, on the other hand, only includes 1983, 1985, and 1988-1990 for the pre-reform era. Between 1983 and 1988 the trend for tariffs is a gradual decline within the sample.

[46]ρ_1 and ρ_2 are scalars.

[47]γ is a $(T-1) \times 1$ vector of coefficients.

also estimate this modified version of equation (19) with a constant term to account for the small tariff changes before and after the reform period where the interpretation of REF_t becomes the deviation from the constant term.

There are potentially endogeneity problems in the estimation. First, $Q_{it}/M_{it}\varepsilon_{it}$ is endogenous with respect to tariffs since it depends on domestic prices, hence on tariffs. Second, previous empirical work documented that trade policy affects productivity which requires accounting for a potential reverse causation. I use the following list of instruments to deal with the endogeneity issues: capital to output ratio, materials prices, a measure of scale economies (value added/number of firms), and the TFP of the upstream industries.[48] Instruments should be correlated with the endogenous regressors and yet be orthogonal to the error term. I present the formal tests of instrument validity in Section 2.6 but I would like to provide some intuition here. Capital share is expected to be negatively related to output/imports ratio (Q_{it}/M_{it}) given that Colombia is more likely to produce products with smaller capital content and import those rich in capital based on a comparative advantage argument. The materials prices affect the domestic output prices, hence $Q_{it}/M_{it}\varepsilon_{it}$ but not the tariffs of a given sector i, conditional on Q_{it}, M_{it}, and ε_{it}. Scale is positively correlated with productivity and it is an inherent characteristic of a sector. The productivity of a sector is also expected to be affected from the embodied upstream productivity which is likely to be independent of the sector's own tariffs.

Since the model is quite parsimonious, it is also prone to an omitted variable bias. The use of fixed industry effects in equation (18) and its different versions, and the first differencing in equation (19) and its different versions should alleviate this potential problem along with the Instrumental Variables (IV) estimation.

Finally, note that my productivity measure is a generated regressor as noted below. This could potentially create measurement error and affect the efficiency and consistency of the estimate for the effect of productivity on tariffs. However, Pagan (1984) notes that when

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[48]The detailed variable definitions and sources are in the appendix section B.2.

generated residual levels are used in a two-step regression framework, the estimates will be consistent and efficient. Thus, this measurement error is abated in my work, since the productivity estimates are the estimated residuals from Eslava et al. (2004) which I use in a two-step efficient GMM estimation.

In the rest of this chapter I present and discuss the data, results, and robustness of my estimations. Then in Section 2.7, I test how accounting for the endogeneity of tariffs with respect to productivity affects the regressions that analyze the impact of trade reform on productivity.

2.4   Data

The base data for the estimations span 1982 through 1998 but given the lack of tariff and production information for certain years the sample reduces to 1983, 1985, and 1988-1998. The tariff and effective rate of protection (ERP) figures are obtained from DNP (National Planning Department) of Colombia at the 8-digit product level,[49] which are then aggregated to the 4-digit ISIC sectors by using simple averages.[50] The 4-digit ISIC level import data come from the COMTRADE dataset, United Nations Statistics Division and the industry production data at the same level are available through UNIDO's Industrial Statistics Database.

Productivity estimates[51], value added, inputs, and materials prices data are obtained from Eslava, Haltiwanger, Kugler and Kugler (2004), where each variable (except value added[52]) is aggregated from the firm level to the 4-digit ISIC industry level with production shares used as weights. The main data source for Eslava et al. (2004) is the Colombian

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[49]The product classification code, called "Nabandina", is due to the Andean Community of Nations. I thank Marcela Eslava at Universidad de Los Andes/CEDE, Colombia for generously sharing the data.

[50]I use simple averages to be consistent with the earlier literature. An alternative way would be to use the import or production shares of each product as weights but these data do not exist for all sample years at this level of disaggregation.

[51]I consider total factor productivity in line with the literature and I am trying to address endogeneity in the context of these productivity studies.

[52]Value added is used to compute a measure of scale economies where it is an unweighted total in each sector.

Annual Manufacturers Survey (AMS) by DANE (National Statistical Institute). I discuss further details about the productivity estimates below in Section 2.4.1.

The import demand elasticity measure is based on the structural estimates in Kee, Nicita and Olarreaga (2004), which I combine with the GDP data from World Development Indicators (WDI), and import data from COMTRADE. The import demand elasticities are available only at the 3-digit ISIC level.[53]

In order to obtain the TFP measure of the upstream industries, I employ the input-output tables provided at the 3-digit ISIC level by Nicita and Olarreaga (2001), which were compiled from version 4 of the Global Trade Analysis Project (GTAP) database. Excluding the inputs being used from the own sector, the upstream measure is based on a combination of TFPs of the remaining input sectors as weighted by their share of usage.

The variable definitions and sources are presented more in detail in the appendix section B.2. In Table 4, I provide the summary statistics for all the variables I use in the estimations.

2.4.1 Productivity Estimates

The productivity estimates come from Eslava, Haltiwanger, Kugler and Kugler (2004). Eslava et al. (2004) estimate total factor productivity (TFP) as the residual from the following production function for each firm $i = 1, ..., N$ and period $t = 1982, ..., 1998$

$$\log X_{it} = b_1 \log K_{it} + b_2 \log L_{it} + b_3 \log E_{it} + b_4 \log I_{it} + \log A_{it} \qquad (20)$$

where K_{it}, L_{it}, E_{it}, and I_{it} denote capital, labor (total employment hours), energy consumption, and materials, respectively. An important concern in such an estimation is the simultaneity bias; that is, productivity shocks may be correlated with the inputs. They correct for this bias by considering a measure of downstream demand as an instrument for inputs along with regional government expenditures and input prices.

A great advantage of the Eslava et al. (2004) dataset is that it involves plant level input

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[53]See the appendix section B.1 for a discussion on how the import demand elasticity is computed.

prices which have not been available to other researchers in the field requiring them to use non-parametric estimation techniques instead of the structural estimation of the production functions.[54] Furthermore, output measures commonly used in the literature have usually been the firm revenue deflated by the industry-level prices. Thus, within-industry price differences (e.g. due to different markups) have been part of the output and productivity estimates of such studies, potentially biasing their results.

2.5 Estimation Results

Before we move on to the results, let us first observe the simple correlations of total factor productivity and tariffs. The overall correlation coefficient for $\log A_{it}$ and $\log \tau_{it}$ in the whole sample of 920 observations is -0.222. This is significant at the 1% level and can be observed graphically in Figure 5 as well. In Table 3, I present the correlation matrix for all combinations of $\log A_{it}$ and $\log \tau_{it}$ across years. The two variables again have a relatively small negative correlation for the most part which is insignificant for certain years such as 1992 through 1994. These relationships also appear in Figure 6 which includes plots of TFP versus tariffs by year. In Table 3, it is interesting to note that the two variables can be concurrently and also intertemporally correlated. This is one reason why using lagged tariff rates may not get around the endogeneity problem of tariffs with respect to productivity. Topalova (2004) notes a similar pattern in the Indian data for the 1997-2001 period and excludes this period from her analysis due to her concern about endogeneity.

However, we cannot establish a causal relationship between tariff protection and productivity with these crude observations alone. We need to control for the other important variables as required by the theory and tackle the endogeneity issues. In this section, I show how productivity influences tariffs after I control for the endogeneity of productivity. Later in Section 2.7, I estimate a system of equations related to this setup and show that

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[54]The methodology in these studies was developed by Olley and Pakes (1996), and advanced by Levinsohn and Petrin (2003). They employ investment or intermediate inputs to control for the correlation between input levels and unobserved firm-level productivity shocks.

accounting for the effect of productivity on tariffs strengthens the positive impact of trade reform on productivity.

As noted in Section 2.3, the two right-hand-side variables–inverse import penetration to import demand elasticity ratio, and total factor produtivity–in the tariff regressions are potentially endogenous which I confirm in the next section. I use instrumental variables to address this problem. More specifically, I employ the two-step efficient generalized method of moments (henceforth IV-GMM) estimator with either fixed effects or first differences for my unbalanced panel. This methodology is more efficient than regular instrumental variables in the presence of heteroskedasdicity of unknown form due to its use of an optimal weighting matrix (Cragg 1983). A Pagan-Hall (1983) test confirms the presence of heteroskedasdicity in the data and further justifies the use of IV-GMM methodology.

In Table 5, I present the main estimation results. In column 1, we have the estimates for equation (18). As predicted by theory, tariff rates depend positively on the inverse import penetration to import demand elasticity ratio ($Q_{it}/M_{it}\varepsilon_{it}$) and positively on total factor productivity (A_{it}). The coefficients for the two main variables, β_1 and β_2, are positive and statistically significant at the 1% level. The unilateral liberalization variable, $UNILIB_t$, takes out the common reduction in tariffs after 1990, and it is significant and negative as expected. In column 2, I provide the estimates for the fist variant of equation (18). Here, we take into account the variation in data by dividing it into three periods as opposed to imposing a one time major decline in tariffs. The two intercept-shifters, REF_t (period dummy for 1990-1992) and $POSTREF_t$ (period dummy for 1993-1998), control for the common decline in tariffs across sectors relative to the 1983-1989 period and come out negative and significant. Thus, the results are in line with the ones in column 1. In column 3, we have the estimates for the second variant of equation (18) that allows for further variation across time with the year effects and captures the gradual decline in tariffs. Both β_1 and β_2 are still positive and statistically significant at the 1% level in columns 2 and 3. The year dummies in column 3 are jointly significant just like the industry fixed effects are

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in all three equations.

A positive coefficient on $Q_{it}/M_{it}\varepsilon_{it}$, such that tariffs are inversely related to import penetration and import demand elasticity is a result consistent with the previous findings in the empirical political economy literature (such as Gawande and Bandyopadhyay 2000 for the US, Mitra et al. 2002 for Turkey, and Karacaovali and Limão 2005a for the EU). A positive coefficient for A_{it}, that is more productive sectors receive higher tariff protection, complements this result and confirms my major theoretical prediction. This result is also important because none of the earlier researchers separate the size effect into A_{it} and Q_{it}. Moreover, I account for the exogenous unilateral liberalization shock common across sectors in all specifications so there is no doubt that political economy does matter for the sectoral variation in tariffs. Therefore, endogeneity of tariffs with respect to productivity is a prevailing problem when researchers plainly regress tariffs on productivity.

In Table 6, I provide the estimates of equation (18) and its variants that measure the effect of yearly productivity changes on tariff changes with the first differenced data. The methodology is still IV-GMM and I employ the first differences of each instrument from Table 5. The sample now reduces to 1988-1998 given the gaps in data. In column 1, β_1 and β_2 have the expected signs but are not significant. This result is not surprising given that $\Delta UNILIB_t$ fails to recognize the gradual decline in tariffs and acts as a single year effect for 1990. I correct for this by estimating equation (18) and replacing $\Delta UNILIB_t$ with a common term for the 1990-1992 period (REF_t) during which the liberalization took place step by step (column 2). In this version, β_1 becomes significant at the 10% level and β_2 at the 5%. REF_t has a negative and significant (at the 1% level) coefficient capturing the common downward trend. In column 3, I further allow for a common constant term on top of REF_t recognizing the small changes in other years, and both β_1 and β_2 become significant at the 5% level. These results indicate that due to political economy, the extent of liberalization is smaller for sectors that have a smaller reduction or higher increase in productivity as compared to similar sectors. Note that in all differenced results, β_1 and β_2

are statistically identical, which is predicted by the model. In levels, this may not occur because of fixed effects.

Although the theoretical section involves protection through tariffs, I repeat the specifications in Table 5 and Table 6 with effective rates of protection (ERP) in order to see whether the results hold with a different measure of protection. Effective rates are based on value added and essentially take into account the effect of tariffs on inputs as well. ERP data are provided by the National Planning Department of Colombia (DNP) and I am limited by their computations since I do not have the detailed data to calculate them myself. As can be observed from Figure 1, and Table 4 the effective rates are higher than the regular tariff rates but otherwise display a similar trend. I exclude the three sectors[55] that exhibit negative ERP (in levels not logs), because it is hard to argue that these sectors are indeed protected. In Table 7, I repeat the specifications from Table 5 and the results appear to be totally consistent. The only difference is that the significance levels for the main variables are lower, and the constant term becomes insignificant in columns 2 and 3. The same arguments apply to the figures in Table 8 which are the replicas of estimates from Table 6 with ERP. The results are again qualitatively similar but less significant.

In the next section, I provide specification tests and some sensitiviy analysis for the main estimations I covered. Then, in Section 2.7, I discuss how accounting for the endogeneity of tariff policy, as implied by my theoretical and empirical results, may improve the estimates of the effect of trade reform on productivity.

2.6   Robustness and Specification Tests

In Table 9, I examine the effect of past productivity on current tariffs to check whether policy implementation occurs with a one period lag although it is not part of the model. I employ one period lags of scale and upstream TFP as instruments for the lag of productivity,

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[55]The excluded sectors are: a) ISIC 3122, manufacture of prepared animal feeds; b) ISIC 3512, manufacture of fertilizers and pesticides; c) ISIC 3822, manufacture of agricultural machinery and equipment.

and hence repeat the specifications in Table 5 with $\log A_{it-1}$ instead of $\log A_{it}$. I find that more productivity yesterday calls for more protection today in all three specifications. However, precaution is required while interpreting this result since it might be picking up the persistence in tariffs as well.

In tables 10 and 11, I present the biased ordinary least squares (OLS) results for comparison. In Table 10, I provide the estimates of equation (18), and in Table 11 the estimates of equation (19) with OLS using both tariffs and effective rates of protection. The OLS coefficients have the same signs as the IV-GMM estimates but they are smaller. In addition to that, $\log(Q_{it}/M_{it}\varepsilon_{it})$ and $\Delta \log(Q_{it}/M_{it}\varepsilon_{it})$ have significant coefficients in all specifications while the coefficients for $\log A_{it}$ and $\Delta \log A_{it}$ are insignificant in all except the one for $\Delta \log A_{it}$ in Table 11, column 2.

I confirm the endogeneity of $\log(Q_{it}/M_{it}\varepsilon_{it})$ and $\log A_{it}$ econometrically through a Durbin-Wu-Hausman endogeneity test, which further justifies the use of instrumental variables instead of OLS. Furthermore, the Hansen-Sargan (Hansen 1982 and Sargan 1958) test of overidentifying restrictions indicate that the instruments are valid, that is they are uncorrelated with the error term and correctly excluded from the estimated equations.[56] The probability value for the null hypothesis that the instruments are valid, range from 0.144 to 0.933 for the main specifications presented in Table 5. The Hansen-Sargan test probability values are presented in the last row of each relevant table and they have high values, as desired, for the estimations in first differences (Table 6) as well. The Hansen-Sargan tests fail for the ERP specifications in levels (Table 7) but not in differences (Table 8). Given the endogeneity and good performance with tariffs, it is prudent to keep these instruments and ensure comparability with the tariff results.

In Table 12, I report the first stage regressions for the main tariff specification in Table 5, column 1, where we see that all the instruments are jointly significant and the regressions have a high explanatory power. I also find that the results are not driven by any specific

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[56]Under the null hypothesis, the test statistic, which is the minimized value of the GMM criterion function (Hansen's J), is distributed as chi-squared in the number of overidentifying restrictions.

instrument which I check by excluding each one at a time.[57] In Table 13, we have the first stage regressions for the main first-differenced specification (Table 6, column 1) which are not as strong as the ones in Table 12 in terms of the explanatory power but all instruments are still jointly significant. The partial R-squared values based on Shea (1997) indicate that the instruments for $\log A_{it}$ explain a substantial fraction of its variation. The same is not true for $\log(Q_{it}/M_{it}\varepsilon_{it})$ and the first-differenced equations.

Figure 1 indicates that in Colombia the major trade liberalization era started in 1990 and continued until 1992 where new persistently lower levels of tariffs were reached. Given the restrictiveness of $UNILIB_t$ by construction, I allowed it to take 1991 instead of 1990 as the cutoff point as well and the results remain robust to this different cutoff value. Furthermore, when $UNILIB_t$ is excluded, the coefficient magnitudes rise but the results carry through.

2.7 Endogeneity Bias and the Effect of Tariffs on Productivity

The theoretical and empirical results I presented in the earlier sections indicate that we should be worried about the endogeneity of trade policy with respect to productivity. If the researchers do not account for the endogeneity, their estimates of the trade policy effects on productivity will be biased. However, it is hard to tell the direction and magnitude of the endogeneity bias unless the system is very simple.[58] Once we have other regressors in the system, the correlations among them do not permit us to make any predictions about the bias. Therefore, I illustrate how the bias might be working with a system of equations

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[57]Including labor share as an additional instrument also does not change the results qualitatively but lowers the probability value of the Hansen-Sargan test.

[58]Suppose that we have the following two equations that relate tariffs and productivity: (1) $\log A_{it} = a_1 + a_2 \log \tau_{it} + w_{1it}$ and (2) $\log \tau_{it} = b_1 + b_2 \log A_{it} + w_{2it}$ where w_{1it} and w_{2it} are mean zero error terms with constant variances $\sigma_{w_1}^2$ and $\sigma_{w_2}^2$. Then assuming that the covariance between the two error terms is zero, i.e. $cov(w_{1it}, w_{2it}) = 0$, we obtain $cov(w_{1it}, \log \tau_{it}) = \frac{b_2}{1 - b_2 a_2}\sigma_{w_1}^2$. If the true values of a_2 and b_2 are such that $a_2 < 0$ and $b_2 > 0$, then we have $cov(w_{1it}, \log \tau_{it}) > 0$. If we estimate a_2 with OLS, ignoring equation (2), and get $\hat{a}_2 < 0$ which is positively correlated with a_2, we would have an upward bias, hence underestimate a_2.

below.

In constructing this system, I partly rely on the setup of my estimations in the previous section. On the other hand, I do not have a structural equation showing how productivity depends on tariffs so I just try to keep it similar to the estimations in the earlier empirical literature. I model the tariff and inverse import penetration equations as before and add a third equation for productivity as follows

$$\log A_{it} = \alpha_1 + \alpha_2 \log \tau_{it} + (\log Z_{1it})\alpha_3 + \mu_{1i}\alpha_4 + Z_{2t}\alpha_5 + \upsilon_{1it} \quad \text{(21a)}$$

$$\log \tau_{it} = \beta_1 + \beta_2 \log A_{it} + \beta_3 \log(\frac{Q_{it}}{M_{it}\varepsilon_{it}}) + \mu_{2i}\beta_4 + \theta_t\beta_5 + \upsilon_{2it} \quad \text{(21b)}$$

$$\log(Q_{it}/M_{it}\varepsilon_{it}) = \gamma_1 + \gamma_2 \log \tau_{it} + (\log Z_{3it})\gamma_3 + \upsilon_{3it} \quad \text{(21c)}$$

where υ_{1it}, υ_{2it}, and υ_{3it} are the error terms for sector $i = 1, ..., N$ at period $t = 1, ..., T$. μ_{1i} and μ_{2i} are $1 \times (N-1)$ vectors of industry dummies, and θ_t is a $1 \times (T-1)$ vector of year dummies. Z_{1it} and Z_{3it} are 1×2 vectors of control variables at the 4-digit ISIC sector level, whereas Z_{2t} is a 1×2 vector of economy-wide controls.[59] Z_{1it} includes the scale measure and upstream TFP, whereas Z_{3it} includes capital to output ratio and materials prices. Note that these industry level control variables are precisely the instruments I used in the instrumental variables estimations above so they are expected to be exogenous. The other advantage of these controls is that I get a consistent framework with the rest of my estimations. Z_{2t} includes GDP growth and inflation to control for the macro changes in the economy that might affect the productivity in all sectors.

My estimates of equation (21a) are at the 4-digit industry level. This limitation precludes any direct comparison between my estimates and the ones in the recent firm-level studies. However, after I estimate the system with three-stage least squares (3SLS), I compare these results with the simple OLS estimates of equation (21a) that ignore endogeneity and get the chance to test whether accounting for endogeneity improves the results within

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[59]Note that α_1, α_2, β_1, β_2, β_3, γ_1, and γ_2 are scalars. α_3, α_5, and γ_3 are 2×1, α_4 and β_4 are $(N-1) \times 1$ vectors, and β_5 is a $(T-1) \times 1$ vector.

my dataset.

In Table 14, I provide the comparative results of estimating the whole system with 3SLS and estimating equation (21a) with OLS only. As in line with the earlier literature, a negative OLS estimate of the coefficient for tariffs in equation (21a), i.e. $\widehat{\alpha}_2 < 0$, indicates that productivity is inversely related to tariffs. The 3SLS regression results not only confirm this finding but also show that the positive effect of lower tariffs on productivity grows slightly stronger (by 1.5%) when I account for the endogeneity of tariffs. The 3SLS results from equation (21b) are similar to the findings I present in Table 5: more productive sectors receive higher protection, and tariffs are inversely related to import penetration and import demand elasticity. In Table 15, I replicate the estimations from Table 14 by using effective rates of protection instead of tariffs and find identical results. However, this time the positive impact of liberalization on productivity is larger by 17% when we estimate the whole system. These findings indicate that the trade policy effects on productivity might be underestimated when endogeneity is not accounted for.

2.8 Final Remarks

In chapters 1 and 2, I have shown, both theoretically and empirically, that we should be concerned about the endogeneity of trade policy with respect to productivity. This has been neglected for the most part in the recent empirical literature. Studies that investigate the effect of trade policy on productivity often argue that the exogeneity of the trade liberalization shock helps to identify a linkage without worrying too much about the endogeneity of tariffs or other forms of trade policy. I account for such an argument in my theoretical and empirical models, and still obtain tariffs to be endogenous.

The main result from my theoretical models, simple yet compelling, is that despite an exogenous unilateral trade liberalization shock that is common across sectors, we obtain a differentiated effect across sectoral protection based on productivity. Based on my theory, I predict that more productive sectors receive more protection and that the extent of

liberalization is less for sectors that experience a higher productivity increase.

Next, I test and confirm these theoretical results using production, trade, and tariff data at the 4-digit ISIC industry level for Colombia between 1983 and 1998. I keep all of my estimations closely related to my theory and account for all the potential endogeneity problems by using relevant instruments and methodologies.

Finally, I estimate a system of equations and show that by not accounting for the endogeneity of trade policy with respect to productivity, we might underestimate the positive impact of trade reform on productivity. Thus, correcting for the endogeneity bias does not overturn the results in the early empirical literature but makes them somewhat stronger for Colombia which would be interesting to test for different countries as well.

3 The Clash of Liberalizations: Preferential vs. Multilateral Trade Liberalization in the European Union

Most of the early theory analyzing the effects of preferential trade agreements (PTAs) on multilateral trade liberalization (MTL) assumed that MTL implied free trade. Therefore, the research focused on how PTAs affect the binary choice between free trade and no MTL and it effectively asked whether PTAs made a multilateral trade round more or less likely.[60] Assuming that a round leads to free trade and focusing on its probability simplifies the analysis but generates predictions that are nearly impossible to test because these rounds are so infrequent. Moreover, countries can choose to conclude a multilateral round with considerable liberalization or one with nearly none. Thus, the focus should be on whether PTAs affect the change in multilateral tariffs as we do below and not simply the probability of a round.[61] Before we present the theory and the empirical results, we first briefly discuss the trade policy in the European Union in the next section.

3.1 The European Union's Trade Policy

Before the expansion in 2004, the EU's membership was composed of 15 countries that accounted for one third of the world output and more than 20 percent of world trade. The EU succeeded the European Communities that started in the 1950s as a customs union. Currently, its members form a single market with free movement of goods, services, capital, and labor. There is also a very strong element of cooperation in non-trade policies, partic-

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[60]Krishna (1998) argues that PTAs reduce the likelihood of a multilateral round because the export rents generated by PTAs disappear when countries liberalize multilaterally and so the producers that benefit from those rents will oppose MTL. Levy (1997) shows that the median voter may reject multilateral free trade after voting for a PTA even though she would have accepted it, if no PTA had been available.

[61]Bagwell and Staiger (1998b) analyze two opposing effects of PTAs on the equilibrium multilateral tariff *level* in a self-enforcing model. They show that PTAs are a stumbling block if countries are very patient and a building block otherwise. Another approach to the PTA vs. MTL issue is due to Krugman (1991) who analyzes the welfare path for exogenously expanding trading blocs, which Bond and Syropoulos (1996) also analyze. Winters (1999) surveys this literature. Several articles in the July 1998 issue of the Economic Journal address various aspects of the regionalism vs. multilateralism issue, see for example Bagwell and Staiger (1998a).

ularly in issues with regional spillovers such as immigration, environment, development of poorer regions, foreign policy, and judicial matters.

The key actors in the formation of EU trade policy are the European Commission and the Council. The Commission proposes, negotiates and enforces trade policy on behalf of the members. The Council, where each member's government is represented, is the decision maker with the power to approve or reject the Commission's proposals for trade policy negotiations and their eventual outcome. That is, the Council is decisive in approving the common external tariff that the Commission negotiates in multilateral trade rounds as well as any preferential treatment it negotiates with non-EU members.[62]

The EU's expansion of preferential trade treatment has occurred both through increased membership—initially 6 and currently 25 countries–and through numerous PTAs with non-members. In the appendix, we provide some details about the latter (including their abbreviations)–here we note only a few key points. First, several of the EU's PTAs do not require the partner to lower their tariffs. Second, many of these PTAs, e.g. preferences to developing countries through GSP and ACP, seek, and at times explicitly require, cooperation in non-trade issues such as labor standards, human rights, migration control, and combat against drugs. The PTAs with the Mediterranean countries are also similar in nature and historically established ties aimed at addressing issues with regional externalities, such as immigration, matter.[63] These features are explicitly captured by our model. Several of the countries that benefit from these preferential treatment fear that MTL on the part of the EU will erode these preferences. Thus, they have at times opposed to MTL but the EU

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[62]After 1987 the Commission gained greater control and the veto power of individual countries in the Council was replaced with qualified majority voting. Consequently, some interest groups have also started lobbying the Commission directly However, even after 1987, industry associations continued to favor lobbying their own government as opposed to the Commission. (Hayes 1993). Thus, our assumption in section **??** that lobbying works through governments is a reasonable one. The European Parliament is regularly informed on trade policy by the Commission and is also involved by giving "assent" on major treaty ratifications that cover more than trade. For details see <http://europa.eu.int/comm/trade/index_en.htm>

[63]According to Jackson (1997, p.160) "during the last twenty-five years or so the experience of the GSP in the GATT system has been that ... the industrialized countries often succumb to the temptation to use the preference systems as part of 'bargaining chips' of *diplomacy*." The conditionality of EU's concessions in exchange for cooperation has further been documented for instance in Grilli (1997).

itself has used the same argument to avoid liberalizing, which is central to our model.[64]

In the estimation we also consider the remaining preferences the EU had in place before the Uruguay Round (UR): to EFTA members that did not eventually join the EU and to some Central and East European economies. These did involve reciprocal trade preferences. However, the East European countries had to comply with several side conditions, e.g. environmental regulations. For the EU, the benefits of these side conditions along with the political integration in Western Europe likely outweighed the preferential treatment provided to the EU exports.[65] A similar argument applies to the accession of Greece, Spain and Portugal to the EU. So our model will focus on this exchange of preferences on the part of the EU for cooperation in non-trade issues, appropriately modified in the cases of accessions where a common external tariff is applied.

3.2 Theory

In this section, we show how PTAs can induce higher MFN tariffs and derive the structural equations that we estimate. The model captures the key features of the EU's PTAs previously described by extending Limão (2002) along several important dimensions. First, we model a political economy motive for the use of tariffs, which is an important determinant of the cross-sectional tariff structure. Second, we allow for a more general trading pattern and, more importantly, for different types of PTAs. The PTAs we consider differ on whether they involve a common external tariff and allow for direct cash transfers across members, which enables us to test alternative important hypotheses relevant for the different types of agreements signed by the EU.

An important advantage of the model we develop is that it provides a rich set of testable predictions about the effect of PTAs that are signed with even small countries. The model

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[64]For example, in 2000 the European Commission argued that a cut in the price support of about 25 percent in EU sugar was not tenable because it would cause an income loss of 250 million euros to ACP countries, some of whom export sugar to the EU under preferential treatment. European Commission (2000), "Commission Proposes Overhaul of Sugar Market," Brussels, October 4th 2000, IP/00/1109.

[65]See Winters (1993) for details on the EU's Eastern European programs.

points to a stumbling block effect of the PTAs on the multilateral tariffs of the large country when nontrade issues matter between the large and the small partner, as in the case of the EU with the ACP countries. However, the prediction also extends to more general agreements when nontrade issues may not be as important, for example in the FTA between the EU and the EFTA countries. When the preferential agreement is valued by the PTA members, reducing the multilateral tariffs is costly since it erodes the preferential margins and the viability of the agreement which is valuable.

3.2.1 Model

Each of the two symmetric regional blocs we model is composed of two economies, L (a large country) and S (a small country). We normalize labor units such that each of the H individuals in each country is endowed with one unit of labor–the only factor of production. We assume that both countries have the same population to ensure that L places a non-negligible weight on those issues proportional to S's population, e.g. on human and labor rights or immigration and environmental issues. The numeraire good is produced with labor according to a constant returns to scale production process. We normalize the price of the numeraire to one, which is identical in all countries.

Individuals in L (and similarly in L^*) have a quasilinear utility function,

$$U \equiv c_0 + \sum_{i=1}^{2I} u_i(c_i) + \Psi(E, E^s) \tag{22}$$

where $\Psi(.)$ represents the subutility function for the public good.[66] $\Psi(.)$ is concave in both the local public good provision, E, and the provision by S, E^s, due to a regional spillover.[67] We can interpret E broadly as public expenditures to address environmental problems, enforce human and labor rights and immigration laws, etc.

In L, some individuals are endowed with X_i units of at most one of the non-numeraire

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[66]Note that due to quasilinearity we have $c_i = d_i(p_i) = u_i'(p_i)^{-1}$ or $u_i'(.) = p_i$.
[67]Limão (2002) shows that the main results extend to the case where the spillovers are global.

goods indexed by i. Thus, there are $2I+1$ types of individuals indexed by their endowment where the "extra" individual type is not endowed with any good, just labor. The population is sufficiently large so that the numeraire good is always produced in equilibrium, which fixes the wage at unity–labor's marginal revenue productivity in the numeraire sector.

For given prices and taxes, an individual of type i chooses the quantities of the private goods she consumes to maximize her utility subject to a budget constraint, $c_0 + \sum_i p_i c_i \leq y$. Given the assumptions on the subutility, the budget constraint is satisfied with equality and all individuals demand the same quantity of each of the non-numeraire goods, $d_i(p_i) = u_i'(p_i)^{-1}$. Thus the indirect utility of an individual of type i is

$$w = y + \Psi(E, E^s) + \sum_{i=1}^{2I} v_i(p_i) \tag{23}$$

where $v_i(.)$[68] represents the consumer surplus. An individual's income sources are the wage, the value of the endowment and net taxes. Net taxes are equal to per capita tariff revenue, TR/H, net of the tax used to finance the public good, e.

The government sets its trade policy and supplies the public good in order to maximize a political support function which we define below in equation (26). The public good is produced using h_e units of labor according to $E = bh_e$. Given that the wage rate is fixed at unity, the balanced budget condition implies that the amount of public good produced in equilibrium is $E = bHe$.[69] Therefore, the income for individual $i \in [1, 2I]$ in L is

$$y = 1 + p_i X_i + TR/H - e \tag{24}$$

We label the goods in increasing order of L's endowment–from $i = 1$ to $2I$. Denoting

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[68]Due to the quasilinear utility function of the individuals, the consumer surplus for the non-numerarire goods can be expressed as $v_i(p_i) = u_i(c_i) - p_i c_i$. Throughout the text we focus on a quadratic form of the subutility, $u_i(c_i) = (ac_i - c_i^2/2)/b$, where a and b are constants. This gives rise to linear demand curves, $d_i(p_i) = c_i = a - bp_i$, and implies that $v_i(p_i) = (a - bp_i)^2/2b$. Moreover, the aggregate demand is simply $D_i(p_i) = Hd_i(p_i)$.

[69]The tariff revenue is distributed lump-sum and we assume that none is used to finance the public good, which maintains the two policies within L separable in the analysis that follows.

the variables for the other regional bloc with an "*", the "mirror" symmetry assumption implies that the endowment of L^* is biggest for $i = 1$. Thus, L imports $i \in [1, I]$ from L^* and exports $i \in [I + 1, 2I]$. We assume that all H individuals in S are identical and that S is endowed with X_i^s of $i \in [1, s]$ where $s \leq I$.[70] Aggregate demand in S is $D_i^s < X_i^s$ for $i \in [1, s]$, and it is fixed and positive up to some price level $\bar{p}_i$ and zero otherwise. Hence S exports $i \in [1, s]$ in exchange for the numeraire.[71] To simplify exposition we focus on the case where net exports from S are price inelastic and thus the main effect of the preference is an income transfer from L to S in the form of higher export prices. However, the qualitative results are similar if we relax this elasticity assumption, as we show in Karacaovali and Limão (2005a).[72]

Country L sets specific tariffs τ_i on the imports from L^* and a preferential tariff $\pi_i \leq \tau_i$ on S. The equilibrium domestic price in L for its imports, p_i, is then derived from the market clearing condition:

$$M_i(p_i) + M_i^*(p_i - \tau_i) + M_i^s = 0 \quad \text{for } i \in [1, I] \tag{25}$$

where $M_i(.) \equiv D(p_i) - X_i$, $M_i^*(.) \equiv D^*(p_i - \tau_i) - X_i^*$ and $M_i^s \equiv D_i^s - X_i^s$ are the import demand functions for L, L^* and S respectively ($i \in [1, s]$ for S). Since export subsidies are generally not permitted by the WTO, we abstract from them. Thus, the domestic price in L^* of a good it exports is simply the price in L net of the tariff, $p_i - \tau_i$. A similar market clearing condition holds for goods $i \in [I + 1, 2I]$ imported by L^*. These conditions implicitly define the domestic prices in L and L^* as functions of the tariffs–$p_i(\tau_i)$ for $i \in [1, I]$ and $p_i^*(\tau_i^*)$ for $i \in [I + 1, 2I]$. Note that because the net export supply functions of the

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[70]One possible justification for employing a representative agent and not modeling a motivation for S to impose tariffs is that the trade policy of the countries that we consider as PTA partners for the EU often has a negligible effect on the issue that we will address.

[71]Symmetrically, S^* exports $i \in [2I - s, 2I]$.

[72]For some of the agreements that we analyze, assuming that the changes in trade flows between L and S do not drive L's trade policy is not only analytically convenient but also plausible, since the additional exports from a small partner to the EU are unlikely to amount to a large share of the EU's total imports. In our data those values for 1994 were 13% for the GSP, 5% for EFTX, 2.7% for MED, and 1.4 % for CEC. GSPL and ACP account for less than 0.5 %.

small countries are price inelastic, the equilibrium prices p_i and p_i^* are not directly affected by the preferential tariffs. It is then simple to show that an increase in τ_i raises p_i, whereas an increase in τ_i^* lowers the price for L's exporters.[73]

In the absence of export subsidies the only trade taxes set by L^* that affect L are its tariffs and we can think of the import sectors in each country as the only ones potentially "favored" by the governments. Since we also assume that any individual endowed with a non-numeraire good represents a negligible share of the population, it is reasonable to focus on a case where those individuals lobby their respective governments only for policies in their own sector. Therefore, the government in L sets the trade policy to maximize the following political support function which is a weighted sum of the social welfare

$$G(\boldsymbol{\tau}, \boldsymbol{\pi}, \boldsymbol{\tau}^*, e, e^s) \equiv H\left(1 - e + \Psi(e, e^s) + \sum_{i=1}^{I} \upsilon_i(p_i(\tau_i)) + \sum_{i=I+1}^{2I} \upsilon_i(p_i(\tau_i^*))\right) \quad (26)$$
$$+ TR(\boldsymbol{\tau}, \boldsymbol{\pi}) + \sum_{i=I+1}^{2I} p_i(\tau_i^*)X_i + \sum_{i=1}^{I} \omega_i p_i(\tau_i)X_i$$

As described above, $1 - e$ represents the wage income net of the per capita tax used to finance the provision of a public good in L, which is valued according to the subutility $\Psi(e, e^s)$.[74] The consumer surplus is $\upsilon_i(.)$ and $TR(.)$ represents the tariff revenue, which we specify in the appendix section C.1.[75] The last two terms of $G(.)$ represent a weighted value of endowments, where $\omega_i \geq 1$. If $\omega_i = 1$ for all i, the objective reduces to a standard social welfare function. Therefore $(\omega_i - 1)$ represents the additional weight the government places on individuals endowed with an import good.[76]

An important issue that arises when we apply the model to the EU is whether equation

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[73]By implicitly differentiating equation (25), we find that $\partial p_i(\tau_i)/\partial \tau_i \in (0, 1)$ and $\partial p_i(\tau_i^*)/\partial \tau_i^* \in (-1, 0)$. The balance of payments condition is satisfied through movements of the numeraire good.

[74]We can express $\Psi(.)$ in terms of e and e^s given that $E = bHe$ (hence $E^s = bHe^s$).

[75]The tariff revenue is distributed lump-sum and we assume that none is used to finance the public good, which maintains the two policies within Large separable.

[76]This is a reduced form that can be obtained as a special case from a model where lobbying is given micro-foundations, such as in Grossman and Helpman (1994), provided that in that model the ownership of the specific factors is concentrated.

(26) represents the objective of an individual government or a joint objective, as maximized by an EU-wide institution. In Karacaovali and Limão (2005a) we show that equation (26) can be obtained as the objective for the EU that arises from bargaining between independent EU-member governments–a fair representation of the EU's trade policy formation, as we described in Section **??**. The weight in equation (26) can then be interpreted as an average of the individual member weights, $\omega_i = \sum_k \omega_i^k \xi_i^k$, where ξ_i^k is the production share of the EU member k in i. This point will also be important in the empirical section because it will provide us with the correct way of aggregating the data for the member countries.[77]

3.2.2 Preferential vs. Multilateral Trade Liberalization

MFN Tariffs in the Absence of Preferences   We first derive the MFN tariff rate that results when PTAs are not allowed.[78] This benchmark tariff plays an important role in the empirical estimation because, as we show, it is also the equilibrium rate for the subset of products in which S either does not export or receive any preferences even when PTAs are already pursued. This subset of goods will be our control group in the estimation.

Following Bagwell and Staiger (1999), we model the main motive for reciprocal trade liberalization in the WTO as a cooperative outcome between countries that gain from overcoming a terms-of-trade externality. Accordingly, most of the negotiations occur between large countries and follow what is known as the principal supplier rule: if, for a given product, country L is the largest exporter to L^*, then L^* proposes a tariff reduction to L on that product in exchange for L's tariff reduction on L^*'s exports to L. The MFN rule

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[77]To obtain equation (26) as the EU objective we assume: (1) identical preferences across union members; (2) no trading costs within the union so the same prices hold for all; (3) different populations and endowments are allowed provided that the set of import sectors (broadly defined) is identical and so import taxes are chosen on similar industries; (4) the Council chooses EU trade policies and e to maximize total surplus $\Sigma_c G^c(.)$ and then bargains over any bilateral transfers; (5) numeraire transfers are possible across members and subject to bargaining; (6) the regional good financed by the EU is valued by each individual in its totality. Note that there is an interesting question of which is the optimal country in the union to decide on the common tariff (Syropoulos 2002), which we do not address because in the EU this decision is better captured by assumption 4 above.

[78]This will also be the equilibrium rate if L does not want to pursue a PTA, e.g. if it did not value the regional public good.

then requires this reduction to be extended to all other WTO exporters of similar goods. Given that both the EU and the rest of the world are several times larger than most of the EU's individual PTA partners we take L and L^* as the principal suppliers. In the estimation section we relax this assumption.

In the absence of PTAs, L and L^* choose their multilateral tariffs to maximize their joint objective. Given the symmetry between them, it is sufficient to focus on one and, since the problem is stationary, we can concentrate on maximizing L's objective within each period. Thus, after imposing the symmetry condition that tariffs in the respective import sectors are equal, $\boldsymbol{\tau}^* = \boldsymbol{\tau}$, the equilibrium multilateral tariffs in the absence of a PTA are given by[79]

$$\boldsymbol{\tau}^m \equiv \arg\max_{\boldsymbol{\tau}}\{G(\boldsymbol{\tau}^* = \boldsymbol{\tau}, \boldsymbol{\pi}, e^s = 0, .) : \boldsymbol{\pi} = \boldsymbol{\tau}\} \tag{27}$$

where the constraint precludes preferential tariffs, i.e. $\boldsymbol{\pi} = \boldsymbol{\tau}$. For simplicity, throughout our analysis we abstract from potential enforcement problems between L and L^* in setting multilateral tariffs by assuming they are sufficiently patient such that the incentive compatibility constraints for MTL do not bind.[80] Given the additive separability of the effect of different goods on the objective function in equation (26) and the symmetry across regional blocs, the tariff for good i is independent of L's MFN tariffs in other goods. Therefore, the expression for the MFN tariff below–derived in the appendix section C.1–applies to any good that is not subject to a preference, i.e. whenever $\tau_i = \pi_i$, and whether PTAs are allowed or not.[81] We derive the advalorem equivalent of tariffs as they are the focus of our empirical work, i.e. $t_i^m = \tau_i^m/p_i^*$, which, according to the first-order-condition (FOC) of

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[79]The tariff vectors are respectively $\boldsymbol{\tau}^* = (\tau_{2I}^*, \tau_{2I-1}^*, ..., \tau_{I+1}^*)$ and $\boldsymbol{\tau} = (\tau_1, \tau_2, ..., \tau_I)$.

[80]The incentive compatibility problem arises because countries have market power in trade and thus an incentive to cheat and increase their tariffs. For a detailed analysis of the issues that arise when these constraints do bind, see Limão (2002).

[81]Symmetry across countries allows us to focus on reciprocity across pairs of symmetric goods. In general, reciprocity occurs across sets of goods, which we will take into account in the estimation.

the program above, is equal to

$$t_i^m = (\omega_i - 1)\frac{X_i/M_i}{\varepsilon_i} + \frac{M_i^s}{M_i^* + M_i^s}\frac{1}{\varepsilon_i^*} \tag{28}$$

The import demand elasticity for L is denoted by ε_i, whereas the foreign export supply elasticity it faces is ε_i^*.[82] If good i is not exported by the regional partner, i.e. if $M_i^s = 0$, this expression is similar to several political economy models (Helpman 1997). The tariff is increasing on the political economy weight, ω_i, and the inverse of the import penetration ratio, X_i/M_i. This value is further weighted by the import demand elasticity for standard Ramsey taxation reasons.[83] The last term represents an MFN externality effect and leads to higher tariffs. It arises if S does not participate in MTL directly because the MFN clause requires L and L^* to lower their tariffs on imports from all partners even if some did not reciprocally lower their own tariffs. This effect disappears either if L has no market power in good i, $1/\varepsilon_i^* = 0$, or the share of S in L's total imports of i is negligible.

MFN Tariffs in the Presence of Preferences   We first model how the preferential tariff is chosen and then determine its effect on multilateral tariffs. The PTA between L and S is characterized by a bargaining solution where L grants preferential tariffs, $\boldsymbol{\pi} \leq \boldsymbol{\tau}$, in exchange for an increase in S's provision of the regional public good. To capture the asymmetry in size and bargaining power between the EU and its PTA partners we allow L to make a take-it-or-leave-it offer to S. In a one-shot interaction both countries have an incentive to cheat but cooperation can be sustained through repeated interaction. This implies that L's offer extracts as much of the bargaining surplus as possible up to the point where S's incentive compatibility constraint is just binding.

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[82]Both of these are evaluated at the equilibrium tariff. Their definitions are $\varepsilon_i \equiv -M_i'p_i^*/M_i$ and $\varepsilon_i^* \equiv [\partial(M_i^* + M_i^s)/\partial p_i^*] \times [p_i^*/(M_i^* + M_i^s)]$. Note that import demand elasticities are typically estimated with respect to the domestic price but we define it slightly differently for the purpose of the model discussion and derivations. However, our empirical implementation will take this into account explicitly. See Section C.2 for details.

[83]The more inelastic the import demand, the lower the deadweight loss from import taxes, i.e. tariffs.

Since we did not model a trade policy motivation for S, the "political support" function it maximizes is identical to its total welfare: labor income net of taxes, endowment value and consumer surplus.

$$G^s(\boldsymbol{\pi}, \boldsymbol{\tau}, e^s) \equiv H(1 - e^s) + \sum_{i=1}^{s \leq I} [(p_i(\tau_i) - \pi_i)X_i^s + (\bar{p}_i - p_i^{sd})D_i^s] \tag{29}$$

where $p_i^{sd} = p_i(\tau_i) - \tau_i$ is the consumption price in S and, for simplicity, we focus on the extreme case where it places no weight on the activity that is valued by L, so it simply enters as a cost, He^s.

The incentive compatible level of e^s is obtained by requiring the current gain to S from deviating, i.e. setting $e^s = 0$, not to exceed the foregone gains from cooperation due to the PTA. The equilibrium condition for e^s under a PTA with no CET is obtained from

$$G^s(\boldsymbol{\pi}, \boldsymbol{\tau}, e^s = 0) - G^s(\boldsymbol{\pi}, \boldsymbol{\tau}, e^s) \leq [\delta/(1 - \delta)] \times [G^s(\boldsymbol{\pi}, \boldsymbol{\tau}, e^s) - G^s(\boldsymbol{\pi} = \boldsymbol{\tau}, \boldsymbol{\tau}, e^s = 0)],$$

where $\delta \in (0, 1)$ represents S's discount factor and we use the fact that $\boldsymbol{\tau}$ will be the threat level of the tariff used by L if S stops cooperating.[84] When S is a WTO member, the highest credible threat tariff that L can use is to revert to the MFN tariffs, $\boldsymbol{\tau}$, as required by the WTO rules. Then, using equation (29) and assuming for simplicity that S exports only good 1, we obtain the equilibrium bargaining level of e^s for a given preferential margin, $\tau_1 - \pi_1$, as

$$e^b = \delta(\tau_1 - \pi_1)X_1^s/H \tag{30}$$

The amount of tax that S collects to supply the regional public good is proportional to the revenue transfer from L due to the preference. Given the additive separability of the objective function in equation (26), the tariffs for goods other than $i = 1$ are specified by

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[84]The MFN tariffs are set on the assumption that S accepts a PTA and will not deviate. Moreover, if it does, L removes the preferences and sets its tariffs equal to $\boldsymbol{\tau}$, the multilateral tariffs originally agreed upon with L^*. That is, we assume that after a deviation by S, L and L^* do not renegotiate their MFN tariffs. An alternative is to assume that after a deviation by S the MFN tariffs implemented are changed to $\boldsymbol{\tau}^m$. This introduces some changes but similar qualitative results can be obtained regarding the stumbling block effect. In practice, we think our assumption is more realistic since there are costs to re-adjusting MFN tariffs between rounds which may lead governments not to do so.

equation (28). The MFN constraint is now relaxed, $\pi \leq \tau$, and the preferential tariff is optimally chosen taking into account the fact that it will affect e^b. Hence, the equilibrium MFN and preferential tariffs are given by

$$\{\tau^{mp}, \pi^p\} \equiv \arg\max_{\tau,\pi}\{G(\boldsymbol{\tau}^* = \boldsymbol{\tau}, \boldsymbol{\pi}, e^s, .) : \pi \leq \tau; e^s = e^b\} \tag{31}$$

which we use to derive the equilibrium advalorem MFN tariff rate, $t_i^{mp} = \tau_i^{mp}/p_i^*.$[85]

$$t_i^{mp} = (\delta G_{e^s}/H - 1)\frac{X_i^s}{M_i p_i'}\frac{1}{\varepsilon_i} + (\omega_i - 1)\frac{X_i/M_i}{\varepsilon_i} + \frac{M_i^s}{M_i^* + M_i^s}\frac{1}{\varepsilon_i^*} \tag{32}$$

To compare this with the tariff if PTAs were forbidden, t_i^m, we take their difference and evaluate at t_i^m. This yields a non-negative term that captures the potential for a stumbling block effect of a PTA:

$$t_i^{mp} - t_i^m = [(\delta G_{e^s}/H - 1)\frac{X_i^s}{M_i p_i'}\frac{1}{\varepsilon_i}]_{t_i=t_i^m} \geq 0 \tag{33}$$

To interpret and sign this term, we first note that $1/M_i p_i' \varepsilon_i$ is positive, so the sign depends on $(\delta G_{e^s}/H - 1)X_i^s$. From equation (30) we obtain $\partial e^b/\partial \tau_i = -\partial e^b/\partial \pi_i = \delta X_i^s/H$ and from equation (26) we have $G_\pi = X_i^s$. Therefore, $(\delta G_{e^s}/H-1)X_i^s = -(G_\pi+G_{e^s}\partial e^b/\partial\pi)$. The last expression is simply the first order condition for π_i, which is positive if the optimal preferential tariff rate, π_i^p, is zero at τ_i^m. That is, if we are at a corner solution in the PTA, where L would like an increase in e^s but cannot lower π further because it is already at zero. In this case L has an incentive to increase the MFN tariff above τ_i^m.[86]

The intuition for the stumbling block effect is straightforward. When the marginal benefit of S increasing e^s is higher for L than the cost in terms of the foregone tariff revenue, L would prefer to increase the preferential margin given to S and it initially does

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[85] See the appendix section C.1 for this derivation.

[86] A sufficient condition for a corner solution in the PTA is for L to place sufficient weight on S's provision of the regional good.

this by reducing the preferential tariff. However, once the preferential tariff is at zero, the preferential margin can only be increased by raising the MFN tariff.[87]

Common External Tariff and Direct Transfers for Cooperation   Most results on PTAs depend on whether they have a CET.[88] Given that between the Tokyo and Uruguay Rounds–the period we analyze in the empirical work–the EU expanded to include new members that share its CET, we analyze the effect of such accessions on MTL.

The use of a CET raises the practical issue of how the tariff revenue is to be distributed over the different countries, e.g. if all goods enter the EU via one port, does that country receive all the revenue? This requires PTAs with a CET to agree to revenue transfer mechanisms. Therefore, one key difference relative to other PTAs is the existence of a mechanism for transfers, which L can use to "purchase" the supply of the regional good. We note that the willingness to implement such transfer schemes is often limited, which along with the need to agree on a CET, explains why customs unions are rare relative to PTAs with no CET. The implicit costs in the use of direct transfers explain why we ruled them out in deriving the stumbling block effect in the absence of a CET.[89] However, those countries that can agree to a CET clearly do not face prohibitive costs of direct transfers since they use them to redistribute revenue. So the PTA solution must now explicitly allow transfers.

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[87]The observed preferential tariffs in the real world are everywhere bound at zero, which explains why we model them in this way. However, there is no *conceptual* motive why they can't be negative, i.e. subsidies. Limão and Olarreaga (2005) estimate that switching to import subsidies would generate considerable welfare gains by allowing additional MTL on the part of the EU, US and Japan. They also discuss solutions to potential implementation problems that may explain why these subsidies have not yet been used.

[88]Cadot et al. (1999) argue that "deepening integration is likely to work toward *reinforcing* protectionist pressures against nonmembers" (p. 651) when there is a CET but not necessarily if the PTA has no CET in place. Bagwell and Staiger (1998b) indicate that in the absence of a CET, PTAs would undermine reciprocity and non-discrimination, the main pillars of the multilateral trading system. However, they also show that PTAs with a CET could still be efficient in terms of reciprocity as long as external tariffs are non-discriminatory.

[89]Using direct transfers may also not be the most efficient way to transfer resources to other countries, as the aid vs. trade literature highlights, or reward cooperation since the direct transfer may end up in the pockets of a politician without providing the best incentives for cooperation. For example, one of the stated aims of the U.S. in providing preferences to the Andean countries is to raise the relative price to activities other than drug production. Political economy constraints that reduce the effectiveness of direct transfers relative to preferences are present in practice, otherwise we would not observe several of the current preference schemes.

As we show in the appendix section C.1, the stumbling block effect disappears under this case. However, despite the ability to use transfers, a preferential rate may still be used because, for given multilateral tariffs, L is indifferent between a transfer *and* preferential tariff reductions. At a given MFN tariff, the cost for L of a reduction in π is simply the lost tariff revenue, which is no more costly than transferring an equivalent amount in the numeraire good. The difference relative to the PTA without a CET is that now if, at $\pi = 0$, S is still not providing "enough" e^s, the optimal solution is for L to increase the transfer rather than the MFN tariff, since the latter distorts the prices. Thus, in equilibrium we have $\tau^{mcu} = \tau^m$.

3.3 Estimation

3.3.1 Predictions and Identification

We now derive the model's estimating equation, point out its main predictions and analyze how it is identified. Combining the expression for the MFN tariff rate in a good with preferences (equation (32)) and the one without preferences (equation (28)), we obtain the following:

$$t_i = (\delta G_{e^s}/H - 1)(\frac{X_i^s}{M_i p_i'} \frac{1}{\varepsilon_i})I_i + (\omega_i - 1)\frac{X_i/M_i}{\varepsilon_i} + \frac{M_i^s}{M_i^* + M_i^s}\frac{1}{\varepsilon_i^*} \tag{34}$$

where I_i is an indicator for whether good i is imported from a preferential partner and receives a zero preferential rate. Simplifying the notation by using x_i for $\frac{X_i/M_i}{\varepsilon_i}$ and m_i for $\frac{M_i^s}{M_i^* + M_i^s}\frac{1}{\varepsilon_i^*}$ and dropping the product subscripts, we have the econometric model in error form

$$t = \phi I + \beta x + m + u \tag{35}$$

where $E(u|x, m, I) = 0, \phi = (\delta G_{e^s}/H - 1)E(\frac{X_i^s}{M_i p_i'} \frac{1}{\varepsilon_i}|x, m, I)$ and $\beta = E((\omega_i - 1)|x, m, I)$. Note that if any good is imported from a preferential partner, then $E(\frac{X_i^s}{M_i p_i'} \frac{1}{\varepsilon_i}|x, m, I) > 0$

and so ϕ is positive if and only if $\delta G_{e^s}/H > 1$, which we showed to be the condition for a stumbling block effect to exist. Therefore, the key question is whether ϕ is positive. We also test two other important predictions that, because they are specific to this model, may lend it support. The first one is that $\phi = 0$ for products with a positive preferential tariff. The second one is that the MFN tariff should be equal between non-PTA goods and goods exported by countries that recently joined the EU and have access to transfers.

The theoretical model captures the key features of trade policy determination. However, it is parsimonious and possibly not fully specified, e.g. tariffs tend to be highly persistent, which may be due to an unobserved product effect. Such an effect may also influence whether a good receives a preference and generate an omitted variable bias. We address this by estimating the model in changes rather than levels.[90] However, this still allows us to estimate the level of the stumbling block effect, as will become clear. Since the model focuses on MFN tariffs, which the EU changes very infrequently, we take the change as the difference between the MFN tariffs negotiated in the UR and those in place before it, which were largely set during the Tokyo Round.[91] Then, the change for a good i that was not imported under a zero preferential tariff before the Tokyo Round but became so by the time the Uruguay Round was negotiated is

$$\Delta t = \phi I + \beta \Delta x + \Delta m + \Delta u \qquad (36)$$

Note that we assume the weights, ω_i, are time-invariant.[92] We also use the fact that for a good i that was not imported under a zero preferential tariff before the Tokyo Round we

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[90]Considering changes over two multilateral rounds in the empirical work is not inconsistent with the theoretical model. Even though the theoretical model features no *expected* changes in protection after MTL occurs and PTAs are agreed, it does allow for unexpected changes. That is if in a period the production to import ratio or political weights fall, then the equilibrium MFN tariff also falls according to the model. Moreover, although we abstracted from them, once we allow the incentive compatibility constraints of the countries negotiating MTL to bind, then shocks to their discount factors would also change the equilibrium level of MFN tariffs.

[91]Although in theory the EU could have renegotiated specific tariff lines between rounds, the WTO shows no record of such renegotiation between the Tokyo and Uruguay rounds.

[92]In Karacaovali and Limão (2005a) we relax this assumption, test it and find that it is reasonable.

have $I_{it-1} = 0$ and if it became a PTA good before the conclusion of the UR, then $I_{it} = 1$.

To confirm that the underlying parameters in the change equation can be interpreted exactly

as the ones in equation (35) when $I_{it-1} = 0$ and $I_{it} = 1$, note that in terms of the underlying

parameters we have $\Delta t_i = (\delta G_{te}s/H_t - 1)\frac{X^s_{it}}{M_{it}p'_{it}}\frac{1}{\varepsilon_{it}}I_{it} + (\omega_i - 1)\Delta x_i + \Delta m_i$. For goods

where $I_{it-1} = I_{it}$ we would have $\Delta t_i = I_i\Delta[(\delta G_e s/H - 1)\frac{X^s_i}{M_i p'_i}\frac{1}{\varepsilon_i}] + (\omega_i - 1)\Delta x_i + \Delta m_i$.

Thus, for PTA goods from agreements that were in place before the Tokyo Round, e.g. for

certain GSP and ACP goods, the coefficient on I_i measures any increase in the marginal

benefit to the EU from the provision of the regional public good between the two rounds. In

Figure 7, we illustrate how our approach identifies the level of the stumbling block effect

in the model and thus provides an estimate for what the tariff in the PTA goods would

have been in the absence of a PTA. The tariff increase up to the dashed line indicates the

stumbling block effect predicted by the model if the preference is duty-free (i.e. $t^{mp} - t^m$).

We plot the tariffs for two goods that are similar except that one becomes a PTA good

between the Tokyo and UR. The tariff increase up to the dashed line indicates the stumbling

block effect predicted by the model if the preference is duty-free. The EU may choose not

to change the bound tariff immediately because this would impose a renegotiation cost (as

well as the costs from higher tariffs on EU products that other countries would be allowed

to set) but, when the new round occurs, the difference in the reduction in the two products

reflects the stumbling block effect[93] (once we condition on the other variables).[94]

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[93]Note that $t^m - t^{m'}$ is the change in MFN tariffs for a non-PTA good between the two periods; whereas $t^m - t^{mp'}$ is the change for a "new" PTA good. The difference between these two differences gives us the stumbling block effect, i.e. $(t^m - t^{m'}) - (t^m - t^{mp'}) = t^{mp'} - t^{m'} = \phi$.

[94]An alternative explanation for the EU waiting until the UR before changing the MFN tariff is that the initial, higher, MFN tariff may generate a sufficiently large preferential margin so that a zero preferential tariff is not used. This was true of several of the EU's programs before the UR. The reduction of MFN tariffs in the UR however reduces the preferential margin, thus generating the stumbling block effect. In fact the EU did reduce many of its preferential tariffs after the UR precisely for this reason. This can also explain why the stumbling block effect interpretation in equation (36) applies even to products that were already imported under a preference during the Tokyo Round since if the preferential tariff was positive then $I_{it-1} = 0$. For instance, the preferences have been expanded through a number of revisions for MED, ACP, GSP, EFTX, which are the agreements that initially took effect before the Tokyo Round. These revisions also included new requirements on cooperation relating to human rights and democracy from all recipients (Brown 2002, Raya 1999). In addition to that, the European Economic Area with EFTA in 1992 provided a much deeper economic integration between partners.

One important determinant that is not explicitly reflected in equation (36) is reciprocity–the extent to which the EU lowered its tariffs in response to other countries' reductions in the UR. Reciprocity is an important principle in WTO negotiations and a basic feature of our theoretical model; it is not fully reflected in equation (36) because we assumed symmetry across the regional blocs and then solved for the equilibrium tariff expression. By relaxing this assumption and controlling explicitly for reciprocity we minimize the possibility for omitted variable bias and can be more confident that the estimated PTA effect, ϕ, captures the structural effect predicted by the model.[95] We follow Limão (2006) who constructs a measure of market access "concessions" that is consistent with the practice in multilateral tariff negotiations. The variable is defined at the product level as $R_i = \sum_k s_{it}^k [\sum_j w_j^k \Delta t_j^k / t_{jt}^k]$ where $\Delta t_j^k / t_{jt}^k$ is the percentage tariff reduction by a non-EU country k in good j and w_{jt}^k is the import share of good j in total imports of k. Therefore the term in brackets captures country k's average market access concession, which is multiplied by s_{it}^k–the export share of a principal supplier k to the EU as a share of total exports from all of the EU's principal suppliers.[96] The prediction is that if k offers relatively larger concessions then the EU reciprocates through larger MFN tariff reductions in the products it imports from k.

The final issue in deriving the estimating equation is data availability. We do not have a bilateral record of which countries negotiated with the EU on each specific 8-digit product during the trade rounds and therefore we can't construct the exact MFN-externality variable, Δm. But we proxy for it by using information on the share of small exporters by product, i.e. the share of those countries that are not one of the top-5 exporters in product i to the EU. Increases in this share between the rounds imply that the probability of an MFN-externality increases, since the EU would have to negotiate with more exporters each

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[95]One concern if we did not account for reciprocity is that products exported by PTA partners tend to have fewer non-PTA members trying to extract tariff reductions from the EU. Although this could reasonably be described as an indirect stumbling block effect, in the sense that it works through reciprocity, it is not the direct effect that we are trying to estimate. By controlling for reciprocity separately this indirect effect is not reflected in the estimated ϕ.

[96]We consider an exporter to be a principal supplier of good i if it is one of the top 5 exporters of good i.

of whom now has a higher incentive to free-ride. We consider the change in this share between 1994 and 1989, the earliest year when the 8-digit harmonized standard data is reported. If the change in this period is sufficiently large then it will be positively correlated with the change over the full period between rounds. We attempt to capture this by constructing an indicator variable, P, for whether the change in this share for good i is above the median change.[97] The model then predicts a positive coefficient on this variable.

Introducing the proxy for Δm and augmenting equation (36) to explicitly account for reciprocity yields our basic estimating equation:

$$\Delta t = c + \phi I + \beta \Delta x + \rho R + \mu P + v \qquad (37)$$

where we include a constant term, c, which does not have a structural interpretation.[98] We also modify the error to explicitly allow for any measurement error due to the proxy and reciprocity variables. Even if we were to rely strictly on the orthogonality conditions imposed by the theory we would have to address new components in the error. Since we are interested in establishing causality, we now discuss how we address the potential endogeneity issues in estimating equation (37) for which we confirm the existence of endogeneity in Section 3.3.5.

The preference may depend on MFN tariff changes, e.g. if a PTA partner expects a small MFN reduction in a product, it is more likely to request a preference in it than in a product where it expects a large MFN reduction. To tackle this source of reverse causation, and also the potential bias from using a proxy for the MFN externality variable, we employ instrumental variables. The main instrument for I is another indicator, which is equal to one when a product is imported by the EU from the PTA partner in 1994 regardless of

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[97]Although our approach here is mainly driven by the lack of data we note that focusing on the changes in the years leading up to the round has the advantage that they are likely driven by factors other than the EU's subsequent MTL. The estimation results do not change when we employ 75th or 90th percentiles instead.

[98]If we extended the model to either provide a unilateral motive for the EU's tariff reduction or explicitly analyze the role of increased patience in its MTL incentive constraints we could provide a structural interpretation for the common term.

whether it receives a preference or not. This instrument is correlated with I, that is whether a product both receives a preference *and* is imported duty-free from the preferential partner but we expect it to be uncorrelated with the error term since the changes in the MFN tariff we use as a dependent variable are implemented starting only in 1995. The second main instrument for I is whether the good was subject to a non-tariff barrier (NTB) set by the EU in 1993 on all countries. A country is more likely to seek a preference in a good if it expects that otherwise it would certainly be subject to an NTB. This effect would be magnified if the country already exports this product, hence we interact this variable with the export indicator as well. Moreover, we will be able to test and verify the exogeneity of the export indicator and NTB variables as instruments because we employ a GMM approach. The set of over-identifying restrictions that allows us to perform these tests arise from including other instruments, such as world price changes between 1992 and 1994, that help to predict if a good was exported in 1994 but are unlikely to depend on the changes in MFN tariffs that take place in the subsequent years.

The variable that captures the political economy effect, Δx, is likely to depend on the MFN tariffs since it involves the production/import ratio weighted by the import demand elasticity, all of which are functions of the EU's domestic prices and hence its MFN tariffs. Therefore, we employ the levels of these variables before the MFN tariff is implemented, e.g. 1978 for x_{t-1} and 1992 for x_t. We find some evidence of endogeneity[99] and therefore instrument Δx with the change in a measure of scale economies (Value added/number of firms) and its interaction with the average world price change in the industry between 1992 and 1994, which are tested for orthogonality to the error term.[100] All else equal, economies of scale is likely to be positively correlated with the inverse import penetration ratio (X/M), yet be independent of tariffs. World prices, on the other hand, directly affect domestic prices which are important determinants of all the components of x, i.e. X, M,

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[99]As we discuss in Section 3.3.5 the Hausman test of endogeneity indicates this evidence.

[100]As we discuss and explain in Section 3.3.2, x is constructed using industry level data. Thus, β can be interpreted as the average EU-wide extra weight taken over different industries rather than products.

and ε but do not depend on the tariff rates that are set subsequently.

Finally, the reciprocity variable is another potential source of endogeneity due to reverse causation since the total tariff reduction by other WTO members in the UR partially depends on EU reductions. We instrument for reciprocity by using the unilateral portion of the total tariff reductions that are eventually offered at the UR. More specifically, several countries undertook unilateral trade liberalizations between 1986 and 1992. They were unilateral because they were undertaken outside of GATT negotiations, without an expectation that they would be reciprocated since the very completion of the round was itself in doubt until 1992. However, when the final multilateral cuts were negotiated, between 1992 and 1994, the unilateral reductions undertaken from 1986 to 1992 were explicitly reciprocated because they had taken place after the official start date of the round (Finger et al. 1999). Therefore, we employ the unilateral liberalization by WTO members between 1986 and 1992 as an instrument for what eventually was used as a basis for their reciprocal liberalization–the amount between 1986 and 1995.

3.3.2 Data

In the appendix section C.2 we provide detailed data definitions and sources, and in Table 20 we have the summary statistics for all the variables used in the estimations. Here we note some of its salient characteristics. We employ the advalorem MFN tariffs from the WTO schedules of concessions[101], and the preferential tariffs from UNCTAD, both at the 8-digit HS level.[102] To construct the reciprocity variable we employ the data in Finger et al. (1999). They use the available tariff reductions for each WTO member during the

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[101]These refer to bound rates but we find that the applied and bound rates are equal for about 99% of the products for the EU in our sample, hence we do not expect this to bias our results.

[102]The model requires using preferences for the post-UR period, hence we employ the preferential rates reported for 1996 for all PTAs except for EFTA, which was only reported in 1993. Moreover, we exclude products with a zero MFN tariff before the Uruguay Round for two reasons. First, when the MFN tariff is zero there is often more noise in the data about whether a preference exists or not, since it is in effect irrelevant. Second, all the tariffs in the sample that were initially zero remained unchanged and are likely to share an unobserved common characteristic. Thus, including those observations would bias the estimates if the proportion of zero tariffs is different for PTA goods relative to the rest of the goods.

UR, and aggregate it from the product level into country-averages. We take these average country concessions and construct a product specific measure of reciprocity by using top 5 suppliers' export shares (from Eurostat) to the EU by 8-digit product.

We use data on production and other industry-level variables for constructing x and its instruments. This data is available for individual EU members and we aggregate it exactly as suggested by the theoretical model.[103] UNIDO's industrial database provides the most comprehensive source covering all EU members and dating back to 1978. It is collected at the industry level and hence more aggregated than the trade and tariff data. We use clustering at the industry level to correct the standard errors for the fact that it is more aggregated than tariffs and trade.[104] Since UNIDO does not provide production data for agriculture we exclude those products, but processed agricultural products are included.[105]

In Table 16, we present the tariff levels and their changes for our sample. Although our analysis is conducted at the product level we provide some statistics here aggregated by industry. The highest tariff rates before and after the UR appear in the tobacco sector (SIC-314): an average of 42 and 25 percent respectively. The lowest pre-UR tariffs are in the miscellaneous petroleum and coal products sector (SIC-354) with 3.9 percent, whereas the iron and steel industry (SIC-371) become the least protected in terms of tariffs after the UR, 0.4 percent. The footwear sector (SIC-324) experienced the least liberalization, 0.8 percentage points, and tobacco the highest, 17. Note also that there is a considerable

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[103]In terms of production this entails simply adding it up over the EU members. The interpretation of the political economy weight estimated in this case is $(\omega_i - 1) = \sum_c (\omega_i^c - 1)\xi_i^c$ where ω_i^c is the individual member weight for a given producer and ξ_i^c is the production share in the EU.

[104]In calculating the variable $(X_I/M_I)/\varepsilon_I$ the remaining variables that we employ are at the same level of aggregation as the production data. The fact that this data is more aggregated could potentially introduce some measurement error. Although we can not rule out this possibility, we note that it may not be such an important concern for the following reason. If the EU negotiators use the data at the most disaggregated level available for most of its members, as we do, then our measure is actually the relevant one. The interpretation of β is now as the average EU-wide extra weight taken over the different industries rather than products. We are comfortable with this interpretation, since producers tend to organize at the industry level to lobby for protection. This is particularly true in the EU, where there is more variation in protection across industries than within them. Therefore, to the extent that the extra weight reflects a political economy motive, the best way to identify it is at the industry level.

[105]Given the prevalence of non-tariff barriers and EU subsidies in agriculture we don't believe this is a drawback since an analysis that focuses on tariffs without taking these other forms of protection into account could be inappropriate for agriculture.

amount of variation in tariff changes both within industries, with coefficients of variation

between 0.28 and 1.5, and across industries, with a coefficient of variation of 0.44.

3.3.3 Estimation Results

The unconditional mean reduction in MFN tariffs by the EU was 4.4 percentage points for

non-PTA products but only 2.9 for PTA products during the UR. A simple t-test confirms

that the difference of 1.5 percentage points, with a standard error of 0.1, is statistically

significant. This difference may be due to other factors that are correlated with the PTA

variable. Therefore, in Table 17 we present the estimates of the parameters in equation

(37). In order to address the endogeneity issues discussed above we employ an instrumen-

tal variables (IV) technique. More specifically, we use the two-step efficient generalized

method of moments estimator (IV-GMM), which is robust to heteroskedasticity with an

undetermined form and cluster at the industry level, for the motive we describe above. In

Section 3.3.5, we discuss the formal tests of endogeneity and heteroskedasticity that justify

this procedure.

Stumbling Block Estimates The indicator variable I^{any0} in Table 17 takes the value one

if the EU imports the good from *any* partner at a duty-free preferential rate. It excludes

countries that acceded after the Tokyo Round, which we estimate separately as suggested

by the theory. The coefficient for I^{any0} provides an estimate of ϕ and we find that it is posi-

tive and significant at the 1 percent level under all specifications. This provides evidence of

a smaller reduction in the EU's MFN tariffs for its PTA products (with a zero preferential

tariff) relative to its non-PTA products as predicted by the model. Before quantifying the

importance of this stumbling block effect, we test other predictions.[106]

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[106] A potential cost of using data that is finely disaggregated is that it is more likely to suffer from product
misclassification when a shipment is recorded. We try to minimize this problem by classifying a good as
being exported by a PTA to the EU only if the value registered in that year is above a certain low threshold.
In our estimations, we employ the 5th percentile of the value of a given PTAs' exports in that year as the
threshold. In Section 3.3.5, we test and find that this does not affect our results .

Although we did not explicitly model simultaneous PTAs we expect that in such an extension if a product is exported by several preferential partners, then a given increase in the margin of preference benefits more than one of these partners and generates a stronger stumbling block effect. We test this in column 2 of Table 17-Panel A by including an additional variable, I^{evy0}, which is an indicator for whether the EU imports the product at a tariff of zero from *every* preferential partner. We find that the stumbling block effect for this subset of products is indeed larger.

In columns 3 and 4 of Table 17-Panel A, we present the OLS results for the main specifications for comparison. The coefficients on I^{any0} and I^{evy0} are similar but smaller and statistically significant at 1 percent. In Section 3.3.5, we compare the IV results to those obtained using OLS more in detail.

A prediction from our model is that the stumbling block effect is only present for products with a zero preferential tariff. We test this in column 1 of Table 17-Panel B where the variable I^{any} takes the value one for the goods imported by the EU at a preferential tariff rate–either zero or positive–whereas I^{pos} is one for the subset of goods with a positive preferential tariff, which account for about 1.5 percent of the observations in the sample. The total effect of a good with a positive preferential tariff is obtained by summing the two coefficients and doing so, we cannot reject the hypothesis that the tariff reduction for such goods is identical to the non-PTA products. This prediction is fairly specific to the model and thus its confirmation provides it strong support.

According to the model MFN tariff changes for products imported from countries that joined the EU between the last two trade rounds should be identical to those of other products, if transfers are offered as part of the accession to the EU. We find this to be true in the data. In column 2 of Table 17-Panel B I^{afs} and I^{spg} are indicator variables for products exported by Austria, Finland, and Sweden and Portugal, Spain, and Greece respectively, which are statistically insignificant. The stumbling block effect generated by the PTAs that do not share a common external tariff with the EU remains unchanged both in magnitude

and significance.

The model also predicts the stumbling block effect to be stronger in products that are important exports for a PTA partner, as we can see from the fact that in equation (34) the stumbling block effect is multiplied by the level of exports from the PTA partner, X_{it}^s. We test this by introducing an additional variable, $I^{hi\,\mathrm{exp}}$–the interaction of I^{any0} with $D^{hi\,\mathrm{exp}}$, where $D^{hi\,\mathrm{exp}}$ is one if the share of a PTA partner's exports in good i relative to its total exports to the EU is above a certain threshold. In column 3 of Table 17-Panel B we estimate that such an extra effect is present and significant.[107]

The estimates presented so far refer to an average effect of all of the EU's PTAs, which is arguably closer to our theory that features a single PTA. However, it is useful to quantify whether the effect is driven by any given PTA in particular, e.g. such estimates are an important input for determining the welfare effects of eliminating specific PTAs, as in Limão and Olarreaga (2005). Moreover, for some PTAs we have $I_{it-1} = 1 = I_{it}$ and for others we do not and we would like to see the separate effects of each. Although there is a positive correlation among the variables for the different programs, we do identify a stumbling block effect originating from each in column 4 of Table 17-Panel B. All individual effects are significant with the exception of the one for the ACP, which is nonetheless significant when tested jointly with the GSP, a program with preferences highly correlated with those in ACP.

In Table 18, we present the first stage regressions for some of the main specifications, which indicate that the instruments are jointly significant in all of our specifications. Moreover, the row at the bottom of Table 17 (both Panel A and Panel B) labeled as "Hansen's J" shows that the excluded instruments pass the orthogonality tests as a group. When the set of instruments is large this test may have low power. Therefore, we also test the subset

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[107]The level of exports is the appropriate variable even if we estimate the equation in changes provided that $I_{it-1} = 0$. We do not use a continuous measure of the level of exports because it is more likely to be determined by the preferential tariff rates whereas the indicator is more likely to capture exporter motives for specialization in some products. In Table 17-Panel B, we present the case where the threshold is set at the twenty-fifth percentile but the results are qualitatively similar if different levels such as the median or 75th percentile are used.

of instruments that are a priori more likely to be endogenous, such as the export dummy and NTB variables. The results are found in the row "C-Stat" and indicate that we cannot reject the orthogonality of the smaller subsets either.

Reciprocity and Political Economy Determinants of EU Tariffs Tariff changes are notoriously hard to predict and in fact most empirical studies that employ a structural approach focus on explaining the cross-section. Nonetheless, given how sparse the evidence is for the EU's trade policy determination, we think that it is interesting to ask whether the remaining variables of our parsimonious model have any explanatory power.

The coefficient on Δx provides an estimate of $(\omega - 1)$, which can be interpreted as the production weighted average of the extra importance attached to producer surplus relative to social welfare of the EU members, as we discuss in Section **??**. We find it to be positive ranging from 0.0025 (column 4 of Table 17-Panel B) to 0.0039 (column 1 of Table 17-Panel B).[108] To our knowledge there are no such estimates for the EU, but for the US, Goldberg and Maggi (1999) estimate this extra weight to be approximately 0.014, whereas Gawande and Bandyopadhyay (2000) estimate a much lower value of 0.0003.[109] Thus our estimate for the EU lies in between these. In Karacaovali and Limão (2005a), we relax the constraint of constant weights across sectors and show that industries with higher share of employment and higher regional concentration receive higher tariff protection, however we also find that the restriction of constant weights (over industries and time) is reasonable for the EU.

As we point out in the introduction, reciprocity is a key variable in the theory behind MTL but there is some disagreement about its use in practice. We find that the EU reduced its tariffs by more in products exported by trading partners that reduced their own tariffs by a greater amount. Note that, reciprocity may magnify the stumbling block effect, be-

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[108] The OLS estimates for the coefficient on Δx are positive and insignificant which is not surprising given its endogeneity (columns 3 and 4 of Table 17-Panel A).

[109] Goldberg and Maggi (1999) actually report $1/\omega = 0.986$ (p. 1145) whereas Gawande and Bandyopadhyay (2000) report $1/(\omega - 1)$ (p. 147).

cause smaller reductions in the EU will be reciprocated by smaller reductions in the trading partners. Since Limão (2006) also finds reciprocity to be a significant factor in the US multilateral tariff reductions during the UR, we expect that the stumbling block effect of the EU and the US had an indirect effect at least in the reciprocal tariff reductions between the two of them.

Our proxy for the change in MFN externality term, Δm, has the expected positive sign (except for the specification in column 4 of Table 17-Panel B) but it is insignificant under all specifications. One explanation for this is that the reciprocity variable already accounts for this effect. Since those countries that free-ride will have small average tariff reductions, the EU will "reciprocate" with smaller tariff reductions of its own as well.[110]

3.3.4 Quantification and Interpretation

The simplest interpretation of the coefficient on the PTA variable is that it represents how much the MFN tariff for PTA products increased relative to the non-PTA products. Its value is 1.5 percentage points for products exported under any PTA and about 2.2 for every PTA. Since the reduction for non-PTA goods was 3.4 percentage points, the magnitude of the stumbling block effect is not trivial.

We can quantify the tariff effect in terms of price changes to assess its economic importance. In the context of the average price effects generated by tariff changes during the UR, the stumbling block effect is not negligible. This is clearest from employing the ratio of the relative price growth effects $\Delta \ln p_{pta}^d / \Delta \ln p_{mfn}^d = \Delta \ln(1 + t^{mp}) / \Delta \ln(1 + t^m) \approx \Delta t^{mp} / \Delta t^m = 1 + \phi/c$, where c is the estimated average tariff change for non-PTA products.[111] Note that, this statistic can also be used to measure the relative world price effects

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[110]It is also possible that our proxy is an imperfect one or that the MFN externality effect is simply negligible. Finger (1974) provides some direct evidence that countries can target concessions to minimize the MFN externality. He reports that in the Dillon Round (1960-61), where negotiations were bilateral and item-by-item as in the Uruguay Round, 70% of US imports of items that it agreed to reduce its tariffs in were exported by countries with whom the concession was directly negotiated.

[111]This equality applies to a "benchmark" good with no changes in market access, nor in the elasticity adjusted production/import ratio. If the stumbling block effect completely offsets the average price effect, then $1 + \phi/c = 0$ and if the price effect for the PTA products were identical to the non-PTA products,

for goods where there is imperfect pass-through, that is $\Delta \ln p_{pta}^w / \Delta \ln p_{mfn}^w \approx 1 + \phi/c$ provided the pass-through rate for PTA goods is similar to other goods.[112] This is important because one key concern with PTAs is that they have an impact on other countries by affecting the prices received by excluded countries, for example by causing higher MFN tariffs, as our model shows.[113] Moreover, there is considerable evidence of imperfect pass-through both from exchange rate changes but also from tariff changes.[114] Therefore, the closer $1 + \phi/c$ is to zero the stronger the stumbling block effect. For example, a value of 0.5 indicates that a non-PTA country received only half of the export price increase from EU's MFN tariff changes in the UR by exporting a PTA good relative to a similar non-PTA good. An alternative interpretation in light of the theoretical model is that the export price for the PTA goods was half of what it would have been in the absence of EU PTAs.

At the bottom of Table 17 (both Panel A and Panel B), the row labeled $1 + \phi/c$ provides the estimates of the price effects as well as their confidence intervals. The effect of any PTA is about 0.55 (column 1, Panel A) and it is not very sensitive to controlling for a positive preferential tariff (column 1, Panel B) or for the exports of AFS or SGP (column 2, Panel B). The effect for goods exported by every PTA is stronger: 0.39 (column 2, Panel A).[115]

An interesting question is whether our estimates carry any information about the unobserved counterfactual of what the average EU tariff would have been in the absence of

the statistic would be equal to 1. The approximation $\Delta \ln(1 + t^{mp}) \approx \Delta t^{mp}$ is valid in our sample since $\Delta \ln(1 + t_t^i) - \Delta t_t^i$ for all types of products takes a value between 0 and 0.005 for 90 percent of the sample and between 0 and 0.011 for 99 percent of the sample.

[112]To be more precise, since we can write the domestic price as $\ln p_t^d = \ln(1 + t_t^{prog}) + \ln p_t^w$ then $\zeta \equiv \Delta \ln p_i^d / \Delta \ln(1 + t^i) = 1 + \Delta \ln p_i^w / \Delta \ln(1 + t^i)$, for $i = pta, mfn$. We can then write the ratio of world price effects for PTA to non-PTA products as $\Delta \ln p_{pta}^w / \Delta \ln p_{mfn}^w = [\Delta \ln(1 + t^{pta}) / \Delta \ln(1 + t^{mfn})](\zeta^{pta} - 1)/(\zeta^{mfn} - 1) \approx 1 + \phi/c$ if $\zeta^{pta} \approx \zeta < 1$.

[113]This concern is confirmed by Chang and Winters (2002) who find that the formation of Mercosur lowered the prices for non-Mercosur producers exporting to them. Olarreaga et al. (1999) show that terms-of-trade effects pose a relatively important motive in explaining Mercosur's external tariff structure.

[114]Finger (1976) estimates that less than one third of the tariff reductions by the U.S., Japan and European Community were passed on to their respective consumers during the Kennedy Round. Goldberg and Knetter (1997) survey the extensive evidence on imperfect pass-through from exchange rates. Feenstra (1989) showed that the effects of the exchange rate pass-through is symmetric to the effects of tariff changes in the US.

[115]The effect of the significant individual programs range from 0.88 (GSP) to 0.93 (EFTA, CEC) and the combined effect of all individual programs is 0.53, smaller than the 0.39 estimated in column 2-Panel A but not statistically so.

any PTAs. A strict interpretation of our estimates according to the theoretical model is that MFN tariffs are 1.5 percentage points higher for PTA products as compared to their absence and since PTA products represent a large share of our sample, *all products* are up by 1.4 percentage points. However, there has also been a considerable amount of debate on whether the PTAs pursued by the US and the EU increased or decreased the probability of completion of the Uruguay Round.

However, there is no consensus on this question. On the one hand the question of stumbling blocks arose as the Uruguay Round was delayed, with some blaming it on PTAs, and on the other hand others have argued that PTAs actually lead partners to the multilateral table. Since multilateral trade rounds are too infrequent, whether PTAs increase or decrease the probability of a round can not be answered econometrically. Given that we cannot estimate this effect on the probability, and the lack of consensus on whether it is even positive or negative, the best we can do is estimate the effects of PTAs on MFN tariffs given that there were PTAs in place in the last round and use the model to interpret these estimates in a way that allows us to get at the counterfactual of what would have happened in the absence of any PTAs.

Although we cannot obtain exact econometric estimates of the effects of PTAs on the probability of the completion of the round, we can provide some bounds for our results that try to incorporate such effects. To do so, we first distinguish between a direct and an indirect effect of PTAs on MTL. The direct effect of the EU's PTAs is the one we estimated: the higher tariffs the EU maintained on its PTA goods given how much other countries changed their tariffs. The indirect effect refers to whether the EU's PTAs increased the probability of the last round and, given that the round did occur, whether those PTAs made other countries reduce their tariffs by more or less. This effect is indirect in that it works through reciprocity. Thus if PTAs affect the probability of a round, they alter the expected value of the EU's tariff changes by changing the expected value of reciprocity. Given this, consider the expected difference in the MFN tariffs of the EU in a world with PTAs, denoted by

a variable $z = 1$, and the unobserved world without them, $z = 0$. The main difference between the two is the existence of PTA goods and the extent of reciprocity.

$$E(\Delta t|z = 1, I, R, \Delta x) - E(\Delta t|z = 0, I, \Delta x, R, P) = \phi E(I) + \rho(p_1 R_1 - p_0 R_0) \quad (38)$$

where we assume that in the presence of PTAs if there is a direct stumbling block effect, it will affect the average tariff independently of whether there is a round and that the unilateral motives for changing the tariffs are identical whether there are PTAs or not. When a round is not completed, the EU does not reciprocate other countries' tariff changes. Thus, we have $\rho = 0$ with probability $1 - p_1$ when there are PTAs and with probability $1 - p_0$ when there are no PTAs. Therefore, the second term reflects the difference in the expected reciprocity effect on the EU's tariffs depending on the existence of PTAs. The most neutral case to assume is that the existence of PTAs affects neither the probability of a round, $p_1 = p_0$, nor the amount of tariff reductions undertaken by other countries *given* that a round is completed, $R_1 = R_0$. In this case the reciprocity term in equation (38) is zero and we obtain the average value of 1.4 percentage points discussed above.[116]

To provide some bounds on the results that account for possible effects of PTAs on the probabilities of MTL, suppose that in the absence of PTAs the UR would not have been completed, $p_0 = 0$, and the mere existence of PTAs assured its completion, $p_1 = 1$. In this case the *total* stumbling block effect is 0.014+0.006(-0.46)≡1.1 percentage points, where $\rho = 0.006$ from Table 17 and $R_1 = -0.46$ from Table 20. So even under this extreme assumption, PTAs are a stumbling block and would have been so unless the average reduction in tariffs by other countries, as represented by R_1, had been almost 6 times larger than what we actually observed. If, on the other hand, $p_0 = 1$ and the probability of completing the round under those PTAs was nearly 0, then the total stumbling block effect is at least 1.4 percentage points. Although we did not observe the realization of R_0, we can reasonably

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[116]To obtain equation (38) we use equation (37) to write $E(\Delta t|z = 1, I, \Delta x, R, P) = p_1(\phi I + \beta\Delta x + \rho R_1 + \mu P + v) + (1 - p_1)(\phi I + \beta\Delta x + \mu P + v)$ and $E(\Delta t|z = 0, I, \Delta x, R, P) = p_0(\beta\Delta x + \rho R_1 + \mu P + v) + (1 - p_0)(\beta\Delta x + \mu P + v)$.

expect that it would have entailed some amount of liberalization such that $R_0 \leq 0$.[117]

Finally, examining the importance of the PTA variable differently, we see that the explained amount of variation in the tariffs across goods which can be attributed to it is significantly higher than the rest of the variables. For instance, changes in both the political economy variable and MFN-externality proxy contribute to about a 5 percent average predicted reduction in tariffs, whereas reciprocity contributes to only a 0.4 percent change relative to a situation where all of them remain unchanged.

3.3.5 Robustness Analysis

We now show whether the results in Table 17 are robust to measurement error in the PTA variable, the inclusion of initial tariffs as an explanatory variable and the estimation method. We summarize the results in Table 19, where the column labeled "IV-GMM" repeats the basic information from Table 17 for ease of comparison. The first row simply gives the coefficient on the PTA variable and the third row, labeled $1 + \phi/c$, provides the quantification discussed in the previous section, both of which refer to specification 1 in Table 17-Panel A. The remaining rows provide the test statistics for whether products with a positive preferential tariff or from countries with a CET generate a stumbling block; they refer to the specifications in columns 1 and 2 of Table 17-Panel B, respectively.

In defining whether a PTA partner exported a particular product to the EU, we employed a low positive value as a threshold to minimize classification errors in recording the product code for low value shipments.[106] Although we expect this threshold to ameliorate any measurement error from misclassification, it also increases the control group of non-PTA goods and, if no classification error were present, this procedure could itself generate

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[117]The estimates above provide not only information on the bounds of the EU's tariffs but also on the likelihood that PTAs had a negative impact on liberalization through reciprocity. To see this more clearly start by assuming no difference, $p_1 = p_0$, and $R_1 = R_0$, and then ask whether the total estimated effect contradicts this assumption. Since even with $p_1 R_1 = p_0 R_0$ we estimate that the EU's PTAs caused an increase in its average tariff through the direct effect, it is then plausible that the observed reciprocal tariff reduction of other countries was smaller than it would have been under no PTAs. This suggests that $p_1 R_1 > p_0 R_0$. From this perspective, reciprocity effects may have amplified the stumbling block effect of PTAs.

a measurement error. Therefore, we repeat our estimations without applying any threshold, e.g. setting I^{any0} equal to 1 if *any* value of a good from any of the PTA partners entered the EU under a preferential tariff rate and find that the coefficients in Table 17 are robust to this in terms of their sign and significance without major changes in the magnitudes of coefficients and the stumbling block effect (Table 19, column 2).

We do not expect our estimates to be biased due to omitted variables because, as we argue above, even if they are correlated with the included regressors we instrument, test, and confirm the orthogonality of the excluded instruments relative to the error term. Nevertheless, we want to explicitly address the effect of including the initial tariff rate in the estimation. The average initial MFN tariff for PTA products in our sample is 7.6 percent, whereas it is 12.8 percent for the non-PTA products. Although in the UR no explicit formula was followed such that higher tariffs would be cut by more than the lower ones, it is certainly a possible outcome and may lead us to find bigger cuts in the non-PTA products. When we add the initial tariff level as a regressor, we find that its coefficient is typically negative, so products with higher initial tariffs had slightly bigger cuts, but it is not always statistically significant. Moreover, the initial tariff does not affect the sign, magnitude or significance of the basic stumbling block effect. As shown in column 3 of Table 19 the relative growth effect evaluated at the average initial tariff is at least as large as the ones found in Table 17. Since the main results are not sensitive to the inclusion of the initial tariff and, according to the Schwarz criterion, the specification without it is preferred, we choose to focus on the latter, which also follows our theoretical model more closely.

In the majority of the SIC three-digit industries there are both PTA and non-PTA products as can be observed in Table 16. The percentage of the PTA products in each sector varies somewhat and substantially differs for a number of industries. The food products industry, SIC 311, contains approximately half of all the products in our sample that do not enter the EU duty-free through preferential agreements. Although this category does not include primary agricultural products (it includes processing of food related products),

it does share one important characteristic with agriculture: high protection. To the extent that this feature is time-invariant, then it is immediately addressed by the fact that we estimate the equations in differences. Moreover, the initial tariff, which is on average higher for SIC 311 than other industries, does not seem to be biasing the results, because, as we have seen, its inclusion does not affect the results significantly. To investigate whether the stumbling block effect is merely driven by a cross-industry difference in the average tariff cut between SIC 311 and other industries, we re-estimate the model by dropping the observations in 311. In column 4 of Table 19 we see that the estimates are qualitatively similar to those in Table 17 in terms of the signs and significance of the coefficients.[118,119] In Table 16, we observe that there is a lot more variation in the products imported under all PTA programs (for which $I^{evy0} = 1$). These constitute 13% of all the products and actually indicate a larger stumbling block effect.

As we argue in Section 3.3.1, there are good reasons to expect the main regressors to be subject to endogeneity, either through reverse causation or correlation with omitted variables. Thus, we report the IV results and, to test if endogeneity is present, we calculate the Hausman statistic. The probability values to reject the null of consistency of the OLS estimates range from 0.04 to 0.52 across different specifications.[120] Given that the tests were overall inconclusive and we want to maintain comparability across different specifications, we have focused on the IV estimates, which may be inefficient but consistent over all regressions. However, we also calculated the OLS counterpart to each specification and found that the results were qualitatively similar to the IV estimates. In Table 19, we provide the summary statistics from the OLS estimation that confirm the main prediction of

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[118]The point estimates of the relative growth effect in the basic specification are different when we exclude products in SIC 311 but the 95 percent confidence intervals overlap with those of the corresponding specification in Table 17.

[119]Separately, we also tested dropping the observations for petroleum refineries (SIC 353) and miscellaneous petroleum and coal products (SIC 354) since production data for these sensitive sectors tends to be inaccurate and in some cases missing. They account for less than 0.8 percent of all products in the sample and so dropping them does not affect the results.

[120]More specifically, we calculate the Durbin-Wu-Hausman statistic–reported in Table 17 (both Panel A and Panel B) in the row labeled "Endogeneity p-val". The value of 0.04 applies to the equivalent of specification 2 from Table 17-Panel B when the initial tariffs are added as a regressor.

the model as well as one of the two auxiliary predictions.[121]Pagan and Hall's (1983) heteroskedasticity tests reject the error terms to be homoskedastic, hence the GMM approach is further justified.

Although we test and verify the exogeneity of the NTB variables as instruments, we note that the presence of NTBs in a product could intuitively affect the subsequent change in tariffs. Therefore, we test the sensitivity of the results to the exclusion of the NTB variables and find that excluding them does not change the results.

3.4   Final Remarks

In this chapter, we analyze the effects of PTAs on multilateral trade liberalization–a controversial issue where the evidence has been scarce. The model we develop captures key features of the current trading system and provides a rich set of predictions regarding the impact of PTAs on MTL. We derive and estimate the structural equations of protection using detailed tariff data for the EU during the last two multilateral rounds and find evidence that its PTAs slowed down MTL. As the model predicts, this occurred only in products with a zero preferential tariff and was not present in agreements with a common external tariff and transfers. Our model also incorporates domestic political economy motives for tariffs and we find a negative relation between import penetration and tariff levels working through the extra weight that governments place on producer surplus. We also find evidence of reciprocity in the EU's MTL.

In the absence of its PTAs the EU would have lowered its MFN tariff on PTA products by an additional 1.5 percentage points. Since the average reduction for non-PTA products was almost twice as high, the average price effect due to the EU's multilateral tariff changes was 50-60 percent for PTA goods relative to other goods. We also discussed how this wedge between PTA and non-PTA products provides an estimate of the effect of PTAs on

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[121]More specifically we estimate Cragg's (1983) "heteroskedastic OLS", which is more efficient than OLS in the presence of heteroskedasticity of unknown form because it uses the orthogonality conditions of the excluded instruments. The excluded instruments are the same we use for the IV estimates.

the expected average reductions in *all* products relative to a situation where the EU has no PTAs and showed that the effect was at least 1.2 percentage points.

The evidence for the US and the EU suggest that we should be concerned about a "clash of liberalizations". Similar work is required for other countries. However, even if the EU and the US turn out to be the exception, this concern would still have to be addressed because their share of world trade implies that their PTAs have a potentially large impact on non-members. These estimates suggest that the stumbling block effect may be even worse for the Doha round, which is currently under negotiation. The motive is simple, after the UR preferences for existing and new PTAs were greatly expanded, partly as a way to counter the preference erosion generated by the lower MFN tariffs. The inevitable final question is what, if anything, can be done to minimize this clash. The current enthusiasm for PTAs means that prohibiting them is not feasible and we have not shown that doing so would necessarily be optimal either. However, there may be ways to grant preferential treatment that do not slow down MTL. Recall that, according to the model, the effect of PTAs on MTL only occurs when the preferential tariff is zero and cannot be lowered further. From this perspective the answer is simple: remove the non-negativity constraint on preferential tariffs and allow import subsidies. Limão and Olarreaga (2005) estimate that the additional MTL thus permitted generates a Pareto improvement for the three groups of countries: non-members, preference granting and receiving countries. This or other proposals that target the source of the problem and take into account the effects on these three groups of countries are the most likely to be accepted by them and minimize any further "clash of liberalizations".

Tables

TABLE 1. Spearman's Rank Correlation Matrix for Tariffs over Time

	τ_{1983}	τ_{1985}	τ_{1988}	τ_{1989}	τ_{1990}	τ_{1991}	τ_{1992}	τ_{1993}	τ_{1994}	τ_{1995}	τ_{1996}	τ_{1997}
τ_{1985}	0.928	1										
τ_{1988}	0.861	0.953	1									
τ_{1989}	0.862	0.954	0.997	1								
τ_{1990}	0.806	0.925	0.952	0.954	1							
τ_{1991}	0.733	0.823	0.830	0.847	0.893	1						
τ_{1992}	0.688	0.764	0.771	0.768	0.795	0.866	1					
τ_{1993}	0.700	0.761	0.773	0.770	0.779	0.861	0.993	1				
τ_{1994}	0.688	0.763	0.777	0.778	0.797	0.876	0.997	0.991	1			
τ_{1995}	0.720	0.794	0.801	0.807	0.828	0.898	0.986	0.978	0.989	1		
τ_{1996}	0.727	0.847	0.874	0.882	0.897	0.857	0.885	0.874	0.887	0.922	1	
τ_{1997}	0.732	0.852	0.882	0.882	0.907	0.859	0.887	0.876	0.889	0.925	0.999	1
τ_{1998}	0.724	0.845	0.874	0.882	0.899	0.856	0.888	0.877	0.889	0.924	0.998	0.999

Note: τ_t stands for the average 4-digit ISIC level tariff in year t.

TABLE 2. Summary Statistics for Tariffs over Time

	Observations	Mean	Standard Deviation	Coefficient of Variation	Minimum	Maximum
τ_{1983}	78	0.427	0.221	0.516	0.09	1.15
τ_{1985}	78	0.377	0.148	0.393	0.059	0.70
τ_{1988}	78	0.347	0.155	0.448	0.07	0.70
τ_{1989}	75	0.344	0.155	0.451	0.07	0.70
τ_{1990}	76	0.297	0.115	0.386	0.07	0.50
τ_{1991}	74	0.211	0.093	0.442	0.016	0.35
τ_{1992}	68	0.134	0.045	0.334	0.05	0.20
τ_{1993}	65	0.135	0.046	0.343	0.05	0.20
τ_{1994}	63	0.136	0.045	0.333	0.05	0.20
τ_{1995}	65	0.136	0.046	0.334	0.043	0.20
τ_{1996}	67	0.139	0.046	0.333	0.048	0.20
τ_{1997}	66	0.140	0.046	0.332	0.048	0.20
τ_{1998}	67	0.140	0.045	0.323	0.048	0.20

Note: τ_t stands for the average 4-digit ISIC level tariff in year t.

TABLE 3. Correlation Matrix for Tariffs and Productivity over Time

	$\log\tau_{1983}$	$\log\tau_{1985}$	$\log\tau_{1988}$	$\log\tau_{1989}$	$\log\tau_{1990}$	$\log\tau_{1991}$	$\log\tau_{1992}$	$\log\tau_{1993}$	$\log\tau_{1994}$	$\log\tau_{1995}$	$\log\tau_{1996}$	$\log\tau_{1997}$	$\log\tau_{1998}$
$\log A_{1983}$	**-0.187**	-0.153	-0.064	-0.071	-0.049	0.003	-0.100	-0.117	-0.073	-0.088	-0.007	-0.014	0.007
$\log A_{1985}$	-0.233**	**-0.179**	-0.108	-0.116	-0.104	-0.076	-0.085	-0.097	-0.076	-0.108	0.012	0.008	0.028
$\log A_{1988}$	-0.220*	-0.237**	**-0.269****	-0.211*	-0.249**	-0.198*	-0.144	-0.151	-0.158	-0.226*	-0.241**	-0.244**	-0.239*
$\log A_{1989}$	-0.208*	-0.217*	-0.197*	**-0.199***	-0.233**	-0.206*	-0.141	-0.125	-0.129	-0.196	-0.219*	-0.223*	-0.220*
$\log A_{1990}$	-0.223*	-0.241**	-0.235**	-0.229**	**-0.260****	-0.253**	-0.138	-0.135	-0.146	-0.198	-0.233*	-0.231*	-0.233*
$\log A_{1991}$	-0.177	-0.195*	-0.238**	-0.224*	-0.234**	**-0.268****	-0.127	-0.124	-0.132	-0.203	-0.205	-0.204	-0.208*
$\log A_{1992}$	-0.145	-0.156	-0.158	-0.162	-0.163	-0.251**	**-0.039**	-0.054	-0.074	-0.199	-0.113	-0.112	-0.115
$\log A_{1993}$	-0.170	-0.193	-0.200	-0.204	-0.229*	-0.265**	-0.161	**-0.148**	-0.163	-0.201	-0.257**	-0.258**	-0.260**
$\log A_{1994}$	-0.195	-0.251**	-0.263**	-0.262**	-0.308**	-0.362***	-0.185	-0.161	**-0.175**	-0.218*	-0.275**	-0.271**	-0.277**
$\log A_{1995}$	-0.179	-0.225*	-0.239*	-0.238*	-0.269**	-0.346***	-0.154	-0.132	-0.147	**-0.227***	-0.225*	-0.225*	-0.227*
$\log A_{1996}$	-0.180	-0.217*	-0.245**	-0.245**	-0.257**	-0.297**	-0.141	-0.125	-0.144	-0.213*	**-0.241****	-0.244**	-0.247**
$\log A_{1997}$	-0.167	-0.194	-0.226*	-0.231*	-0.241*	-0.294**	-0.146	-0.126	-0.143	-0.220*	-0.225*	**-0.232***	-0.234*
$\log A_{1998}$	-0.206*	-0.229*	-0.272**	-0.271**	-0.294**	-0.337***	-0.223*	-0.205	-0.219*	-0.265**	-0.302**	-0.307**	**-0.311****

Note: $\log\tau_t$ stands for the natural logarithm of the average 4-digit ISIC level tariff in year t, and $\log A_t$ stands for the natural logarithm of the average 4-digit ISIC level total factor productivity in year t

TABLE 4. Summary Statistics for All the Variables in the Estimations

	Observations	Mean	Standard Deviation	Minimum	Maximum
$\log\tau_{it}$	920	-1.646	0.641	-4.107	0.140
$\Delta\log\tau_{it}$	840	-0.093	0.228	-1.971	1.583
$\log\tau_{it}^{eff}$	902	-1.128	0.884	-4.294	1.556
$\Delta\log\tau_{it}^{eff}$	821	-0.113	0.526	-12.613	2.377
$\log(Q_{it}/M_{it}\varepsilon_{it})$	920	0.248	2.376	-6.139	11.470
$\Delta\log(Q_{it}/M_{it}\varepsilon_{it})$	840	-0.098	0.641	-6.025	3.201
$\log A_{it}$	920	1.508	0.590	0.091	4.097
$\Delta\log A_{it}$	840	0.031	0.270	-1.951	2.154
$\log Capital\ Share$	920	-1.765	0.777	-5.549	0.598
$\Delta\log Capital\ Share$	840	0.027	0.324	-3.714	1.771
$\log Materials\ Prices$	920	-0.067	0.267	-1.488	0.929
$\Delta\log Materials\ Prices$	840	-0.018	0.134	-0.777	1.338
$\log Scale$	920	11.726	1.489	5.595	16.264
$\Delta\log Scale$	830	0.050	0.528	-5.107	3.488
$\log Upstream\ TFP$	920	1.523	0.140	1.206	2.096
$\Delta\log Upstream\ TFP$	840	0.017	0.067	-0.205	0.490

Notes: The tariff data are not available for 1982, 1986, and 1987 so we start out with 1310 4-digit ISIC tariff lines. When we take into account the missing output figures (not present for the whole year of 1984), the sample reduces to 1004 observations. Finally, considering the other missing observations on the right-hand-side, the sample further declines to around 920 for the main estimations.

TABLE 5. The Effect of Productivity on Tariffs

	(1)	(2)	(3)
$\log(Q_{it}/M_{it}\varepsilon_{it})$	0.390***	0.606***	0.864***
($\beta_1>0$)	(0.073)	(0.142)	(0.173)
$\log A_{it}$	0.271***	0.386***	0.551***
($\beta_2>0$)	(0.066)	(0.097)	(0.116)
$UNILIB_t$	-0.533***		
($\beta_3<0$)	(0.065)		
REF_t		-0.492***	
($\rho_1<0$)		(0.035)	
$POSTREF_t$		-0.306**	
($\rho_2<0$)		(0.154)	
Constant	-1.536***	-1.884***	-2.186***
	(0.190)	(0.269)	(0.296)
Year Effects	No	No	Yes
Observations	920	920	920
Chi^2-test p-val for all μ_i=0 [a]	0.000	0.000	0.000
Chi^2-test p-val for all θ_t=0 [b]	n/a	n/a	0.000
Hansen's J p-val [c]	0.144	0.180	0.933

Notes: (1) Standard errors are in parentheses. (2) *, **, and *** indicate significance at a 10%, 5%, and 1% level, respectively. (3) The dependent variable is the natural logarithm of the advalorem tariff rate ($\log\tau_{it}$). (4) The predicted signs for the coefficients of the regressors are indicated in parentheses below them. (5) All regressions include 4-digit ISIC industry dummies as regressors but are not reported. (6) List of instruments (all in logs): Capital share, materials prices (deviated from the producer price index), measure of scale economies (value added/number of firms), and the TFP of upstream sectors.

[a] "Chi^2-test p-val for all μ_i=0" provides the probability value for the Chi-squared test of H$_0$: All μ_i (industry fixed effects) are jointly insignificant.

[b] "Chi^2-test p-val for all θ_t=0" provides the probability value for the Chi-squared test of H$_0$: All θ_t (year effects) are jointly insignificant.

[c] "Hansen's J p-val" provides the probability value for the Hansen-Sargan test of overidentifying restrictions for H$_0$: Excluded instruments are uncorrelated with the error term and correctly excluded from the estimated equation.

TABLE 6. The Effect of Productivity Differences on Tariff Differences

	(1)	(2)	(3)
$\Delta\log(Q_{it}/M_{it}\varepsilon_{it})$	0.190	0.514*	0.449**
$(\beta_1>0)$	(0.726)	(0.290)	(0.213)
$\Delta\log A_{it}$	0.231	0.519**	0.476**
$(\beta_2>0)$	(0.658)	(0.263)	(0.209)
$\Delta UNILIB_t$	-0.120***		
$(\beta_3<0)$	(0.031)		
REF_t		-0.185***	-0.231***
$(\varphi <0)$		(0.069)	(0.045)
Constant			0.031*
			(0.016)
Observations	676	676	676
Hansen's J p-val [a]	0.572	0.929	0.958

Notes: (1) Standard errors are in parentheses. (2) *, **, and *** indicate significance at a 10%, 5%, and 1% level, respectively. (3) The dependent variable is the one year change in the natural logarithm of the advalorem tariff rate ($\log\tau_{it}$). (4) The predicted signs for the coefficients of the regressors are indicated in the parentheses below them. (5) List of instruments (all in logs): First differences of capital share, materials prices (deviated from the producer price index), measure of scale economies (value added/number of firms), and the TFP of upstream sectors. (6) All estimations allow for arbitrary intra-industry correlation over time.
[a] "Hansen's J p-val" provides the probability value for the Hansen-Sargan test of overidentifying restrictions for H_0: Excluded instruments are uncorrelated with the error term and correctly excluded from the estimated equation.

TABLE 7. The Effect of Productivity on the Effective Rates of Protection

	(1)	(2)	(3)
$\log(Q_{it}/M_{it}\varepsilon_{it})$	0.333***	0.270*	0.303**
$(\beta_1>0)$	(0.084)	(0.142)	(0.139)
$\log A_{it}$	0.261***	0.190**	0.198**
$(\beta_2>0)$	(0.070)	(0.091)	(0.096)
$UNILIB_t$	-0.598***		
$(\beta_3<0)$	(0.079)		
REF_t		-0.500***	
$(\rho_1<0)$		(0.045)	
$POSTREF_t$		-0.715***	
$(\rho_2<0)$		(0.165)	
Year Effects	No	No	Yes
Constant	-0.415**	-0.207	-0.066
$(\alpha>0)$	(0.198)	(0.363)	(0.342)
Observations	887	887	887
Chi^2-test p-val for all μ_i=0 [a]	0.000	0.000	0.000
Chi^2-test p-val for all θ_t=0 [b]	n/a	n/a	0.000
Hansen's J p-val [c]	0.004	0.001	0.000

Notes: (1) Standard errors are in parentheses. (2) *, **, and *** indicate significance at a 10%, 5%, and 1% level, respectively. (3) The dependent variable is the natural logarithm of the effective rate of protection ($\log \tau_{it}^{eff}$). (4) The predicted signs for the coefficients of the regressors are indicated in parentheses below them. (5) All regressions include 4-digit ISIC industry dummies as regressors but are not reported. (6) List of instruments (all in logs): Capital share, materials prices (deviated from the producer price index), measure of scale economies (value added/number of firms), and the TFP of upstream sectors.

[a] "Chi^2-test p-val for all μ_i=0" provides the probability value for the Chi-squared test of H_0: All μ_i (industry fixed effects) are jointly insignificant.

[b] "Chi^2-test p-val for all θ_t =0" provides the probability value for the Chi-squared test of H_0: All θ_t (year effects) are jointly insignificant.

[c] "Hansen's J p-val" provides the probability value for the Hansen-Sargan test of overidentifying restrictions for H_0: Excluded instruments are uncorrelated with the error term and correctly excluded from the estimated equation.

TABLE 8. The Effect of Productivity Differences on the Effective Rate of Protection Differences

	(1)	(2)	(3)
$\Delta\log(Q_{it}/M_{it}\varepsilon_{it})$	0.337	0.553	0.519*
$(\beta_1>0)$	(0.838)	(0.337)	(0.269)
$\Delta\log A_{it}$	0.297	0.504*	0.490*
$(\beta_2>0)$	(0.758)	(0.294)	(0.251)
$\Delta UNILIB_t$	-0.105***		
$(\beta_3<0)$	(0.040)		
REF_t		-0.182**	-0.223***
$(\varphi<0)$		(0.089)	(0.065)
Constant			0.032
			(0.021)
Observations	652	652	652
Hansen's J p-val [a]	0.482	0.695	0.765

Notes: (1) Standard errors are in parentheses. (2) *, **, and *** indicate significance at a 10%, 5%, and 1% level, respectively. (3) The dependent variable is the one year change in the natural logarithm of the effective rate of protection ($\log\tau_{it}^{eff}$). (4) The predicted signs for the coefficients of the regressors are indicated in the parentheses below them. (5) List of instruments (all in logs): First differences of capital share, materials prices (deviated from the producer price index), measure of scale economies (value added/number of firms), and the TFP of upstream sectors. (6) All estimations allow for arbitrary intra-industry correlation over time.

[a] "Hansen's J p-val" provides the probability value for the Hansen-Sargan test of overidentifying restrictions for H_0: Excluded instruments are uncorrelated with the error term and correctly excluded from the estimated equation.

TABLE 9. The Effect of Past Productivity on Current Tariffs

	(1)	(2)	(3)
$\log(Q_{it}/M_{it}\varepsilon_{it})$	0.586***	0.518***	0.351***
($\beta_1>0$)	(0.116)	(0.118)	(0.101)
$\log A_{it-1}$	0.186**	0.168**	0.205***
($\beta_2>0$)	(0.088)	(0.080)	(0.067)
$UNILIB_t$	-0.361***		
($\beta_3<0$)	(0.104)		
REF_t		-0.494***	
($\rho_1<0$)		(0.044)	
$POSTREF_t$		-0.381***	
($\rho_2<0$)		(0.139)	
Constant	-2.207***	-2.058***	-1.610***
	(0.289)	(0.293)	(0.239)
Year Effects	No	No	Yes
Observations	895	895	895
Chi^2-test p-val for all μ_i=0 [a]	0.000	0.000	0.000
Chi^2-test p-val for all θ_t=0 [b]	n/a	n/a	0.000
Hansen's J p-val [c]	0.406	0.061	0.056

Notes: (1) Standard errors are in parentheses. (2) *, **, and *** indicate significance at a 10%, 5%, and 1% level, respectively. (3) The dependent variable is the natural logarithm of the advalorem tariff rate ($\log\tau_{it}$). (4) The predicted signs for the coefficients of the regressors are indicated in parentheses below them. (5) All regressions include 4-digit ISIC industry dummies as regressors but are not reported. (6) List of instruments (all in logs): Capital share, materials prices (deviated from the producer price index), one period lag of the measure of scale economies (value added/number of firms), and one period lag of the TFP of upstream sectors.

[a] "Chi^2-test p-val for all μ_i=0" provides the probability value for the Chi-squared test of H$_0$: All μ_i (industry fixed effects) are jointly insignificant.

[b] "Chi^2-test p-val for all θ_t =0" provides the probability value for the Chi-squared test of H$_0$: All θ_t (year effects) are jointly insignificant.

[c] "Hansen's J p-val" provides the probability value for the Hansen-Sargan test of overidentifying restrictions for H$_0$: Excluded instruments are uncorrelated with the error term and correctly excluded from the estimated equation.

TABLE 10. The Effect of Productivity on Tariffs and Effective Rates of Protection: OLS Results

	(1) $\log\tau_{it}$	(2) $\log\tau_{it}^{eff}$
$\log(Q_{it}/M_{it}\varepsilon_{it})$	0.125***	0.134***
($\beta_1>0$)	(0.015)	(0.019)
$\log A_{it}$	0.046	0.071
($\beta_2>0$)	(0.032)	(0.046)
$UNILIB_t$	-0.731***	-0.741***
($\beta_3<0$)	(0.024)	(0.031)
$Constant$	3.418***	0.199**
($\alpha>0$)	(0.078)	(0.092)
Observations	920	887
R^2	0.823	0.842
Wald test p-val [a]	0.000	0.000

Notes: (1) Standard errors are in parentheses. (2) *, **, and *** indicate significance at a 10%, 5%, and 1% level, respectively. (3) $\log\tau_{it}$ is the natural logarithm of the advalorem tariff rate, and $\log\tau_{it}^{eff}$ is the natural logarithm of the effective rate of protection. (4) The predicted signs for the coefficients of the regressors are indicated in the parentheses below them. (5) The estimates include 4-digit ISIC industry dummies as regressors but are not reported.

[a] Wald test p-val provides the probability value for the F-test of H_0: The regressors are jointly insignificant.

TABLE 11. The Effect of Productivity Differences on Tariff and Effective Rate of Protection Differences: OLS Results

	(1) $\Delta\log\tau_{it}$	(2) $\Delta\log\tau_{it}^{eff}$
$\Delta\log(Q_{it}/M_{it}\varepsilon_{it})$	0.076***	0.084***
($\beta_1>0$)	(0.022)	(0.031)
$\Delta\log A_{it}$	0.079*	0.071
($\beta_2>0$)	(0.046)	(0.066)
$\Delta UNILIB_t$	-0.128***	-0.113***
($\beta_3<0$)	(0.017)	(0.031)
Observations	676	652
R^2	0.056	0.042
Wald test p-val [a]	0.000	0.021

Notes: (1) Standard errors are in parentheses. (2) *, **, and *** indicate significance at a 10%, 5%, and 1% level, respectively. (3) $\Delta\log\tau_{it}$ is the one year change in the natural logarithm of the advalorem tariff rate, and $\Delta\log\tau_{it}^{eff}$ is the one year change in the natural logarithm of the effective rate of protection. (4) The predicted signs for the coefficients of the regressors are indicated in the parentheses below them. (5) All estimations allow for arbitrary intra-industry correlation over time.

[a] Wald test p-val provides the probability value for the F-test of H_0: The regressors are jointly insignificant.

TABLE 12. First Stage Regressions: Table 5 Column 1 Specification

	$\log(Q_{it}/M_{it}\varepsilon_{it})$	$\log A_{it}$
$UNILIB_t$	-0.686***	0.097***
	(0.0672)	(0.020)
log*Capital Share*	-0.109	-0.334***
	(0.069)	(0.020)
log*Materials Prices*	0.432***	0.008
	(0.159)	(0.047)
log*Scale*	-0.139***	0.187***
	(0.0458)	(0.013)
log*Upstream TFP*	-0.901***	0.435***
	(0.303)	(0.088)
Constant	4.531***	-2.164***
	(0.703)	(0.205)
Observations	920	920
R^2	0.897	0.858
Adjusted R^2	0.887	0.844
Shea's partial R^2	0.033	0.434
Wald test p-val [a]	0.000	0.000

Notes: (1) Standard errors are in parentheses. (2) *, **, and *** indicate significance at a 10%, 5%, and 1% level, respectively. (3) These first stage regressions refer to the main tariff specification in column 1 of Table 5. (4) The dependent variables are indicated in the header row of each column.
[a] Wald test p-val provides the probability value for the F-test of H_0: The regressors are jointly insignificant.

TABLE 13. First Stage Regressions: Table 6 Column 1 Specification

	$\Delta\log(Q_{it}/M_{it}\varepsilon_{it})$	$\Delta\log A_{it}$
$\Delta UNILIB_t$	-0.064	0.053**
	(0.075)	(0.026)
$\Delta\log$Capital Share	0.379***	-0.405***
	(0.085)	(0.030)
$\Delta\log$Materials Prices	0.017	-0.061
	(0.183)	(0.064)
$\Delta\log$Scale	-0.077*	0.103***
	(0.045)	(0.016)
$\Delta\log$Upstream TFP	0.345	0.004
	(0.377)	(0.132)
Observations	676	676
R^2	0.041	0.289
Adjusted R^2	0.034	0.283
Shea's partial R^2	0.002	0.014
Wald test p-val [a]	0.000	0.000

Notes: (1) Standard errors are in parentheses. (2) *, **, and *** indicate significance at a 10%, 5%, and 1% level, respectively. (3) These first stage regressions refer to the main first-differenced tariff specification in column 1 of Table 6. (4) The dependent variables are indicated in the header row of each column.
[a] Wald test p-val provides the probability value for the F-test of H_0: The regressors are jointly insignificant.

TABLE 14. Tariffs and Productivity: A System of Equations

	OLS	3SLS		
	$\log A_{it}$	$\log A_{it}$	$\log \tau_{it}$	$\log(Q_{it}/M_{it}\varepsilon_{it})$
$\log \tau_{it}$	-0.066***	-0.067***		1.869***
	(0.022)	(0.021)		(0.107)
$\log(Q_{it}/M_{it}\varepsilon_{it})$			0.362***	
			(0.096)	
$\log A_{it}$			0.198***	
			(0.057)	
$\log$Capital Share				1.038***
				(0.082)
$\log$Materials Prices				1.041***
				(0.241)
$\log$Scale	0.246***	0.245***		
	(0.029)	(0.014)		
$\log$Upstream TFP	0.260***	0.257***		
	(0.092)	(0.096)		
Constant	-1.842***	-1.828***	-1.612***	5.227***
	(0.321)	(0.219)	(0.229)	(0.239)
Observations	920	920	920	920
R^2	0.812	0.812	0.770	0.338
Wald test p-val	0.000	0.000	0.000	0.000

Notes: (1) Standard errors are in parentheses. (2) *, **, and *** indicate significance at a 10%, 5%, and 1% level, respectively. (3) The dependent variables are indicated in the header row of each column. (4) The $\log A_{it}$ equations include industry dummies, GDP growth, and inflation as controls which are not reported here. The $\log \tau_{it}$ equation includes both industry and year dummies which are not reported.
[a] Wald test p-val provides the probability value for the Chi-squared-test of H_0: The regressors are jointly insignificant.

TABLE 15. Effective Rates of Protection and Productivity: A System of Equations

	OLS	3SLS		
	$\log A_{it}$	$\log A_{it}$	$\log \tau_{it}^{eff}$	$\log(Q_{it}/M_{it}\varepsilon_{it})$
$\log \tau_{it}^{eff}$	-0.059***	-0.069***		1.513***
	(0.022)	(0.020)		(0.080)
$\log(Q_{it}/M_{it}\varepsilon_{it})$			0.468***	
			(0.127)	
$\log A_{it}$			0.320***	
			(0.074)	
$\log$Capital Share				1.074***
				(0.082)
$\log$Materials Prices				0.966***
				(0.239)
$\log$Scale	0.247***	0.247***		
	(0.029)	(0.014)		
$\log$Upstream TFP	0.265***	0.247**		
	(0.092)	(0.098)		
Constant	-1.767***	-1.729***	-0.545*	3.906***
	(0.332)	(0.229)	(0.302)	(0.183)
Observations	887	887	887	887
R^2	0.809	0.809	0.756	0.363
Wald test p-val	0.000	0.000	0.000	0.000

Notes: (1) Standard errors are in parentheses. (2) *, **, and *** indicate significance at a 10%, 5%, and 1% level, respectively. (3) The dependent variables are indicated in the header row of each column. (4) The $\log A_{it}$ equations include industry dummies, GDP growth, and inflation as controls which are not reported here. The $\log \tau_{it}^{eff}$ equation includes both industry and year dummies which are not reported.
[a] Wald test p-val provides the probability value for the Chi-squared-test of H_0: The regressors are jointly insignificant.

TABLE 16. Tariffs and PTA-good Indicators in the EU by Industry

SIC Code	Sector	Before UR Mean	Before UR Std.Dv.	After UR Mean	After UR Std.Dv.	The Change Mean	The Change Std.Dv.	The Change Coef.Var.[a]	I^{any0} Mean	I^{evy0} Mean	No. of obs[b]
311	Food products	0.161	0.087	0.114	0.073	0.047	0.026	0.553	0.437	0.000	419
313	Beverages	0.108	0.038	0.073	0.021	0.035	0.018	0.514	0.800	0.000	5
314	Tobacco	0.422	0.195	0.252	0.118	0.17	0.089	0.524	0.250	0.000	4
321	Textiles	0.096	0.03	0.069	0.023	0.026	0.02	0.769	0.987	0.120	853
322	Wearing apparel except footwear	0.126	0.026	0.109	0.025	0.017	0.008	0.471	0.997	0.501	375
323	Leather products	0.051	0.023	0.034	0.023	0.016	0.009	0.563	1.000	0.373	83
324	Footwear except rubber or plastic	0.095	0.048	0.087	0.04	0.008	0.012	1.500	1.000	0.243	37
331	Wood products except furniture	0.056	0.022	0.02	0.025	0.036	0.011	0.306	0.878	0.068	74
332	Furniture except metal	0.058	0.007	0.012	0.017	0.046	0.013	0.283	1.000	0.406	32
341	Paper and products	0.088	0.02	0.044	0.018	0.044	0.017	0.386	0.982	0.114	167
342	Printing and publishing	0.093	0.032	0.047	0.024	0.047	0.017	0.362	1.000	0.143	21
351	Industrial chemicals	0.08	0.029	0.055	0.015	0.025	0.027	1.080	0.950	0.016	767
352	Other chemicals	0.067	0.018	0.031	0.03	0.036	0.029	0.806	0.961	0.071	254
353	Petroleum refineries	0.046	0.02	0.03	0.018	0.015	0.008	0.533	0.795	0.000	39
354	Miscellaneous petroleum and coal products	0.039	0.023	0.026	0.034	0.013	0.011	0.846	0.900	0.000	10
355	Rubber products	0.053	0.023	0.034	0.023	0.019	0.01	0.526	1.000	0.170	53
356	Plastic products	0.111	0.048	0.084	0.046	0.027	0.017	0.630	1.000	0.165	97
361	Pottery china earthenware	0.078	0.027	0.06	0.025	0.019	0.011	0.579	1.000	0.571	21
362	Glass and products	0.074	0.029	0.048	0.031	0.026	0.012	0.462	0.968	0.064	125
369	Other non-metallic mineral products	0.045	0.021	0.021	0.017	0.024	0.009	0.375	1.000	0.063	95
371	Iron and steel	0.057	0.018	0.004	0.012	0.054	0.021	0.389	0.926	0.000	435
372	Non-ferrous metals	0.061	0.024	0.041	0.027	0.021	0.014	0.667	0.963	0.000	163
381	Fabricated metal products	0.057	0.019	0.031	0.016	0.026	0.013	0.500	0.992	0.117	384
382	Machinery except electrical	0.045	0.013	0.02	0.014	0.025	0.012	0.480	0.990	0.140	776
383	Machinery electric	0.063	0.025	0.034	0.021	0.029	0.016	0.552	0.990	0.263	312
384	Transport equipment	0.077	0.047	0.053	0.05	0.024	0.018	0.750	0.972	0.143	217
385	Professional and scientific equipment	0.062	0.014	0.028	0.016	0.034	0.014	0.412	1.000	0.255	251
390	Other manufactured products	0.063	0.017	0.029	0.015	0.034	0.017	0.500	0.996	0.236	225
	Total	0.079	0.046	0.049	0.042	0.03	0.022	0.733	0.939	0.133	6294

Advalorem tariff rates are reported. The total number of observations in our sample is equal to 6294. Note that the products with zero initial tariff rates are excluded from the sample as explained in the text. (a) Stands for coefficient of variation. (b) Number of observations for I^{any0} and I^{evy0} in each SIC 3-digit sector.

TABLE 17. Stumbling Block Estimates

Panel A: Main Estimations

	IV-GMM		HOLS	
	(1)	(2)	(3)	(4)
I^{any0}	0.015***	0.015***	0.013***	0.013***
($\phi^{any0}>0$)	(0.003)	(0.003)	(0.001)	(0.001)
I^{evy0}		0.007***		0.004***
($\phi^{evy0}>0$)		(0.002)		(0.001)
Δx	0.004*	0.003**	0.000	0.000
($\beta>0$)	(0.002)	(0.001)	(0.000)	(0.000)
R	0.006*	0.005*	0.010***	0.009***
($\rho>0$)	(0.003)	(0.003)	(0.002)	(0.002)
P	0.001	0.000	0.001*	0.000
($\mu>0$)	(0.001)	(0.000)	(0.000)	(0.000)
Constant	-0.034***	-0.034***	-0.038***	-0.038***
(*c*)	(0.005)	(0.004)	(0.002)	(0.002)
Observations	6294	6294	6294	6294
Schwarz Criterion	-7.58	-7.60	-7.68	-7.68
Hansen's J p-val [a]	0.506	0.567	n/a	n/a
C-stat p-val [b]	0.729	0.562	n/a	n/a
Endogeneity p-val [c]	0.517	0.248	n/a	n/a
Heterosked. p-val [d]	0.000	0.000	0.000	0.000
1+ ϕ/c [e]	0.55	0.58	0.66	0.65
	(.41,.68)	(.47,.69)	(.60, .71)	(.60, .71)
1+($\phi+\phi^{all}$)/c [e]	n/a	0.39	n/a	0.56
		(.21,.56)		(.49 , .63)

Robust standard errors in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%
Clustering at the 3-digit SIC level.
The predicted signs for the coefficients of the variables are indicated in brackets below them.
IV-GMM refers to the two-step efficient generalized method of moments estimator.
HOLS refers to the heteroskedastic ordinary least squares estimator.
(a) Hansen-Sargan test of overidentifying restrictions. Probability value for H_0: Excluded instruments are uncorrelated with the error term, and correctly excluded from the estimated equation. (b) Difference-in Sargan (C) statistic. Probability value for H_0: The subset of variables/instruments marked with "‡" in Table 2, 3, and 4 are exogenous. (c) Endogeneity test based on the C statistic for the main regressors. Probability value for H_0: No endogeneity among regressors. (d) Pagan-Hall heteroskedasticity test. Probability value for H_0: Disturbance is homoskedastic. (e) Confidence intervals calculated using the delta method.

TABLE 17. Stumbling Block Estimates

Panel B: Auxiliary Estimations

	(1)	(2)	(3)	(4)
I^{any}	0.013***			
($\phi^{any}>0$)	(0.003)			
I^{pos}	-0.026			
($\phi^{pos}+\phi^{any}=0$)	(0.032)			
I^{any0}		0.015***	0.011***	
($\phi^{any0}>0$)		(0.003)	(0.002)	
I^{afs} ‡		0.002		
($\phi^{afs}=0$)		(0.002)		
I^{spg} ‡		-0.001		
($\phi^{spg}=0$)		(0.001)		
I^{hiexp}			0.005***	
($\phi^{hiexp}>0$)			(0.002)	
I^{gsp} †				0.003***
($\phi^{gsp}>0$)				(0.001)
I^{gspl} †				0.003***
($\phi^{gspl}>0$)				(0.001)
I^{acp}				0.000
($\phi^{acp}>0$)				(0.001)
I^{eftx} †				0.002***
($\phi^{eftx}>0$)				(0.001)
I^{med}				0.002***
($\phi^{med}>0$)				(0.001)
I^{cec} †				0.002***
($\phi^{cec}>0$)				(0.001)
Δx	0.004*	0.003**	0.003**	0.003**
($\beta>0$)	(0.002)	(0.002)	(0.001)	(0.001)
R	0.008*	0.006*	0.006**	0.008***
($\rho>0$)	(0.004)	(0.004)	(0.003)	(0.003)
P	0.001	0.001	0.001	-0.000
($\mu>0$)	(0.001)	(0.001)	(0.001)	(0.000)
Constant	-0.030***	-0.035***	-0.036***	-0.028***
(*c*)	(0.005)	(0.004)	(0.003)	(0.003)
Observations	6294	6294	6294	6294
Schwarz Criterion	-7.56	-7.60	-7.61	-7.64
Hansen's J p-val [a]	0.559	0.495	0.569	0.159
C-stat p-val [b]	0.446	0.722	0.553[e]	0.114
Endogeneity p-val [c]	0.399	0.525	0.270	0.210
Heterosked. p-val [d]	0.000	0.000	0.000	0.000
$1+\phi/c$ [h]	0.57 (.42,.72)	0.57 (.47,.66)	0.69 (.56,.81)	n/a
$1+(\phi+\phi^{hi})/c$ [h]	n/a	n/a	0.56 [f] (.44, .68)	0.53 [g] (.37, .69)
$\phi^{pos}+\phi^{any}=0$ p-val	0.68 (accept)	n/a	n/a	n/a

Estimation method is IV-GMM. †: the following coefficient restrictions in place, $\phi^{gsp}=\phi^{gspl}$, $\phi^{eftx}=\phi^{cec}$, based on a test failing to reject their equality. (a) Hansen-Sargan test of overidentifying restrictions. Probability value for H_0: Excluded instruments are uncorrelated with the error term, and correctly excluded from the estimated equation. (b) Difference-in Sargan (C) statistic. Probability value for H_0: The subset of variables/instruments marked with "‡" in Table 2, 3, and 4 are exogenous. (c) Endogeneity test based on the C statistic for the main regressors. Probability value for H_0: No endogeneity among regressors. (d) Pagan-Hall heteroskedasticity test. Probability value for H_0: Disturbance is homoskedastic. (e) The following extra instruments are tested for this specification: D^{hiexp}, $D^{ntball}xD^{hiexp}$ for which the first stage regression results are similar to those in Table 3 but not reported. (f) The value for the combined effect of I^{any0} and I^{hiexp}. (g) Calculated for a product exported under every program. The other values, with confidence intervals in brackets, are GSP and GSPL: 0.88 (.82, .94), ACP: 0.99 (.93, 1.06), MED: 0.92 (.87, .97), EFTX and CEC: 0.93 (.88, .97). (h) Confidence intervals calculated using the delta method.

TABLE 18. First Stage Regressions
(Any and Every PTA Specifications)

	Table 2-Panel A-Column 1			Table 2-Panel A-Column 2			
	I^{any0}	Δx	R	I^{any0}	I^{evy0}	Δx	R
D^{anyexp} ‡	0.936***	-0.866***	0.021***	0.933***	-0.003	-0.774***	0.020***
	(0.023)	(0.217)	(0.007)	(0.023)	(0.020)	(0.215)	(0.007)
D^{evyexp} ‡				0.035***	0.801***	-0.755***	0.013***
				(0.007)	(0.006)	(0.063)	(0.002)
D^{ntball} ‡	0.008	-0.888**	-0.010	0.013	-0.014	-0.974**	-0.009
	(0.041)	(0.388)	(0.012)	(0.041)	(0.036)	(0.383)	(0.012)
D^{ntball}xD^{anyexp} ‡	-0.229***	0.506	0.010	-0.251***	0.000	0.319	0.009
	(0.042)	(0.392)	(0.012)	(0.041)	(0.036)	(0.389)	(0.012)
D^{ntball}xD^{evyexp} ‡				0.190***	-0.109***	1.497***	0.012*
				(0.026)	(0.022)	(0.240)	(0.007)
Δp_{9294}	-0.003	0.051	-0.004**	-0.002	-0.001	0.035	-0.004**
	(0.006)	(0.059)	(0.002)	(0.006)	(0.005)	(0.059)	(0.002)
$(\Delta p_{9294})^2$	-0.009***	-0.005	0.000	-0.007***	0.000	-0.024	0.001
	(0.003)	(0.028)	(0.001)	(0.003)	(0.003)	(0.027)	(0.001)
$(\Delta p_{9294})^3$	0.002*	-0.007	0.000	0.002*	0.000	-0.004	0.000
	(0.001)	(0.009)	(0.000)	(0.001)	(0.001)	(0.009)	(0.000)
D^{ntb} ‡	0.051***	1.014***	0.025***	0.049***	0.020***	1.072***	0.024***
	(0.006)	(0.060)	(0.002)	(0.006)	(0.006)	(0.059)	(0.002)
$\Delta scale$	0.189***	-0.497***	-0.032***	0.190***	0.003	-0.550***	-0.031***
	(0.009)	(0.082)	(0.002)	(0.009)	(0.008)	(0.081)	(0.002)
$(\Delta p_{9294})^{avg}$x$\Delta scale$ ‡	-0.362***	-0.917	0.102***	-0.285***	-0.017	-1.465*	0.119***
	(0.085)	(0.803)	(0.024)	(0.085)	(0.074)	(0.797)	(0.024)
R^{uni}	0.041**	-0.075	0.754***	0.042**	0.024	-0.058	0.754***
	(0.017)	(0.163)	(0.005)	(0.017)	(0.015)	(0.161)	(0.005)
P	0.039***	-0.274***	-0.004***	0.036***	0.003	-0.252***	-0.005***
	(0.005)	(0.046)	(0.001)	(0.005)	(0.004)	(0.045)	(0.001)
$Constant$	-0.039*	-1.129***	-0.275***	-0.042*	0.003	-1.084***	-0.275***
	(0.024)	(0.222)	(0.007)	(0.023)	(0.020)	(0.219)	(0.007)
Observations	6294	6294	6294	6294	6294	6294	6294
R-squared	0.379	0.079	0.792	0.390	0.767	0.102	0.794
Adj. R^2	0.378	0.078	0.792	0.389	0.767	0.100	0.794
Shea's partial R^2	0.323	0.066	0.780	0.342	0.670	0.082	0.783
F statistic	348.89	49.26	2178.40	308.61	1593.15	54.63	1863.06
F-test p-val [a]	0.000	0.000	0.000	0.000	0.000	0.000	0.000
F statistic excluded	362.23	50.35	2395.79	316.06	1713.12	55.90	2017.93
F-test excl. p-val [b]	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Robust standard errors in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%.
Clustering at the 3-digit SIC level.
‡: the subset of instruments further tested for exogeneity. The probability value for the difference-in Sargan (C) statistics for these instruments are reported on the row labeled C-stat p-val. in Table 2.
(a) Probability value for the F–test of H_0: The instruments are jointly insignificant.
(b) Probability value for the F–test of H_0: The *excluded* instruments are jointly insignificant.

TABLE 19. Robustness and Specification Analysis

	IV-GMM	IV-GMM (No threshold)	IV-GMM (Initial tariff)	IV-GMM (No 311)	HOLS
	(1)	(2)	(3)	(4)	(5)
[A.1] ϕ^{any0}	0.015	0.022	0.018	0.005	0.013
(s.e.)	(0.003)	(0.003)	(0.004) [b]	(0.002)	(0.001)
[A.1] $1+ \phi/c$ [a]	0.55	0.47	0.36	0.79	0.66
(95% CI)	(.41,.68)	(.30, .64)	(-.03, .70) [c]	(.66,.92)	(.60, .71)
[B.1] H$_0$: $\phi^{pos} + \phi^{any} = 0$	Can't reject	Can't reject	Can't reject [b]	Can't reject	Reject [d]
(p-val)	(0.68)	(0.78)	(0.99)	(0.42)	(0.00)
[B.2] [e] ϕ^{afs} (s.e)	0.002 (0.002)	0.002 (0.002)	0.003 (0.002) [b]	-0.001 (0.001)	0.000 (0.001)
ϕ^{spg} (s.e)	-0.001 (0.001)	0.001 (0.001)	0.000 (0.001)	-0.000 (0.001)	-0.001 (0.001)
[1] Schwarz Criterion	-7.58	-7.60	-7.45	-7.68	-7.68
Observations	6294	6294	6294	5875	6294

The numbers in square brackets in the first cell of each row refer to the specification numbers from Table 2.

IV-GMM refers to the two-step efficient generalized method of moments estimator.

HOLS refers to the heteroskedastic ordinary least squares estimator.

a. Measures the relative growth of world prices due to PTAs for imperfect pass-through (such that $\zeta^{PTA} \approx \zeta < 1$). Confidence intervals calculated using the delta method.

b. The coefficient on the initial tariff variable (t_{t-1}) for the three different specifications with the standard errors in brackets are [1]: -0.195 (0.111), [3]: -0.151 (0.119), and [4]: -0.170 (0.115).

c. Refers to the relative growth at the mean initial tariff i.e. $1+\phi/(c+ 0.0789* \phi^{ini})$. When we account for the different average initial tariffs, 0.0757 when $I^{any0}=1$ and 0.128 otherwise, that is calculate $(c+ 0.0757* \phi^{ini} +\phi)/(c+ 0.128* \phi^{ini})$, we obtain 0.26 (-.09, .61).

d. The 95% confidence interval for $I^{pos} + I^{any}$ is [-0.0161, -0.0047] .

e. The test of the combined effect $\phi^{afs} + \phi^{spg} = 0$ yields the following p-values for columns (1) through (5) respectively: 0.84, 0.28, 0.29, 0.58, 0.44.

TABLE 20. Summary Statistics

Variable Name	Mean	Std. Dev.	Min	Max
Δt	-0.030	0.022	-0.268	0.000
I^{any0}	0.939	0.239	0	1
I^{evy0}	0.133	0.339	0	1
I^{any}	0.954	0.210	0	1
I^{pos}	0.015	0.121	0	1
I^{afs}	0.902	0.297	0	1
I^{spg}	0.875	0.330	0	1
I^{hiexp}	0.891	0.311	0	1
I^{gsp}	0.646	0.478	0	1
I^{gspl}	0.190	0.392	0	1
I^{acp}	0.291	0.454	0	1
I^{eftx}	0.870	0.337	0	1
I^{med}	0.508	0.500	0	1
I^{cec}	0.671	0.470	0	1
Δx	-2.004	1.853	-13.884	5.466
R	-0.460	0.118	-0.960	0.000
D^{anyexp}	0.984	0.126	0	1
D^{evyexp}	0.167	0.373	0	1
D^{gsp}	0.899	0.302	0	1
D^{gspl}	0.224	0.417	0	1
D^{acp}	0.333	0.471	0	1
D^{eftx}	0.904	0.294	0	1
D^{med}	0.594	0.491	0	1
D^{cec}	0.852	0.355	0	1
D^{hiexp}	0.948	0.221	0	1
R^{uni}	-0.267	0.139	-0.922	0
D^{ntb}	0.288	0.453	0	1
D^{ntball}	0.096	0.295	0	1
$D^{ntball}\text{x}D^{anyexp}$	0.091	0.288	0	1
$D^{ntball}\text{x}D^{evyexp}$	0.010	0.101	0	1
$D^{ntball}\text{x}D^{gsp}$	0.069	0.253	0	1
Δp_{9294}	0.001	0.461	-3.912	4.874
$\Delta scale$	0.307	0.322	-0.351	1.047
$(\Delta p_{9294})^{avg}\text{x}\Delta scale$	0.005	0.032	-0.053	0.126
P	0.502	0.500	0	1
t_{t-1}	0.079	0.046	0.005	0.65

The number of observations in our sample (n) is 6294. There are 8688 non-missing values for Δt (the dependent variable), which is reduced to 7784 when we omit the lines with zero initial tariffs. Missing import and market access variables to construct the reciprocity variable reduce the sample to 6837, and missing price data to 6721. Production related data accounts for the remaining missing values and leaves us with n=6294.
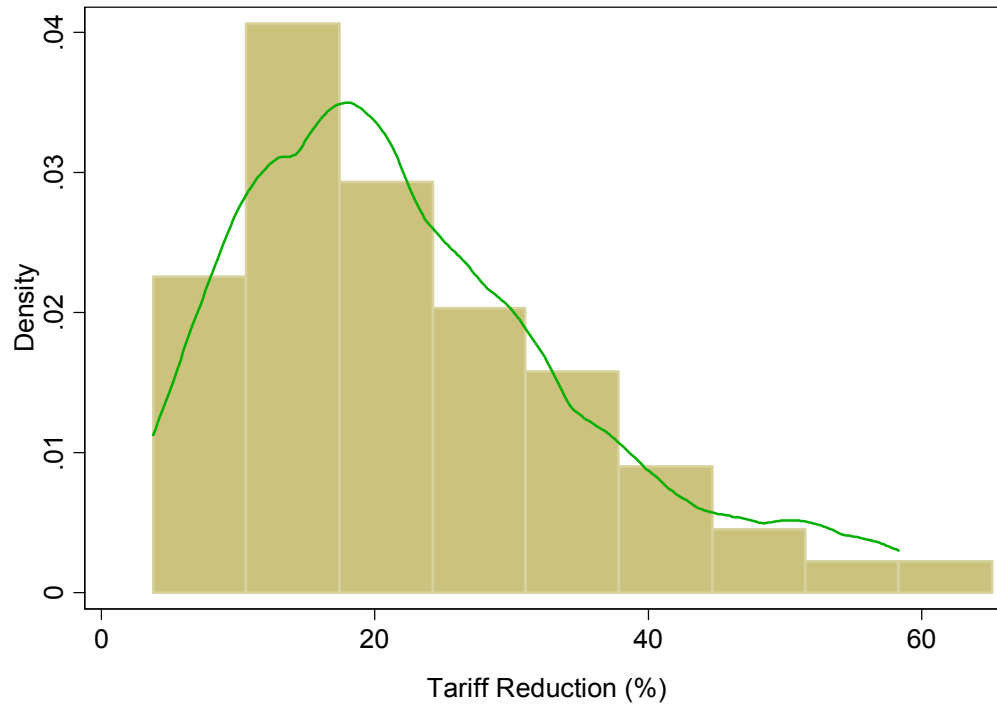
Figures

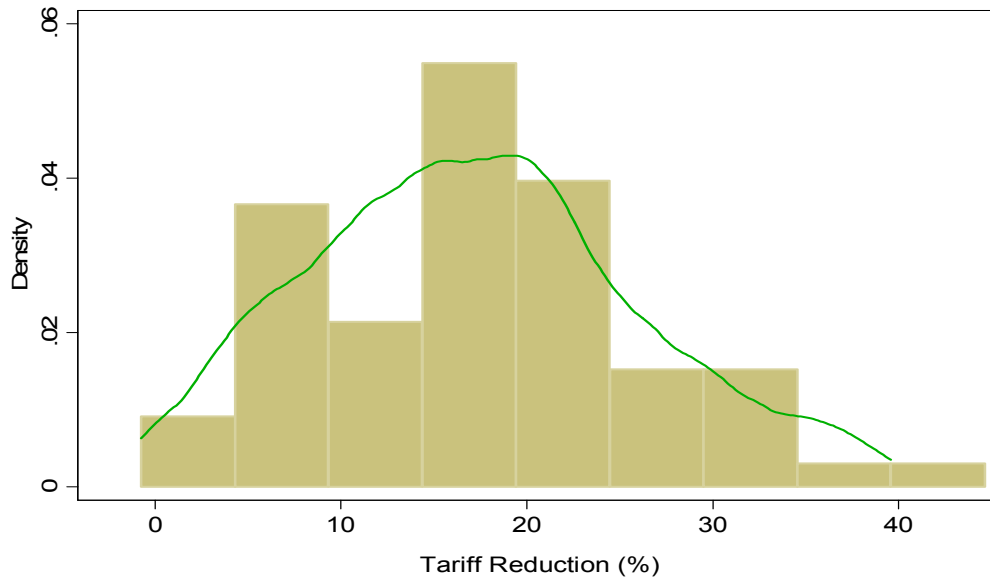**FIGURE 1. Average Tariffs and Effective Rates of Protection in Colombia 1983-1998**
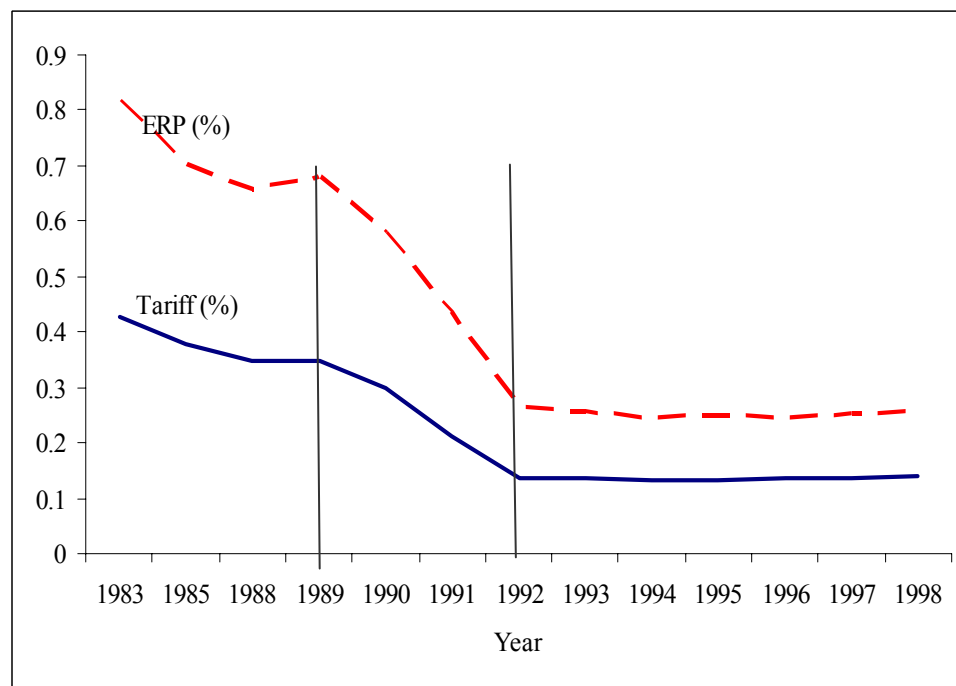
Source: DNP and author's own calculations.

FIGURE 2. Histogram of the Percentage Decline in Tariffs between 1983 and 1995 at the 4-digit ISIC Level
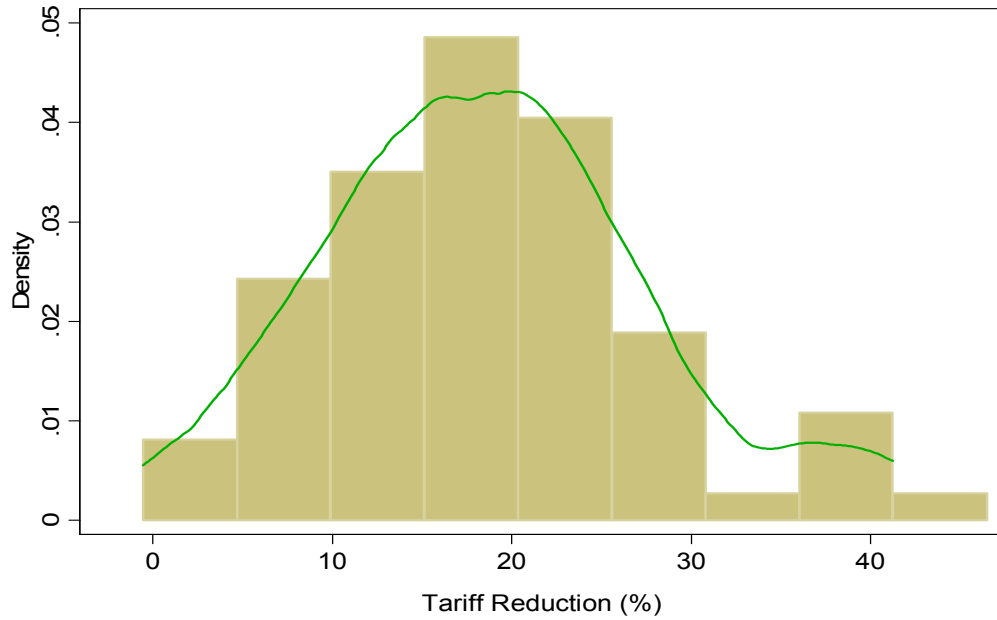

Note: Tariff reduction is calculated as $[\log(1+\tau_{i1983})-\log(1+\tau_{i1995})]*100$
Source: DNP and author's own calculations.

FIGURE 3. Histogram of the Percentage Decline in Tariffs between 1988 and 1995 at the 4-digit ISIC Level

Note: Tariff reduction is calculated as $[\log(1+\tau_{i1988})-\log(1+\tau_{i1995})]*100$
Source: DNP and author's own calculations.

FIGURE 4. Histogram of the Percentage Decline in Tariffs between 1983-1989 average and 1992-1998 average at the 4-digit ISIC Level

Note: Tariff reduction is calculated as $[\log(1+\text{avg}\tau_{i1983-1988})-\log(1+\text{avg}\tau_{i1992-1998})]*100$
Source: DNP and author's own calculations.

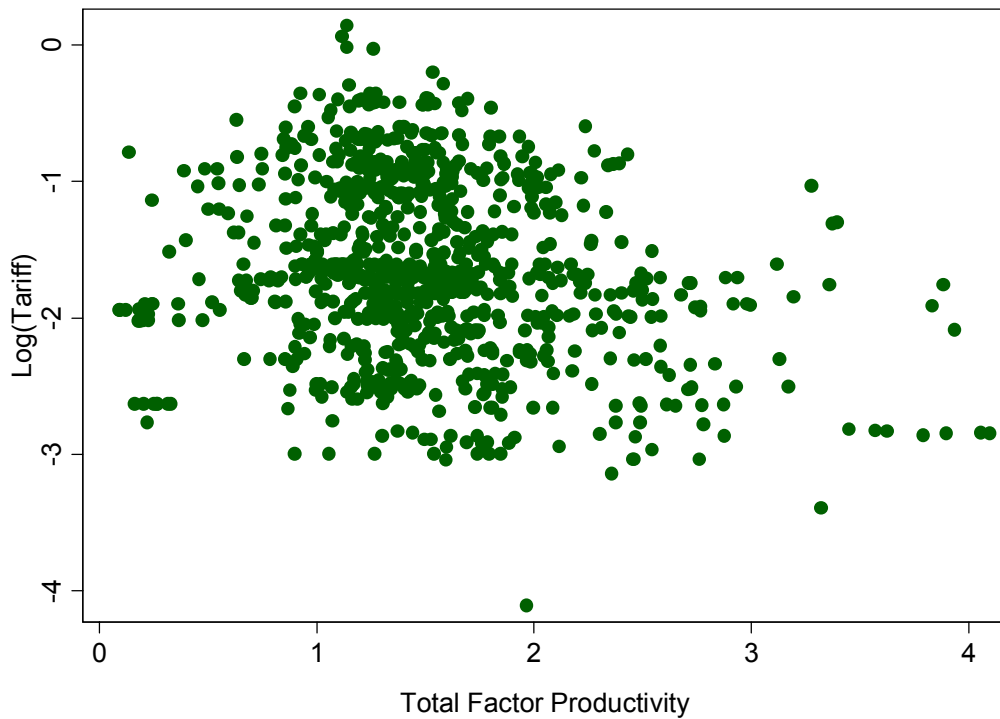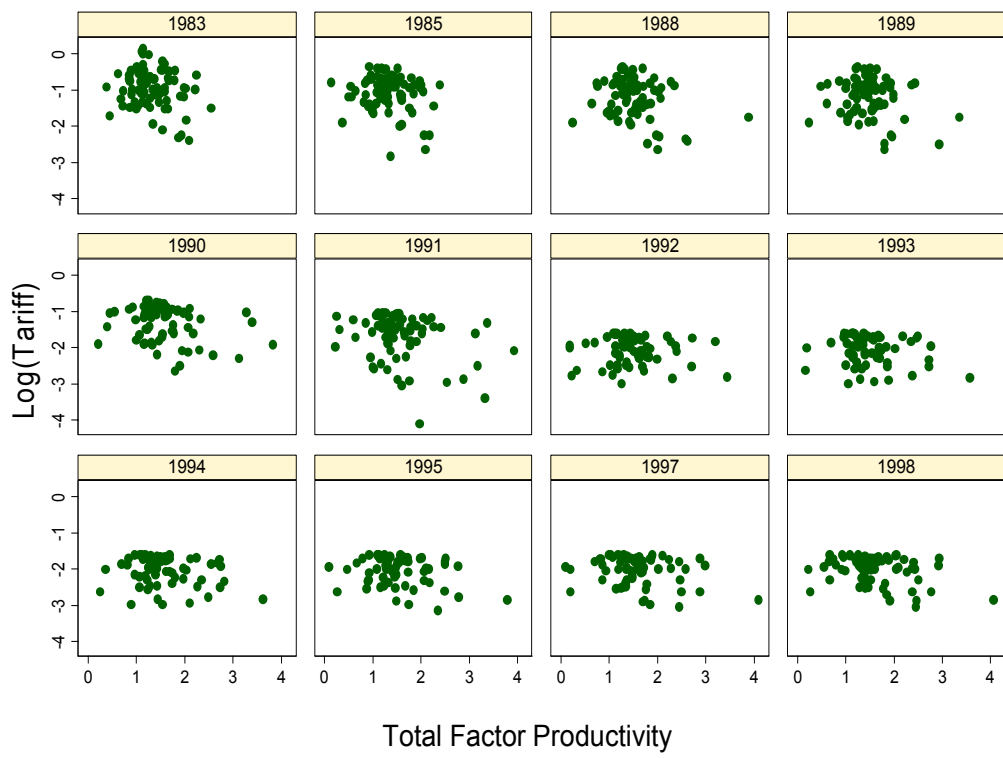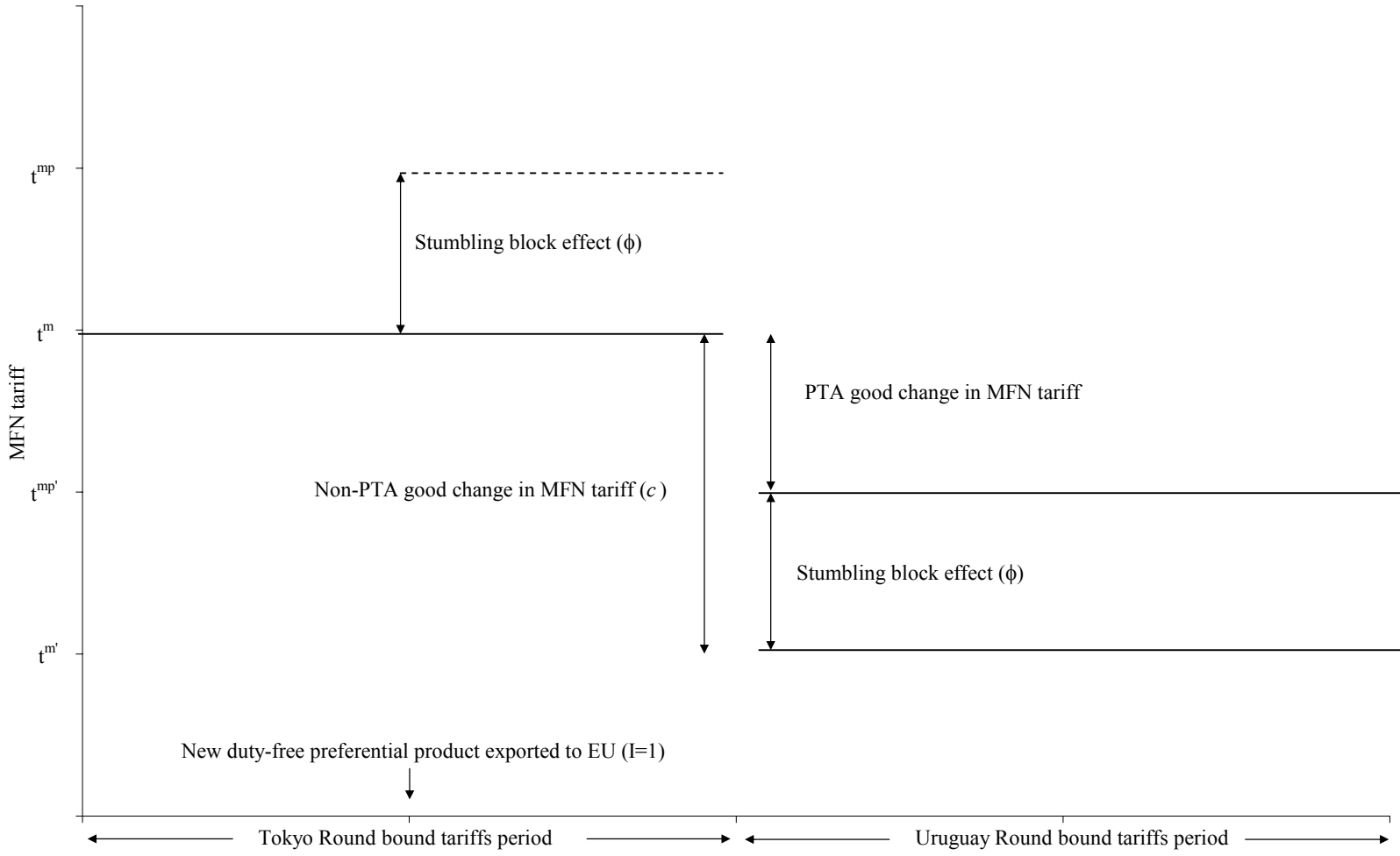**FIGURE 5. Tariffs and Productivity: Whole Sample**

FIGURE 6. Tariffs and Productivity: By Year

Graphs by year

FIGURE 7.
Identification of the Stumbling Block Effect through MFN Tariff Changes

Appendices

A Derivations for Chapter 1

Equation (2)
We maximize equation (1) with respect to τ_i to obtain the following first order condition

$$
\begin{aligned}
\frac{\partial G}{\partial \tau_i} &= -D_i(\tau_i) + \omega A_i Q_i(\tau_i) + M_i(\tau_i) + \tau_i M_i'(\tau_i) \\
&= (\omega - 1)A_i Q_i(\tau_i) + \tau_i M_i'(\tau_i)
\end{aligned}
\tag{39}
$$

Equating to zero and solving for τ_i, and then dividing both sides of this expression by $p_i^w = 1$ and using the following elasticity definition $\varepsilon_i \equiv -M_i' p_i^w / M_i$ yields equation (2).

Equation (6)
In order to obtain equation (6), we implicitly differentiate the specific tariff version of τ_i as expressed in equation (5) with respect to α and use the linearity assumption for M_i (so that $M_i'' = 0$), the restriction $0 < \alpha < 2 - D_i'/A_i Q_i'$ and concavity of $\sigma_i(\tau_i)$ (i.e. $\sigma_i' > 0$, $\sigma_i'' < 0$)

$$
\frac{d\tau_i}{d\alpha} = -\frac{\sigma_i'}{M_i'(\tau_i) + (\omega - 1)A_i Q_i'(\tau_i) + \alpha \sigma_i''(\tau_i)} > 0
\tag{40}
$$

Equation (13)
The first order condition for a solution to equation (11) is

$$
\begin{aligned}
\frac{\partial E_t(G_{it} + \delta G_{it+1})}{\partial \tau_{it}} &= (\omega - 1)\phi_{it}Q_{it}(\tau_{it}) + \tau_{it}M_{it}' - \delta\frac{\partial \tau_{it+1}^e(\tau_{it})}{\partial \tau_{it}}D_{it+1}(.) \\
&\quad + \delta\omega\frac{\partial}{\partial \tau_{it}}\int_0^{1+\tau_{it+1}^e}\overline{\phi}_{it+1}\lambda(\phi_{it}Q_{it}(\tau_{it}))Q_{it+1}(\tau_{it+1})d\tau_{it+1} \\
&\quad + \delta\frac{\partial \tau_{it+1}^e(\tau_{it})}{\partial \tau_{it}}M_{it+1}(.) + \delta\frac{\partial \tau_{it+1}^e(\tau_{it})}{\partial \tau_{it}}\tau_{it+1}^e(\tau_{it})M_{it+1}'
\end{aligned}
\tag{41}
$$

which after a few steps of manipulation becomes

$$
\begin{aligned}
\frac{\partial E_t(G_{it} + \delta G_{it+1})}{\partial \tau_{it}} &= (\omega - 1)\phi_{it}Q_{it}(\tau_{it}) + \tau_{it}M_{it}' \\
&\quad + \delta\omega\left[\frac{\lambda'(\phi_{it}Q_{it}(\tau_{it}))}{\lambda(\phi_{it}Q_{it}(\tau_{it}))}\phi_{it}Q_{it}'\int_0^{1+\tau_{it+1}^e}\overline{\phi}_{it+1}\lambda(.)Q_{it+1}(\tau_{it+1})d\tau_{it+1}\right] \\
&\quad + \delta\frac{\partial \tau_{it+1}^e(\tau_{it})}{\partial \tau_{it}}\left[\begin{array}{c}(\omega - 1)\overline{\phi}_{it+1}\lambda(.)Q_{it+1}(\tau_{it+1}^e(\tau_{it})) \\ +\tau_{it+1}^e(\tau_{it})M_{it+1}'\end{array}\right]
\end{aligned}
\tag{42}
$$

Using equation (12) to substitute in for $\tau_{it+1}^e(\tau_{it})$ and employing the definition in equation (14), the first order condition simplifies to

$$
\frac{\partial E_t(G_{it} + \delta G_{it+1})}{\partial \tau_{it}} = (\omega - 1)\phi_{it}Q_{it}(\tau_{it}) + \tau_{it}M_{it}' + \delta\omega\Lambda_i = 0
\tag{43}
$$

Dividing both sides of equation (43) by $p_i^w = 1$ and using the same elasticity term ε_i as described above yields equation (13).

Equations (16a), (16b), and (16c)

Employing the functional form given in equation (15), the LBD term can now be expressed as

$$\Lambda_i = n\phi_{it}^n Q_{it}'(Q_{it}(\tau_{it}))^{n-1} \int_0^{1+\tau_{it+1}^e} \overline{\phi}_{it+1} Q_{it+1}(\tau_{it+1}) d\tau_{it+1} \tag{44}$$

The relationships in equations (16a), (16b), and (16c) are then obtained by plugging equation (44) in equation (43) and differentiating τ_{it} in equation (43) with respect to $\overline{\phi}_{it+1}$ implicitly, ϕ_{it} partially, and ϕ_{it} implicitly. For $\overline{\phi}_{it+1}$ we get

$$\frac{d\tau_{it}}{d\overline{\phi}_{it+1}}\Big|_{n<1} \tag{45}$$

$$= -\frac{\delta\omega n\phi_{it}^n Q_{it}'(Q_{it}(\tau_{it}))^{n-1} \int_0^{1+\tau_{it+1}^e} Q_{it+1} d\tau_{it+1}}{M_{it}' + \delta\omega n(n-1)\phi_{it}^n (Q_{it}')^2 (Q_{it})^{n-2} \int_0^{1+\tau_{it+1}^e} \overline{\phi}_{it+1} Q_{it+1} d\tau_{it+1} + (\omega-1)\phi_{it} Q_{it}'} > 0$$

Similarly for ϕ_{it} we get the following two

$$\frac{\partial\tau_{it}}{\partial\phi_{it}}\Big|_{n<1} \tag{46}$$

$$= -\frac{\delta\omega n^2 \phi_{it}^{n-1} Q_{it}'(Q_{it})^{n-1} \int_0^{1+\tau_{it+1}^e} \overline{\phi}_{it+1} Q_{it+1} d\tau_{it+1} + (\omega-1)Q_{it}}{M_{it}'} > 0$$

$$\frac{d\tau_{it}}{d\phi_{it}}\Big|_{n<1} \tag{47}$$

$$= -\frac{\delta\omega n^2 \phi_{it}^{n-1} Q_{it}'(Q_{it})^{n-1} \int_0^{1+\tau_{it+1}^e} \overline{\phi}_{it+1} Q_{it+1} d\tau_{it+1} + (\omega-1)Q_{it}}{M_{it}' + \delta\omega n(n-1)\phi_{it}^n (Q_{it}')^2 (Q_{it})^{n-2} \int_0^{1+\tau_{it+1}^e} \overline{\phi}_{it+1} Q_{it+1} d\tau_{it+1} + (\omega-1)\phi_{it} Q_{it}'} > 0$$

Equation (17)

The actual tariff in period $t+1$ is similar to the one in equation (12) but now its terms are not dependent on X_{it}, because I assume that the LBD process is realized to be a false perception:

$$\tau_{it+1} = (\omega-1)\frac{\phi_{it+1} Q_{it+1}(\tau_{it+1})/M_{it+1}(\tau_{it+1})}{\varepsilon_{it+1}(\tau_{it+1})} \tag{48}$$

Now, by using equation (13) and equation (48), we can express the difference in tariff rates between the two periods as

$$\Delta\tau_{it+1} = \tau_{it+1}|_{n=0} - \tau_{it}|_{n>0} = -\frac{1}{M_i'}(\omega-1)(\phi_{it+1} Q_{it+1} - \phi_{it} Q_{it})$$

$$+\frac{1}{M_i'}\delta\omega n\phi_{it}^n Q_{it}'(Q_{it})^{n-1} \int_0^{1+\tau_{it+1}^e} \overline{\phi}_{it+1} Q_{it+1} dp_{it+1} \tag{49}$$

Equation (17) is then obtained by implicitly differentiating equation (49) with respect to

$\Delta\phi_{it+1}$.

$$\frac{d\Delta\tau_{it+1}}{d\Delta\phi_{it+1}}\Big|_{\tau_{it},\phi_{it}} = \frac{(\omega-1)Q_{it+1}(\tau_{it+1})}{M_i'(.) + (\omega-1)\phi_{it+1}Q_{it+1}'(\tau_{it+1})} > 0 \qquad (50)$$

B Data Details for Chapter 2

B.1 Import Demand Elasticity

In Chapter 1, I define the import demand elasticity, ε_i, as $M_i' p_i^w / M_i$ but traditionally and in the empirical data in Chapter 2 it is evaluated at the domestic prices, not the world prices. I take this into account in obtaining the elasticity adjusted inverse import penetration ratio, given the fact that ouput value is evaluated at the domestic prices, whereas imports are evaluated at the world prices. Therefore,

$$\frac{X_i/M_i}{\varepsilon_i} = \frac{X_i/M_i}{M_i' p_i^w / M_i} = \frac{p_i X_i / p_i^w M_i}{M_i' p_i / M_i} \tag{51}$$

I use the structural estimates from Kee, Nicita and Olarreaga (2004) to compute the import demand elasticities. Based on Kee et al. (2004), I obtain the import demand elasticity for sector i as

$$\varepsilon_{it} = \frac{a_i}{s_{it}} + s_{it} - 1 \tag{52}$$

where s_{it} is the negative of the imports to GDP ratio and a_i is an estimated structural price parameter from a GDP function.

B.2 Variable Definitions and Sources for Chapter 2

Name	Definition	Source
τ_{it}	Advalorem tariff rate (%): Obtained at the 8-digit product level ("Nabandina" code) and aggregated to the 4-digit ISIC level by simple averaging	National Planning Department (DNP), Colombia
τ_{it}^{eff}	Effective rate of protection (%): Obtained at the 8-digit product level ("Nabandina" code) and aggregated to the 4-digit ISIC level by simple averaging	National Planning Department (DNP), Colombia
X_{it}	Output values in 1000 USD at the 4-digit ISIC level	UNIDO, Industrial Statistics Database
M_{it}	Import values in 1000 USD at the 4-digit ISIC level	COMTRADE, United Nations Statistics Division
ε_{it}	Import demand elasticity at the 3-digit ISIC level: obtained by combining import and GDP data with estimated structural price parameters.	Structural estimates (Kee et al. 2004), GDP (World Development Indicators, World Bank), imports (COMTRADE).
A_{it}	Total factor productivity (TFP): Obtained at the firm level by estimating production function residuals with a 2SLS model. Aggregated from the firm to the 4-digit ISIC level by using production shares as weights.	Eslava, Haltiwanger, Kugler and Kugler (2004)
Capital Share	Capital stock series obtained at the firm level using fixed assets, gross investment, "observed" depreciation rates, and a gross capital formation deflator. The ratio of capital stock to output is then aggregated to the 4-digit ISIC level by using firms' production shares as weights.	Eslava, Haltiwanger, Kugler and Kugler (2004)
Materials Prices	Obtained at the firm level using Tornqvist indices which are aggregated to the 4-digit ISIC level by using firms' production shares as weights.	Eslava, Haltiwanger, Kugler and Kugler (2004)
Scale	The ratio of total value added to the number of firms in a given 4-digit ISIC sector.	Eslava, Haltiwanger, Kugler and Kugler (2004)
Upstream TFP	Using the input-output tables at the 3-digit ISIC level, I exclude the inputs being used from the own sector, and obtain the upstream measure based on a combination of TFPs of the remaining input sectors as weighted by their share of usage.	Input-output tables (Nicita and Olarreaga 2001, originally from Global Trade Analysis Project), TFP (Eslava et al. 2004).
GDP Growth	The annual percentage change in the GDP (constant 2000 US dollars)	World Development Indicators (WDI), World Bank
Inflation	Annual percentage change in the GDP deflator	World Development Indicators (WDI), World Bank

C Derivations and Data Details for Chapter 3

C.1 Tariff Expressions

C.1.1 No Common External Tariff

Equation (28)
The tariff revenue expression in equation (26) depends on whether there is a PTA and the PTA involves a CET.

$$TR(\boldsymbol{\tau}, \boldsymbol{\pi}) = \begin{cases} -\sum_{i=1}^{I} \tau_i M_i^*(p_i(\tau_i) - \tau_i) + \sum_{i=1}^{s \leq I} \pi_i[X_i^s - D_i^S] - \sum_{i=1}^{s \leq I}(\tau_i - \pi_i)D_i^S & \text{No CET} \\ -\sum_{i=1}^{I} \tau_i M_i^*(p_i(\tau_i) - \tau_i) + \sum_{i=1}^{s \leq I} \pi_i[X_i^s - D_i^S] & \text{CET} \end{cases}$$

$$(53)$$

The first line applies if there is a PTA without a CET, and the second applies to the case of a PTA with a CET or no PTA. They differ because in the absence of a CET the consumers in Small purchase from the lowest cost supplier, Large*, so an amount D_i^S–previously exported by Large* to Large–on which τ_i was levied is now exported by Small to Large and only π_i is collected.

Consider good $i = I$, which is imported by Large from Large* and its symmetric counterpart $i = I + 1$, exported to Large*. Using equation (26) and the first line in equation (53) we simplify the first-order-condition (FOC) for an interior solution to equation (27) and obtain

$$\begin{aligned} G_{\tau_I} + G_{\tau_{I+1}^*} + G_{\pi_I} &= -[M_I^s + M_I^* + H\tau_I(p_I' - 1)d_I^{*\prime}] \\ &\quad -p_I' M_I - (p_{I+1}'^* - 1)M_{I+1} + (\omega_I - 1)p_I' X_I \\ &= -[H\tau_I(p_I' - 1)d_I^{*\prime}] - (p_I' - 1)M_I \\ &\quad -(p_{I+1}'^* - 1)M_{I+1} + (\omega_I - 1)p_I' X_I \end{aligned} \qquad (54)$$

where $p' \equiv \partial p/\partial \tau$, $d^{*\prime} \equiv \partial d^*/\partial p^*$ and we use the market clearing condition in equation (25) for I. Equating to zero, solving for τ_I and using $M_I^{*\prime} = D_I^{*\prime}$ (fixed supply) we obtain

$$\tau_I^m = \frac{(\omega_I - 1)p_I' X_I - (p_I' - 1)M_I - (p_{I+1}'^* - 1)M_{I+1}}{(p_I' - 1)M_I^{*\prime}} \qquad (55)$$

By employing the symmetry, we have $p_I' = p_{I+1}'^*$. The symmetry also implies that $M_I = M_{I+1}^*$ and $M_I^s = M_{I+1}^{s*}$, which, along with equation (25) implies $M_{I+1}^* + M_{I+1}^{s*} = -M_{I+1}$, so $M_{I+1} = -(M_I + M_I^s)$. Finally, to obtain equation (28), we divide equation (55) by p_I^*, use $p' = M^{*\prime}/[M^{*\prime} + M']$ (from implicit differentiation of equation (25) and $M_I^{\prime s} = 0$) and employ the following elasticity definitions: $\varepsilon \equiv -M'p^*/M$ and $\varepsilon^* \equiv [\partial(M^* + M^s)/\partial p^*] \times [p^*/(M^* + M^s)] = [\partial M^*/\partial p^*] \times [p^*/(M^* + M^s)]$.

Equation (32)

In the FOC to obtain τ^{mp} we combine equation (26) and the first line of equation (53):

$$
\begin{aligned}
G_{e^s}\frac{\partial e^b}{\partial \tau_I} + G_{\tau_I} + G_{\tau^*_{I+1}} &= \left[G_{e^s}\frac{\partial e^b}{\partial \tau_I} - D_I^s - M_I^* - H\tau_I(p_I' - 1)d_I^{*\prime}\right] \\
&\quad - p_I'(D(p_I(\tau_I)) - X_I) \\
&\quad - (p_{I+1}'^* - 1)(D_{I+1} - X_{I+1}) + (\omega_I - 1)p_I'X_I \\
&= \left[G_{e^s}\frac{\partial e^b}{\partial \tau_I} - X_I^s - H\tau_I(p_I' - 1)d_I^{*\prime}\right] \\
&\quad - (p_I' - 1)M_I - (p_{I+1}'^* - 1)M_{I+1} + (\omega_I - 1)p_I'X_I
\end{aligned} \tag{56}
$$

where we use $M_I^s \equiv D_I^s - X_I^s$ and equation (25). Equating to zero, solving for τ_I and using $M_I^{*\prime} = D_I^{*\prime}$ (fixed supply) we obtain

$$
\tau_I^{mp} = \frac{(\omega_I - 1)p_I'X_I - (p_I' - 1)M_I - (p_{I+1}'^* - 1)M_{I+1} + \left[G_{e^s}\frac{\partial e^b}{\partial \tau_I} - X_I^s\right]}{(p_I' - 1)M_I^{*\prime}} \tag{57}
$$

To obtain equation (32) we apply the symmetry conditions described in the previous derivation, divide equation (57) by p_I^*, employ the same elasticity definitions and use $\partial e^b/\partial \tau_I = \delta X_I^s/H$ from equation (30).

C.1.2 Common External Tariff and Direct Transfers

Allowing a transfer T from Large to Small when cooperation starts, the equilibrium level of e^s for a given preference, $\tau_1 - \pi_1$, and transfer, T is[122]

$$
e^{bcu} = \delta(T + (\tau_1 - \pi_1)(X_1^s - D_1^s))/H \tag{58}
$$

The large countries maximize their joint objective net of transfers made to the regional partner.

$$
\{\tau^{mcu}, \pi^{pcu}, T^{cu}\} \equiv \arg\max_{\tau,\pi,T}\{G(\boldsymbol{\tau}^* = \boldsymbol{\tau}, \boldsymbol{\pi}, e^s, .) - T : \boldsymbol{\pi} \leq \boldsymbol{\tau}; e^s = e^{bcu}\} \tag{59}
$$

The FOCs for a good obtaining a preference under this program of CET with transfers are

$$
G_\tau + G_{\tau^*} + G_{e^s}\frac{\partial e^b}{\partial \tau} \leq 0; \quad G_\pi + G_{e^s}\frac{\partial e^b}{\partial \pi} \leq 0 ; \quad G_T + G_{e^s}\frac{\partial e^b}{\partial T} \leq 0 \tag{60}
$$

where we recall that $G(.)$ is defined by equation (26) with the tariff revenue term given by the second line in equation (53). Evaluating the FOC of the MFN tariff in the absence of preferences, i.e. equation (54), at the level of the MFN tariff under the CU in equation (60)

---

[122]The incentive compatibility constraint for Small is now $[G^s(\boldsymbol{\pi}, \boldsymbol{\tau}, e^s = 0) + T] - [G^s(\boldsymbol{\pi}, \boldsymbol{\tau}, e^s) + T] \leq \frac{\delta}{1-\delta}[G^s(\boldsymbol{\pi}, \boldsymbol{\tau}, e^s) + T - G^s(\boldsymbol{\pi} = \boldsymbol{\tau}, \boldsymbol{\tau}, e^s = 0)]$ where G^s is still defined by equation (29) but the consumption price in Small is now $p_i^{sc} = p_i(\tau_i) - \pi_i$, since if it were to import from Large* it would need to pay the CET.

we obtain

$$\left[G_{\tau_I} + G_{\tau^*_{I+1}} + G_{\pi_I}\right]_{G_\tau + G_{\tau^*} + G_{e^s}\frac{\partial e^b}{\partial \tau} = 0} = G_{\pi_I} - G_{e^s}\frac{\partial e^b}{\partial \tau_I} \tag{61}$$

$$= G_{\pi_I} + G_{e^s}\frac{\partial e^b}{\partial \pi_I} = 0$$

where the second line uses equation (58). In order to establish the last equality in equation (61), we must show that the FOC for π in equation (60) is zero. Suppose it is not, such that $G_\pi + G_{e^s}\frac{\partial e^b}{\partial \pi} = -M^s + (\delta M^s/H)G_{e^s} = (-1 + \delta G_{e^s}/H)M^s < 0$ when evaluated at $\tau^{mcu} = \tau^m$. This implies that Large would gain by further lowering π but it can only do so until it is zero. However, $G_T + G_{e^s}\frac{\partial e^b}{\partial T} = -1 + \delta G_{e^s}/H$, which is positive if $G_\pi + G_{e^s}\frac{\partial e^b}{\partial \pi} < 0$. Thus $\tau^{mcu} = \tau^m, T = 0$ and $\pi = 0$ is not a solution. T must be increased until $-1 + \delta G_{e^s}/H = 0$, which implies that $G_\pi + G_{e^s}\frac{\partial e^b}{\partial \pi} = 0$. Therefore we obtain $\tau^{mcu} = \tau^m$, $T^{cu} > 0$ and $\pi = \pi^{pcu} < \tau^{mcu}$.

C.2   Data Sources and Definitions

- Δt: The change in the bound advalorem MFN tariffs between the pre-Uruguay Round (UR) and post-UR periods for the HS 8-digit product i. Source: WTO.

- I^{any0} [I^{evy0}]: An indicator variable equal to 1, if good i is imported at a duty-free preferential rate by EU under any [all] of its PTAs in 1994. It excludes PTAs involving a common external tariff. Sources: Eurostat's COMEXT (trade flows) and UNCTAD's TRAINS (preferential tariff rates).

- I^{any} [I^{pos}]: An indicator equal to 1, if good i is imported by the EU under any of its PTAs at either a duty-free or positive preferential tariff rate [a positive preferential rate only] in 1994. Sources: COMEXT, TRAINS.

- I^{afs} [I^{spg}]: An indicator equal to 1 if good i is imported by the EU from the "recent" members Austria, Finland, or Sweden [Spain, Portugal, or Greece] in 1994. Source: COMEXT.

- $I^{hi\,exp}$: An indicator equal to 1 if the exports of any of the PTA partners (excluding the ones with CET) to the EU in good i is greater than the 25th percentile of its exports to the EU and it is exported under the respective preferential program, i.e. the interaction of I^{any0} and $D^{hi\,exp}$ (defined below). Sources: COMEXT, TRAINS.

- $R \equiv \sum_k s^k_i (\sum_j w^k_j \Delta t^k_j / t^k_{jt})$: Reciprocity variable measuring changes in market access provided by the major exporters of good i to the EU during the UR; where $\Delta t^k_j / t^k_{jt}$ is the percentage tariff reduction by country $k \notin$ EU in good j between 1986 and 1995, w^k_j is the 1992 import share of good j in total imports of k, and s^k_i is the exports of a principal supplier (a top 5 exporter) k to the EU in good i as a share of total exports of good i from all of the EU's principal suppliers. Sources: Finger et al. (1999) and authors' calculations from COMEXT.

- R^{uni}: Reciprocity variable computed only for the unilateral liberalization (between 1986 and 1992) by the major exporters to the EU. The computation is otherwise similar to that of R. Sources: Finger et al. (1999), COMEXT and authors' calculations.

- Δx: The EU-wide change in the elasticity adjusted inverse import penetration ratio between 1978 (pre-Tokyo Round) and 1992 (pre-UR), where $x_{It} \equiv X_{It}/M_{It}\varepsilon_{It}$ for each 3-digit SIC industry I. Computed using the members of the EU in 1978 – Belgium, Denmark, France, Germany, Ireland, Italy, Luxembourg, Netherlands, United Kingdom. We employ the production value measured in domestic prices, $p_{It}X_{It}$, whereas the import values are measured at the world prices, $p_{It}^*M_{It}$. The elasticity measure that we use is also evaluated at the domestic prices, hence we calculate the measure required by the model: $x_{It} = X_{It}/M_{It}(M'_{It}/M_{It})p_{It}^* = p_{It}X_{It}/p_{It}^*M_{It}(M'_{It}p_{It}/M_{It})$. The import demand elasticity we calculate, $M'_{It}p_{It}/M_{It}$, is for the EU as a whole, as required by the model. Following Kee et al. (2004) we compute it as $a_{II}/s_I + s_I - 1$, where a_{II} is an estimated structural price parameter in the GDP function and s_I is the EU's import to GDP ratio in sector I. Sources: Kee et al (2004) (a_{II}); UNIDO ($p_{It}X_{It}$), COMTRADE and Penn World Tables (s_I).

- P: Proxy for the change in the MFN externality effect, Δm. Computed as a dummy equal to one if the change in the share of the non-top 5 exporters in total exports to the EU between 1989 and 1994 is above the median for an HS 8-digit good i. Source: COMEXT.

- I^{pta_name}: Indicator equal to 1, if good i is imported at a duty-free preferential rate by EU under the "pta_name" program, which includes GSP, GSPL, ACP, MED, CEC, and EFTX. Sources: COMEXT and TRAINS.

- $D^{any\,exp}$ [$D^{evy\,exp}$]: Indicator equal to 1, if good i is imported by EU from any [all] of its PTA partners in 1994 (regardless of whether they receive a preference or not). Source: COMEXT.

- $D^{hi\,exp}$: An indicator equal to 1, if good i is an important export for a PTA partner (greater than its 25th percentile of exports). Source: COMEXT.

- D^{ntb} [D^{ntball}]: An indicator equal to 1 if good i is subject to a non-tariff barrier that applies to at least one exporter [all exporters] of good i to the EU. Source: TRAINS.

- Δp_{9294}, $(\Delta p_{9294})^2$, $(\Delta p_{9294})^3$: The change in the world price of good i (computed using unit values) between 1992 and 1994 averaged over all of its exporters. Source: COMEXT.

- $\Delta scale$: The change in the EU-wide value added/number of firms between 1978 and 1992. Sources: UNIDO, and COMTRADE.

- $(\Delta p_{9294})^{avg}x\Delta scale$: Interaction of Δp_{9294} averaged over sector i and $\Delta scale$. Sources: UNIDO, and COMTRADE.

C.3 Details on the EU's PTAs

Name of Program	Recipients	Start Date	Type of Preference	Import share 1994	Share in '94 PTA imports	Notes / Non-trade Issues
ACP (African, Caribbean, and Pacific)	Over 70 countries, mostly former colonies of EU members	1976	Unilateral PTA	0.5%	1.9%	Colonial ties major motivation. Financial and political cooperation; human rights play a role. (its earliest predecessor Yaoundé in 1963)
CEC[1] (Central and East European)	Slovak Republic, Czech Republic, Poland, and Hungary	1992	Bilateral FTA	1.4%	6%	Serves as a transition to full membership. Recipients committed to pass laws such as in intellectual property rights to conform with EU.
EFTX	Switzerland, Norway, Iceland, Liechtenstein.	1973 - 1974	Bilateral FTA	5.2%	22.3%	EFTA members excluding AFS. Mainly industrial goods, excludes most agricultural products.
GSP[2] (Generalized System of Preferences)	More than 100 developing countries	1971	Unilateral PTA	13%	57%	Widest program; includes non-duty-free rates. Preferential rates vary according to competitiveness of the recipient countries.
GSPL (GSP for least developed)	About 50 of the poorest nations in the world	1971	Unilateral PTA	0.3%	1.2%	Objective: Improving access to global markets for agricultural and industrial goods and services
MED[3] (Mediterra-nean countries)	Algeria, Israel Morocco, Tunisia, Egypt, Jordan, Syria	1975 - 1977	Unilateral PTA	2.7%	11.3%	Cooperation in social affairs, migration, human rights, and democracy. Preferences on industrial goods only, with strict rules of origin.
AFS and SPG	EU members joined between Tokyo and Uruguay rounds	See note	Bilateral CU	n/a	n/a	AFS: Austria (1995), Finland (1995), Sweden (1995). SPG: Spain (1986), Portugal (1986), Greece (1981). Accession years in brackets.

[1]Romania and Bulgaria signed FTA agreements with the EU in 1993, hence should be part of the CEC category but they are not included in our analysis due to lack of data.

[2]There exist special arrangements supporting measures to combat drugs under the GSP program. The recipients are the Andean group (Colombia, Venezuela, Ecuador, Peru, and Bolivia) and the Central American Common Market group (Costa Rica, El Salvador, Guatemala, Honduras, and Nicaragua). The extra concessions data for these groups is not available and hence they are considered only as part of the general GSP program.

[3]Lebanon made a unilateral PTA arrangement with the EU in 1977 but it is not included in our estimations due to again lack of data.

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