Preferential Trade Agreements and MFN Tariffs: Global Evidence*

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Abstract

We study the effects of countries' import composition on multilateral liberalization using a global tariff database that covers the 2000-2011 period. Employing a theoretically motivated empirical approach and instrumental variable strategy, we provide evidence that greater preferential trade agreement (PTA) import shares induce tariff cuts on non-member countries. Our baseline estimates imply that a 10 percentage point increase in the share of imports from PTA partners, or alternatively a 1 percentage point PTA-induced decline in applied tariffs, lowers most-favored nation (MFN) tariff rates by about 0.4 percentage points. This effect is driven by countries that negotiate deeper preferential trade deals. PTAs that span more policy fields are prone to lead to more inefficient trade diversion, which creates a stronger incentive to subsequently cut MFN tariffs. At the same time, our results are remarkably consistent across other subsamples emphasized in the literature, including high- and low-tariff importers, poorer and richer economies as well as large and small countries.

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1 Introduction

Preferential trade agreements (PTAs) have become an increasingly central part of the global trading system over the past few decades.[1] As PTAs have proliferated rapidly, especially since the early 2000s (see Figure 1), an increasing fraction of countries' imports originates from PTA partners (see Figure 2). Between 2000 and 2011, our sample period, the average PTA share of imports across countries increased from 34.4 to 44.5 percent. As more trade takes place between PTA partners, there is an increased concern across the world about the potential consequences of being excluded from trading blocs and having to compete in international markets at less favorable terms than other countries. These concerns have become especially salient in the United States following its withdrawal from the Trans-Pacific Partnership (TPP) and the subsequent ratification of the TPP-11 and the Regional Comprehensive Economic Partnership (RCEP) without the US. Given this broader context, it is natural to ask how the increased importance of PTAs in global trade affects policies towards non-members.

Our paper specifically examines how the PTA share of imports affects most favored nation (MFN) tariffs at the product-level using data for a diverse sample of countries. Since the actual PTA share of imports is likely to be endogenous to the MFN tariffs on the product, we instrument for the actual shares with a country's PTA partners' share of exports to the rest of the world, which can be interpreted as a measure of the preferential partners' propensity to export a particular product. This measure – which we call the *predicted PTA share* – could change both in response to the formation of new PTAs and due to changes in the existing PTA partners' propensities to export a product. The general approach underlying our predicted PTA share measure is in the spirit of Autor et al. (2013) and Hummels et al. (2014) who predict bilateral imports using the exporting country's trade flows to other locations in the world.

Since any effect of rising PTA shares on MFN tariffs would be mediated by differences between the MFN and preferential tariffs, we also use detailed data on preferential tariffs to provide estimates of the implied relationship between applied tariff reductions induced by increased PTA shares and MFN tariffs. To that end our analysis makes use of the CEPII (2012) tariff database, which provides tariff rates at the HS 6-digit level while exhaustively covering all PTAs that entered into force between 2000 and 2011. This database – which to our knowledge has not been used before in this

[1] In the remainder of the paper, we use the term PTA to refer to any kind of bilateral free trade agreement, including customs unions.

context – allows us to study a diverse sample of countries and agreements during a time period that witnessed extensive worldwide PTA activity. Prior analyses of the PTA effects on multilateral trade relations have been hampered by a lack of comprehensive product-level data on preferential tariff rates across agreements and countries. Beyond facilitating a global analysis, our data allows us to account in our empirical work for country-year, product-year and country-product fixed effects, so that our estimates can be identified purely off of variation at the country-product level over time.

We find robust evidence across several alternative specifications that higher PTA shares lead to a reduction in MFN tariffs. Our baseline model implies that a 10 percentage point increase in the product-level PTA share of imports decreases the associated MFN tariff by 0.40 percentage points. Alternatively, expressed in terms of implied tariff rates, a 1 percentage point decrease in the weighted-average tariff rate on a product (at constant initial MFN tariff rates) reduces the associated MFN tariff by a similar 0.42 percentage points. As we show using a simple partial equilibrium model, a higher PTA share could incentivize countries to reduce MFN tariffs as a way of avoiding MFN tariff revenue losses – a loss that has no corresponding benefit for the importing country. By constructing an appropriate trade diversion measure consistent with the theory, we find evidence in favor of this explanation: Increased PTA shares are associated with substantially larger MFN tariff reductions for products with a greater potential for MFN tariff revenue losses due to trade diversion.

To explore which type of agreements may be driving our results, we go one step further and expand our analysis to examining the importance of *PTA depth* in this context, which refers to the extent to which a PTA covers various non-tariff policies. We find that the relationship between PTA shares and MFN tariffs is substantially driven by countries with deeper trade agreements. This result is consistent with the argument that deeper agreements magnify the effects of trade diversion due to increased discrimination against non-members in more policy areas. To our knowledge, this result provides for the first time evidence that links MFN tariff rates to non-tariff characteristics of PTAs. In earlier related work that focuses purely on trade flows, Mattoo et al. (2017) find that deeper trade agreements lead to less trade diversion than more shallow deals. Our results indicate that substantial reductions in MFN tariffs in response to deeper trade agreements could in part explain this phenomenon.

Our results relate to a prominent literature studying whether PTAs are "building blocks" or "stumbling blocks" towards multilateral liberalization, and our findings provide evidence consistent with the building block view. The existing body of work has found notably mixed results, with some papers reporting a stumbling block effect (e.g., Limão 2006, 2007 for the US and Karacaovali and Limão 2008 for the EU). Others instead detect a building block effect (e.g., Estevadeordal et al. 2008 for South America, Calvo-Pardo et al. 2009 for ASEAN, and Ketterer et al. (2014) and Mai and Stoyanov (2015) for Canada) or provide evidence consistent with both effects depending on circumstances (Crivelli 2016). Our work differs from the existing literature in two major dimensions.

First, by thinking about the relationship between PTAs and MFN tariffs in terms of the effects of increasing PTA shares, we sidestep some of the policy endogeneity concerns that are at the center of this literature. PTA and MFN policies are ultimately government choices driven by many of the same economic and political factors, such as the strength of domestic interest groups as well as concerns about government revenue and consumer welfare. These underlying determinants are likely to affect countries' tariff choices but also more discrete aspects of trade agreements, for instance, the decision to exclude a particular good from preferential tariff concessions. Moreover, the potential for tariff reductions on a product under a PTA might depend mechanically on the initial MFN tariff itself. By focusing on PTA shares, we provide a fresh perspective on the building block vs. stumbling block literature that relies on partners' export propensities as the source of identifying variation rather than tariff rates. We should note, however, that our alternative approach addresses a question that is somewhat different from most of the papers in the literature. We examine how the increased importance of PTAs, as measured by PTA import shares, affects MFN tariffs rather than how preferential tariff changes translate into MFN tariff changes. While certainly related, these questions could have different policy implications as new PTAs may not always substantially affect PTA shares and PTA shares could change for reasons other than new PTA formation.

Second, given our diverse sample of countries, we are also in a position to directly test whether there are systematic differences in the effect of PTA shares across different categories of countries. Importantly, we do not find a differential impact between low- and high-tariff countries as suggested by Baldwin and Freund (2011), Crivelli (2016) and Limão (2016).[2] Our results indicate a building block effect of similar magnitude for both groups of countries. Cutting the sample differently, we find significant building block effects for both lower and higher income countries and, if anything, our estimates suggest a stronger building block effect for the latter group. Similarly, both smaller and larger importers experience comparable building block effects, indicating that the earlier identified stumbling block effects for the US and the EU are not driven by market power considerations alone. Finally, consistent with Estevadeordal et al. (2008), we also detect that the building block effect is

[2] Note that the papers cited in this paragraph focus on the effects of PTA tariffs on MFN tariffs, whereas we consider the impact of PTA import shares on the latter.

concentrated in countries which are not in customs unions, while there is no significant effect for customs union members.

The next section provides the theoretical foundation for our empirical approach. Section 3 introduces our empirical strategy and discusses the data. Section 4 provides our baseline results, and section 5 examines the evidence for the importance of PTA depth as driver of multilateral building block effects. Section 6 reconsiders the evidence for several extensions of the empirical framework that have been suggested to unify the existing mixed results in the literature. Section 7 concludes.

2 Theoretical Framework

In this section, we develop a parsimonious theoretical framework that will guide our empirical work, focusing on the optimal MFN tariff in the presence of a PTA using a canonical partial equilibrium trade model. Our model illustrates why the composition of a country's imports with regard to its trading partners is a crucial determinant of its MFN tariff. After deriving our model's empirical predictions, we discuss how it relates to the substantial theoretical literature that studies the consequences of PTAs for policies towards third countries.

2.1 Setup

Consider a partial equilibrium setting with an importing country – country A – and two exporting countries – countries B and C. Without loss of generality, we assume country B is in a PTA with country A, and country C is subject to MFN tariffs. Country A's welfare is given by the indirect utility function of the representative household:

$$V\left[p, \Pi + t_B X_B\left(p - t_B\right) + t_C X_C\left(p - t_C\right)\right] \quad ,$$

where p is the price in country A, Π is domestic producer surplus, t_i is the specific tariff imposed on country i, and $X_i\left(p - t_i\right)$ is the exports of country i to country A. We assume throughout an interior solution where both countries B and C export strictly positive quantities to A.

2.2 Optimal MFN Tariff

We will derive the optimal MFN tariff rate for country A taking as given the terms of its preferential agreement with B. We therefore assume the government chooses t_C to maximize welfare, taking t_B

as predetermined.[3] The first-order condition for the government's problem is:

$$\frac{dV}{dt_C} = -D\frac{dp}{dt_C} + X_A\frac{dp}{dt_C} + t_B\frac{dX_B}{dp}\frac{dp}{dt_C} + t_C\frac{dX_C}{dp}\left(\frac{dp}{dt_C} - 1\right) + X_C = 0 \quad ,$$

where D and X_A are A's consumption and domestic output, respectively. Note that the derivation of the first term above makes use of Roy's identity and the second of Hotelling's Lemma. We can re-arrange this expression to obtain the ad valorem equivalent MFN tariff on imports from C:

$$\frac{t_C}{p - t_C} = \frac{1}{\sigma_C} - \frac{\sigma_B}{\sigma_C}\frac{X_B}{X_C}\left(\frac{dp/dt_C}{1 - dp/dt_C}\right)\left(\frac{1}{\sigma_B} - \frac{t_B}{p - t_B}\right) \quad ,$$

where σ_i is the export supply elasticity for country i. If we further assume that the foreign export supply elasticities are the same for countries B and C, i.e., $\sigma_B = \sigma_C = \sigma$, we get the following:

$$\frac{t_C}{p - t_C} = \frac{M}{X_C}\frac{dp}{dt_C}\left[\frac{t_C}{p - t_C}\frac{X_C}{M} + \frac{t_B}{p - t_B}\frac{X_B}{M} - \frac{1}{\sigma}\right] + \frac{1}{\sigma} \quad , \tag{1}$$

where M denotes the total imports of the good in country A. This expression relates the optimal MFN tariff for a good in ad-valorem terms to the weighted-average of the tariff rates applied across trading partners, where the weights are each country's share in country A's total imports of the good in question, i.e., X_B/M and X_C/M. We see that it is a combination of (i) a low PTA tariff relative to the MFN rate and (ii) a substantial PTA import share that together provide an incentive to reduce the MFN tariff.

To provide further clarity into the effect of the PTA import share, it will be helpful to isolate the MFN tariff rate expression in equation (1), $t_C/(p - t_C)$, on the left-hand side. To simplify the interpretation in what follows, we focus on the standard case when the PTA between A and B leads to zero preferential tariffs in both countries, or $t_B = 0$.[4] With the zero preferential tariff assumption, country A's optimal MFN tariff in (1) can be re-arranged to:

$$\frac{t_C}{p - t_C} = \frac{1}{\sigma}\left[1 - \frac{X_B}{X_C}\left(\frac{dp/dt_C}{1 - dp/dt_C}\right)\right] \quad . \tag{2}$$

[3] While we consider the welfare maximization problem here, introducing an additional parameter that overweights producer surplus to capture political pressures to protect import-competing industries leads to very similar optimal tariff expressions.

[4] Deardorff and Sharma (2021) find that, on average, about 85% of products in worldwide free trade agreements have zero tariffs, which indicates that these trade deals are far from "free trade" in a true sense of the term, but nevertheless entail zero tariffs on most products.

Equation (2) illustrates how the optimal MFN tariff inherently depends on the composition of country A's imports. If $X_B = 0$, so that all trade is with C, then the optimal MFN tariff reduces to the standard inverse export supply elasticity formula. Increases in the share of imports from A's preferential trading partner, which corresponds to a rise in X_B/X_C, in turn lower the tariff set on country C.[5] That is, a higher reliance on a country's PTA partners translates into a lower optimal MFN tariff. The predictions from equations (1) and (2) form the basis for our empirical approach that we lay out in detail in the next section.

The underlying mechanism in the model that drives the inverse relationship between the import share from PTA partners and the optimal MFN tariff is due to the trade diversion created by the PTA.[6] Intuitively, a PTA with B has two opposing welfare effects on A. First, a reduction in tariffs for B will lower domestic prices in A, increase imports and raise domestic consumer surplus, which is also known as the trade creation channel for PTAs. Second, the PTA diverts country A's imports from non-PTA member C to PTA member B due to the preferential tariff treatment of the latter. This trade diversion is harmful for A as it leads to a loss in tariff revenue for its government without any corresponding benefits for the private sector. The negative effects of trade diversion can be mitigated when A, subsequent to the PTA agreement, also lowers its MFN tariff. Equation (2) captures exactly this mechanism. As trade diversion is more prevalent when PTA partner B is an important source of imports for A, a larger PTA import share is associated with a smaller optimal MFN tariff. In Appendix A, we show that the optimal MFN tariff can be expressed as a direct function of this trade diversion reversal incentive.

What if the preferential tariff, t_B, is non-zero? In Appendix A, we illustrate that our theoretical predictions below are similar as long as the preferential tariff on B is below A's unilateral optimal tariff. Intuitively, as long as the preferential tariff meets this condition, the PTA has "bite" and will create harmful trade diversion away from non-members.[7] Across a range of products, we can therefore expect a negative effect of the PTA share on the MFN tariff, even if some items are excluded from complete tariff elimination under a PTA. Nevertheless, to the extent that these exclusions are systematic, they will affect the interpretation of some of our empirical results. Deardorff and

[5] Note that $0 < dp/dt_C < 1$, which can be shown by differentiating the market clearing condition, $X_B + X_C - M = 0$. Intuitively, a one-unit increase in t_C will lead to a less than one-unit increase in p, both because some of the tariff is absorbed by producers and because C is not the only exporter to A.

[6] Trade diversion as a potential motive for MFN tariff reductions has been emphasized by many contributions in the literature, among them Viner (1950), Krugman (1991), Richardson (1993, 1995), Ornelas (2005), and Estevadeordal et al. (2008).

[7] Preferential tariffs that are reduced over time as part of a gradual phase out would also have bite in this sense.

Sharma (2021) find that developed countries tend to exempt sectors with more trade creation from PTA concessions, whereas developing countries exempt sectors with more trade diversion. This pattern is consistent with developed countries being primarily motivated by protecting domestic import-competing industries – which are hurt by trade creation – when choosing exemptions but developing countries are more concerned about lost tariff revenues due to trade diversion. By the logic of our model, this difference might contribute towards a weaker effect of the PTA import share on MFN tariffs in developing countries, since their PTAs are by construction designed to reduce trade diversion.

2.3 Other Theories

While we have emphasized the parsimonious trade diversion channel in our analysis as the motivating factor for countries to lower their MFN tariffs after an increase in the PTA import share, several other theories have been suggested in the literature that are also consistent with PTAs being building blocks toward multilateral free trade.[8] Bagwell and Staiger (1999) emphasize that terms-of-trade motives can provide another incentive to lower MFN tariffs after joining a PTA. Specifically, PTA members import less from non-members, lowering their incentive to charge high tariffs to manipulate the terms-of-trade in their favor. Providing an even stronger result, Bond et al. (2004) establish that the drop in the optimal external tariff of PTA members is large enough to also improve the terms of trade of non-members. Freund and Ornelas (2010) discuss how political economy forces can further strengthen PTA members' incentive to lower external MFN tariffs. For instance, in the protection-for-sale model of Grossman and Helpman (1994), a PTA will weaken the impact of protection-seeking domestic producers as their market share decreases, which raises the prospect of lower tariffs on non-member countries.

Gradual tariff reductions after closing a trade agreement can also be caused by domestic-commitment motives. Specifically, a trade agreement can help to lock in domestic policy reforms and shut out lobbying activities. In the presence of both terms-of-trade and commitment issues, a trade agreement addressing the former will lead to subsequent tariff cuts to address long-run distortions from trade policies for which the government is not compensated. Maggi and Rodriguez-Clare (1998, 2007) and Maggi (2014) provide a detailed discussion of this point. Focusing on a different political economy angle, Baldwin (1994) and Baldwin and Robert-Nicoud (2015) propose that PTAs can

[8] Maggi (2014) provides a detailed discussion of the literature examining how PTAs can affect trade barriers on outsiders.

lead to multilateral tariff decreases due to juggernaut effects. A PTA expands a country's export sectors and shrinks its import-competing sectors. As a result, the political economy support for protection decreases and facilitates future preferential and multilateral tariff liberalization.

Another strand of the literature focuses instead on potential channels that could elevate protection against non-member countries of PTAs. Grossman and Helpman (1995) and Krishna (1998) show that when producer-driven special interest groups have more influence, governments are more likely to implement PTAs which enhance tariff protection towards outside countries. Freund and Ornelas (2010) also provide a detailed analysis of this point. Stoyanov (2009) argues that the presence of foreign lobbying can lead to higher external tariffs as well in the context of a PTA due to their interest in preserving and expanding the preferential market access of PTA partners. Limão (2007) emphasizes that preferential tariffs can be used as bargaining chips with PTA partners when countries care about non-trade objectives, making subsequent external tariff decreases less likely.

Importantly, the predictions for the external effects of trade agreements can vary substantially by their type. When setting a common external tariff, custom unions (CU) members enjoy more market power than members of other types of PTAs. Although Kemp and Wan (1976) show that any customs union can be welfare-neutral for outsiders when the CU's tariffs are lowered such that external trade remains constant, CU members have an incentive to manipulate the terms of trade in their favor by setting higher tariffs. Kennan and Riezman (1990) argue that the latter is more likely the greater the market power of a customs union. Other contributions that also study CU members' incentives to set higher external tariffs include, among others, Yi (1996), Bagwell and Staiger (1999), Cadot et al. (1999), Freund (2000), and Ornelas (2007).

3 Empirical Strategy and Data

3.1 Empirical Strategy

Our primary empirical specification is motivated by equation (2) in section 2, which relates the optimal MFN tariff rate to the relative importance of a country's PTA partners, as measured by their share in imports. When more imports of a given product enter a country at a low preferential tariff rate, trade diversion concerns are most serious, implying in turn a greater incentive to subsequently lower the MFN tariff. With this framework in mind, our baseline empirical model takes the following form:

$$MFN_{ist} = \alpha_{it} + \alpha_{is} + \alpha_{st} + \beta PTAshare_{ist-1} + \epsilon_{ist} \quad , \tag{3}$$

where MFN_{ist} is the MFN tariff rate that country i applies on the 6-digit HS product s in year t and $PTAshare_{ist-1}$ is the share of imports of product s that originates from i's PTA partners. The impact of this treatment variable is straightforward to interpret. The coefficient β tells us how a change in the PTA share for a given product affects the MFN tariff rate. Based on our discussion in section 2, we would expect that an increase in the PTA share lowers the MFN tariff rate due to increased trade diversion ($\beta < 0$). While we discuss below our instrumental variable strategy to deal with potential sources of endogeneity in this specification, we use throughout a one-period lag to link the PTA import shares to MFN tariffs to avoid simultaneity that could complicate the interpretation of our estimates. To control for a wide range of unobserved heterogeneity and to ensure that our estimates are identified using only variation within products and countries over time, we include importer-year fixed effects, α_{it}, 6-digit HS level importer-product fixed effects, α_{is}, and 6-digit HS level product-year fixed effects, α_{st}.

Estimating equation (3) by OLS will not recover an unbiased estimate of β because, even apart from the simultaneity issues described above, the factors that determine MFN and/or preferential trade policies could also influence the actual trade flows. To address these concerns, we use a novel instrumental variable strategy. We instrument the PTA import share variable, $PTAshare_{ist-1}$, by estimating the following first-stage regression:

$$PTAshare_{ist-1} = \alpha_{it-1} + \alpha_{is} + \alpha_{st-1} + \gamma PS_{ist-1} + \mu_{ist-1} \quad . \tag{4}$$

PS_{ist} is what we call the *predicted PTA share* and is defined as:

$$PS_{ist} = \frac{\sum_{j \in PTA_i} \sum_{k \neq i} X_{jkst}}{\sum_j \sum_{k \neq i} X_{jkst}} \quad ,$$

where X_{jkst} are the exports of product s from exporter j to importer k in year t and PTA_i is the set of countries that are PTA partners with i. The PS_{ist} measure captures the share of exports to the rest of the world (i.e., excluding country i) that is accounted for by the PTA partners of country i in product s in year t. The denominator of this share is the sum of all exports of product s to all destinations except for i, whereas the numerator is the sum of all such exports specifically by the partners of country i.[9] This predicted PTA share measures the propensity of country i's partner countries to export a particular product – perhaps due to their patterns of comparative advantage – and thus quantifies the extent to which PTA partners are likely to affect a given product in i. It should not, however, affect the MFN tariff of country i except through its effect via the actual PTA import share. A significant advantage of our empirical strategy is the identification of the PTA import share effect on multilateral trade policies independent of confounding factors that could drive both the choice of PTA and MFN tariffs on a given product.

Our instrumental variable strategy is in the spirit of several other papers that also predict bilateral imports using exporters' trade flows to other locations in the world. For example, Autor et al. (2013) instrument for US imports from China with China's exports to other high-income countries when studying the effect of Chinese competition on local labor markets in the US. Similarly, Hummels et al. (2014) construct an instrument for firm-level offshoring in Denmark by using information on exporting countries' exports to the rest of the world. Conceptually, such approaches are justified when the country (or subnational region) in question is small enough to have a negligible effect – including through general equilibrium effects – on the global export patterns of its partners. We therefore provide robustness tests below that drop observations of importing countries which could potentially be considered as having a substantial impact on world trade patterns in a particular product. In using predicted trade shares as an instrument in a trade policy context, our approach is also related to Saggi et al. (2018) who employ a sectoral gravity model to generate predicted import shares. Their approach follows Do and Levchenko (2007), which itself is a sectoral adaptation of the geographic instrumentation strategy from Frankel and Romer (1999). As noted by Do and Levchenko (2007), Frankel and Romer's approach generates limited time variation in predicted shares, which would not be advantageous for our analysis.

In addition to the baseline level fixed effects model in equation (3), we also consider alternative specifications that control for unobserved importer-product characteristics by first differencing. We explore two options. We use (i) a short first difference (SD) between subsequent periods to exploit the short-run changes in the PTA share to identify effects on MFN tariffs and (ii) a long first-difference (LD) specification that focuses on the change between the first and last periods in

[9] When we exclude exports to a country's own PTA partners the results are nearly identical to our baseline specification in Table 3 below. Omitting observations where PTA partners account for most of the imports in a country does not change our conclusions either. Detailed estimates are available upon request.

our dataset:

$$\Delta_{D} MFN_{ist} = \alpha_{it} + \alpha_{st} + \beta_{D} \Delta_{D} PTAshare_{ist-1} + \epsilon_{ist} \quad , \tag{5}$$

where $D \in \{SD, LD\}$. α_{it} and α_{st} are again importer-year and product-year fixed effects. Note that in the long-difference specification the fixed effects reduce to the importer and product levels, i.e., α_i and α_s, respectively. Consistent with our baseline specification, we continue to use a one-year lag for the PTA import share variable. While the long first-difference approach has to content with a smaller sample size, it has the advantage of capturing long-term tariff trends instead of period-to-period changes.

Equation (1) in section 2 shows that any effect of rising PTA shares on MFN tariffs should be magnified by the difference between the MFN and preferential tariffs. In fact, if the preferential tariff is identical to the MFN tariff, an increase in the PTA share should not translate into any change in the MFN tariff. Therefore, to support our baseline analysis, we also report below estimates that account for the actual PTA tariffs that importers impose on their partners. Specifically, we replace the PTA import share variable with a weighted applied tariff measure, WT:

$$MFN_{ist} = \alpha_{it} + \alpha_{is} + \alpha_{st} + \beta WT_{ist-1} + \epsilon_{ist} \quad . \tag{6}$$

The weighted tariff measure is defined as

$$WT_{ist-1} = \sum_{j=1}^{J} w_{ijst-1} T_{ijst-1}$$

where w_{ijst-1} describes each exporter j's respective share in product s imports in country i in year $t-1$ and T_{ijst-1} is the corresponding tariff rate imposed by country i on exporter j.[10]

Importantly, when estimating equation (6), we calculate this weighted average tariff at a constant initial MFN tariff rate, so that changes in this variable capture only the reduction in applied tariffs induced by preferential tariff cuts and increases in the PTA import shares. To see how this measure works, it is useful to consider an example. Suppose that, in ad valorem terms, the initial MFN tariff for a product is 0.10, the preferential rate is equal to 0, and the PTA share increases from an initial share of 0.25 to 0.50. In this case, the initial value of our weighted tariff measure would

[10] As a robustness test, we used the initial period weights instead of time-varying weights for both the weighted tariff and PS variables. These estimates are similar to our baseline results in Table 3 and available upon request.

be: $0 \times 0.25 + 0.10 \times 0.75 = 0.075$. After the PTA share increases, the weighted tariff would be: $0 \times 0.50 + 0.10 \times 0.50 = 0.050$. Hence, the reduction in the weighted applied tariff rate induced by the rising PTA share would be 0.025.[11] If the preferential tariff rate were equal to the MFN rate of 0.10, the reduction in the applied tariff rate would be zero despite the 0.25 increase in the PTA share.

Beyond the identification concerns discussed in the context of equation (3), the preferential tariff rates themselves are likely to be endogenous. Some of the factors that affect a country's choice of preferential tariff rates – including whether to exempt a given product from a PTA – are also likely to have an impact on decisions surrounding MFN tariffs. For example, a strong domestic lobby in a particular industry might press for higher protection against all exporting countries, thereby affecting both MFN and preferential tariff rates. To address these concerns, we again instrument WT with the predicted PTA share variable, PS. An increase in PS, for example, might increase the actual PTA share, and thereby reduce WT by shifting more weight to the lower preferential tariff. Based on our discussion in section 2, we would expect that a drop in the weighted tariff will then decrease the MFN rate due to increased trade diversion ($\beta > 0$).

3.2 Comparison with Other Approaches

It will be useful to briefly contrast our empirical strategy with other approaches in the literature that consider the relationship between PTAs and MFN tariffs. Most existing studies follow the empirical methodology of either Limão (2006) or Estevadeordal et al. (2008), and we discuss these in turn. Focusing on the US, Limão (2006) studies the effect of PTAs on MFN tariff reductions negotiated during the Uruguay Round. His approach introduces non-PTA goods, defined as goods that are not exported to the US under preferential terms, as a control group for PTA goods. Given the potential endogeneity in trade policy preferences, Limão uses as the primary instrumental variable an indicator of whether the good is exported at all to the US by its PTA partners, i.e., irrespective of whether or not under preferential terms. Additional instruments are transportation cost levels and changes in US prices at the border. Limão (2007), Karacaovali and Limão (2008), Ketterer et al. (2014) and (in part) Mai and Stoyanov (2015) follow a similar identification strategy.

The Limão (2006) approach works cleanest in the original context where it is possible to look

[11] Note that if this reduction brings about a cut in the MFN tariff rate through a building block effect, our applied calculation would not be affected as we always use the initial MFN tariff. Hence, our measure captures only the direct PTA-share-induced applied tariff reduction.

at a period between two rounds of multilateral negotiations and would be less suited for the more recent period we study. Because our sample period is subject to an explosion of PTAs relative to the era studied by Limão (2006), the discrete distinction of products based on whether they are exported by PTA partners would provide much less variation in our context.[12] Moreover, the Limão strategy relies on the idea that non-PTA goods are a suitable control group for PTA goods when considering subsequent multilateral tariff changes. However, a less competitive domestic industry may lead a country to import the product in question from a larger number of exporters, implying also a greater likelihood of importing from PTA partners, which could affect multilateral tariff negotiations independently of PTAs.

Estevadeordal et al. (2008) study a sample of South American countries and instead use as their treatment variable the minimum preferential tariff rate offered to a partner. Given the potential endogeneity of this measure, they use as an instrument the preferential tariff of its partner countries in the same industry. They also add a lagged version of the treatment variable as instrument. Crivelli (2016) employs the same approach but adds product-year fixed effects (as we also do throughout).[13] Using the minimum preferential tariff rate as a treatment variable would be less suitable in our context because most countries already have multiple existing PTAs at the start of our sample period, which limits the variation in the minimum tariff rate, particularly given that about 85% of preferential tariffs are set to zero. Another possible concern with this type of instrument is that the partner countries' preferential tariffs may be affected by the trade policies of the importer in question. In addition, the same industries across countries within a regional block could be subject to common shocks that affect both preferential and multilateral trade policies.

3.3 Data

Previous analyses of the relation between PTAs and multilateral trade relations have been hampered by the lack of comprehensive product-level data on preferential tariff rates across agreements and countries. Limão (2006, 2007) focuses on US tariffs around the Uruguay Round. Karacaovali and Limão (2008) conduct a similar analysis for the European Union and its PTAs during the same time frame. Estevadeordal et al. (2008) and Crivelli (2016) examine instead 10 Latin American countries

[12] Mai and Stoyanov (2015) make this point in the context of studying Canadian tariff changes due to CUSFTA, where there is much less discrete variation in terms of whether Canada imports a particular product from the US at all or not.

[13] In their study of ASEAN countries, Calvo-Pardo et al. (2009) follow a broadly similar general setup but use the earlier scheduled future preferential tariff reductions as instrument for the later actually implemented preferential tariff changes.

for the period 1990-2001. Calvo-Pardo et al. (2009) consider ASEAN members and their policies toward non-member countries during 1992-2007, while Ketterer et al. (2014) and Mai and Stoyanov (2015) both focus on the effects of CUSFTA during 1989-1998.

We examine for the first time the relation between PTA shares, preferential tariffs and MFN rates for a diverse sample of countries and agreements. Our analysis is conducted at the HS 6-digit level, which constitutes the most detailed degree of internationally comparable products. Our main source of tariff information is the MacMap HS-6 database from the International Trade Center and CEPII (CEPII 2012). This data contains ad valorem tariff rates (or their equivalents) for a large number of countries while exhaustively taking into account each importer's preferential trade agreements and is available to us in the form of three-year averages for 2000-2002, 2003-2005, 2006-2008 and 2009-2011.[14] While the standard sources such as TRAINS and WTO-IDB in principle take into account preferential tariffs, the coverage is in practice often spotty and MFN tariffs are frequently reported as applied tariffs even when separate preferential tariffs are applicable. The MacMap data therefore allows us to go beyond country- and/or agreement-specific data that previous inquiries were limited to.

Data on PTA formation dates and member countries come from Mario Larch's updated Regional Trade Agreements Database used in Egger and Larch (2008). Our analysis focuses on WTO member countries that entered into at least one new PTA during the sample period, i.e., between 2001-2010.[15] While the latter requirement is not essential for our empirical identification strategy, we are likely to get more relevant and substantial variation by focusing on countries with new PTAs, in particular with regard to the explosive growth of trade agreements during the early 2000s. In addition, to minimize the influence of potential outliers, we drop very small countries from our sample, defined as those with a population of less than 1 million in any of the sample years. To further purge outliers from the analysis that follows, we also remove the top 1% of observations that experienced the largest MFN tariff changes over the sample period. Our final sample contains 51 countries and 95,466 country-product observations over the period 2001-2010.[16] Table 1 provides the list of countries in our data and their respective count of PTA memberships prior to the start (pre-2001) and at the end (2010) of the sample period. We discuss more descriptive statistics in passing below.

[14] We thank Houssein Guimbard of CEPII for providing us with the 2009-2011 data. Note that going forward we use the middle year to refer to each respective period, e.g., 2001 for the period 2000-2002.

[15] We only include countries that were already WTO members by 2000.

[16] We treat the European Union as a single entity as for all purposes the member countries pursue a unified external trade policy. Note that we only consider extra-EU trade to calculate our PTA import share measure and the corresponding instrument.

In addition to information on product-specific tariffs, we also require trade data at the HS 6-digit level. We use CEPII's version of Comtrade data (CEPII 2016), which applies a statistical procedure to give more weight to either importer- or exporter-reported data depending on the estimated reliability of the importer and exporter in question (including adjustments for f.o.b. and c.i.f. differences). Having a systematic procedure to account for mirror data is an advantage for our analysis, which involves a wide variety of countries, including many developing economies. Table 2 provides detailed summary statistics and definitions for all variables that we use in the empirical analysis. Appendix B lays out in more detail the data sources and construction of all variables. Between 2001 and 2010, the average MFN tariff decreased by 3.8 percentage points in our sample. During the same time frame, our weighted tariff measure, which accounts for import shares and PTA preferences, dropped by about 1.9 percentage points. The share of imports from PTA partners increased by 15.7 percentage points during the sample period. We investigate next to what extent this increased exposure to PTA partners has contributed to or halted the decrease in MFN tariff rates.

4 Baseline Results

4.1 IV Regressions

We first focus on the estimation of the level regressions corresponding to equations (3) and (6). In line with the earlier discussion, we regress the product-level MFN tariff rate on (i) the PTA import share, $PTAshare_{ist-1}$ and (ii) the lagged weighted applied tariff measure, WT_{ist-1}. In both cases, we instrument with the predicted PTA import share, PS_{ist-1}, outlined in equation (4). To control for a host of unobservable factors, both the first- and second-stage regressions include importer-year, importer-product and product-year fixed effects. The standard errors are clustered throughout at the importer/6-digit HS level to account for potential serial correlation at the importer-product-year level.[17]

Let us first consider the second-stage regression results with the PTA import share, $PTAshare_{ist-1}$, which are reported in column (1) of Table 3. Note that the first-stage F statistic is very large relative to conventional benchmarks, suggesting that the predicted PTA share does remarkably

[17] To account for the possible correlation of tariff rates within customs unions, the reported standard errors also treat countries in the same customs union as a single importer for the purpose of clustering. Our results are similar when we cluster our standard errors instead at the importer/HS 4-digit level. These estimates are available upon request.

well in explaining the variation in the actual PTA import share.[18] The coefficient estimate for the $PTAshare_{ist-1}$ variable is negative and statistically significant, implying that an increase in the product-level import share of PTA partners puts downward pressure on the corresponding MFN tariff. The point estimate of -0.040 indicates that a 10 percentage point increase in the PTA import share for a given product leads to a 0.4 percentage point decrease in the MFN tariff.

Columns (2) and (3) in Table 3 repeat the analysis with the PTA import share using the difference approaches outlined in equation (5). The former considers differences between two consecutive periods in the sample, whereas the latter uses instead differences between the first and last periods in the sample, i.e., between 2000-2002 and 2009-2011. The short-difference specification accounts again for importer-year and product-year fixed effects and the long-difference approach includes importer and product fixed effects. Neither of the difference specifications consider importer-product fixed effects as these are eliminated through the differencing procedure. The full sample results from both the short- and long-difference specifications are very similar to our level regression in column (1) and suggest a statistically significant building block effect of PTA import shares toward multilateral free trade of a comparable magnitude.

Columns (4)-(6) in Table 3 report results using the weighted applied tariff measure, WT_{ist-1}, which accounts for preferential tariff levels in addition to the PTA import share. The reported second-stage results indicate throughout that a drop in the weighted applied tariff – which would be induced by a rise in the PTA import share – leads to subsequent decreases in the MFN tariff. The point estimate in column (4) indicates that a 1 percentage point drop in the weighted applied tariff on a product leads to a 0.419 percentage point decrease in the MFN tariff. This effect is again statistically significant across all three specifications. As indicated by the first-stage F statistics, the predicted PTA share is a highly significant predictor of the weighted applied tariff.[19] Altogether, the results in Table 3 suggest that the increased importance of PTAs leads to lower tariffs on non-member countries.

We also consider a few additional robustness tests. As briefly mentioned in the previous section, our instrumentation approach is most justified when the country in question is small enough to have a negligible effect – including through general equilibrium channels – on the global export

[18] Columns (C1)-(C3) in Table C1 in Appendix C report the full first-stage regression results for specifications (1)-(3) in Table 3. As expected, in all three specifications, an increase in the predicted PTA import share, PS, has a significant positive effect on the actual PTA import share.

[19] Columns (C4)-(C6) in Table C1 in the Appendix C present the full first-stage regression results of the weighted applied tariff measure, WT, on the predicted PTA trade share variable, PS. In all three specifications, an increase in the predicted trade share of its PTA partners results in a lower applied tariff in the importing country.

patterns of its partners. To check whether our results are potentially skewed by large importers, we repeat our regression analysis and exclude any importer-product observations where the importer accounted for more than 20%, 10% or 5%, respectively, of the global imports of the product in the initial sample period. Table C2 and Table C3 in Appendix C report these estimates using the PTAshare and WeightedTariff variables, respectively. In all cases, the results are nearly identical to our baseline estimates in Table 3. Even when using a more restrictive sampling approach to rule out potential general equilibrium effects, PTA import shares are a building block towards multilateral free trade.[20] In another robustness test, Table C4 in Appendix C repeats again our analysis for the level specification but this time also includes outliers and small countries that were excluded from the baseline specifications earlier.[21] The results are again very similar to the estimates in Table 3. In fact, when including the outlier observations, the magnitude of the estimated impact of PTA import shares on MFN tariffs even increases.[22]

4.2 OLS Regressions

To offer a baseline comparison, Table 4 reports the OLS counterparts to our instrumental variable estimates from Table 3. We see from column (7) in Table 4 that the OLS level results with the PTA share variable also point to a significant building block effect but with a coefficient size that is only about five percent of the corresponding IV estimate. The two difference specifications are also attenuated towards zero. These results are consistent with both attenuation due to measurement error and reverse causality in the OLS regressions.

Reverse causality could induce a positive bias in the $PTAshare$ regressions in columns (7)-(9) of Table 4 when a country reduces its MFN tariffs for reasons unrelated to preferential trade agreements. In that case, the PTA share is likely to decrease because third countries would become relatively more competitive. This link would create a positive correlation between changes in the MFN tariff and the PTA share, thereby biasing the PTA share OLS estimates upwards and the weighted tariff estimate downwards, which is consistent with our results.

[20] We also checked for the presence of a general "China effect" by replacing the importer-year with importer-year-HS-2-digit fixed effects in our baseline specifications. The results pattern is similar to the estimates reported in Table 3. Detailed results are available upon request.

[21] The results are similar when focusing on the short- and long-difference models. These results are available upon request.

[22] We also examined whether the results are different across agricultural and non-agricultural products. We find that the latter seem to be mostly the source of the building block effect of PTA import shares on MFN tariffs, although we should caution that the sample size for agricultural products is substantially smaller. Detailed estimates are available upon request.

The most likely source of measurement error is the reliance on bilateral trade flows that are known to contain various potential statistical discrepancies (Kellenberg and Levinson 2019). Since our instrumental variable, the predicted PTA share, PS, is based on what are effectively global export shares for each exporter, this more aggregated measure is likely to be less noisy than the bilateral export shares, addressing in turn the measurement error. This notion is confirmed when considering the OLS relative to the IV estimates with the PTA share measure in columns (7) to (9) in Table 4, which all exhibit a similar attenuation pattern. The compilation of the weighted tariff variable in columns (10) to (12) relies as well on potentially mismeasured bilateral import share weights. While there could also be measurement error in the preferential tariffs, we believe that it is a less severe source than the bilateral trade flows because CEPII makes an explicit effort to exhaustively take into account PTA tariffs. Minimal measurement error in the tariffs is consistent with the observed greater attenuation in the PTA share OLS results relative to their IV counterparts compared to the case when we use the weighted tariff measure.

4.3 An Alternative Instrument and Overidentifying Restrictions Tests

In this part, we introduce an alternative instrumental variable that provides a further check on our empirical strategy and also allows us to implement overidentifying restriction tests. For our alternative instrument, we follow Autor et al. (2013) and differentiate export shares based on the development level in the destination countries. Specifically, we divide countries into two groups based on their real per capita income levels, i.e., high or low income. That is, we create a second predicted PTA share instrument, 'PS income', that only captures PTA partners' exports to countries in the same income group as the importer. Since countries in the same income group may have more similar demand and comparative advantage patterns, an importer is likely to be more exposed to PTA shares if its partner countries export mostly to comparable economies.

Specification (13) in Table 5 reports the level results when using the 'PS income' variable alone to instrument for the PTA share. The coefficient of the PTA share variable is of a similar magnitude and statistical significance as in column (1) of Table 3. Specification (14) uses both instruments: the original 'PS' variable and the new 'PS income' measure. Two results emerge. First, the estimated impact of the PTA import share on MFN tariffs is virtually identical to specification (13). And second, the p-value of the Sargan Over-ID test is 0.4070, which implies that we cannot reject the null hypothesis that the instruments are valid at any reasonable statistical significance level. Columns (15) and (16) report the corresponding short-difference estimates. The conclusions are similar to the level estimates. Adding the 'PS income' instrument results in an estimated impact of the PTA share variable on MFN tariffs that mirrors the baseline results in Table 3. Moreover, we again cannot reject the validity of our instruments based on the p-value of 0.9016 from the Sargan Over-ID test in column (16).

Specifications (17) through (20) use the same empirical approach but replace the PTA share variable with the weighted tariff measure. A similar picture emerges as for the corresponding PTA share specifications. The coefficient estimates of the weighted tariff variable from both the level and first-difference specifications are similar to the corresponding results in Table 3. Moreover, the p-values of 0.9018 and 0.9447 from the Sargan Over-ID tests in columns (18) and (20) indicate again that we cannot reject the validity of our instrumental variable approach.

4.4 Testing for the Tariff Revenue Channel

Our theoretical model in section 2 lays out that importers will decrease MFN tariffs after an increase in the PTA import share due to concerns of tariff revenue losses induced by trade diversion. We should therefore observe a greater building block effect for products with a greater potential for MFN tariff revenue losses. In this part, we test this prediction.

Note that we can write the revenue loss from trade diversion for a good as the change in the product of the MFN tariff rate and the imports from the non-PTA country C: $d\left(t_C X_C\right)$. Rewriting this trade diversion expression in terms of the export supply elasticity, σ, we get:

$$d\left(t_C X_C\right) \frac{p - t_C}{d\left(p - t_C\right)} = \left[\frac{dX_C}{d\left(p - t_C\right)} \frac{p - t_C}{X_C}\right] t_C X_C = \sigma t_C X_C \quad , \tag{7}$$

which shows that the threat from tariff diversion for a product increases in the export supply elasticity and the current MFN tariff revenue. To compute the potential MFN tariff revenue loss in (7), we need HS 6-digit level foreign export supply elasticity estimates, which we obtain from Nicita et al. (2018).[23] We can compile product-level MFN tariff revenue with the tariff and trade data that we already use. In a last step, we also normalize the above expression by the total imports of the product in a given country to eliminate any potential product size effects.

Based on our potential MFN tariff revenue loss calculation, we then divide the sample into a 'low diversion' and a 'high diversion' group, and reestimate the baseline PTA import share specifications

[23] When elasticity estimates for a product are not available for a given country in our sample, we use the average product-level elasticity across countries.

from Table 3. Table 6 reports these results. Focusing first on the level specifications in columns (21) and (22), we see that the magnitude of the building block effect is substantially larger in the 'high diversion' sample compared to the 'low diversion' group. The difference in the PTA share point estimates is statistically significant at the 10 percent level. The short- and long-difference results in columns (23) to (26) show a similar pattern. Hence, in line with the theory, importers are more likely to adjust their MFN tariffs downwards after increases in PTA import shares when there is greater scope for potential MFN tariff revenue losses through trade diversion.

5 PTA Depth and MFN Tariffs

The increased importance of PTAs in the global trading system is not just reflected in tariff changes but also by the fact that they can vary substantially by their "depth," i.e., the coverage of non-tariff policy areas. In our context, it is natural to ask whether the effect of increased PTA import shares on MFN tariffs is likely to be stronger or weaker depending on the depth of a country's PTAs. While there is increased interest in understanding the consequences of PTA depth, existing investigations have so far been mostly confined to studying the effects of PTA depth on trade flows. In this section, we contribute to this strand of the literature by examining how the depth of a country's trade agreements relates to its tariff policies towards non-members.

The canonical explanation for a building block effect is that countries reduce MFN tariffs after providing preferential tariff cuts to PTA partners in order to attenuate the welfare losses from inefficient trade diversion. It follows naturally from this argument that non-tariff provisions in trade agreements should be judged by the same token. Deeper PTA ties between countries are likely to increase trade diversion from non-partner countries, incentivizing in turn MFN tariff cuts to alleviate potential welfare losses from discrimination and tariff revenue decreases in the importing country.[24] On the other hand, as pointed out by Baldwin et al. (2009) and Mattoo et al. (2017), deeper agreements could also include more provisions that facilitate trade with all exporters, resulting instead in trade creation for non-PTA members.

To shed light on the question of how PTA depth relates to MFN tariff choices, we obtain detailed data on trade agreement provisions from Hofmann et al. (2017). Their data maps, in a binary fashion, 52 provisions for all PTAs notified to the WTO that were signed since 1958. We follow

[24] In a simple partial equilibrium trade model, a deeper agreement will cause more trade diversion as long as the foreign export supply for the PTA partner is upward sloping and we are at an interior solution where the importing country imports both from the PTA partner and a non-partner.

the standard approach in the literature (e.g., Mattoo et al. 2017) and simply add up the number of included agreement provisions to obtain a PTA depth measure at the importer-exporter level. That is, the PTA depth of an agreement can range between 0 and 52. In some cases, when a pair of countries is covered by more than one agreement, we take the maximum depth count among the available agreements. Next, we compute for all sample periods a unique weighted average PTA depth measure for each importer, using as weights a PTA partner's share in the importing country's aggregate imports from all PTA partners. In the final step, we then average for each importer the year-specific PTA depth measures across the four sample periods. Hofmann et al. (2017) also detail whether each of the provisions included in a PTA is legally enforceable.[25] For robustness purposes, we construct a second depth measure that only focuses on legally enforceable provisions rather than all included provisions. As a caveat, we should add that the structure of the PTA depth data does not allow us to track the PTA depth of agreements that are not in place anymore today.

Using the PTA import share measure, Table 7 presents results when differentiating between the top and bottom half of countries in terms of their PTA depth. The level specifications in columns (27) and (28) reveal that there is a statistically significant building block effect for countries in both groups of PTA depth. However, the magnitude of the building block effect is substantially larger for countries with deeper PTAs. The difference between the coefficients in the two samples is statistically significant at the five percent level. Columns (29) and (30) reveal a comparable pattern – though with less precision – when employing the first-difference specification. The difference between both coefficients is again significant at the five percent level. Importantly, countries with shallower PTAs do not witness anymore a significant negative impact of the PTA share on MFN tariffs. Columns (31) to (34) in Table 7 report results when focusing only on legally enforceable provisions to capture PTA depth. The estimates paint a similar picture, although the difference between importers with shallower and deeper PTAs is more pronounced when focusing on legally enforceable PTA rules. In any case, countries that negotiate PTAs touching on more non-tariff policy areas – legally enforceable or not – are subject to significant building block effects, whereas the same cannot be said for participants in shallow PTAs. Table 8 reports the corresponding estimates with the weighted applied tariff instead of the PTA import share variable. The pattern of the results is virtually identical to Table 7. Countries with deeper trade agreements are more likely to respond with MFN tariff cuts after a drop in their weighted applied tariffs.[26]

[25] Hofmann et al. (2017) report that their depth measure is highly correlated with an alternative index from Dür et al. (2014).

The evidence in Table 7 and Table 8 suggests that greater PTA import shares only lead to substantial cuts in MFN rates in countries with deeper trade agreements. Interestingly, when focusing on aggregate bilateral trade flows, Mattoo et al. (2017) find evidence that deeper PTAs can actually lead to trade creation even for non-member countries. Our results indicate that at least part of this effect may be due to more extensive product-level MFN tariff cuts by importers with deeper PTAs.[27] That is, importers with deeper PTAs counter potential trade diversion impacts with non-discriminatory tariff cuts that outweigh any negative trade effects on third countries arising from more extensive non-tariff policy cooperation between PTA partners. Hence, PTA depth is a crucial determinant of whether bilateral trade deals move the world as a whole closer to (tariff-)free trade. If PTAs are sufficiently deep, bilateral trade deals can indeed be building blocks.

6 Reconsidering the Evidence on Building and Stumbling Blocks

As previously discussed, a hallmark of the earlier literature on building and stumbling block effects of preferential trade agreements is the remarkable variation in the empirical evidence that has been uncovered. We therefore consider in this part a number of extensions to the baseline framework that have been proposed to reconcile the mixed evidence in the literature. Our diverse sample of countries offers a unique testing ground to examine the robustness of existing hypotheses, which are generally based on comparisons across different studies. We should caution once more, however, that we study specifically the effect of PTA import shares on MFN tariffs, which differs somewhat from most existing work with its focus on preferential tariff rates.

One established empirical fact in the literature is the markedly different adjustment in subsequent MFN tariffs depending on whether countries enter a customs union (CU) or another less integrated form of a trade agreement. In their sample of Latin American countries in the 1990s, Estevadeordal et al. (2008) find that the building block effects of PTAs are entirely driven by non-CU arrangements. One potential reason for this result is that CU members have more market power when negotiating a common external tariff, which incentivizes them to raise, or at least not lower, external MFN tariffs; see Baldwin and Freund (2011) for a detailed theoretical discussion of this channel. A second

[26] Note that while the number of observations in Table 7 and Table 8 slightly differ from earlier, when re-estimating the baseline specifications in Table 3 with the slightly smaller samples we get virtually identical results. Detailed estimates are available upon request.

[27] Mattoo et al. (2017) suggest that the presence of non-discriminatory PTA provisions is a particular driver of their results. With our product-level data, we find no significant differences in terms of building block effects between countries that include a larger or smaller number of these provisions in their agreements. These results are available on request.

possibility for why CU members may choose not to lower MFN tariffs is that from a theoretical perspective CUs can be designed to be purely trade creating (Kemp and Wan 1976), which removes the incentive to lower MFN tariffs to limit the negative effects of trade diversion.

To examine the evidence for the customs union channel in our sample, columns (43) and (44) in Table 9 split the importers in our data into CU members and non-CU members.[28] Note that Table 9 reports results throughout with the PTA share variable, while Table 10 considers the corresponding estimates with the weighted applied tariff measure.[29] We see from these specifications that the building block effect in our diverse sample of countries is also entirely driven by non-customs union members. The p-value from a t-test of coefficient equality suggests that this difference is statistically significant at the one percent level. A similar pattern emerges when using the weighted applied tariff variable in columns (51) and (52) in Table 10. While in line with the earlier findings in the literature, this outcome is still remarkable given that many developing country CUs in our sample are not particularly close to being customs unions in the true sense of the term, and are often seen as PTAs with an aspiration to move towards a CU over time. Our results therefore suggest that even such partial CUs are meaningfully different from standard PTAs. However, it is also possible that the absence of a building block effect for CUs could be due to prior trade agreements between members that already cut most tariffs substantially. The EU is an example for this scenario. Another caveat to the interpretation of these estimates is that any CU effect is more likely to occur around the time a CU is actually established, which is mostly outside of our sample period.

Beyond the customs union question, Baldwin and Freund (2011), Crivelli (2016) and Limão (2016) attempt to reconcile the existing literature by arguing that we tend to see building block effects for countries with high initial tariffs and stumbling block effects for countries with low initial tariffs. This result could arise because PTAs might lead to greater trade diversion in high-tariff countries, implying a greater incentive to subsequently lower MFN tariffs. While this argument is based on a very plausible interpretation of the existing evidence, it should also be noted that it draws on the evaluation of distinct studies, which tend to vary substantially in terms of methodology, time period under consideration, and the sample of countries being studied.

Given our diverse sample of countries, we are in a position to test directly whether the effect

[28] The following countries other than the EU are classified as members of CUs: Guatemala, Honduras, Nicaragua, El Salvador – CACM; Colombia, Peru – CAN; Jamaica, Trinidad and Tobago – CARICOM; Egypt, Madagascar, Mauritius, Malawi, Zambia – COMESA; Kenya, Rwanda, Uganda – EAC; Paraguay, Uruguay – MERCOSUR.

[29] While Table 9 and Table 10 only report level results, the short- and long-difference estimates are similar throughout and available on request.

of PTA import shares varies systematically depending on a country's initial MFN tariff rates. We classify a country as having high initial tariffs if the average MFN tariff rate is greater than 13 percent, which corresponds to the median in our data, and run the baseline regression on both samples separately. Columns (45) and (46) in Table 9 present the results using the PTA import share measure. Both specifications show a statistically significant building block effect, although the magnitude is nearly twice as large for high-tariff countries. However, the p-value of 0.125 from the coefficient equality test across the two samples indicates that the difference is not statistically significant at conventional levels. Importantly, these estimates suggest that at least during the period of exponential PTA growth in the early 2000s the presence of a building block effect was not confined to high-tariff countries. The same is true when considering the estimates for the weighted tariff measure in columns (53) and (54) in Table 10.

Splitting the sample differently, we also examine whether there are systematic differences between low- and high-income countries, which could serve as another proxy for different degrees of trade protection. The literature generally does suggest building block effects for developing countries and stumbling block effects for advanced economies, with the important exception of Ketterer et al. (2014) and Mai and Stoyanov (2015) who find building block effects for Canada. In columns (47) and (48) in Table 9, we report results with the PTA share variable when dividing the sample into two groups based on their real per capita income levels. Interestingly, in our sample, we find a building block effect for both sets of countries but with a substantially larger point estimate for economies with higher incomes. Although the difference in the estimated coefficient magnitudes is not statistically significant at conventional levels with a p-value of 0.527, the pattern is consistent with our previous discussion in section 2 that developing economies are more likely to exempt products from PTAs that create substantial trade diversion. A similar pattern emerges with the weighted tariff variable in columns (55) and (56) Table 10.

Finally, given that Limão (2007) and Karacaovali and Limão (2008) have found stumbling block effects for the US and the EU while other studies have identified building block effects for many smaller countries, we also evaluate whether there might be any heterogeneity based on a country's size relative to its PTA partners. Limão (2007) and Karacaovali and Limão (2008) emphasize that non-economic objectives of larger countries can lead to stumbling block effects in order to maintain concessions from smaller partner countries. We classify a country as large if it is, on average over the sample period, larger than its PTA partners in terms of GDP. Using the PTA import share variable, the results from splitting the sample in this way are shown in columns (49) and (50) in Table 9. Once again, we find a significant building block effect for both groups of countries. The point estimate is higher for smaller countries, which is in line with the outlined theoretical channel. The point estimate difference between the small and large country sample is also statistically significant at the five percent level. When using the weighted tariff variable in columns (57) and (58) in Table 10 we find a similar pattern, although the difference between small and large countries is not statistically significant in this case.

7 Concluding Remarks

Using a diverse sample of countries, we consider the question of whether increased PTA import shares help or hinder multilateral trade liberalization. To circumvent endogeneity concerns, our empirical strategy relies on identifying variation that measures the exposure of importers to PTA partners' exports of a given product. We show that during our sample period from 2000 to 2011 an increase in import shares accounted for by PTA partners is associated with cuts in countries' most-favored nation tariffs.

Our results imply that even during a period that was marked by a tremendous increase in PTA deals and slow-moving multilateral negotiations, greater reliance on imports from PTA partners fed into tariff reductions on third countries. The associated inefficient trade diversion effects from PTAs therefore seem to be a serious consideration for WTO members, even in the absence of reciprocal MFN tariff concessions from other trading partners. Consistent with this interpretation, we provide evidence that the effect we identify is driven by countries who negotiate trade deals that cover more non-tariff policy areas, which could potentially lead to greater trade diversion. Trade agreements that attempt to reduce non-tariff barriers between PTA members create a stronger incentive to subsequently lower MFN tariffs.

In contrast to some interpretations of the disparate results in the literature, we find that the existence of a building block effect from PTA import shares to multilateral trade liberalization is remarkably consistent across a number of subsamples, including high- and low-tariff countries, richer and poorer economies, and for large and small nations. The only exception is customs union members, for which we cannot detect a significant relationship between PTA import shares and MFN tariffs. Altogether, our results instead indicate that the actual content of PTAs is the key to understanding building and stumbling block effects. We believe that further exploring the tradeoffs between trade agreement provisions and MFN tariff choices is a promising area for future research.

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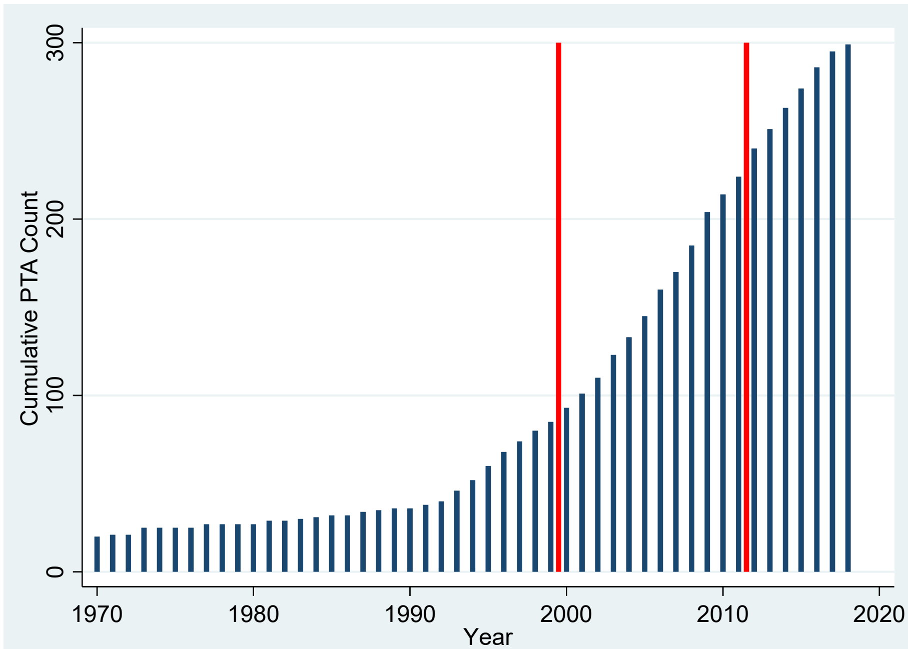
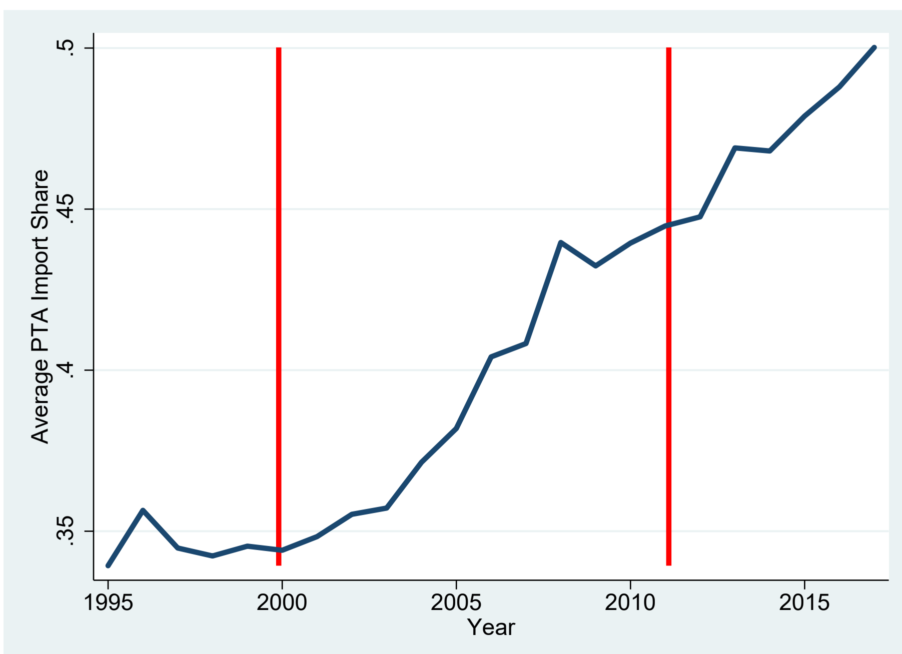
Figure 1: Cumulative Number of PTAs in Force



Notes: The figure shows the number of cumulative PTAs in force that have been notified to the WTO. The red vertical lines delimit our sample period.

Figure 2: Average PTA Import Share Across Countries



Notes: The figure shows the average of countries' shares of imports from preferential trading partners. Trade data to compile this figure comes from CEPII (2016). The red vertical lines delimit our sample period.

Table 1: **Countries in Sample – Number of PTA Partners, Pre-2001 and 2010**

Country	Number of Pre-2001 PTA Partners	Number of 2010 PTA Partners
Albania	0	35
Australia	2	11
Bangladesh	0	6
Canada	4	9
Chile	2	45
Colombia	5	8
Costa Rica	1	10
Croatia	3	35
Dominican Republic	3	45
Egypt	35	61
El Salvador	5	11
European Union	38	67
Georgia	6	8
Guatemala	5	11
Honduras	5	11
India	1	17
Indonesia	9	12
Israel	26	32
Jamaica	11	37
Japan	0	13
Jordan	18	47
Kenya	17	18
Korea (South)	0	15
Madagascar	13	16
Malawi	15	16
Malaysia	9	15
Mauritius	16	17
Mexico	26	40
Morocco	32	47
Mozambique	6	5
Myanmar	8	14
New Zealand	2	10
Nicaragua	4	9
Norway	29	43
Oman	16	18
Pakistan	0	8
Panama	0	8
Papua New Guinea	1	29
Paraguay	3	3
Peru	4	8
Philippines	9	14
Rwanda	11	12
Sri Lanka	1	6
Switzerland	30	45
Trinidad and Tobago	11	38
Tunisia	29	46
Turkey	28	41
Uganda	16	18
United States	4	16
Uruguay	3	4
Zambia	15	14

Table 2: Summary Statistics

Variable	**Definition**	**Mean**	**SD**	**Min**	**Max**
MFN_{ist}	Applied MFN tariff rate (including ad valorem equivalents)	0.127	0.181	0.000	10.000
WT_{ist-1}	Trade-weighted average applied tariff rate (using 2001 MFN tariffs)	0.097	0.167	0.000	10.000
PS_{ist-1}	Predicted PTA share (PTA partners' share of exports to the rest of the world)	0.162	0.199	0.000	0.995
PTAshare_{ist-1}	Share of imports originating from PTA partners	0.454	0.380	0.000	1.000
$\Delta_{SD}\text{MFN}_{ist}$	Change in MFN tariff rate between consecutive periods	-0.013	0.057	-1.000	1.000
$\Delta_{SD}\text{WT}_{ist-1}$	Change in WT between consecutive periods	-0.007	0.064	-4.664	7.609
$\Delta_{SD}\text{PS}_{ist-1}$	Change in PS between consecutive periods	0.042	0.101	-0.733	0.945
$\Delta_{SD}\text{PTAshare}_{ist-1}$	Change in PTAshare between consecutive periods	0.050	0.283	-1.000	1.000
$\Delta_{LD}\text{MFN}_{ist}$	Change in MFN tariff rate between 2001 and 2010 periods	-0.038	0.089	-0.994	0.988
$\Delta_{LD}\text{WT}_{ist-1}$	Change in WT between 2001 and 2010 periods	-0.019	0.114	-7.314	5.105
$\Delta_{LD}\text{PS}_{ist-1}$	Change in PS between 2001 and 2010 periods	0.128	0.159	-0.596	0.960
$\Delta_{LD}\text{PTAshare}_{ist-1}$	Change in PTAshare between 2001 and 2010 periods	0.157	0.377	-1.000	1.000

Notes: All variables are at the importer-period-HS-6 level.

Table 3: MFN Tariffs, PTA Shares and Applied Tariffs – Baseline IV Results

	Level	SD	LD	Level	SD	LD
Dep. Variable:	MFN_{ist}	$\Delta_{SD}MFN_{ist}$	$\Delta_{LD}MFN_{ist}$	MFN_{ist}	$\Delta_{SD}MFN_{ist}$	$\Delta_{LD}MFN_{ist}$
	(1)	(2)	(3)	(4)	(5)	(6)
PTAshare_{ist-1}	-0.040***					
	(0.009)					
$\Delta_{SD}\text{PTAshare}_{ist-1}$		-0.020**				
		(0.009)				
$\Delta_{LD}\text{PTAshare}_{ist-1}$			-0.072***			
			(0.009)			
$\text{WeightedTariff}_{ist-1}$				0.419***		
				(0.093)		
$\Delta_{SD}\text{WeightedTariff}_{ist-1}$					0.343**	
					(0.154)	
$\Delta_{LD}\text{WeightedTariff}_{ist-1}$						0.560***
						(0.088)
Observations	367,991	272,927	82,926	367,991	272,927	82,926
R-squared	0.914	0.185	0.386	0.911	0.140	0.050
First-stage F-stat	1121	857.4	614	191.2	79.17	70.88
Importer x year FE	Yes	Yes	Yes	Yes	Yes	Yes
6-digit HS x importer FE	Yes	No	No	Yes	No	No
6-digit HS x year FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Clustered standard errors at the importer/6-digit HS level are in parentheses. ***, ** and * indicate 1 percent, 5 percent and 10 percent significance levels, respectively.

Table 4: MFN Tariffs, PTA Shares and Applied Tariffs – OLS Results

	Level	SD	LD	Level	SD	LD
Dep. Variable:	MFN_{ist}	$\Delta_{SD}MFN_{ist}$	$\Delta_{LD}MFN_{ist}$	MFN_{ist}	$\Delta_{SD}MFN_{ist}$	$\Delta_{LD}MFN_{ist}$
	(7)	(8)	(9)	(10)	(11)	(12)
PTAshare_{ist-1}	-0.002**					
	(0.001)					
$\Delta_{SD}\text{PTAshare}_{ist-1}$		-0.001**				
		(0.000)				
$\Delta_{LD}\text{PTAshare}_{ist-1}$			-0.005***			
			(0.001)			
$\text{WeightedTariff}_{ist-1}$				0.115***		
				(0.042)		
$\Delta_{SD}\text{WeightedTariff}_{ist-1}$					0.045***	
					(0.013)	
$\Delta_{LD}\text{WeightedTariff}_{ist-1}$						0.040***
						(0.007)
Observations	367,991	272,927	82,926	367,991	272,927	82,926
R-squared	0.915	0.188	0.442	0.916	0.189	0.444
Importer x year FE	Yes	Yes	Yes	Yes	Yes	Yes
6-digit HS x importer FE	Yes	No	No	Yes	No	No
6-digit HS x year FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Clustered standard errors at the importer/6-digit HS level are in parentheses. ***, ** and * indicate 1 percent, 5 percent and 10 percent significance levels, respectively.

Table 5: MFN Tariffs and PTA Shares – Alternative Instrument and Over-ID Tests

	Level		SD		Level		SD	
Dep. Variable:	MFN_{ist}		$\Delta_{SD}MFN_{ist}$		MFN_{ist}		$\Delta_{SD}MFN_{ist}$	
	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
PTAshare$_{ist-1}$	-0.036***	-0.036***						
	(0.007)	(0.007)						
Δ_{SD}PTAshare$_{ist-1}$			-0.020***	-0.020***				
			(0.006)	(0.006)				
WeightedTariff$_{ist-1}$					0.411***	0.413***		
					(0.085)	(0.082)		
Δ_{SD}WeightedTariff$_{ist-1}$							0.336***	0.336***
							(0.103)	(0.103)
Observations	367,991	367,991	272,927	272,927	367,991	367,991	272,927	272,927
R-squared	0.914	0.914	0.184	0.185	0.911	0.911	0.142	0.142
Instruments	PS income	PS + PS income	PS income	PS + PS income	PS income	PS + PS income	PS income	PS + PS income
First-stage F-stat	1,850.0	929.5	1469.0	735.5	126.9	111.5	55.08	51.44
Over-ID Test p-value	N/A	0.4070	N/A	0.9016	N/A	0.9018	N/A	0.9447
Importer x year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
6-digit HS x importer FE	Yes	Yes	No	No	Yes	Yes	No	No
6-digit HS x year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Clustered standard errors at the importer/6-digit HS level are in parentheses. ***, ** and * indicate 1 percent, 5 percent and 10 percent significance levels, respectively.

Table 6: MFN Tariffs and PTA Shares – Low vs. High Potential Tariff Revenue Diversion

	Level		SD		LD	
Dep. Variable:	MFN_{ist}		$\Delta_{SD}MFN_{ist}$		$\Delta_{LD}MFN_{ist}$	
	(21)	(22)	(23)	(24)	(25)	(26)
Potential Tariff Revenue Diversion:	Low	High	Low	High	Low	High
PTAshare_{ist-1}	-0.032**	-0.087***				
	(0.015)	(0.029)				
$\Delta_{SD}\text{PTAshare}_{ist-1}$			0.002	-0.046**		
			(0.008)	(0.022)		
$\Delta_{LD}\text{PTAshare}_{ist-1}$					-0.054***	-0.083***
					(0.015)	(0.015)
Observations	161,066	161,406	136,412	119,573	39,222	38,987
R-squared	0.900	0.938	0.187	0.290	0.439	0.436
Tests:						
First-stage F-stat	276.9	444.9	452.6	357	178.7	310.0
Coefficient equality test p-value	0.090		0.044		0.174	
Importer x year FE	Yes	Yes	Yes	Yes	Yes	Yes
6-digit HS x importer FE	Yes	Yes	No	No	No	No
6-digit HS x year FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Clustered standard errors at the importer/6-digit HS level are in parentheses. ***, ** and * indicate 1 percent, 5 percent and 10 percent significance levels, respectively.

Table 7: MFN Tariffs and PTA Shares – Trade Agreement Depth

	PTA Depth				PTA Depth LE			
Dep. Variable:	MFN_{ist}		$\Delta_{SD}MFN_{ist}$		MFN_{ist}		$\Delta_{SD}MFN_{ist}$	
	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)
	Less Depth	More Depth	Less Depth	More Depth	Less Depth	More Depth	Less Depth	More Depth
PTAshare$_{ist-1}$	-0.010*	-0.057***			-0.008	-0.062***		
	(0.006)	(0.020)			(0.007)	(0.016)		
Δ_{SD}PTAshare$_{ist-1}$			0.008	-0.035*			0.004	-0.035**
			(0.005)	(0.021)			(0.007)	(0.015)
Observations	187,875	178,977	139,510	132,554	184,792	181,828	137,266	134,631
R-squared	0.949	0.910	0.260	0.223	0.869	0.934	0.289	0.176
Tests:								
First-stage F-stat	666.6	465.4	503.3	352.3	582.9	528.8	429.4	417.8
Coefficient equality test p-value	0.025		0.044		0.002		0.022	
Importer x year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
6-digit HS x importer FE	Yes	Yes	No	No	Yes	Yes	No	No
6-digit HS x year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Clustered standard errors at the importer/6-digit HS level are in parentheses. ***, ** and * indicate 1 percent, 5 percent and 10 percent significance levels, respectively.

Table 8: MFN and Applied Tariffs – Trade Agreement Depth

	PTA Depth				PTA Depth LE			
Dep. Variable:	MFN_{ist}		$\Delta_{SD}MFN_{ist}$		MFN_{ist}		$\Delta_{SD}MFN_{ist}$	
	(35)	(36)	(37)	(38)	(39)	(40)	(41)	(42)
	Less Depth	More Depth	Less Depth	More Depth	Less Depth	More Depth	Less Depth	More Depth
WeightedTariff$_{ist-1}$	0.117*	0.536***			0.082	0.607***		
	(0.066)	(0.195)			(0.076)	(0.162)		
Δ_{SD}WeightedTariff$_{ist-1}$			-0.151	0.562			-0.072	0.593**
			(0.107)	(0.347)			(0.128)	(0.273)
Observations	187,875	178,977	139,510	132,554	184,792	181,828	137,266	134,631
R-squared	0.948	0.906	0.243	0.115	0.869	0.930	0.285	0.017
Tests:								
First-stage F-stat	161	54.85	55.75	23.22	168.3	68.78	50.63	30.63
Coefficient equality test p-value	0.041		0.049		0.003		0.027	
Importer x year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
6-digit HS x importer FE	Yes	Yes	No	No	Yes	Yes	No	No
6-digit HS x year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Clustered standard errors at the importer/6-digit HS level are in parentheses. ***, ** and * indicate 1 percent, 5 percent and 10 percent significance levels, respectively.

Table 9: MFN and PTA Shares – Extensions (Level Results)

Dep. Variable:	CU vs. No CU Members MFN_{ist}		High vs. Low Tariff Countries MFN_{ist}		Low vs. High Income Countries MFN_{ist}		Large vs. Small Countries MFN_{ist}	
	(43) No CU	(44) CU	(45) Low Tariffs	(46) High Tariffs	(47) Low Income	(48) High Income	(49) Small	(50) Large
PTAshare_{ist-1}	-0.056***	0.003	-0.033***	-0.065***	-0.035***	-0.048**	-0.097***	-0.033**
	(0.012)	(0.015)	(0.010)	(0.018)	(0.007)	(0.020)	(0.027)	(0.013)
Observations	271,058	94,409	188,124	178,776	181,134	183,052	108,894	168,612
R-squared	0.932	0.789	0.949	0.905	0.927	0.915	0.917	0.952
Tests:								
First-stage F-stat	941.3	151.2	469.5	627.8	620	451.7	236.5	324.9
Coefficient equality test p-value	0.001		0.125		0.527		0.035	
Importer x year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
6-digit HS x importer FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
6-digit HS x year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Clustered standard errors at the importer/6-digit HS level are in parentheses. ***, ** and * indicate 1 percent, 5 percent and 10 percent significance levels, respectively.

Table 10: MFN and Applied Tariffs – Extensions (Level Results)

Dep. Variable:	CU vs. No CU Members MFN_{ist}		High vs. Low Tariff Countries MFN_{ist}		Low vs. High Income Countries MFN_{ist}		Large vs. Small Countries MFN_{ist}	
	(51) No CU	(52) CU	(53) Low Tariffs	(54) High Tariffs	(55) Low Income	(56) High Income	(57) Small	(58) Large
$\text{WeightedTariff}_{ist-1}$	0.552***	-0.061	0.378***	0.544***	0.266***	0.914**	0.568***	0.472**
	(0.119)	(0.302)	(0.122)	(0.150)	(0.055)	(0.414)	(0.168)	(0.200)
Observations	271,058	94,409	188,124	178,776	181,134	183,052	108,894	168,612
R-squared	0.928	0.789	0.946	0.900	0.930	0.894	0.913	0.944
Tests:								
First-stage F-stat	152.5	8.717	99.51	106.2	196.9	22.99	61.52	26.81
Coefficient equality test p-value	0.051		0.390		0.120		0.719	
Importer x year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
6-digit HS x importer FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
6-digit HS x year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Clusteed standard errors at the importer/6-digit HS level are in parentheses. ***, ** and * indicate 1 percent, 5 percent and 10 percent significance levels, respectively.

Appendix A: Theory

A.1 Optimal MFN Tariff vs. PTA Import Share: Non-zero PTA Tariffs

Equation (2) in section 2.2 illustrates that the optimal MFN tariff for country A decreases in the share of imports from PTA partner B. We derived this relationship assuming that the preferential rate is zero, or $t_B = 0$. To consider the case of a positive preferential tariff, $t_B > 0$, we can solve equation (1) in the main text for A's optimal MFN tariff:

$$\frac{t_C}{p - t_C} = \frac{1}{\sigma} - \frac{X_B}{X_C}\left(\frac{dp/dt_C}{1 - dp/dt_C}\right)\left(\frac{1}{\sigma} - \frac{t_B}{p - t_B}\right) \quad . \tag{A.1}$$

Given equation (A.1), what is the effect of an increase in the PTA share – or equivalently, in X_B/X_C, which is an increasing function of X_B/M – on the optimal MFN tariff?

As shown in the main text, the effect is clearly negative when $t_B = 0$. The same is true when t_B is sufficiently small. We can also see that this effect is tempered when $t_B > 0$. Can we say anything in general about the sign of $1/\sigma - t_B/(p - t_B)$? It turns out we can, under some reasonable assumptions. If both t_B and t_C were chosen optimally, the tariffs in this setup would be $t_B/(p - t_B) = t_C/(p - t_C) = 1/\sigma$. To see this point, note that we could obtain a condition similar to (A.1) by using the first-order condition with respect to t_B but with B and C switched. The two equations together can be solved for the optimal ad valorem tariffs above, which equal the inverse export supply elasticity. It then follows that $1/\sigma - t_B/(p - t_B) \geq 0$, and this expression only equals zero when the PTA tariff coincides with the optimal MFN tariff. Hence, as long as the PTA has any "bite" in this particular product, i.e., the PTA tariff is less than the optimal MFN tariff in the absence of a PTA, an increase in the PTA share will necessarily reduce the optimal MFN tariff. This effect will be stronger when the preferential tariff is smaller.[30]

A.2 Optimal MFN Tariff vs. PTA Import Share: The Role of Trade Diversion

In section 2.2, we explain that revenue loss from trade diversion is at the heart of the inverse relationship between the PTA import share and the optimal MFN tariff. In order to minimize the tariff revenue reduction after entering a PTA with B, country A will lower its MFN tariff on C. In terms of the model, the reversion of trade diversion from country B due to an MFN tariff cut is given by $-dX_B/dt_C$. Similarly, the total increase in exports from C to A due to the reduction in the MFN tariff, dX_C/dt_C, equals the reversion of trade diversion plus trade creation. The ratio of these two derivatives indicates the importance of the trade diversion reversal relative to the overall trade effect. Calculating the ratio $(-dX_B/dt_C)/(dX_C/dt_C)$ and re-arranging, we can solve for:

$$\frac{X_B}{X_C}\left(\frac{dp/dt_C}{1 - dp/dt_C}\right) = \left(-\frac{dX_B/dt_C}{dX_C/dt_C}\right)\left(\frac{p - t_C}{p - t_B}\right) \quad . \tag{A.2}$$

Combing equations (A.1) and (A.2), we can then obtain A's optimal MFN tariff in terms of the relative trade diversion reversal:

$$\frac{t_C}{p - t_C} = \frac{1}{\sigma} - \left(-\frac{dX_B/dt_C}{dX_C/dt_C}\right)\left[\frac{p - t_B}{(p - t_C)\,\sigma} - \frac{t_B}{p - t_C}\right] \quad . \tag{A.3}$$

[30] The interpretation of these results is slightly more complicated when $\sigma_B \neq \sigma_C$, though the thrust of the results remains. In this case, the unrestricted unilateral optimum for A is to set $t_B = 1/\sigma_B$ and $t_C = 1/\sigma_C$. The PTA therefore has "bite" as long as the preferential tariff is less than A's unilateral optimum on B, which may not be the optimal tariff on C.

Hence, in our framework, the incentive for country A to reduce the MFN tariff in response to a PTA is deeply tied to the magnitude of the trade diversion reversal that can be achieved. The greater the scope for reversing the harmful trade diversion from the PTA, the larger will be the subsequent MFN tariff reduction by country A.

Appendix B: Data

This appendix provides more details about our data sources and the steps we follow in order to construct the key variables for our empirical analysis.

Tariffs: The key tariff data source for our analysis is the CEPII (2012) MAcMap-HS6 database. This dataset is built and updated by CEPII using underlying tariff line information that is maintained by the International Trade Center. CEPII constructs the HS6 level preferential and MFN tariff rates by taking a simple average of the underlying tariff line rates. These tariff lines can vary substantially by country and the aggregation to the HS6 level ensures global harmonization. CEPII uses a methodology based on reference countries to calculate ad valorem equivalents for specific tariffs and tariff-rate quotas. When both specific and ad valorem tariffs are available for a product, the ad valorem tariff rate is preferred. Finally, and crucially for our application, the database exhaustively takes into account tariff rates under any applicable preferential trade agreement. We complement missing MFN tariff data with information from the TRAINS database.

Trade Flows: We source our trade data at the HS6 level from the CEPII (2016) BACI database. While the raw trade flows on which the BACI dataset is based are sourced from UN Comtrade, CEPII applies a harmonization procedure to improve the data quality. In addition to cleaning the database, CEPII makes use of trade flows reported by both the importer and the exporter, giving more weight to the more reliable partner. The reliability weights are obtained by using a variance analysis methodology that is based on reporting distances among partners. The database also adjusts for the differences due to c.i.f. and f.o.b. reporting that arises when using both importer and exporter reported data.

Preferential Trade Agreements: We obtain detailed information on countries' PTA partners from Mario Larch's Regional Trade Agreements database (Egger and Larch 2008). In addition to keeping track of multilateral and bilateral trade agreements worldwide between 1950 and 2017, this data distinguishes FTAs from other types of preferential agreements such as customs unions and partial scope agreements.

Predicted PTA Share: We use the Larch database together with the CEPII (2016) trade flow information to calculate our instrument, the predicted PTA share variable, PS in equation (4). For this variable, we calculate the share of global trade in a product accounted for by FTA partners of a given importer, excluding exports to the importing country in question. Note that for this variable, we specifically use FTA partners and not all preferential agreements. This constraint is imposed for two reasons. First, the common external tariffs for customs unions complicates the interpretation of the link between imports from CU members and MFN tariffs in any particular CU country. Second, partial scope trade agreements would presumably weaken the instrument as for many products the applied tariffs would not be affected at all. In any case, the estimates reported above are similar when also considering CU and partial scope agreements in the construction of our instrument. These results are available upon request.

Weighted Tariff: To construct the weighted applied tariff measure, WT in equation (6), we use information from all data sources above. The basic idea is to have a weighted applied tariff measure that keeps MFN tariff rates at their 2001 level. To achieve this goal, we apply the 2001 MFN tariff rate to all exporters that are not in any kind of preferential agreement with the country in question. For exporters in a preferential agreement, we generally use the preferential applied tariff rate provided in CEPII (2012). For years after 2001, we need to account for cases where the MFN tariff rate itself decreased but the preferential tariff rate remains equal to the new MFN tariff. To circumvent this issue, we use the 2001 MFN tariff for countries in a preferential agreement for all years as long as the preferential tariff is equal to the MFN rate in that year.

Appendix C: Additional Results

Table C1: MFN Tariffs, PTA Shares and Applied Tariffs – First-stage Results, Table 3

Dep. Variable:	Level $PTAshare_{ist-1}$ (C1)	SD $\Delta_{SD}PTAshare_{ist-1}$ (C2)	LD $\Delta_{LD}PTAshare_{ist-1}$ (C3)	Level WT_{ist-1} (C4)	SD $\Delta_{SD}WT_{ist-1}$ (C5)	LD $\Delta_{LD}WT_{ist-1}$ (C6)
PS_{ist-1}	0.335***			-0.032***		
	(0.010)			(0.002)		
$\Delta_{SD}PS_{ist-1}$		0.321***			-0.018***	
		(0.011)			(0.002)	
$\Delta_{LD}PS_{ist-1}$			0.323***			-0.042***
			(0.013)			(0.005)
Observations	367,991	272,927	82,926	367,991	272,927	82,926
R-squared	0.808	0.201	0.331	0.943	0.156	0.129
Importer x year FE	Yes	Yes	Yes	Yes	Yes	Yes
6-digit HS x importer FE	Yes	No	No	Yes	No	No
6-digit HS x year FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Clustered standard errors at the importer/6-digit HS level are in parentheses. ***, ** and * indicate 1 percent, 5 percent and 10 percent significance levels, respectively.

Table C2: MFN Tariffs and PTA Shares – Excluding Large Importers

Exclusion criterion:	World import share ≥ 20%			World import share ≥ 10%			World import share ≥ 5%		
Dep. Variable:	Level MFN_{ist} (C7)	SD $\Delta_{SD}MFN_{ist}$ (C8)	LD $\Delta_{LD}MFN_{ist}$ (C9)	Level MFN_{ist} (C10)	SD $\Delta_{SD}MFN_{ist}$ (C11)	LD $\Delta_{LD}MFN_{ist}$ (C12)	Level MFN_{ist} (C13)	SD $\Delta_{SD}MFN_{ist}$ (C14)	LD $\Delta_{SLD}MFN_{ist}$ (C15)
$PTAshare_{ist-1}$	-0.041***			-0.040***			-0.043***		
	(0.009)			(0.009)			(0.010)		
$\Delta_{SD}PTAshare_{ist-1}$		-0.020**			-0.019**			-0.019**	
		(0.009)			(0.009)			(0.010)	
$\Delta_{LD}PTAshare_{ist-1}$			-0.072***			-0.073***			-0.076***
			(0.009)			(0.010)			(0.010)
Observations	357,043	265,154	81,806	345,089	256,387	79,978	328,303	243,985	77,211
R-squared	0.913	0.185	0.387	0.913	0.186	0.386	0.912	0.188	0.384
First-stage F-stat	1072	821.3	604.5	984.3	752.8	570	860.3	659.5	514.2
Importer x year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
6-digit HS x importer FE	Yes	No	No	Yes	No	No	Yes	No	No
6-digit HS x year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Clustered standard errors at the importer/6-digit HS level are in parentheses. ***, ** and * indicate 1 percent, 5 percent and 10 percent significance levels, respectively.

Table C3: MFN and Applied Tariffs – Excluding Large Importers

Exclusion criterion:	World import share $\geq$ 20%			World import share $\geq$ 10%			World import share $\geq$ 5%		
	Level	SD	LD	Level	SD	LD	Level	SD	LD
Dep. Variable:	MFN_{ist}	$\Delta_{SD}MFN_{ist}$	$\Delta_{LD}MFN_{ist}$	MFN_{ist}	$\Delta_{SD}MFN_{ist}$	$\Delta_{LD}MFN_{ist}$	MFN_{ist}	$\Delta_{SD}MFN_{ist}$	$\Delta_{LD}MFN_{ist}$
	(C16)	(C17)	(C18)	(C19)	(C20)	(C21)	(C22)	(C23)	(C24)
WeightedTariff$_{ist-1}$	0.418***			0.397***			0.416***		
	(0.094)			(0.092)			(0.096)		
Δ_{SD}WeightedTariff$_{ist-1}$		0.347**			0.329**			0.336**	
		(0.158)			(0.156)			(0.169)	
Δ_{LD}WeightedTariff$_{ist-1}$			0.560***			0.557***			0.552***
			(0.089)			(0.091)			(0.091)
Observations	357,043	265,154	81,806	345,089	256,387	79,978	328,303	243,985	77,211
R-squared	0.910	0.139	0.050	0.911	0.145	0.053	0.910	0.145	0.062
First-stage F-stat	188.7	75.69	69	178.1	70.33	66.36	165.2	60.16	64.51
Importer x year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
6-digit HS x importer FE	Yes	No	No	Yes	No	No	Yes	No	No
6-digit HS x year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Clustered standard errors at the importer/6-digit HS level are in parentheses. ***, ** and * indicate 1 percent, 5 percent and 10 percent significance levels, respectively.

Table C4: MFN Tariffs, PTA Shares and Applied Tariffs – IV Results with Outliers and Small Countries

Dep. Variable:	Level MFN_{ist} (C25)	Level MFN_{ist} (C26)	Level MFN_{ist} (C27)	Level MFN_{ist} (C28)	Level MFN_{ist} (C29)	Level MFN_{ist} (C30)
	+ Outliers	+ Small	+ Outliers & Small	+ Outliers	+ Small	+ Outliers & Small
PTAshare$_{ist-1}$	-0.064***	-0.038***	-0.058***			
	(0.014)	(0.009)	(0.014)			
WeightedTariff$_{ist-1}$				0.706***	0.421***	0.694***
				(0.169)	(0.104)	(0.186)
Observations	369,530	391,682	393,408	369,530	391,682	393,408
R-squared	0.876	0.908	0.872	0.844	0.905	0.840
First-stage F-stat	1118	1124	1120	57.57	172.8	50.42
Importer x year FE	Yes	Yes	Yes	Yes	Yes	Yes
6-digit HS x importer FE	Yes	Yes	Yes	Yes	Yes	Yes
6-digit HS x year FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Clustered standard errors at the importer/6-digit HS level are in parentheses. ***, ** and * indicate 1 percent, 5 percent and 10 percent significance levels, respectively.