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Lisandra Flach, Fabian Gräf

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Telephone +49 (0)89 2180-2740, Telefax +49 (0)89 2180-17845, email office@cesifo.de
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Abstract

This paper uncovers new stylized facts on the relation between economic integration and world trade prices. Using export price data combined with data on 32 WTO (World Trade Organization) accessions by developing countries and hundreds of new PTAs (Preferential Trade Agreements), we show that a country's membership in trade agreements is associated with an increase in export prices of differentiated goods. For WTO, this effect is captured by the developing countries that were subject to rigorous WTO accession procedures. We also exploit the importance of the depth of an PTA and of its different provisions. Whereas the effect of the depth per se is not significant, individual provisions evoke distinct effects on prices. In particular, we find that PTAs with provisions on investments are associated with higher export prices. The results are consistent with recent theoretical models that relate competition to the innovation behavior of firms.

JEL-Codes: F130, F140.

Keywords: export prices, WTO membership, PTAs, product quality.

Lisandra Flach
Department of Economics
University of Munich
Germany – 80539 Munich
lisandra.flach@econ.lmu.de

Fabian Gräf
E.CA Economics
Schlossplatz 1
Germany – 10178 Berlin
graef@e-ca.com

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1 Introduction

A large empirical literature has investigated the trade promoting effects of membership in the WTO and in PTAs.[1] Over the first twenty years of its existence, thirty-two developing countries have joined the WTO and hundreds of PTAs have been signed across countries. However, little is known about the effect of trade agreements on world trade prices.[2] Membership in trade agreements lowers trade barriers on imported goods, which decreases export prices through a cost-reducing effect. On the other hand, lower trade barriers might increase access to more variety and better quality products (see Amiti and Khandelwal (2013) and Fan et al. (2015)) and affect firm decision over higher quality production (Chisik, 2012), leading to a positive impact on prices. Moreover, whereas tariffs capture an important part of the effect of trade agreements on prices, other mechanisms have been suggested by the literature, such as changes in the regulations and investment rules between members (see Baier and Bergstrand (2007) and Ossa (2016)).[3] Hence, the net effect on export prices is a priori unclear.

We offer a first attempt to measure the effect of trade agreements on *fob* export prices at the world and product level. We also disentangle the effect of different provisions within PTAs on prices and highlight a mechanism to explain the results. One important advantage of our approach is the use of highly disaggregated *fob* (free on board) export unit values from BACI (international trade database). BACI is particularly suitable for the analysis of prices, as it is the unique database that provides consistent values at the world and product level.[4]

Our analysis covers 32 WTO accessions, ranging from some of the least-developed coun-

[1] Rose's seminal 2004 papers neither found evidence that membership at GATT/WTO (General Agreement on Tariffs and Trade/World Trade Organiization) has increased trade (Rose (2004a)) nor that it has led to a more open trade policy of its members (Rose (2004b)). These papers motivated a large literature on the trade-promoting effects of trade agreements.

[2] In their 2002 paper, Chang and Winters (2002) study the effect of regional integration on trade prices and note with surprise that "there is not a single *ex post* empirical study of the price effects of integration"apart from their own 2000 paper. One possible explanation is the lack of free on board price data. In recent years, few studies have investigated the price effects of trade liberalization (for instance, Amiti and Khandelwal (2013) and Fan et al. (2015)). However, these studies focus on the experience of ojjnnnnnnnnnn rested in general equilibrium effects using all events of PTAs and WTO membership in recent years.

[3] According to the recently released Desta dataset that we use in this paper, one can divide the provisions of an PTA in 7 groups, where tariffs represent only one of the 7 provisions. Moreover, for the WTO, Ossa (2016) writes for instance that WTO rules also limit foreign direct investment (FDI) policies that governments can apply. For example, the Trade Related Investment Measures (TRIMS) agreement limits the local content requirements which can be imposed on foreign-owned firms. Also, FDI flows are increasingly subject to bilateral investment treaties (Ossa, 2016).

[4] As we describe in more detail in the data section, average prices from BACI are more reliable in comparison to Comtrade. Moreover, at BACI transportation costs are always removed, such that the results can be consistently interpreted in terms of *fob* export prices (see Gaulier and Zignano (2010)).

tries (as Nepal, Vanuatu and Tajikistan) to some of the world's largest traders and largest emerging economies (as China and Russia), as well as hundreds of PTAs. Using 16 years of data with roughly 125 million observations for all countries and all manufacturing traded products, we uncover new stylized facts. First, we show that a country's membership in the WTO and/or in an PTA is associated with an increase in export prices of differentiated goods, whereas for homogeneous goods the effect is not robust and almost never significant. For the WTO, we show that this effect is captured by the developing countries that were subject to rigorous WTO accession procedures and not to accession under Article XXVI 5(c).[5] Moreover, for intermediate goods, we show that the membership effect is only significant in developing countries when the *importer* joins the WTO.

Second, we go beyond the analysis of membership in PTAs as a binary variable. Using a newly released dataset on the different provisions negotiated in an PTA, we investigate the importance of the depth of the agreement. We find that the effect of the depth on prices is not significant, but that individual provisions have distinct effects on prices. In particular, we find that PTAs with provisions related to investment are associated with higher export prices.

Although the aggregate data at the product level hides important composition effects (we discuss composition effects in the next section), our main results constitute evidence consistent with innovation and quality upgrading following trade liberalization. The positive effect on prices of differentiated goods (which have scope for quality differentiation) and the fact that only importers respond in case of intermediate goods are consistent with a model in which the quality of inputs increases following trade liberalization (see Fan et al. (2015)).

Concerning the second stylized fact, the positive price effect for PTAs with provisions related to investment is likely associated with quality upgrading. As discussed by Amiti and Khandelwal (2013), quality upgrading is one important element of investments in research and technology. For firms close to the technology frontier (measured by the degree of quality differentiation), the increase in competition following trade liberalization can increase the incentives to invest and innovate.[6] Using product-level data on exports to the U.S., they show that for firms selling high quality product products (products close to the technology frontier), low import tariffs promote investment and quality upgrading.

[5]Until the end of 1994, some countries (listed in Table A2) entered GATT/WTO under Article XXVI5(c). While other countries conducted extensive reforms and passed through long negotiations processes, in particular many former colonies turned WTO members by invoking Article XXVI5(c) (a more detailed description of Article XXVI5(c) is provided by Tang and Wei (2009)). These countries were not obliged to conduct structural reforms and are arguably less open than other WTO members.

[6]For firms selling high quality products, it reduces the cannibalization of existing profits and enables incumbent firms to escape from the threat of competition. Aghion et al (2009) refer to this as the escape-entry effect (see also Aghion and Howitt (2005) and Aghion et al (2005)).

The effect of trade liberalization on prices was a priori unclear. On the one hand, we could expect a negative effect of trade liberalization on prices. Following heterogeneous firms models, aggregate productivity rises as resources are reallocated towards more productive firms (e.g., Melitz (2003) and Pavcnik (2002)). Hence, when trade barriers fall, input prices decrease, such that firms relying on intermediate inputs face lower marginal costs and charge lower export prices.[7] On the other hand, the literature has shown at least two mechanisms by which lower trade barriers promote innovation and access to better inputs, which leads to quality upgrading and higher prices. Amiti and Khandelwal (2013) show that lower import tariffs promote quality upgrading for products close to the technology frontier, as it increases import competition. Fan et al. (2015) show that lower import tariffs following China's WTO membership are associated with higher export prices, as exporters gain access to higher quality inputs. Finally, a literature on trade disputes has shown a positive relation between trade agreements and the decision over higher quality production. For instance, Chisik (2012) provides a theoretical framework in which firms inefficiently choose lower levels of quality production when harmful trade disputes are more common. In this framework, deeper trade relationships coming from an environment of more transparency and macroeconomic stability affect the production of higher quality.

Our empirical results suggest that, for differentiated goods, the quality mechanism dominates the cost effect. For homogeneous goods we do not expect neither a quality effect nor a cost effect, leaving prices by large unaffected.[8] Although we do not draw direct policy implications, our results indicate that, if we consider only the cost-reducing effect of trade agreements and disregard innovation and quality upgrading following trade liberalization, we might understate the welfare effects from trade agreements.

To help minimize endogeneity concerns of trade agreements, we conduct several robustness checks. First, we exploit available data on the time gap between application and accession to WTO. Second, we check the residuals of the regressions on prices for new members in comparison to a control group. We show that prior to accession, the price behavior of the two groups is very similar. Finally, we exploit heterogeneous effects of trade agreements for countries that joined WTO under Article XXVI 5(c) in comparison to countries that were subject to rigorous accession procedures. We show that the effect of membership on prices

[7]Lower trade barriers have also important pro-competitive effects because a decrease in output tariffs changes the residual demand of firms, which exerts a downward pressure on markups and firm prices, as shown by Goldberg et al. 2016. However, the price decline following a decrease in input tariffs might be small as firms might react by raising their markups (see Goldberg et al. (2016)).

[8]First, homogeneous goods are unaffected by access to cheaper/better imported inputs, in contrast to most differentiated goods. Second, homogeneous goods are less likely to observe quality upgrading. Third, because we use *fob* prices, changes in freight and insurance costs following trade liberalization do not directly affect prices.

comes entirely from the developing countries that committed to trade policy.

The rest of the paper is organized as follows. Section 2 briefly describes the literature. In section 3, we present the data and the empirical strategy. In section 4, we show the main empirical results. Section 5 discusses robustness checks and identification. Section 6 concludes. Further details concerning the data analysis are shown in the data appendix.

2 Related Literature

Our paper conducts a comprehensive analysis of world trade flows at the product level and provides new stylized facts on the relation between export prices and membership in trade agreements. However, the data we use at the product level hides substantial composition effects. The price response to trade liberalization might reflect quality upgrading within the firm as well as changes in the share of sales across firms within product categories. One example of a paper that investigates firm responses and composition effects is Fan et al. (2015). They show that lower import tariffs induce Chinese firms to upgrade quality and raise export prices for differentiated goods, whereas this effect is lower or nonexistent for homogeneous goods.[9]

Moreover, an additional channel that explains changes in prices is the incomplete pass-through following trade agreements (see Goldberg and Pavcnik (2016)). As we discuss in section 4.2, the price effect we observe could in part reflect changes in markups following trade liberalization, besides product quality. However, as in most of the literature,[10] it is beyond the scope of this paper to disentangle the quality effect from changes in markups. In particular, because changes in markups tend to be higher for high quality goods. Nonetheless, by uncovering new stylized facts, our results uncover the direction of price effects and highlight the importance of product quality and further channels to explain trade prices.

Our results are also related to the literature that links better access to imported intermediate inputs, quality upgrading and firm performance. Goldberg et al. (2010) provide evidence of the effect on product scope and Amiti and Khandelwal (2013) on quality upgrading. Several papers show empirical evidence that import competition leads to quality

[9]Whereas Fan et al. (2015) exploit in detail the experience of one country following membership in the WTO, our results are more general. A reduction in tariffs as investigated by Fan et al. (2015) was certainly a condition for China to join the WTO; however, other requirements might as well affect export prices after WTO accession, as discussed in the literature (see Baier and Bergstrand (2007)). In fact, our results remain significant even when controlling for tariffs, which suggests that other mechanisms are important to explain the effect of trade agreements.

[10]The incomplete pass-through is not present in CES (constant elasticity of substitution) models, which are widely used in the trade literature. One exception of a paper that discusses quality and variable markups is Hottman et al. (2016). They show that most firms are well approximated by monopolistic competition models with constant markups, but that in particular the largest firms exhibit variable markups.

investments (Martin and Mjean, 2014; Bloom et al., 2016; Utar, 2014).[11]

Finally, our paper is related to Breinlich et al. (2016), who estimate the welfare effect of FTAs for countries within the European Union (EU). Using aggregate data from Comtrade, they provide a detailed analysis of the decomposition of welfare effects in the EU into variety gains, quality and lower prices. We are rather interested in the price effects of membership in the WTO *and* PTAs for different types of goods, as well as in the importance of the different provisions within an agreement. For our research question, one advantage is the use of BACI data to calculate trade prices (see footnote 4 and data section).

Moreover, whereas Breinlich et al. (2016) focus on welfare effects within EU countries, we investigate price effects for world export flows including developed and developing countries. This might be important in particular for the quality channel. As discussed in Goldberg and Pavcnik (2016), "developing countries are still substantially less liberalized than developed countries, and the role of international trade in their growth and development remains one of the most interesting and policy-relevant questions". Moreover, in developing countries, measurement issues with membership in trade agreements might be less severe. As Goldberg and Pavcnik (2016) point out, most developing countries did not actively participate in earlier GATT/WTO negotiation rounds, such that import tariffs remained high until large scale trade liberalization. And, in many cases, non-tariff barriers were also reduced, which was not the case in developed countries, where tariffs were often replaced by non-tariff barriers.

3 Data and Empirical Design

3.1 Data

We use data on export flows at the 6-digit HS (Harmonized System) level over the period 1995-2014 from BACI, which is based on the Commodities Trade Statistics database (Comtrade). Gaulier and Zignano (2010) use the Comtrade data to construct the BACI dataset with some modifications that make it especially suited to analyze trade prices (Gaulier and Zignano (2010)). They point out that trade flows in the Comtrade dataset can be reported in four different ways: the exporter reports the tradeflow in *fob* values; the importer reports the tradeflow in *cif* (cost, insurance, freight) values; both trade partners report the trade flow or none of the countries reports the trade flow. BACI, on the other hand, provides consistent values at the world and product level.[12]

[11] Martin and Mjean (2014) show that import competition leads to quality upgrading for French firms. The literature also shows that competitive pressures from Chinese products, in particular following WTO membership, make firms rely more on innovation (Bloom et al., 2016; Utar, 2014).

[12] In the Data Appendix, we briefly sketch how Gaulier and Zignano (2010) construct the BACI data.

The 6-digit HS classification distinguishes more than 5,000 different products and covers the years 1995 to 2014 and 250 countries and territories. Due to the large number of observations, we create four-year averages of the time-dependent variables, such that the final data used in the paper contains five time periods and roughly 33 million observations. Export prices are proxied by unit values, as described in detail in the Data Appendix.

Data for the explanatory variables of interest - WTO membership and membership in a PTA - stem from two different sources. Michael Tomz provides data for WTO membership until 2001 on his website (Tomz (2007)), which are used for instance by Goldstein et al. (2007) to analyze the impact of GATT/WTO membership on trade (see details in the Data Appendix). We complete the dataset until the year 2014 using information from the official WTO website (WTO, 2016). For each country, we create a dummy variable which is one if a country has joined the WTO in the period and zero otherwise, and use further information in the robustness checks. The bilateral variable for WTO ($\text{WTO}_{ij\tau}$) takes on values of zero, one and two; zero when neither i nor j were part of the WTO in period τ, one when one of the two is a member, and two when both are members. A detailed description is provided in the Data Appendix.

Besides GATT/WTO membership, we investigate the price effect of membership in PTAs. The new Design of Trade Agreements (Desta) database constructed by Baccini et al. (2014) provides information on PTAs. We include a dummy that indicates if a PTA exists as well as a depth measure. The Appendix contains further information on how we calculate the PTA variables. We use a depth measure that counts the number of provisions in certain areas (tariff reduction, intellectual property rights, procurements, standards, services, investments, and competition) that are covered by an agreement. Hence, this depth measure ranges from zero (if a PTA exists but none of the provisions is covered, e.g. Protocol on Trade Negotiations) to seven (e.g. NAFTA - North American Free Trade Agreement). If the same country pair is a member in multiple agreements, we include the agreement with the greatest depth value.

The two maps (Figure 1 and Figure 2) present a cross-country comparison of PTAs in the 5^{th} time period (2011-2014). Figure 1 depicts that deeper PTAs are negotiated in North and Central America, Europe, and East Asia, whereas PTAs in Africa and Central Asia seem rather shallow.[13]

The second map (Figure 2) shows all partner countries of each country, i.e. the number of countries that have a common agreement with that particular country. Countries in Europe

[13]We used the first depth measure to construct this map. The user-written commands for STATA (shp2dta, spmap) stem from Kevin Crow and Maurizio Pisati. Data can be downloaded e.g. from the Natural Earth website.

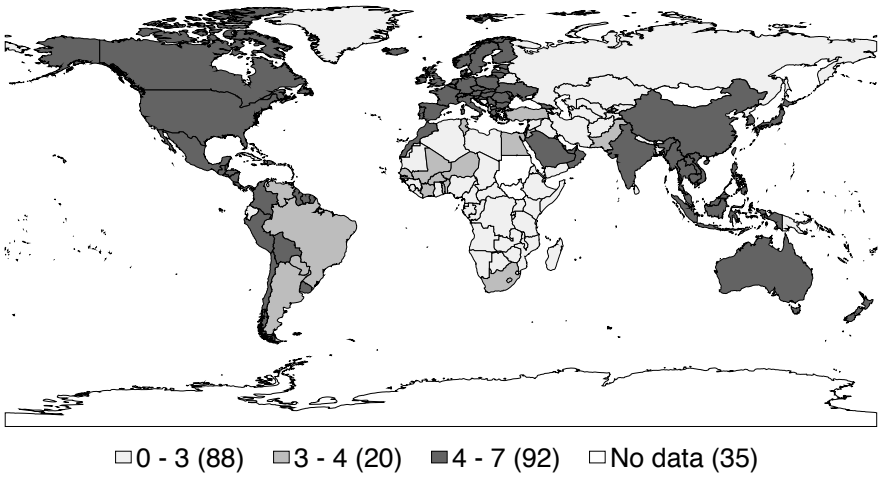


Figure 1: Depth of PTAs in Period 5

and Africa have the highest number of partner countries. While the high number of partner countries for Europe is of little surprise, the number of partner countries in Africa is mainly driven by some PTAs with many members such as the African Economic Community which alone has 51 members and covers two provisions.

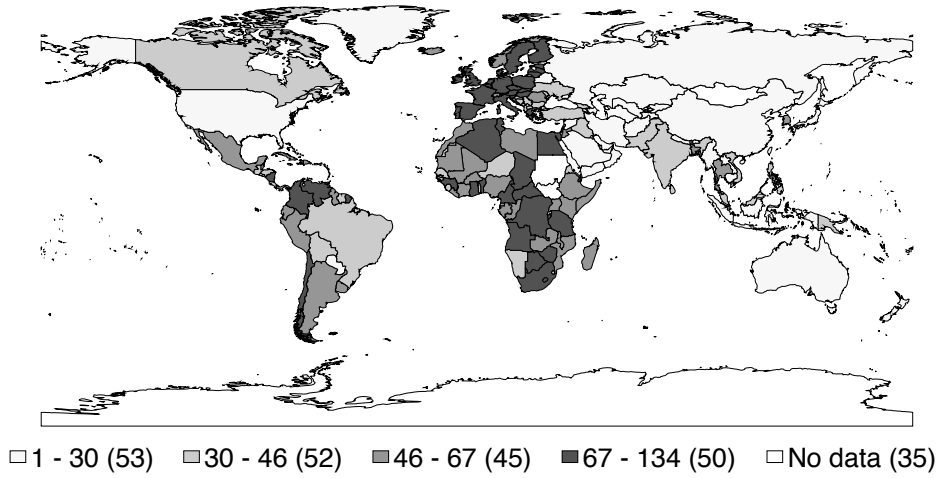


Figure 2: Number of Partner Countries in PTAs in Period 5

Data for the other explanatory variables, real GDP and tariffs, come from the Penn World Table database, version 8.1 (Feenstra et al. (2015)) and the World Integrated Trade Solution (WITS) database (Bank (2016)), respectively. In the Appendix we explain the transformations made to construct the tariff data.

Table 1 shows how the main explanatory variables - WTO membership and the depth measures for PTAs - evolve over the observed time period 1995 - 2014.

The first variable in Table 1 counts the number of WTO members over time. The list of

Table 1: *Explanatory Variables over Time*

	Period 1 1995-1998	Period 2 1999-2002	Period 3 2003-2006	Period 4 2007-2010	Period 5 2011-2014
WTO Variables after 1995					
WTO member	132	143	148	152	158
PTA Depth Measure					
0 depth PTA	1,245	1,183	1,135	1,119	1,077
1 depth PTA	415	759	1,582	1,373	1,373
2 depth PTA	1,463	1,400	1,497	1,496	1,490
3 depth PTA	1,172	1,343	1,424	1,312	1,293
4 depth PTA	194	228	318	507	537
5 depth PTA	199	252	399	458	459
6 depth PTA	19	35	75	135	144
7 depth PTA	3	7	14	403	688

Notes: Change of explanatory variables over time. Unit of variation for WTO: countries; unit of variation for PTAs: country pairs. The depth measures reflect the depth of a shared agreement ranging from zero to seven. Each time period consists of four years. The difference in WTO members between time period 5 and 1 does not equal 32 as in the appendix table since six countries joined the WTO in the first time period.

countries that became member of WTO in every year is shown in Table 2.

Table 2: *WTO Accessions between 1995 and 2014*

Accession Country	Accession Year	Accession Country	Accession Year
Albania	2000	Armenia	2003
Bulgaria	1996	Cambodia	2004
Cape Verde	2008	China	2001
Congo, Democratic Republic of	1997	Croatia	2000
Ecuador	1996	Estonia	1999
Georgia	2000	Jordan	2000
Kyrgyzstan	1998	Laos*	2013
Latvia	1999	Lithuania	2001
Taiwan	2002	Mongolia	1997
Moldova, Republic of	2001	Oman	2000
Nepal	2004	Vanuatu	2012
Panama	1997	Russian Federation	2012
Saudi Arabia	2005	Viet Nam	2007
Tajikistan	2013	Tonga	2007
Ukraine	2008	Macedonia**	2003
Samoa	2012	Yemen	2014

Notes: *Laos: Lao People's Democratic Republic, **Macedonia: The Former Yugoslav Republic of Macedonia.

The following variables in Table 1 describe the depth of the PTA. We count the country pairs that are members of a PTA with a certain depth measure at a certain time; e.g. in time period 1 (1995 - 1998) 1,172 country pairs were member of a PTA with depth measure 3. A common pattern that we observe is that the number of country pairs that are members of "deeper" PTAs increases over time. The number of country pairs with "shallow" PTAs increases until period 3 and declines slightly afterwards. Only the number of country pairs with the most "shallow" PTA consistently declines. To better describe the importance and heterogeneity of PTAs in terms of the provisions, Table 3 shows how many country pairs are

governed by the single provisions. For instance, in the first period 1,309 country pairs were members of a PTA that included a provision on competition.

The description of all variables and summary statistics are shown in Table A1.

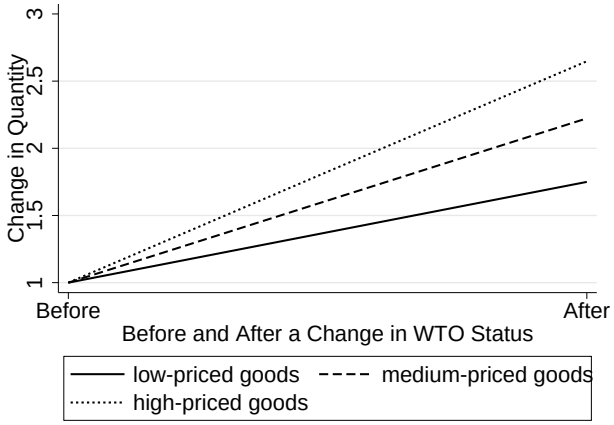
Table 3: *Number of Different Provisions over Time*

	Period 1	Period 2	Period 3	Period 4	Period 5
Competition	1309	1390	1667	2152	2475
Full Tariff Red.	2610	2861	3338	4084	4408
Investments	1261	1309	1654	2103	2427
IPRS	41	83	153	598	898
Procurement	167	260	386	910	1198
Services	1351	1514	1823	2366	2663
Standards	2241	3644	4821	5088	5387

Notes: Number of provisions per country pair in different time periods. E.g. in time period 1 1,309 country pairs were members of an PTA that included a provision on competition. IPRS: Intellectual property rights.

Figure 3 plots a further pattern in the data. We show the quantity traded both before and after WTO membership for products in different export price categories. We divide products into tertiles within each industry, based on price categories according to their export prices in the period before a change in WTO status. To make products comparable, quantities are standardized to unity in the before period, and the tertiles are created within every 2-digit industry. The figure shows that the trade volume increases for all price categories following WTO membership. This general result could be driven by a common time trend. However, it is interesting that the traded *quantities* of products with an export price in the highest tertile in the before period increase the most, whereas products with prices in the lowest tertile the least. Hence, the increase in prices that we observe in our empirical analysis is likely not due to lower sales. One plausible explanation for the increase in traded quantities of goods in the highest tertile (within an industry) is quality upgrading of goods close to the frontier (with high degree of quality differentiation). As shown by Amiti and Khandelwal (2013), by increasing competition and the incentives to innovate, trade liberalization is associated with quality upgrading for products close to the world quality frontier, whereas the opposite holds for products distant from the frontier.

Figure 3: Trade Volume before and after WTO Membership, for Different Groups of Products (Tertiles of Prices within an Industry)



3.2 Empirical Design

To investigate the reaction of trade prices to trade agreements, we start with a very simple linear specification including interacted importer-exporter-industry fixed effects as well as period fixed effects, as follows:

$$\ln p_{kij\tau} = \beta_0 + \beta_1 trade\_agreement_{ij\tau} + \beta_2 \mathbf{X_{kij\tau}} + \delta_\tau + \omega_{kij} + \epsilon_{kij\tau} \quad (1)$$

where $p_{kij\tau}$ is the *fob* export price measured as unit value of product k exported from country i to country j at time τ. $trade\_agreement_{ij\tau}$ either represents WTO membership ($\text{WTO}_{ij\tau}$)[14] or membership in a PTA ($\text{PTA}_{ij\tau}$). Both are created as dyadic, time-variant variables with $\text{PTA}_{ij\tau}$ as a simple dummy variable and $\text{WTO}_{ij\tau}$ taking the values zero, one, and two. $X_{kij\tau}$ contains the logarithmized interaction of real GDP ($\ln(\text{GDP}_{it} * \text{GDP}_{jt})$) and the tariff variable averaged over four years ($tariff_{ijk\tau}$), as further described in the Appendix. In the section on robustness checks we include further control variables. ω_{kij} represents product-exporter-importer fixed effects and δ_τ period fixed effects.

Note that, given the large amount of fixed effects when we include interacted HS 6-digit *product-importer-exporter* fixed effects and period fixed effects in a sample with over 33 million observations, it is computationally cumbersome and inefficient to include additionally importer-product-period and exporter-product-period fixed effects. In the robustness check

[14]Note that, by coding the WTO variable as described above, we obtain a variable that varies in the exporter-importer-time dimension. However, different from the PTA, this variable is only ordinally interpretable since we look at the effect of an increase from zero to one and one to two. In the robustness check section, we reestimate the baseline results with separated importer-time ($\text{WTO}_{j\tau}$) and exporter-time ($\text{WTO}_{i\tau}$) WTO variables.

section, we account for multilateral resistance terms as in Hallak (2006) and Head et al. (2010).[15] We cluster the errors in the same dimension as the fixed effects. $\epsilon_{kij\tau}$ is the error term.

In a second step, we investigate the differential effects for different types of goods and different types of trade agreements. We divide goods in homogeneous (*HOM goods*) and differentiated goods (*DIFF goods*) following Rauch (1999). In this case, we interact the variable $trade\_agreement_{ij\tau}$ with indicator variables for *HOM goods* and *DIFF goods*. According to the literature on quality upgrading as a response to a fall in tariffs (e.g. Fan et al. (2015)), we expect the positive effect of $trade\_agreement_{ij\tau}$ on prices to be driven by differentiated goods.

Finally, we investigate the importance of the depth of a PTA, as follows:

$$\ln p_{kij\tau} = \beta_0 + \beta_1 \text{PTA}_{ij\tau} + \beta_2 \text{PTA}_{ij\tau} * \text{depth}_{ij\tau} + \delta_\tau + \omega_{kij} + \epsilon_{kij\tau} \tag{2}$$

where $\text{PTA}_{ij\tau}$ is a dummy variable that indicates the presence of a PTA, as before, and $\text{depth}_{ij\tau}$ indicates the number of provisions in certain areas (tariff reduction, intellectual property rights, procurements, standards, services, investments, and competition) that are covered by a PTA. The depth measure ranges from zero (if a PTA exists but none of the provisions is covered, e.g. Protocol on Trade Negotiations) to seven (e.g. NAFTA). All estimations include exporter-importer-product fixed effects. Additionally, we disentangle the depth measure in its seven provisions to get an insight on how they affect export prices:

$$\ln p_{kij\tau} = \beta_0 + \beta_1 \text{PTA}_{ij\tau} + \sum_{p=1}^{7} \beta_{p+1} \text{PTA}_{ij\tau} * provision_{ij\tau p} + \delta_\tau + \omega_{kij} + \epsilon_{kij\tau} \tag{3}$$

where $provision_{ij\tau p}$ is an indicator taking one if a particular provision is covered and zero otherwise. All estimations include exporter-importer-product fixed effects.

As standard in the literature, we provide the baseline results (shown in Table 4) with errors clustered by $i - j - k$. However, as we discuss later in more detail, in further results we add two-way clusters which include time-varying clusters. Clustering over time is crucial in the context of our paper. As shown for instance in Cao and Flach (2015), there is a negative dependence of the standard deviation of prices on WTO membership. Hence, without correction, the error term would likely be heteroskedastic. For a comparison, we report the

[15] Due to the large amount of product-exporter-importer categories, we use the user-written command "reghdfe" written by Correia (2014) who further develops the work of Guimaraes and Portugal (2010). This procedure allows for fixed effects in multiple dimensions and for multi-way clustering.

results from Table 4 with two-way clusters in the Appendix Table A4.

4 Empirical Results

The first results for the effect of WTO and PTAs on prices are shown in Table 4 and refer to equation (1). The results include interacted 6-digit product-importer-exporter fixed effects, as well as time fixed effects. In robustness checks we include alternative groups of fixed effects to account for multilateral resistance terms. All results in the paper are reported using 4-year averages, which yields a sample of roughly 33 million observations. Besides computational gains, taking averages also allows us to deal with issues related to serial correlation and the adjustment of standard errors (see Bertrand et al. (2004)). Moreover, crucial for our analysis, all results are reported using *fob* export prices, i.e., the prices at the port of shipment, excluding transportation costs and other costs associated with insurance and unloading.

Table 4: *Baseline Results for WTO and PTA*

Dependent variable: $\ln p_{kijt}$	(1)	(2)	(3)	(4)	(5)	(6)
WTO	0.0697***				0.0692***	0.0716***
	(0.00758)				(0.00760)	(0.00818)
WTO * DIFF good		0.0792***				
		(0.00772)				
WTO * HOM good		0.0312***				
		(0.00977)				
PTA			0.0255***		0.0228**	0.0643**
			(0.00975)		(0.00975)	(0.0290)
PTA * DIFF good				0.0316***		
				(0.00966)		
PTA * HOM good				0.00239		
				(0.0122)		
PTA * WTO						-0.0212
						(0.0144)
$\ln(\text{GDP}_{it} * \text{GDP}_{jt})$	0.0174***	0.0175***	0.0298***	0.0298***	0.0182***	0.0182***
	(0.00533)	(0.00533)	(0.00530)	(0.00530)	(0.00533)	(0.00533)
Observations	33,161,901	33,161,901	33,161,901	33,161,901	33,161,901	33,161,901
RMSE	0.9587	0.9587	0.9588	0.9588	0.9587	0.9587
Adjusted r-squared	0.793	0.793	0.793	0.793	0.793	0.793
Fixed effects	t & ijk	t & ijk	t & ijk	t & ijk	t & ijk	t & ijk

Notes: Robust S.E. are shown in parentheses. ***, **, * denotes significance at the 1%, 5%, and 10% level, respectively. Robust S.E. are clustered by importer-exporter-product and time groups. DIFF.: differentiated; HOM.: homogeneous.

As shown in columns 1, 3 and 5, membership in the WTO and/or in PTAs is associated with higher *fob* export prices. Columns 2 and 4 show the results for different types of

goods. Whereas for PTAs the effect is captured by differentiated goods, for membership in the WTO the results are smaller in magnitudes but also significant for homogeneous goods. However, as we will show in further results in the paper, for homogeneous goods the WTO effect is not robust and no longer significant when using alternative specifications, whereas for differentiated goods the results are always positive and significant. Moreover, once we include two-way clusters, which are important for our analysis, the effect for homogeneous goods vanishes (see Table A4).

In column 6, we include an interaction term between the WTO and the PTA variable to test whether there is a complementarity between the WTO and the PTA variable. Subramanian and Wei (2007) suggest for trade volumes that, conditioning on having a common FTA, WTO membership does not further increase trade. The insignificant coefficient for the interaction term in column 6 indicates independence of the WTO and PTA variable, as WTO membership does not change export prices any further for countries that are already in a common PTA.

Note that, different from all other tables in the paper where we add two-way clusters including time-varying clusters, errors in Table 4 are clustered by ijk, as standard in the literature. However, clustering over time turns out to be relevant in the context of our paper. Robust standard errors over time are important as the main result of Cao and Flach (2015) is the negative dependence of price volatility, measured as the standard deviation of prices, on WTO membership. Hence, without correction the error term would likely be heteroskedastic. We report the same results from Table 4 with two-way time-varying clusters in the Appendix Table A4. All further tables in the paper include two-way clusters by ijk and time.

In Table A5 in the Appendix, we conduct the same analysis as in Table 4 but include *tariffs* as a control variable. We lose many observations because of missing tariff data. In this table, all results include the two-way clusters with time-varying clusters. Controlling for PTA and WTO membership, higher tariffs are associated with higher prices. Most importantly, most of the results for WTO and PTA remain stable (in comparison to Table A4), although for PTA the coefficient is less precisely estimated once we control for tariffs.

The results in Table A5 controlling for tariffs may suggest that, although tariffs capture an important part of the effect of trade agreements on prices, other channels may explain the price variation (see, for instance, Baier and Bergstrand (2007) and Ossa (2016) for a discussion on the reaction to trade agreements). The results also suggest that it is important to investigate trade agreements in a finer level of detail, which we do in the next section.

4.1 The Depth of the Agreement and its Provisions

According to the recently released Desta dataset that we use in this paper, one can divide the provisions of an PTA in seven groups with tariffs representing one of them. We take advantage of this level of detail and investigate the importance of the depth of an PTA as well as of the different provisions within an agreement.

The results shown in Table 5 column 1 reveal that the depth of the agreement has no effect on prices. However, the results differ when we conduct the analysis for different groups of countries, i.e., for trade among high-income countries (high inc group) and trade among low-income countries (low inc group), as shown in columns 2 and 3. Whereas for trade among low-income countries the PTA dummy captures the whole effect on prices, for trade among high-income countries the depth of the agreement captures the whole effect. Hence, to better understand the importance of the depth measure, we investigate its different provisions, as shown in columns 4 to 6.

Table 5: *The Depth of an PTA and individual provisions*

Dependent variable: $\ln p_{kij\tau}$	(1) full sample	(2) low inc group	(3) high inc group	(4) full sample	(5) i low j high inc	(6) j low i high inc
PTA	0.0564*	0.0760*	0.0183	0.00608	0.100**	0.0153
	(0.0251)	(0.0335)	(0.0342)	(0.0159)	(0.0233)	(0.0579)
Full tariff red.				0.0112	-0.0508	0.135*
				(0.0303)	(0.0368)	(0.0586)
IPRS				-0.0710*	-0.0236	0.104***
				(0.0314)	(0.0435)	(0.0184)
Procurement				0.0130	-0.0245	-0.121**
				(0.0238)	(0.0196)	(0.0329)
Standards				0.0368	-0.0134	-0.0263
				(0.0263)	(0.0236)	(0.0450)
Services				-0.0472*	-0.0487	-0.0786
				(0.0187)	(0.0431)	(0.0496)
Investments				0.101***	0.126**	-0.0152
				(0.0207)	(0.0276)	(0.0669)
Competition				-0.0454	-0.0103	-0.0187
				(0.0480)	(0.0432)	(0.0317)
PTA * depth	-0.00783					
	(0.00379)					
PTA * depth * DIFF goods		-0.0274	0.00939*			
		(0.0136)	(0.00396)			
PTA * depth * HOM goods		-0.0149	-0.00533			
		(0.0161)	(0.00653)			
$\ln(\text{GDP}_{it} * \text{GDP}_{jt})$	0.0295	0.0331	0.0503*	0.0294	0.127***	-0.0528***
	(0.0149)	(0.0268)	(0.0195)	(0.0147)	(0.0271)	(0.00840)
Observations	33,161,901	11,482,680	10,961,345	34,925,188	8,355,224	8,705,053
Adjusted r-squared	0.793	0.799	0.807	0.795	0.804	0.787
Fixed effects	t & ijk	t & ijk	t & ijk	t & ijk	t & ijk	t & ijk

Notes: Robust S.E. are shown in parentheses. ***, **, * denotes significance at the 1%, 5%, and 10% level, respectively. Robust S.E. are clustered by importer-exporter-product and time groups. DIFF.: differentiated; HOM.: homogeneous.

The most interesting result in column 4 refers to the positive relation between investment provisions and prices. This is particularly true if the exporter is a low-income and the importer is a high-income destination, as shown in column 5. For trade from high-income to low-income countries (column 6), the positive effect on trade prices is rather captured by intellectual property rights (IPRS) and tariff reductions. It is interesting to note that, besides the tariff mechanism, which is consistent with Fan et al. (2015), investments and property rights exert a positive effect on prices. These results can be reconciled with Amiti and Khandelwal (2013), who provide evidence of quality upgrading following trade liberalization and relate their results to distance to the frontier models. According to these models, the increase in competition following trade liberalization increases the incentives to invest and innovate for firms close to the technology frontier.[16] Aghion et al (2009) refer to this as the escape-entry effect, as innovation enables incumbent firms to escape from the threat of competition. It might sound counterintuitive that IPRS in column 4 has a negative effect on prices. However, this effect is true once we control for investments. If we combine investments and IPRS in one provision group, the effect is positive and significant. Note also that in column 5, the level effect of the PTA dummy remains with a positive effect on prices, meaning that for trade from low- to high-income countries, membership in the agreement (despite the provisions) has already a positive effect on prices, whereas the same is not true for trade from high- to low-income countries.

4.2 Exporter and Importer WTO Accessions

In the the baseline results, the WTO variable is coded as an importer-exporter-time specific variable and takes the values zero, one, and two.[17] To better understand what is driving the results, we disentangle the WTO variable in Table 6 and include a WTO dummy for exporter and importer membership into the regression. This analysis reinforces the hypothesis of the quality mechanism for differentiated goods, but also suggests that the incomplete pass-through might explain part of the results.

In line with the quality upgrading explanation suggested by Fan et al. (2015), we find that, for exporter accession, the positive effect on prices is solely captured by differentiated goods. The results remain robust when we control for tariffs and membership in PTAs. However, they are less precisely estimated when we control for both tariffs and PTA. In this case, the positive effect on prices is captured by the PTA dummy.

For importer accession, we find a smaller difference between homogeneous and differenti-

[16] See Aghion and Howitt (2005), Aghion et al (2005) and Aghion et al (2009). Note that, as in Amiti and Khandelwal (2013), our results are at the product level.

[17] The disadvantage of coding the WTO variable in this way is that it can only be interpreted ordinally.

ated goods. The larger effect for differentiated goods (in comparison to homogeneous goods) could be interpreted along the lines of Kugler and Verhoogen (2012), who suggest that, to produce higher quality, the importer has to use more expensive intermediate goods, implying higher prices. To investigate this mechanism in more detail, we conduct an analysis only for intermediate goods in the next section.

Another explanation for the positive effect for both types of goods could be the pass-through: as tariffs in the importing country decrease, exporters have some scope for a price increase, given that the import market is not perfectly competitive. Thus, consumer prices would not decrease by the same amount as the decrease in import tariffs. In other words, the price decline following a decrease in input tariffs might be small as firms might react by raising their markups (see Goldberg et al. (2016)).[18] Moreover, along with the pass-through hypothesis, one explanation for the slightly smaller coefficient for homogeneous products could be that markets for homogeneous products are more competitive and hence firms that export homogeneous products cannot set as high of a markup as they can for differentiated products.

Comparing the results from Tables 6 and 4 it is also clear that the effect of an unit increase of the WTO variable as specified in the baseline results is not exactly linear. One does not obtain the size of the WTO coefficients in Table 4 by simply averaging the respective coefficients from Table 6. However, the coefficients in the baseline results are reasonably close to the average of the coefficients reported in Table 6 (see column 1 in 6 and column 2 in Table 4).

4.3 Intermediate Goods

To better understand the theoretical mechanism proposed by Fan et al. (2015), according to which the quality of the imported inputs increases following trade liberalization, we investigate the effect for intermediate goods. Fan et al. (2015) also provide empirical evidence for Chinese firms that the fall in tariffs following membership in the WTO increases export prices, as it leads to imports of higher quality goods. In line with their results, we show in Table 7 that, for intermediate goods, the positive effect of WTO membership on prices is driven solely by *importer accession*. For PTAs, which are always bilateral agreements, the effect is not significant.[19] As in former results, the results are robust to the inclusion of interacted importer-exporter-product fixed effects as well as time fixed effects.

[18] See also Goldberg and Pavcnik (2016) on the incomplete pass-through following trade agreements.

[19] The fact that the results are not significant for PTAs might again indicate the importance of closer evaluation of the different provisions within a trade agreement.

Table 6: *Exporter and Importer WTO Accession*

Dependent variable: $\ln p_{kij\tau}$	(1)	(2)	(3)	(4)
WTO Exporter * DIFF. Good	0.049*	0.046*	0.045*	0.040
	(0.020)	(0.019)	(0.020)	(0.019)
WTO Exporter * HOM. Good	-0.047	-0.062	-0.053	-0.074
	(0.051)	(0.062)	(0.051)	(0.064)
WTO Importer * DIFF. Good	0.102**	0.104**	0.100**	0.102**
	(0.029)	(0.033)	(0.028)	(0.033)
WTO Importer * HOM. Good	0.087**	0.095*	0.086**	0.092*
	(0.030)	(0.036)	(0.029)	(0.035)
$tariff_{ijkt}$ * DIFF. Good		0.001		0.001
		(0.001)		(0.001)
$tariff_{ijkt}$ * HOM. Good		0.002		0.002
		(0.002)		(0.002)
PTA			0.045	0.080*
			(0.032)	(0.032)
PTA Depth * DIFF. Good			-0.005	-0.016*
			(0.004)	(0.006)
PTA Depth * HOM. Good			-0.008	-0.010
			(0.006)	(0.007)
$\ln(\text{GDP}_{it} * \text{GDP}_{jt})$	0.018	0.015	0.019	0.015
	(0.015)	(0.028)	(0.015)	(0.028)
Observations	33,162	24,410	33,051	24,315
RMSE	0.959	0.946	0.959	0.946
Adjusted R^2	0.716	0.714	0.716	0.714
Fixed effects	t & ijk	t & ijk	t & ijk	t & ijk

Notes: Robust S.E. are shown in parentheses. ***, **, * denotes significance at the 1%, 5%, and 10% level, respectively. Robust S.E. are clustered by importer-exporter-product and time groups. DIFF.: differentiated; HOM.: homogeneous. Number of observations in 1,000.

Table 7: *Results for intermediate goods*

Dependent variable: $\ln p_{kij\tau}$	(1)	(2)	(3)	(4)
WTO Exporter	-0.0473	-0.0509	-0.0552	-0.0618
	(0.0529)	(0.0516)	(0.0594)	(0.0597)
WTO Importer	0.0820**	0.0804**	0.0879*	0.0861*
	(0.0262)	(0.0252)	(0.0326)	(0.0312)
PTA		-0.0169		0.0292
		(0.0324)		(0.0301)
PTA * depth		-0.00441		-0.00984
		(0.00477)		(0.00537)
$tariff_{ijkt}$			0.00336**	0.00335**
			(0.000968)	(0.000970)
$\ln(\text{GDP}_{it} * \text{GDP}_{jt})$	-0.0169	-0.0181	-0.0290	-0.0296
	(0.0270)	(0.0273)	(0.0383)	(0.0386)
Observations	9,950,122	9,918,925	7,248,789	7,221,534
Adjusted r-squared	0.808	0.808	0.815	0.815
Fixed effects	t & ijk	t & ijk	t & ijk	t & ijk

Notes: Robust S.E. are shown in parentheses. ***, **, * denotes significance at the 1%, 5%, and 10% level, respectively. Robust S.E. are clustered by importer-exporter-product and time groups.

5 Robustness Checks

5.1 Tetrads and multilateral resistance terms

In our baseline results, the estimation is conducted using interacted product-importer-exporter fixed effects and period fixed effects.[20] Adding further dimensions of fixed effects for data with this dimensionality has two drawbacks: it is computationally cumbersome and more degrees of freedom are lost. Hence, in this case, one standard way to account for multilateral resistance terms is the use of tetrads (see, for instance, Hallak (2006) and Head et al. (2010) for an analysis using tetrads and Anderson and Van Wincoop (2003) for a discussion on multilateral resistance terms). The advantage of tetrads in the context of our data is that we can additionally account for time-varying importer-period and exporter-period fixed effects.

We follow Head et al. (2010) and use the USA as the reference importer and Germany as the reference exporter country.[21] Hence, the new variables can be shown as follows:

$$X_{\text{newVariable}} = \frac{X_{i,j}/X_{i,US}}{X_{GER,j}/X_{GER,US}} \tag{4}$$

The complete procedure for the estimation of tetrads is explained in the Appendix. Transforming the LHS and RHS of our baseline equation we can show that all time-exporter and time-importer specific variation cancels out and we estimate the following equation:

$$\ln(\overline{\text{price}_{kij\tau}}) = \beta_0 + \beta_1 \overline{ijWTO_{ij\tau}} + \overline{\omega_{kij}} + \overline{\epsilon_{kij\tau}} \tag{5}$$

where variables with a bar represent transformed variables according to equation (4). For example, the decomposition of the error term into its four elements gives $\overline{\epsilon_{kij\tau}} = \epsilon_{kij\tau} - \epsilon_{ki,US\tau} - \epsilon_{k,GER,j\tau} + \epsilon_{k,GER,US\tau}$. We estimate equation (5) with time fixed effects to capture the last element of the transformed error term and with importer-exporter-time fixed effects to absorb unobserved heterogeneity in the importer-exporter-product dimension, $\overline{\omega_{kij}}$. Additional to the time and importer-exporter-product dimension, we cluster over importer-time and exporter-time groups as Head et al. (2010) show that error terms are no longer independently distributed if one uses the tetrad method because parts of the (now) composite error reoccur.

We also use China as a reference exporter to check the validity of the tetrad method. Before we present the results we address two concerns. First, the new WTO dummy at-

[20] This is made computationally possible thanks to the stata command written by Correia (2014).

[21] The reason for the choice of the reference importer and exporter is the size and diversity of the US and the German economies, which allow us to observe and reference as many traded products as possible.

tempts to capture the effect of both countries being members of the WTO compared to a base category where either one country or no country is a member of the WTO. Hence, the results for the estimations of equation (5) are not directly comparable to the baseline results where the WTO variable is not a dummy, but distinguishes between zero, one, and two members. Second, we have chosen China as an alternative reference exporter for the same reason we have chosen Germany: we can reference as many traded products as possible. However, China's WTO status changes for some observations in the observed time period. Hence, the transformed export price could not only change because non-reference countries join the WTO, but also because China's WTO accession could influence the Chinese reference price. This implies that the results are not directly comparable to the results using Germany as baseline. To compare the results, we have to assume that the price of Chinese export products to any other country, $price_{CHN,j\tau}$, changes at the same rate as the price of Chinese export products to the USA, $price_{CHN,US\tau}$, and therefore the endogeneity problem due to Chinese WTO accession is removed in the ratio.

Table 8 presents the results for the tetrad method: similar to Head et al. (2010), we find that the choice of the reference exporter changes the results. Although the results in the first column of Table 8 and the results in Table 4 are not directly comparable because of the different specification, the coefficients on the WTO measure are generally larger in the tetrad specification. Assuming that this increase is not entirely attributable to the different WTO variable in the baseline specification, this would mean that the tetrad method is able to capture unobserved heterogeneity in the importer-time and/or exporter-time dimension. This unobserved heterogeneity would be negatively correlated with the WTO variable in the baseline regression.

The results shown in columns 2 to 5 confirm our earlier results. As in the baseline results, the tetrads reveal that WTO accession is associated with a higher increase in the export price of differentiated products compared to homogeneous products. Moreover, the WTO coefficients stay unaffected if we additionally control for membership in a PTA, which is another sign that the WTO and the PTA variable are conditionally independent. The results using China as the second reference exporter do not change our interpretation.

Table 8: *Tetrad Results - Robustness Checks I*

	GER-US			CHN-US		
	(1)	(2)	(3)	(4)	(5)	(6)
i and j WTO	0.343**	0.185***	0.186***	0.226***	-0.058*	-0.057*
	(0.087)	(0.033)	(0.033)	(0.020)	(0.023)	(0.024)
i and j WTO * diff		0.194*	0.193*		0.337***	0.333***
		(0.073)	(0.073)		(0.040)	(0.039)
PTA			0.021			0.087**
			(0.013)			(0.026)
Observations	26,589	26,589	26,589	25,679	25,679	25,679
RMSE	1.260	1.260	1.260	1.355	1.355	1.355
Adjusted R^2	0.269	0.269	0.269	0.281	0.281	0.282

Notes: Robust S.E. are shown in parentheses. ***, **, * denotes significance at the 1%, 5%, and 10% level, respectively. Robust S.E. are clustered by importer-exporter-product, time, importer-time, and exporter-time groups. Number of observations in 1,000. FEs: time, exporter-importer-product; Absorbed heterogeneity in the time-exporter and time-importer dimension via tetrad method; diff: dummy equals one if the product is differentiated.

5.2 Official versus unofficial members, comparative advantage, and terms-of-trade

We investigate the robustness of the results when adding further control variables. First, we use an alternative classification of WTO membership following Goldstein et al. (2007). Second, we discuss how comparative advantage may affect our results.

Goldstein et al. (2007) distinguish various ways by which territories joined the GATT/WTO. We take advantage of the richness of WTO accession categories by changing the WTO membership definition. Goldstein et al. (2007) point out that colonies and provisional members are officially not WTO members, but have largely the same rights as official members. They also consider these non-members in their analysis and find, contrary to Rose (2004a), a trade promoting effect of WTO membership using the same approach as Rose (2004a).

Following their idea, we treat colonies as WTO members. In the data, no country is a provisional member. We do not include de facto members because the WTO, contrary to the GATT, no longer accepts this status.[22] On the other hand, territories and countries that joined the GATT by evoking Article XXVI:5(c) were not obliged to conduct far-reaching, structural reforms and are thus arguably less open than other WTO members. Instead of an interaction term as in Cao and Flach (2015), we conduct a thought experiment and code these countries as non-members.

As expected, the results in columns 2 and 5 in Table 9 show that the WTO coefficients increase for both kinds of products if we apply the different WTO definition (for comparison, we report the coefficients with the standard definition in columns 1 and 4). Also in this specification, the effect is only significant and higher in magnitudes for differentiated goods.

[22]See data section in the Appendix A1 for further information.

The size and significance levels of the output-side real GDP coefficients and tariffs do not change and are not reported throughout the table.

Columns 3 and 6 introduce a proxy for comparative advantage of the exporter and importer, as in Cao and Flach (2015). The measure is taken from Mayda and Rodrik (2005) and is constructed as follows:

$$CA_{ikt} = \begin{cases} 1, & \text{if } M_{ikt}(1-\lambda) - X_{ikt} < 0, \\ 0, & \text{if } M_{ikt}(1-\lambda) - X_{ikt} > 0 \end{cases} \tag{6}$$

where M_{ikt} are imports of country i in sector k at time t, X_{ikt} are exports of country i in sector k at time t and λ is an adjustment defined as follows:

$$\lambda = \frac{\sum_{it}(M_{it} - X_{it})}{\sum_{it} M_{it}} \tag{7}$$

This proxy assumes that a country has a comparative advantage if its exports at time t in sector k exceed its imports in this sector at the same time corrected by one minus the adjustment factor. We use the first two digits of the SITC3 industry classification to define a sector.

The results in columns 3 and 6 reveal that the dummy that indicates a comparative advantage is not significantly correlated with the export price for the exporter, whereas for the importer the effect is negative and significant. However, it is interesting to note that this negative partial correlation is dampened if the importer joins the WTO. It could be argued that it is more difficult for a firm in the exporting country to sell its products to a sector where the importing country has a comparative advantage. To enter sectors in which the importing country has a comparative advantage firms in the exporting country have to lower their prices in order to be competitive enough. If the importer joins the WTO, entering these sectors becomes easier and firms do not have to decrease their prices as much. The counteracting effect is economically irrelevant for the depth of PTAs. Importantly, the magnitude and significance of the WTO coefficients for homogeneous and differentiated products do not change.

Finally, the results for comparative advantage could also be interpreted along the lenses of the terms-of-trade theory of trade agreements, according to which a trade agreement can address inefficiencies related to policies of governments that exercise market power (Bagwell and Staiger, 2016).

Table 9: *Robustness Checks II*

	Sample without tariff			Sample with tariff		
	(1)	(2)	(3)	(4)	(5)	(6)
WTO * DIFF. Good	0.077**		0.074**	0.074**		0.075**
	(0.022)		(0.024)	(0.025)		(0.026)
WTO * HOM. Good	0.028		0.025	0.021		0.021
	(0.030)		(0.029)	(0.036)		(0.034)
PTA	0.041	0.041	0.036	0.072*	0.072*	0.075*
	(0.031)	(0.031)	(0.031)	(0.029)	(0.029)	(0.029)
PTA Depth * DIFF. Good	-0.004	-0.004	-0.004	-0.014*	-0.014*	-0.015*
	(0.004)	(0.004)	(0.004)	(0.006)	(0.006)	(0.006)
PTA Depth * HOM. Good	-0.007	-0.007	-0.007	-0.009	-0.009	-0.009
	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)	(0.007)
Diff. WTO Def. * DIFF. Good		0.093**			0.090**	
		(0.021)			(0.023)	
Diff. WTO Def. * HOM. Good		0.038			0.027	
		(0.030)			(0.038)	
Exporter has CA			-0.007			-0.001
			(0.012)			(0.025)
Importer has CA			-0.029**			-0.045**
			(0.009)			(0.010)
WTO * Exporter CA			-0.003			-0.011
			(0.006)			(0.011)
WTO * Importer CA			0.014**			0.014**
			(0.004)			(0.004)
PTA Depth * Exporter CA			-0.000*			-0.000
			(0.000)			(0.000)
PTA Depth * Importer CA			-0.000			0.000*
			(0.000)			(0.000)
Observations	33,051	33,051	33,048	24,315	24,315	24,314
RMSE	0.959	0.959	0.959	0.946	0.946	0.946
Adjusted R^2	0.716	0.716	0.716	0.714	0.714	0.714
FE	t & ijk	t & ijk	t & ijk	t & ijk	t & ijk	t & ijk

Notes: Robust S.E. are shown in parentheses. ***, **, * denotes significance at the 1%, 5%, and 10% level, respectively. Robust S.E. are clustered by importer-exporter-product and time groups. DIFF.: differentiated; HOM.: homogeneous. Number of observations in 1,000. CA: Comparative advantage.

5.3 Endogeneity of trade agreements

One could cast doubt on the exogeneity of trade agreements. We document several patterns in the data that help minimize endogeneity concerns.

Article XXVI5(c) and the heterogeneity among new WTO members: Until the end of 1994, some countries (listed in Table A2) entered GATT under Article XXVI5(c) without strict commitments to policy reforms. In particular, former colonies could invoke Article XXVI5(c) upon becoming independent.[23] While other countries conducted extensive reforms and passed through long negotiations processes, countries under Article XXVI5(c) turned members by sending a request to GATT (a more detailed description of Article XXVI5(c) is provided by Tang and Wei (2009)).

In Table 10 columns 1 and 2 we exploit the heterogeneity between the two groups of new WTO members. We show that the effect of membership on prices comes entirely from the developing countries that committed to trade policy, which involved binding commitments and long negotiation efforts. This result is shown by the interaction between WTO with a dummy $ArtXXVI = 1$ if a country (i or j) was subject to Article XXVI5(c). For country i, we even find a negative effect for the interaction term on prices.

Note that, because the BACI data is not available for the years prior to 1995, for this exercise we use Comtrade data documented by Feenstra et al. (2005) at the SITC2 (Standard International Trade Classification) 4-digit classification, indexed by s.

One important concern regarding the validity of these results is comparability between the two schemes. The inclusion of ij fixed effects in the estimation is helpful but does not rule out biases coming from systematic differences between Article XXVI5(c) and non-Article XXVI5(c) countries. Moreover, since many of the countries under Article XXVI5(c) are small island economies, we do observe systematic differences in country characteristics in *levels*, when we compare them to non-Article XXVI5(c) countries. However, one crucial argument in our favor is the fact that the pre-accession behavior of prices between the two groups is very similar, whereas the average post-accession of non-Article XXVI 5(c) countries is significantly different.

Comparability of residuals between new members and a control group: A further concern with our analysis could be that prior to membership in a trade agreement there

[23] As discussed by Tang and Wei (2009), Cambodia and Algeria, former French colonies, were the only two countries eligible for Article XXVI5(c) that did not make use this article. Both of them made important efforts to accede to GATT/WTO on their own, instead of asking France to sponsor their accession. The latter was a requirement for invoking membership in the terms of Article XXVI5(c).

are intrinsic differences in the paths of prices of new members in comparison to other countries. If countries are already conducting major policy changes, new members and further countries are no longer comparable. To assess this concern, we check the residuals of the regressions on prices for new members (4 years before WTO or PTA membership) and a control group (referring to non-members and old members). We compute the residuals for the treatment and control group separately for importers and exporters. For WTO, we find that the means of residuals for treatment and control groups are both near zero[24] and the standard deviation is lower than 0.15. Similar values are found for PTAs, although in this case the standard deviation is slightly higher. Hence, prior to accession, the price behavior appears to be similar to the behavior of our control group.

The long time gap between application and accession: Another concern is whether accession in a trade agreement is in fact exogeneous. For instance, countries that apply for a trade agreement are already conducting policies towards more economic stability, world market integration, etc. In this case, membership could capture an effect that would have happened anyway. We assess this concern by exploiting available data on the time gap between application and accession to WTO, using the long and variable time lags between application and accession. The dummy variable stands for $Application = 1$ for the periods between application and accession. Perhaps surprisingly, the coefficients for application are not significant, as shown in columns 3 and 4 in Table 10. However, if we divide countries according to the time of negotiation, we also see that this effect is mostly driven by countries that had longer periods of negotiations (longer than 5 years), whereas for the other countries the effect of *Application* on prices is significant at 10% for country j.[25] Crucially, the WTO variables remain stable and significant.

[24]The means for importers are 0.15 and 0.09 for treatment and control group, respectively. The means for exporters are 0.12 and 0.08 for treatment and control group, respectively.

[25]These results can be reconciled with Tang and Wei (2009), who use application dates to investigate the effect of membership on growth rates. They show that application to WTO increased temporarily growth rates, but actual accession had a stronger effect on growth.

Table 10: *Application versus accession and membership under Article XXVI5(c)*

Dependent variable: $\ln p_{kijt}$ (from Comtrade)	(1)	(2)	(3)	(4)
WTO_{it}	0.0761***		0.0399*	
	(0.0229)		(0.0206)	
WTO_{jt}	0.00867		0.0334***	
	(0.0174)		(0.0103)	
WTO_{it}*ArticleXXVI$_i$	-0.0981**			
	(0.0449)			
WTO_{jt}*ArticleXXVI$_j$	0.0210			
	(0.0292)			
WTO_{ijt}		0.0267*		0.0249**
		(0.0142)		(0.0125)
WTO_{ijt}*ArticleXXVI$_{ijt}$		-0.00850		
		(0.0242)		
Application$_{it}$			-0.0571***	
			(0.0122)	
Application$_{jt}$			0.0215	
			(0.0156)	
Application$_{ijt}$				0.000131
				(0.00755)
ln(GDP$_{it}$ * GDP$_{jt}$)	0.101***	0.101***	0.0987***	0.101***
	(0.0115)	(0.0115)	(0.0115)	(0.0115)
Observations	2,234,837	2,234,837	2,234,837	2,234,837
R-squared	0.956	0.956	0.956	0.956
Fixed effects	t & ijs	t & ijs	t & ijs	t & ijs

Notes: Robust S.E. are shown in parentheses. ***, **, * denotes significance at the 1%, 5%, and 10% level, respectively. Robust S.E. are clustered by importer-exporter-product and time groups. The sample used in this table refers to Comtrade data at the SITC2 4-digit classification. 4-digit sectors are indexed by s.

6 Conclusion

Despite the large interest and discussion concerning the trade promoting effects of membership in multilateral trade agreements, little is known about the effect of membership on world trade prices. Multilateral trade agreements lower trade barriers on imported goods, which might affect export prices not only through a cost effect but also through access to better quality products and the innovation behavior of firms. Hence, the net effect of trade agreements on export prices is a priori unclear.

Using the most comprehensive data available on *fob* export prices for world trade flows at the 6-digit product level, we show that membership in trade agreements is associated with an increase in export prices of differentiated goods, which are likely goods closer to the technology frontier. Besides the analysis of trade agreements as a binary choice, we exploit the importance of the depth of an PTA and of its different provisions. Although the depth measure is not significant in the full sample, we show that individual provisions such as investments are associated with higher trade prices.

The positive relation we find between prices of differentiated goods and economic integration is consistent with a recent literature showing that lower trade barriers promote innovation and access to better inputs, which leads to quality upgrading and higher prices.

Although our paper does not draw direct policy implications, it suggests that, if we disregard the impact of trade agreements on innovation and quality upgrading, we might understate their price and welfare effects. Moreover, as discussed by Amiti and Khandelwal (2013), the production of high-quality goods is often viewed as a pre-condition for economic development. Hence, it is important to understand whether trade agreements foster competition and influence the transition towards production of higher-quality products.

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A Appendix

A.1 Data Construction and Summary Statistics

BACI: In a first step Gaulier and Zignano (2010) make imports reported at *cif* values comparable to exports reported at *fob* values. They estimate transport costs using a gravity framework and remove the transport costs from the importer's reports. Applying this procedure they can recover missing exporter reports by using the same tradeflow reported by the importer instead. However, inconsistent mirror tradeflows are declared, even though exporters and importers should report the same value for the same tradeflow. Therefore, besides estimating transportation costs, Gaulier and Zignano (2010) assess the accuracy of each country's report and use these assessments to arrive at an averaged tradeflow value. Finally, if feasible, they convert all units into tons.

Prices: Trade values are divided by quantities from the BACI to get unit values as a proxy for trade prices.

GATT/WTO: Data on WTO membership until 2001 come from Tomz (2007). A notable feature of the data is the distinction between formal members and participants that are not members. Apart from the GATT founding members (18 countries), formal members either became GATT members by undergoing the accession procedure according to Article XXXIII (45 countries), joined the GATT according to Article XXVI:5(c) (64 countries) or joined the WTO (32 countries), the successor of the GATT.[26] Newly independent territories could negotiate accession according to Article XXXIII. In contrast, Article XXVI:5(c) allowed territories that gained independence to become GATT members under conditions negotiated by their former colonizers and thus without the need to implement reforms (Cao and Flach (2015)). Goldstein et al. (2007) also distinguish three types of non-member participants: colonies, de facto members, and provisional members. Countries in this group are not formal members of the GATT, but are entitled to the majority of rights that official GATT members have. De facto members are recently independent territories whose relation to the GATT has not been clarified after they gained independence and thus continue to be treated under GATT terms. Provisional non-members are defined as those countries that were granted GATT conditions while negotiations were still ongoing. However, no country has such a status in the period under observation in the data. Goldstein et al. (2007) point out that de facto members were admitted for an unlimited time until the creation of the WTO. Note that, because we do not know if all de facto countries lost this status right away

[26] These numbers are based on the data. The inconsistency with information from the WTO website for founding members - they count 23 founding members - stems from the fact that we do not consider countries that dissolved and/or exited the GATT.

with the creation of the WTO, we keep the de facto status. De facto members are coded as non-members. Hence, in the data a country only loses its de facto status if it formally joins the WTO. Crucially, none of the results are affected by this procedure.
For the years following 2001, we take data from the official WTO website. For colonies, de facto participants, and countries that joined the WTO after 1995, we introduce a variable counting the number of countries within a country pair (maximum two, minimum zero) that became a member, or were a member, over the course of the observed time.[27] For original member countries, accessions under Article XXVI:5(c), and accessions under Article XXXIII, the WTO measure reflects their status before the time period of interest.[28]

The Democratic Republic of Congo joined the WTO in 1997. We coded it as a direct WTO accession whereas Tomz (2007) coded it as an accession under Article XXXIII. Hence, the country is recorded as entering the WTO in two different ways in the data. This is the reason the accessions mentioned in the text add up to 159 in time period 5 and the accessions in Table (1) to 158 in time period 5. Moreover, adding up the GATT variables in Table 1 plus the new WTO accessions (see Table 2) should equal the number of WTO members in each time period. Due to the coding status the number of WTO members is lower by one in each time period. However, this does not change the regression results in any way.
PTAs: The Desta database includes a main data file that lists the country pairs in a PTA and the year the PTA was finalized, a file with accession countries and the year they joined a certain PTA, and a file with add-on agreements, i.e. when PTAs were renegotiated. First, we completed the main data file by adding the accession countries and the country pairs composed by accession countries only, e.g. if Finland, Austria and Sweden joined we added Finland-Sweden, Finland-Austria, Austria-Sweden. We added these combinations for large treaties where several countries joined. Second, we generate a time variable and expand the dataset such that it varies over time and country pairs. Finally, we correct manually for sample attrition and add-on agreements and merge this data with a datafile containing the depth measure and one containing the seven different provisions. The depth measure and the average number of member countries was constructed as follows: if the same country pair was a member in multiple agreements, we include the agreement with the greatest depth value and calculate the average number of member states in all shared PTAs.
Tariffs: The data come from WITS (Bank (2016)). However, it contains several duplicate values with respect to the exporter, importer, time and product category as this data also

[27]In doing so, we follow Martin et al. (2008) who code their GATT variable by counting the members within a country pair.

[28]De facto members, provisional members, members that joined the GATT under Article XXXIII, and original members do not change their status in the observed time, and, hence, do not influence our analysis; colonies and Article XXVI:5(c) accessions are only considered in the Robustness Checks section.

varied over different tradesources. To make the observations comparable, we keep the observations with Comtrade as a source, in case not much information is lost. We use effectively applied tariffs and filled in missing tariff values. For instance, if Germany has tariff data for a certain product in the years 1996 and 1997 and then again in 2000, we use the 1997 tariff value for the years 1998 and 1999 (note that, for our estimations, we take four years average of the data). Another complication is that countries within the EU use the common EU tariff. We made the simplifying assumption that every EU member shares the same tariff rate on the same products at the same time as the EU. For some EU accessions after 2004 there were still country specific tariffs even two years after the accession date. In these (very few) cases, we keep the country specific tariffs to avoid duplicate values.

Table A1: *Summary Statistics I*

Variables	Labels	mean	sd	min	max	count
price	Ln of export (f.o.b.) price	2.48	1.86	-10.96	19.95	4.48e+07
Main Explanatory WTO						
wto	No. of countries with WTO membership	1.77	0.46	0.00	2.00	4.48e+07
wto_i	Exporter WTO member	0.93	0.25	0.00	1.00	4.48e+07
wto_j	Importer WTO member	0.84	0.36	0.00	1.00	4.48e+07
art26_5	No. of countries that have ever applied Art.25.5	0.31	0.53	0.00	2.00	4.48e+07
col	No. of countries that hold a colony status	0.02	0.14	0.00	2.00	4.48e+07
df	No. of countries with de facto member status	0.00	0.06	0.00	2.00	3.60e+07
Main Explanatory PTA						
fta	Country pair has a common PTA	0.23	0.42	0.00	1.00	4.48e+07
depth1	1st depth measure of PTA	3.17	1.81	0.00	7.00	1.03e+07
depth2	2nd depth measure of PTA	0.30	0.89	-1.73	1.89	9.62e+06
lnumber_member	Ln of average no. of overall members in agreements between i and j	2.69	0.80	0.69	4.62	1.04e+07
No_of_PTAs	No. of PTAs between country pair	2.52	1.83	1.00	11.00	1.04e+07
all_pta_full	PTA Provision: Full Tariff Reduction	0.82	0.38	0.00	1.00	1.03e+07
all_iprs	PTA Provision: Intellectual Property Righs	0.11	0.31	0.00	1.00	1.03e+07
all_procurement	PTA Provision: Procurement	0.20	0.40	0.00	1.00	1.03e+07
all_standards	PTA Provision: Standards	0.70	0.46	0.00	1.00	1.03e+07
all_services	PTA Provision: Services	0.55	0.50	0.00	1.00	1.03e+07
all_investments	PTA Provision: Investments	0.42	0.49	0.00	1.00	1.03e+07
all_competition	PTA Provision: Competition	0.54	0.50	0.00	1.00	1.03e+07
Other Explanatory Variables						
ln_gdp_interaction	Ln of interaction of output-side real GDP at current PPPs (in mil. 2005 US Dollar) of i and j	25.28	2.40	11.81	32.65	3.98e+07
weightedAHS	Mean of effectively applied tariff averaged over 4 years	7.49	9.53	0.00	1,502.50	3.21e+07
weightedMFN	Mean of most favorite nation (MFN) tariff averaged over 4 years	8.71	9.56	0.00	1,502.50	3.18e+07
diff	Differentiated goods, conservative estimation according to Rauch 1999	0.80	0.40	0.00	1.00	4.24e+07

Notes: Variable names as used in the STATA dofiles.

Table A2: Article XXVI5(c) members (accession between 1984 and 1999)

Country	**Accession year**	**Country**	**Accession year**
Angola	1994	Liechtenstein	1994
Antigua and Barbuda	1987	Macao, China	1991
Bahrain	1993	Mali	1993
Botswana	1987	Mozambique	1992
Brunei Darussalam	1993	Namibia	1992
Djibouti	1994	Papua New Guinea	1994
Dominica	1993	Qatar	1994
Fiji	1993	Saint Kitts and Nevis	1994
Grenada	1994	Saint Lucia	1993
Guinea	1994	Saint Vincent & the Grenadines	1993
Guinea Bissau	1994	Solomon Islands	1994
Hong Kong, China	1986	Swaziland	1993
Lesotho	1988	United Arab Emirates	1994

Source: WTO list of contracting parties,
`http://www.wto.org/english/res\_e/booksp\_e/gatt\_ai\_e/appendix\_e.pdf`.

A.2 Estimation Methodology using Tetrads

The baseline results revealed that a WTO accession has distinct effects depending on the differentiation of the products and that the WTO and PTA variables are conditionally independent. We can corroborate both findings using the tetrad method. Anderson and Van Wincoop (2003) introduced the concept of multilateral resistance in the gravity estimation context and pointed out that not controlling for the importer and/or exporter specific unobserved multilateral resistance terms will lead to biased estimates. Many researchers (e.g. Hallak (2006); Head et al. (2010)) have used tetrads or some kind of ratio estimation to remove these multilateral resistance terms.

In our framework, the tetrad method proves helpful to control for unobserved heterogeneity in the exporter-time and importer-time dimension. Following Head et al. (2010), to conduct an estimation with tetrads, one essentially uses a reference importer and exporter, transforms all variables, and estimates the equation of interest with the transformed variables. We use the tetrad method as presented in Head et al. (2010) and choose the USA as the reference importer and Germany as the reference exporter.

$$X_{\text{newVariable}} = \frac{X_{i,j}/X_{i,US}}{X_{GER,j}/X_{GER,US}} \tag{8}$$

The reason for the choice of the reference importer and exporter is the size and diversity of the US and the German eonomies, which allow us to observe and reference as many traded products as possible.

Reversing the logarithmic transformation the basic estimation equation with exporter-time and importer-time unobserved heterogeneity reads as follows:

$$price_{kij\tau} = gdp_{i\tau} gdp_{j\tau} \exp(WTO_{i\tau} + WTO_{j\tau}) \exp(\phi_{i\tau}) \exp(\delta_{j\tau}) \tag{9}$$

where $\phi_{i\tau}$ represents exporter-time and $\delta_{j\tau}$ importer-time unobserved heterogeneity. Next, we show that a transformation as in equation (8) removes the unobserved heterogeneity:

$$\begin{aligned}\frac{price_{ij\tau} price_{iUS\tau}}{price_{GERj\tau} price_{GER,US\tau}} &= \frac{gdp_{i\tau} gdp_{j\tau} gdp_{i\tau} gdp_{US\tau}}{gdp_{GER\tau} gdp_{j\tau} gdp_{GER\tau} gdp_{US\tau}} \\ \frac{\exp(WTO_{i\tau} + WTO_{j\tau})\exp(WTO_{i\tau} + WTO_{US\tau})}{\exp(WTO_{GER\tau} + WTO_{j\tau})\exp(WTO_{GER\tau} + WTO_{US\tau})} &\frac{\exp(\phi_i\tau)\exp(\phi_i\tau)}{\exp(\phi_{GER\tau})\exp(\phi_{GER\tau})} \frac{\exp(\delta_j\tau)\exp(\delta_{US\tau})}{\exp(\delta_j\tau)\exp(\delta_{US\tau})}\end{aligned} \tag{10}$$

where the last two elements cancel out.[29] Taking the natural logarithm in equation (10) we arrive at an estimable specification free of importer-time and exporter-time unobserved heterogeneity. Yet, we are left with one problem: We created the WTO variable and the output-side real GDP variable so they are importer-exporter-time specific. However, they are not "intrinsically" varying over the exporter-importer dimension, but are just a linear combination of importer-time and exporter-time varying variables. Hence, the transformed output-side real GDP interaction and, more importantly for our purpose, the transformed WTO variable drop out:

$$\frac{\frac{(e^0_{ij}, \quad e^1_{ij}, \quad e^2_{ij})}{(e^1_{i,US}, e^2_{i,US})}}{\frac{(e^1_{GER,j}, e^2_{GER,j})}{e^2_{GER,US}}} \tag{11}$$

Equation (11) lists all possible outcomes of the WTO variable for each of the four tradeflows. Since both the USA and Germany are members of the WTO for all time periods the variable takes the value two for products exported from Germany to the USA.

Table A3 displays all possible outcome values of the transformed WTO variable in equation (10).

Table A3: *Possible Outcomes of Transformed WTO Variable*

	$i = 1$	$i = 0$
$j = 1$	$\frac{\frac{e^2_{ij}}{e^2_{i,US}}}{\frac{e^2{}_{\text{GER,j}}}{e^2{}_{\text{GER,US}}}}$	$\frac{\frac{e^1_{ij}}{e^1_{i,US}}}{\frac{e^2{}_{\text{GER,j}}}{e^2{}_{\text{GER,US}}}}$
$j = 0$	$\frac{\frac{e^1_{ij}}{e^2_{i,US}}}{\frac{e^1{}_{\text{GER,j}}}{e^2{}_{\text{GER,US}}}}$	$\frac{\frac{e^0_{ij}}{e^1_{i,US}}}{\frac{e^1{}_{\text{GER,j}}}{e^2{}_{\text{GER,US}}}}$

Notes: i represents the exporter and j the importer.

However, it is clear that, for every possible exporter-importer combination, the transformed WTO variable takes the value one or after taking the natural logarithm zero. Hence, no variation is left and the WTO variable would be omitted. We solve that by creating the dummy variable $\overline{ijWTO_{ij\tau}}$ that is "intrinsically" exporter-importer-time specific and takes one if both countries are members of the WTO and zero otherwise, similar to the GATT variable in Head et al. (2010). We rewrite the population model in equation (9) with the new WTO variable, an error term, and explicitly modelling unobserved

[29] We abstain from including the product subscript since it does not increase understanding.

importer-exporter-product heterogeneity.

$$price_{kij\tau} = gdp_{i\tau} gdp_{j\tau} \exp(WTO_{ij\tau}) \exp(\phi_{i\tau}) \exp(\delta_{j\tau}) \exp(\omega_{ijk}) \exp(\epsilon_{ijk\tau}) \tag{12}$$

Transforming the LHS and RHS the output-side real GDP interaction and all time-exporter and time-importer specific variation cancels out and we are left with the following estimation equation:

$$\ln(\overline{\text{price}_{kij\tau}}) = \beta_0 + \beta_1 \overline{WTO_{ij\tau}} + \overline{\omega_{kij}} + \overline{\epsilon_{kij\tau}} \tag{13}$$

where variables with a bar represent transformed variables according to equation (8). Decomposing for example the error term into its four elements gives $\overline{\epsilon_{kij\tau}} = \epsilon_{kij\tau} - \epsilon_{ki,US\tau} - \epsilon_{k,GER,j\tau} + \epsilon_{k,GER,US\tau}$. We estimate equation (13) with time fixed effects to capture the last element of the transformed error term and with importer-exporter-time fixed effects to absorb unobserved heterogeneity in the importer-exporter-product dimension, $\overline{\omega_{kij}}$. Errors are clustered over importer-time and exporter-time groups, as Head et al. (2010) shows that error terms are no longer independently distributed if one uses the tetrad method because parts of the (now) composite error reoccur.

A.3 Further Robustness Checks

Table A4: *Robustness checks for Table 4, results including all clusters*

	(1)	(2)	(3)	(4)	(5)	(6)
WTO * DIFF good		0.0792**				
		(0.0226)				
WTO * HOM good		0.0312				
		(0.0303)				
WTO	0.0697**				0.0692**	0.0716*
	(0.0236)				(0.0239)	(0.0258)
PTA			0.0255		0.0228	0.0643
			(0.0157)		(0.0154)	(0.0306)
PTA * DIFF good				0.0316		
				(0.0192)		
PTA * HOM good				0.00239		
				(0.0177)		
WTO * PTA						-0.0212
						(0.0215)
$\ln(\text{GDP}_{it} * \text{GDP}_{jt})$	0.0174	0.0175	0.0298	0.0298	0.0182	0.0182
	(0.0144)	(0.0144)	(0.0148)	(0.0148)	(0.0143)	(0.0143)
Observations	33,161,901	33,161,901	33,161,901	33,161,901	33,161,901	33,161,901
Adjusted r-squared	0.793	0.793	0.793	0.793	0.793	0.793
Fixed effects	t & ijk	t & ijk	t & ijk	t & ijk	t & ijk	t & ijk

Notes: Robust S.E. are shown in parentheses. ***, **, * denotes significance at the 1%, 5%, and 10% level, respectively. Robust S.E. are clustered by importer-exporter-product and time groups. DIFF.: differentiated; HOM.: homogeneous.

Table A5: *Baseline Results for WTO and PTA including tariff data*

Dependent variable: $\ln p_{kij\tau}$	(1)	(2)	(3)	(4)	(5)	(6)
WTO	0.0681***				0.0677***	0.0699***
	(0.00812)				(0.00813)	(0.00873)
WTO * DIFF good		0.0782**				
		(0.0248)				
WTO * HOM good		0.0240				
		(0.0365)				
PTA			0.0190		0.0157	0.0565*
			(0.0124)		(0.0124)	(0.0318)
PTA * DIFF good				0.0188		
				(0.0124)		
PTA * HOM good				0.0195		
				(0.0158)		
PTA * WTO						-0.0208
						(0.0156)
$tariff_{ijk\tau}$	0.00111***	0.00113	0.00108***	0.00108***	0.00112***	0.00111***
	(0.000261)	(0.00102)	(0.000262)	(0.000262)	(0.000260)	(0.000260)
$\ln(\text{GDP}_{it} * \text{GDP}_{jt})$	0.0144**	0.0145	0.0268***	0.0268***	0.0147**	0.0148**
	(0.00674)	(0.0273)	(0.00671)	(0.00671)	(0.00675)	(0.00675)
Observations	24,410,363	24,410,363	24,410,363	24,410,363	24,410,363	24,410,363
RMSE	0.9460	0.9460	0.9461	0.9461	0.9461	0.9459
Adjusted r-squared	0.797	0.797	0.797	0.797	0.797	0.797
Fixed effects	t & ijk	t & ijk	t & ijk	t & ijk	t & ijk	t & ijk

Notes: Robust S.E. are shown in parentheses. ***, **, * denotes significance at the 1%, 5%, and 10% level, respectively. Robust S.E. are clustered by importer-exporter-product and time groups. DIFF.: differentiated; HOM.: homogeneous.