The Effect of Phase-In Tariffs on Import Growth

Xiuming Dong

Ross Jestrab

ECONOMICS WORKING PAPER SERIES
Working Paper 2022–03–B

U.S. INTERNATIONAL TRADE COMMISSION
500 E Street SW
Washington, DC 20436

March 2022

We are grateful for the comments and suggestions from Kristy Buzard, Peter Herman, James Lake, Mengxiao Liu, Mary E. Lovely, Devashish Mitra, David Riker, Abdulaziz Shifa, and participants at the USITC Seminar Series. We also thank Leonardo Baccini for providing the PTA tariff data. All errors are our own.

The Effect of Phase-In Tariffs on Import Growth
Xiuming Dong and Ross Jestrab
Economics Working Paper 2022–03–B
March 2022

Abstract

This paper estimates the causal effect of phase-in tariffs on import growth for the 12 preferential trade agreements (PTAs) signed by the United States since the North American Free Trade Agreement (NAFTA). The phase-in hypothesis from Baier and Bergstrand (2007) implies that products with gradual tariff decreases should experience gradual import growth. Using recently available PTA tariff data, we extend the work of Besedes et al. (2020) and utilize a triple-difference empirical strategy to provide additional evidence that import growth is not consistent with the phase-in hypothesis. We show that phase-in tariffs do not necessarily yield additional import growth relative to already duty-free products. The analysis documents the average effect of phase-in tariffs and country-specific estimates, highlighting the rich heterogeneity in the response of imports. We also consider both the intensive and extensive margins of import changes by explicitly accounting for zero trade flows.

Xiuming Dong
University of Auckland
audrey.dong@auckland.ac.nz

Ross Jestrab
Research Division, Office of Economics
U.S. International Trade Commission
ross.jestrab@usitc.gov

1 Introduction

The dramatic rise of preferential trade agreements (PTAs) has cemented their importance in the international trading system. Between 1990-2020, the number of active PTAs has increased more than six-fold from 45 to 307 (WTO, 2021). While PTAs cover a wide range of topics aimed at reducing trade barriers, the effect of tariff decreases on imports is of particular interest to workers, firms, and policymakers alike. In general, the empirical trade literature finds that PTAs increase imports between PTA members, as reviewed in the meta-analysis by Cipollina and Salvatici (2010). Moreover, it is well documented this increase of imports occurs gradually over time (Baier and Bergstrand, 2007; Anderson and Yotov, 2016; Dutt, 2020).

Baier and Bergstrand (2007) propose the delay of imports may be due to the gradual decrease of PTA tariffs, known as phase-in tariffs. This "phase-in hypothesis" implies that products with gradual tariff decreases should experience gradual import growth. For example, phase-in tariffs lasting 5 years should yield import growth over the 5 years before leveling off. However, Besedes et al. (2020) recently show that US imports under the North American Free Trade Agreement (NAFTA) are not consistent with the phase-in hypothesis. NAFTA products with tariffs immediately cut to zero and products with phase-in tariffs of 5-10 years do not yield different patterns of import growth for the US.[1] While the insights from NAFTA provide a crucial first step to understanding the relationship between phase-in tariffs and imports, it is unclear how the results generalize to more recent PTAs.

This paper further explores the effect of phase-in tariffs on import growth for the 12 PTAs signed by the US since 1995. To identify the causal effect of phase-in tariffs, we use a triple-difference approach that builds on the work of Besedes et al. (2020). Intuitively, we take a standard difference-in-differences strategy, that compares the log of imports in the pre- to post-PTA periods and PTA members to nonmembers, and take a third difference by also comparing phase-in to already duty-free products. Duty-free products serve as a suitable comparison group as their tariffs do not change after PTAs, which isolates the effect of phase-in tariffs on import growth. The triple-difference empirical strategy also controls for a wide range of unobservables and explicitly allows for heterogeneity over time and by the length of phase-in tariffs. Introducing such heterogeneity

[1] Besedes et al. (2020) refer to phase-in tariffs as "phase-out tariffs." Both phrases are referring to the same decrease of PTA tariffs over time.

is necessary for testing the phase-in hypothesis and limits the functional form assumptions on the triple-difference estimates.

The main challenge when studying phase-in tariffs is obtaining detailed PTA tariff data. We overcome this challenge by using recently available digitized PTA tariffs collected by Baccini et al. (2018). The tariff data is available at the Harmonized System 6-digit (HS6) level and includes the negotiated PTA tariffs for all years of the phase-in schedule, including future years. This detailed tariff data allows for calculation of the phase-in lengths for each product.

Our results provide additional evidence that US import growth is not consistent with the phase-in hypothesis. However, different from Besedes et al. (2020), we show that phase-in tariffs do not necessarily yield additional import growth relative to already duty-free products. This is directly counter to the phase-in hypothesis and implies longer phase-in periods may not protect domestic industries from increased foreign competition in the short run.

We use both a unified model that pools the 12 US PTAs together and country-specific models that focus on US import trends from each PTA partner. The pooled sample identifies the average effect of phase-in tariffs on imports and provides a tractable method for examining the effect of phase-in tariffs for a wide range of countries.[2] The country-specific estimates, on the other hand, document the heterogeneity across different exporters and PTAs. For example, US imports from Jordan exhibit patterns of delayed import growth, while countries such as South Korea have much different trends that suggest products with phase-in tariffs have similar import growth as already duty-free products.

Finally, our empirical strategy allows us to explicitly account for products with zero import values and is another contribution of this paper. Excluding the extensive margin of trade rules out the possibility of new products being imported by the US from PTA partners and could potentially bias the triple-difference estimates. This is especially salient given approximately 40% of the US tariffs from the PTA tariff data have imports values equal to zero. We include zero import values by using Poisson pseudo-maximum-likelihood (PPML) estimation with a triple-difference model that includes the level of imports as the dependent variable. The PPML results provide additional

[2] Recent econometrics research notes a pooled difference-in-differences model estimates a weighted average of the treatment effect when units enter into treatment over different periods (e.g., De Chaisemartin and d'Haultfoeuille, 2020; Borusyak et al., 2021; Callaway and Sant'Anna, 2021; Goodman-Bacon, 2021; Sun and Abraham, 2021; Athey and Imbens, 2022).

support that US import growth is not consistent with the phase-in hypothesis.

The next section provides an overview of the data and discusses the structure of US phase-in tariffs. Section 3 details the empirical strategies. Section 4 presents the main results. Section 5 includes robustness checks. Section 6 concludes and outlines possible avenues for future research.

2 Data

The empirical analysis requires data on the length of PTA phase-in tariffs, most-favored-nation (MFN) tariffs prior to each PTA, and US import values from all trading partners. This yields a sample that covers the 12 PTAs signed by the US since the signature of NAFTA with Canada and Mexico. Table 1 lists the PTA members with the date of signature and date of entry into force. The majority of the agreements enter into force within 1-3 years after signature; while Colombia, Costa Rica, Panama, and South Korea have longer delays. Each PTA is a free trade agreement notified under Article XXIV of the General Agreement on Tariffs and Trade (GATT) that requires substantial decreases of tariffs for all PTA members.

Table 1: Sample of US PTA Trading Partners

Countries	Date of Signature	Date of Entry Into Force
Australia	5/18/2004	1/1/2005
Bahrain	9/14/2005	8/1/2006
Chile	6/6/2003	1/1/2004
Colombia	11/22/2006	5/15/2012
Costa Rica*	8/5/2004	1/1/2009
Dominican Republic*	8/5/2004	3/1/2007
El Salvador*	8/5/2004	3/1/2006
Guatemala*	8/5/2004	7/1/2006
Honduras*	8/5/2004	4/1/2006
Jordan	10/24/2000	12/17/2001
Morocco	6/15/2004	1/1/2006
Nicaragua*	8/5/2004	4/1/2006
Oman	1/19/2006	1/1/2009
Panama	6/28/2007	10/31/2012
Peru	4/12/2006	2/1/2009
Singapore	5/6/2003	1/1/2004
South Korea	6/30/2007	3/15/2012

Notes: Countries are listed alphabetically. The * denotes members of the Dominican Republic-Central America FTA (CAFTA-DR). Dates are from the WTO's Regional Trade Agreement Database.

2.1 Import Data

Import values are from the BACI database and are recorded annually between 1995-2017 for imports of at least 1,000 US dollars (Gaulier and Zignago, 2010). Products follow the HS6 nomenclature under the 1992 revision. We focus exclusively on US imports and drop all other importers. Countries that signed a PTA with the US before 1995 are excluded to avoid the effect of contemporaneous phase-in tariffs (i.e., Canada, Israel, and Mexico). All other countries with import data available are included in the analysis, see Appendix Table A1 for a list of the 198 exporters.

2.2 Tariff Data

The US phase-in tariffs are from Baccini et al. (2018) and kindly provided by Leonardo Baccini. Using the World Integrated Trade Solution (WITS) and appendices from the official PTA tariff schedules, they collect the annual negotiated ad valorem tariffs at the HS6 level. This includes future years since the negotiated tariffs are listed through the completion of the phase-in process. The data set also contains applied ad valorem MFN tariffs for the periods before each PTA enters into force.

Using the WITS product concordance, we map HS6 products to the 1992 revision to match the import data. The mapping results in some observations being categorized into the same product. When this occurs we take a simple average across the products.[3] Merging the US import and tariff data results in approximately 40% of the products from the tariff data being dropped due to missing import values (i.e., 33,029 out of the 82,196 products). To identify whether observations with missing trade values are true zeros, we use the BACI companion dataset.[4]

To measure the length of phase-in tariffs, we calculate how many years it takes each tariff to reach its final PTA tariff in the last year of the phase-in schedule. After concording of products, some PTA tariffs are slightly different across the phase-in schedule due to rounding and not substantial tariff decreases. To adjust for these small differences, we round the ad valorem tariffs to 3 decimal points. Reassuringly, all tariffs are decreasing through the phase-in schedule except for one that we drop. Eliminating PTA tariffs is the norm for the US with over 98% of the tariffs in the sample

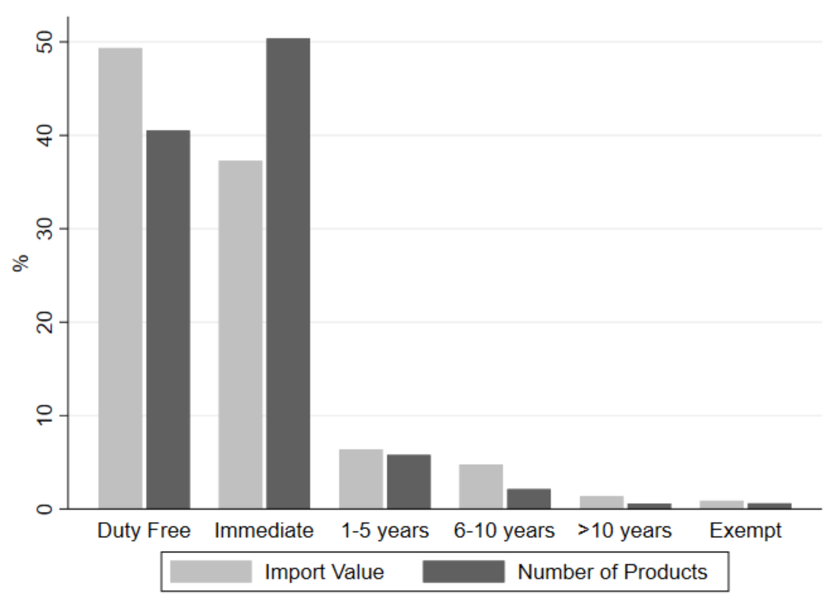
[3] The empirical results are similar when using the non-concorded tariff data, as further investigated in section 5.

[4] Out of the previously unmatched 33,029 observations, we are able to identify all but 51 as observations with import values equal to zero.

eventually decreased to zero. The remaining tariffs are either entirely exempt from tariff decreases or decrease to some amount greater than zero. For the empirical analysis in the following sections, we drop products that are entirely exempt.

Figure 1 highlights the distribution of US phase-in tariffs across the 12 PTAs, with Appendix Table A2 documenting the data underlying the figure. For ease of exposition, we classify products into the following categories: (a) already duty free prior to PTA signature with an MFN tariff equal to zero and hence continue duty free; (b) immediately cut to their final PTA tariff in the first year; (c) phase-in tariffs lasting 1-5 years; (d) phase-in tariffs lasting 6-10 years; (e) phase-in tariffs lasting more than 10 years; and (f) exempt from liberalization. The figure plots the distributions of total imports between 1995-2017 and by counting the number of HS6 products. The majority of the products are either already duty free or immediately cut, while each remaining category is less than 10% of the total sample. In comparison to other importers, the US phases in less products. Teti (2020) shows that on average 75% of tariffs reach their final level when PTAs enter into force for a sample of 149 agreements.

Figure 1: Distribution of US Phase-In Tariffs



Notes: Duty Free denotes products that have MFN tariffs equal to zero prior to the PTA entering into force. Immediate products are decreased to their final tariff in the first year of the PTA. Exempt products do not experience any tariff cut and have MFN tariffs greater than zero. The remaining categories denote how long the products are phased in. Import Value uses the total import values between 1995-2017 and Number of Products counts the number of HS6 lines per category.

3 Empirical Strategy

3.1 Triple-Difference Specification

To estimate the causal effect of phase-in tariffs on import growth, we use a triple-difference specification that builds on the work of Besedes et al. (2020). The empirical strategy compares the log of US imports over the pre- to post-PTA periods (first difference), PTA to non-PTA members (second difference), and products that receive *any* phase-in tariff to products that are already duty free with MFN tariffs equal to zero prior to the PTA (third difference). More precisely, we separate products receiving *any* phase-in tariffs based by whether they are immediately cut or phased in over time. The advantage of using already duty-free products as a comparison group is they have tariffs that do not change after PTAs, which isolates the effect of immediately cut and phase-in tariffs on US import growth.

The triple-difference approach can be expressed by the regression:

$$ln\left(M_{jpt}\right) = \beta^{Immediate} D_{jpt}^{Immediate} + \beta^{Phase} D_{jpt}^{Phase} + \gamma_{pt} + \gamma_{jt} + \gamma_{jp} + \varepsilon_{jpt}, \tag{1}$$

where $ln\left(M_{jpt}\right)$ is the log of US imports from exporter j of product p in year t. $D_{jpt}^{Immediate}$ is a binary variable that equals one when the US has an active PTA with exporter j in year t, and product p is classified as receiving immediate tariff cuts to its final tariff.[5] Similarly, D_{jpt}^{Phase} equals one when the US has an active PTA with exporter j in year t, and product p is classified as receiving phase-in tariffs over at least one year. Given that the phase-in tariff schedule is known once the PTA is signed, we treat a PTA as active the year after PTA signature. As shown in Table 1, 5 out of the 12 PTAs enter into force the year after signing the agreement. In these cases, the definition of an active PTA corresponds to when the PTA enters into force. For the remaining PTAs, it takes 2-6 years to enter into force.

Product-year (γ_{pt}), exporter-year (γ_{jt}), and exporter-product (γ_{jp}) fixed effects isolate variation at the exporter-product-year level. Each fixed effect is implicitly importer-specific since the US is the only importer in the sample. This implies the exporter-year fixed effects can be interpreted as time-varying directional country pair fixed effects. Baier and Bergstrand (2007) suggest that

[5] As discussed in the previous section, the final tariff level for almost all products is equal to zero.

country pair fixed effects control for the endogeneity of PTAs, helping to alleviate concerns that the choice to pursue PTAs is non-random.

The coefficients of interest are $\beta^{Immediate}$ and β^{Phase}. Positive estimates suggest that immediately cut or phased-in products experience additional import growth than products that are already duty free, as predicted by the phase-in hypothesis. While both coefficients are predicted to be positive, a positive β^{Phase} is particularly important for the phase-in hypothesis as it directly measures import growth of products subject to tariffs that take time to phase-in. Standard errors are clustered two-way by exporter-product and product-year. The exporter-product clustering addresses potential serial correlation in the error term, while the product-year clustering addresses potential correlation in the US importing decisions of each product in a given year (e.g., trade diversion).

The identifying assumption is there exists no contemporaneous shock affecting import growth of products with immediate or phase-in tariffs relative to already duty-free products from PTA and non-PTA members (Gruber, 1994; Besedes et al., 2020). In other words, this is the triple difference equivalent of the difference-in-differences parallel trends assumption. The triple-difference assumption is plausible as it focuses on the distribution of shocks affecting import growth across products and not on the total import trends of PTA and non-PTA members. To further explore the validity of the triple-difference approach, we take an econometric strategy with an event study, as a next step and discussed below.

3.2 Event Study

The triple-difference specification in Equation 1 restricts the effect of immediate and phase-in tariffs to be homogeneous over time. However, the phase-in hypothesis predicts import growth to vary based on how many years a PTA has been active. To explore the heterogeneity of import growth over time, we relax the restriction by using the following event study with estimates varying by year:

$$ln\left(M_{jpt}\right) = \sum_{s=-5}^{15} \beta_{s}^{Immediate} D_{jps}^{Immediate} + \sum_{s'=-5}^{15} \beta_{s'}^{Phase} D_{jps'}^{Phase} + \gamma_{pt} + \gamma_{jt} + \gamma_{jp} + \varepsilon_{jpt}. \quad (2)$$

Since PTAs occur over different years, we normalize the time periods s and s' to be the number of years since the PTA was signed. Period zero denotes the signature year of each PTA and serves as the omitted reference year. To ensure that each PTA member has the same number of pre-periods, observations that occur more than 5 years prior to the signature year are binned into time period -5. Additionally, observations that occur more than 15 years after signature are binned into time period 15.

The dummy variable $D_{jps}^{Immediate}$ equals to one when all the following hold true: (i) the time period is s, (ii) the US and exporter j have a PTA anytime over the sample period, and (iii) product p from exporter j is classified as receiving immediate tariff cuts at any point. Similarly, $D_{jps'}^{Phase}$ is also a dummy variable equals to one when: (i) the time period is s', (ii) the US and exporter j have a PTA anytime over the sample period, and (iii) product p from exporter j is classified as receiving phase-in tariffs over at least one year at any point. The phase-in hypothesis predicts that immediate tariff cuts will lead to an immediate jump of imports after PTA signature, that will level off for the remaining years. For products with phase-in tariffs over at least one year, the phase-in hypothesis predicts more gradual increases of import growth over time.

The event study also allows for examination of the previously discussed triple difference equivalent of the parallel trends assumption. If the assumption is valid, then we expect estimates to be insignificantly different from zero prior to PTA signature (i.e., when the time periods are negative). Divergence prior to PTA signature suggests that at least some of the import growth effects in the post period capture underlying trends not due to PTA tariffs.

3.3 Heterogeneous Phase-In Effects

In the previous sections we have differentiated between products receiving immediate tariff cuts, phase-in tariffs, and those which are already duty free. However, there exists additional variation in phase-in lengths that is valuable for identifying the effect of phase-in tariffs. To incorporate differing phase-in lengths, the estimates in Equation 2 now vary by the length of phase-in tariffs with the regression:

$$ln\left(M_{jpt}\right) = \sum_{i=1}^{4} \sum_{s=-5}^{15} \beta_s^i D_{jps}^i + \gamma_{pt} + \gamma_{jt} + \gamma_{jp} + \varepsilon_{jpt}, \tag{3}$$

where $i = 1$ for phase-in tariffs that are immediately cut, $i = 2$ for phase-in tariffs that are decreased over 1-5 years, $i = 3$ for phase-in tariff that are decreased over 6-10 years, and $i = 4$ for phase-in tariffs that are decreased over more than 10 years. Consistent with the homogeneous and event study triple-difference specifications, products that are already duty free serve as the reference group. The year of PTA signature at time period zero also continues to serve as the omitted reference year.

As discussed in the event study section, the phase-in hypothesis predicts immediately cut products should experience a jump in imports then level off, while products with longer phase-in periods should have longer and more gradual import growth. More precisely, imports should increase more gradually for products with tariffs phased in over more than 10 years than products with phase-in tariffs lasting 6-10 years.

3.4 Country-Specific Effects

To this point, the US PTAs have been pooled together into a single sample. This assumes that the effect of phase-in tariffs on import growth is the same for each PTA. With differences across exporters, such as developed versus developing economies, there likely exists important differences in US import trends. To explore heterogeneity across exporters we re-estimate Equations 1-3 separately for each PTA member. For these country-specific regressions, the control group of non-PTA members stays the same and imports from all other US PTA members are dropped.

4 Results

4.1 Homogeneous Triple-Difference Results

The results from Equation 1 are in the OLS columns of Table 2. The baseline sample in the first row pools the 12 PTAs together. For immediately cut products, the point estimate is negative and statistically significant at the 1% level. This implies that immediately cut products experience significant contractions of import growth relative to products that are already duty free, which is counter to the phase-in hypothesis. However, the estimate on phase-in products is positive and also statistically significant at the 1% level. This is reassuring as it aligns with the common view that phase-in tariffs lead to at least some delayed import growth and is consistent with the prediction from the phase-in hypothesis. The positive estimate implies that phase-in tariffs lead to about 14% ($e^{0.132} - 1 = 0.14$) additional import growth than products that are already duty free prior to the

PTA. In addition, the magnitude of this positive phase-in estimate is stronger than the negative immediately cut estimate that corresponds to about 9% less import growth than already duty-free products.

To explore whether similar patterns persist across PTA members, we re-estimate Equation 1 separately for each exporter and present the results in the remaining rows. The country-specific estimates vary considerably with differing signs and levels of significance. For example, 5 countries (Costa Rica, Dominican Republic, Guatemala, Singapore, South Korea) continue to have negative and significant estimates for immediately cut products, while only Peru is positive and statistically significant. The remaining 11 countries have statistically insignificant estimates at the 10% level.

For products with phase-in tariffs, 4 countries (Colombia, El Salvador, Jordan, Morocco) have positive and statistically significant estimates, while the Australia and Oman estimates are negative and statistically significant. Jordan has the largest estimate of 1.160 log points, implying that phase-in products from Jordan experience additional import growth that is about 250% larger than already duty-free products. However, Jordan joins the World Trade Organization (WTO) in the same year as its PTA signature with the US. Thus, it is possible that some of the estimated PTA phase-in effect is actually the result of its WTO accession. For Colombia, El Salvador, and Morocco the growth rates are smaller but still strong with 47%, 236%, and 160% additional import growth, respectively. The remaining country-specific estimates are statistically insignificantly different from zero.

Overall, while the baseline estimate on phase-in products is positive, the heterogeneity across countries and the negative estimates on immediately cut products cast doubt on the phase-in hypothesis. Our results suggest that phase-in tariffs may (but do not always lead to) greater import growth. In other words, phase-in tariffs are not a sufficient condition for delayed import growth. However, to provide a complete analysis of phase-in tariffs on import growth, there exists important variation over time and by length of phase-in schedule that the homogeneous triple-difference estimates do not use. We allow the estimates to vary in both dimensions in the remaining sections.

Table 2: Homogeneous Triple-Difference Estimates

	OLS				PPML			
Sample	$\beta^{Immediate}$	β^{Phase}	R^2	Observations	$\beta^{Immediate}$	β^{Phase}	Pseudo R^2	Observations
Baseline	-0.093***	0.132***	0.805	2,992,679	0.051	0.113	0.971	7,451,183
	(0.021)	(0.037)			(0.102)	(0.124)		
Australia	0.069	-0.136**	0.812	2,613,845	-0.049	-0.240	0.974	6,442,331
	(0.049)	(0.068)			(0.189)	(0.258)		
Bahrain	0.363	0.317	0.814	2,556,169	0.119	4.676***	0.974	6,366,914
	(0.240)	(1.046)			(0.296)	(1.070)		
Chile	-0.089	0.104	0.814	2,580,426	-0.103	1.271***	0.974	6,412,969
	(0.071)	(0.182)			(0.240)	(0.439)		
Colombia	-0.046	0.388**	0.813	2,586,866	-0.328	0.187	0.974	6,418,639
	(0.065)	(0.180)			(0.239)	(0.276)		
Costa Rica	-0.293***	-0.325	0.813	2,580,003	-1.112***	-1.202***	0.974	6,411,360
	(0.084)	(0.266)			(0.279)	(0.326)		
Dominican Republic	-0.388***	0.197	0.813	2,581,535	-0.193	-0.066	0.974	6,417,308
	(0.083)	(0.242)			(0.243)	(0.269)		
El Salvador	0.178	1.212***	0.814	2,569,954	0.669	0.632	0.974	6,395,326
	(0.119)	(0.284)			(0.451)	(0.725)		
Guatemala	-0.206**	0.301	0.814	2,575,309	0.534**	0.378	0.974	6,407,895
	(0.088)	(0.382)			(0.253)	(0.290)		
Honduras	-0.007	0.025	0.814	2,572,643	0.009	-0.376	0.974	6,408,752
	(0.096)	(0.318)			(0.222)	(0.254)		
Jordan	0.176	1.253***	0.814	2,561,392	-0.414	3.383***	0.974	6,376,508
	(0.372)	(0.195)			(1.026)	(0.868)		
Morocco	0.085	0.957***	0.814	2,565,925	-0.215	-0.260	0.974	6,384,004
	(0.127)	(0.134)			(0.565)	(0.400)		
Nicaragua	0.207	-0.169	0.814	2,562,770	0.749**	0.183	0.974	6,379,822
	(0.141)	(0.294)			(0.366)	(0.302)		
Oman	-0.342	-1.045**	0.814	2,556,676	0.368	-3.545***	0.974	6,366,064
	(0.234)	(0.422)			(0.564)	(0.397)		
Panama	-0.001	0.216	0.813	2,568,885	-0.441	-0.439	0.974	6,401,174
	(0.086)	(0.338)			(0.708)	(0.713)		
Peru	0.188***	0.071	0.814	2,583,317	-0.046	-0.002	0.974	6,417,050
	(0.065)	(0.477)			(0.195)	(0.361)		
Singapore	-0.227***	0.003	0.812	2,598,105	0.364	0.182	0.973	6,432,019
	(0.070)	(0.091)			(0.228)	(0.312)		
South Korea	-0.298***	0.013	0.814	2,626,816	0.186	0.136	0.973	6,442,515
	(0.055)	(0.070)			(0.162)	(0.163)		

Notes: Standard errors in parentheses are clustered two-way by exporter-product and product-year. The baseline sample pools the 12 PTA together and the remaining rows are country-specific regressions.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

4.2 Event Study Results

We now relax the assumption that import growth is constant over time and use the event study in Equation 2. The pooled OLS baseline results with shaded 95% confidence intervals are plotted by year since PTA signature in Figure 2. Panel (a) includes the time-varying estimates for products that have tariffs immediately cut to their final tariff. Following PTA signature, the estimates are mostly statistically insignificant through the 15 years. Only year 4 yields a negative estimate that is statistically significant at the 5% level. In other words, immediately cut and already duty-free products do not have significantly different trends of import growth. This is similar to the homogeneous triple-difference result, and is not consistent with the phase-in hypothesis that predicts a jump in import growth right after PTA signature that levels off in subsequent years.

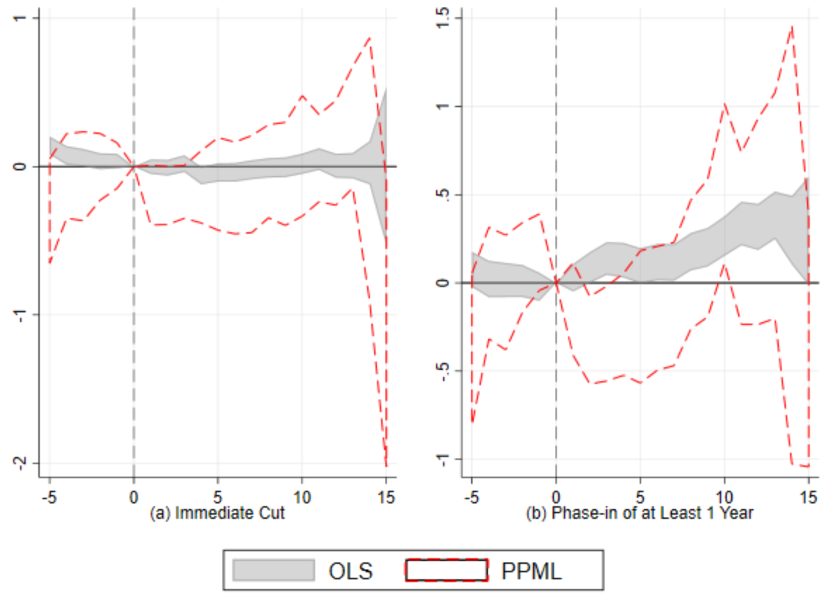
Panel (b) plots the phase-in estimates and show trends of delayed import growth that occurs gradually after PTA signature over the 15 years. In year 15, the estimate becomes more imprecise since only PTAs signed by 2002 are included (i.e., only the US PTA with Jordan). Focusing on years prior to year 15 when the estimates are more precise, the point estimate of import growth peaks around 0.384 log points (or approximately 47%) in year 13. The gradual increase of import growth for products receiving phase-in tariffs provides support for the phase-in hypothesis.

The event study also allows for examination of the triple-difference equivalent to the parallel trends assumption. If the assumption is valid then we expect statistically insignificant estimates prior to PTA signature. For immediately cut products, there exists some evidence of pre-trends prior to PTA signature, where the estimates are statistically significant 3 years prior to signature. When approaching PTA signature, the estimates are insignificant and support the identifying assumption.[6] For products with phase-in tariffs, the pre-trends are even more supportive of the identifying assumption where the estimates are insignificant at the 10% level for each pre-period.

Figure 3 includes the OLS country-specific estimates, with Panels (a) and (b) providing the results for immediately cut and phase-in products, respectively. Beginning with immediately cut products, the majority of the country-specific estimates are insignificant after PTA signature or have downward trends. Only Bahrain and El Salvador show some patterns of an increase in import

[6] Our pre-trends are similar to the pre-trends of Mexico from Besedes et al. (2020) who only have data for 3 years prior to NAFTA, while for Canada they show statistically significant estimates in the pre-periods. Additionally, their main homogeneous and event study results do not differentiate between immediate and phase-in products.

Figure 2: Event Study Estimates



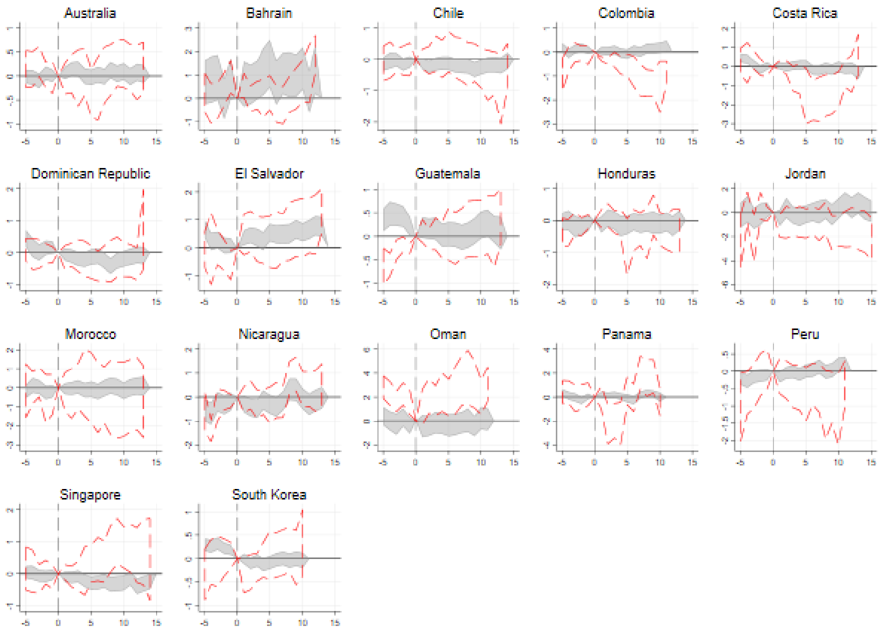
Notes: Plots represent the 95% confidence intervals of the pooled baseline triple-difference estimates. Dashed vertical line at year zero is the signature year and serves as the reference year. Standard errors are clustered two-way by exporter-product and product-year.

growth right after PTA signature. Colombia also has patterns of delayed import growth, but it takes many years after PTA signature to occur. For phase-in products, Jordan and Morocco continue to show the strongest trends of delayed imports growth. However, there does not exist persist trends of additional import growth for a wide range of countries. Across countries, most of the pre-trends are insignificant. Two particularly interesting results include the imports from Guatemala and South Korea. Prior to the PTA, products that would be classified as immediately cut have strong import growth relative to already duty-free products. Once the PTA was signed, the import growth differences diminish to zero. One possible explanation for the South Korea scenario could be the almost 5 years between year of signature and entry into force, where import growth may be hampered by trade policy uncertainty.

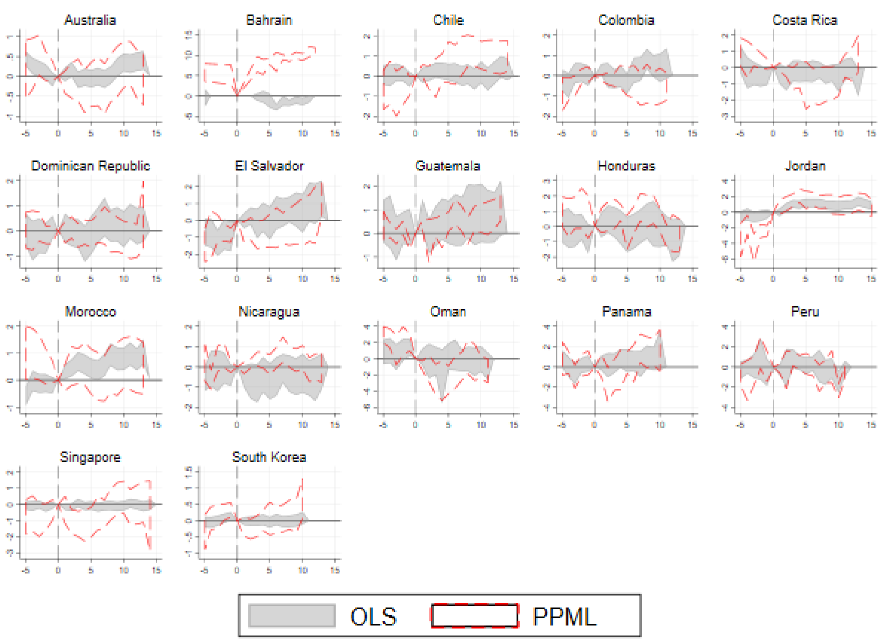
Even after incorporating time-varying variation, the overall conclusion is relatively similar to the homogeneous triple-difference results. The baseline samples for phase-in tariffs and some of the country-specific estimates yield patterns of delayed import growth. However, the insignificant estimates for the immediately cut products and varying trends of phase-in products across countries provides greater support that phase-in tariffs may yield additional import growth, but this is not always the case.

Figure 3: Event Study Estimates by PTA Member

(a) Immediate Cut



(b) Phase-in of at Least 1 Year



Notes: Plots represent 95% confidence intervals. Dashed vertical line at year zero is the signature year and serves as the reference year. Standard errors are clustered two-way by exporter-product and product-year.

4.3 Heterogeneous Phase-In Results

The previous analysis has differentiated between products that are already duty free versus products with immediately cut or phase-in tariffs. To better account for differing phase-in lengths, we now compare import growth by the length of phase-ins. The pooled OLS baseline results of Equation 3 are in Figure 4. Panel (a) plots the estimates for products receiving immediate tariff cuts and follows the previous event study results. The estimates are mostly insignificant prior and after signature. The phase-in hypothesis predicts a jump of import growth right after PTA signature then leveling off, which is not consistent with the null results we estimate.

Next, Panel (b) considers phase-in products of 1-5 years. Import growth gradually increases after signature for 11 years before leveling off around 0.3 log points. In other words, products with longer phase-in periods experience additional import growth than already duty-free products. For phase-in tariffs lasting 1-5 years, the phase-in hypothesis expects to see leveling of import growth near year 5. With the slowing of import growth around year 5, this is somewhat consistent with the phase-in hypothesis. The import growth increases a few years after year 5 could be driven by countries with PTAs that take longer to enter into force.

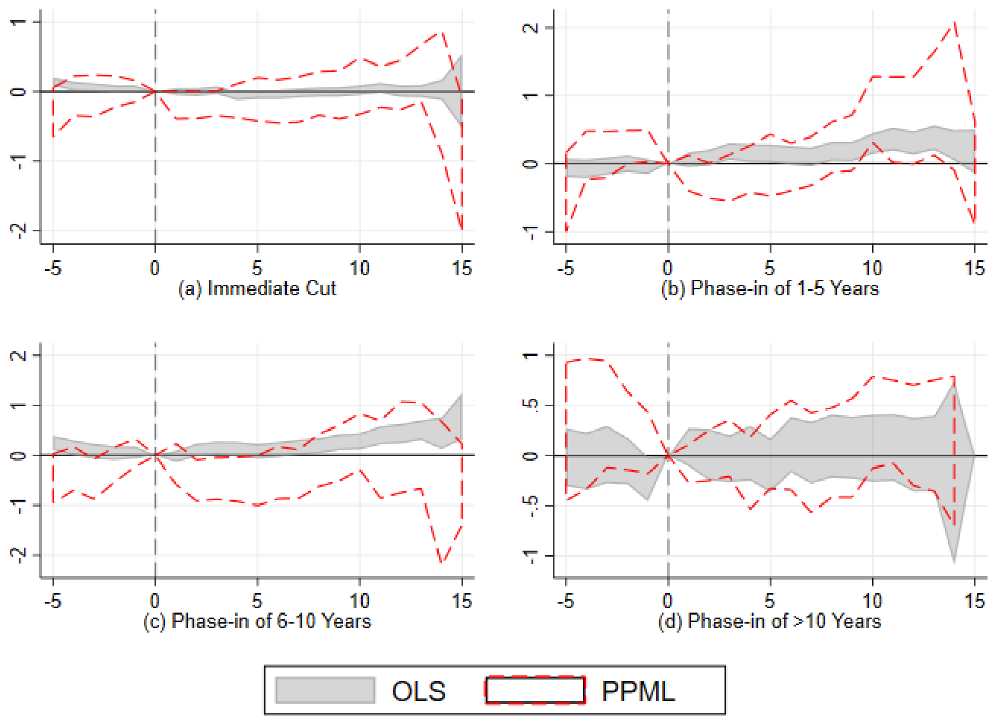
Panel (c) plots phase-in products lasting 6-10 years. After signature, import growth continues to increase for the majority of the 15 years. This is slightly longer than the 10 years predicted by the phase-in hypothesis. However, as previously noted, the PTAs that take longer to enter into force could be responsible for the longer period of import growth. In addition, there are more pre-trend fluctuations in Panel (c) implying care is needed for interpretation of the estimates.

Finally, Panel (d) examines phase-in tariffs lasting more than 10 years. The phase-in hypothesis predicts even more gradual import growth than the products with phase-in tariffs of 6-10 years. Thus, the insignificant estimates after PTA signature are not supportive of the phase-in hypothesis. One likely explanation is the lack of power in the data as less than 2% of the products are classified into this category. Nonetheless, the results cast additional doubt on the phase-in hypothesis.

Appendix Figures A1-A17 plot the country-specific results. The lack of consistent trends across countries with the wide range of heterogeneity provides clear evidence against the phase-in hypothesis. Even for countries that have some features consistent with the phase-in hypothesis in the homogeneous and event study specifications, such as Jordan, are inconsistent with the hypothesis.

For example, focus on the first 5 years after signature for Jordan in Appendix Figure A10. Here products with phase-in tariffs of 1-5 years in Panel (b) grow slower than products with phase-in tariffs of 6-10 years in Panel (c). The phase-in hypothesis predicts the opposite should occur.

Figure 4: Heterogeneous Phase-In Estimates



Notes: Plots represent 95% confidence intervals of the pooled baseline triple-difference estimates. Dashed vertical line at year zero is the signature year and serves as the reference year. Standard errors are clustered two-way by exporter-product and product-year.

5 Robustness Checks

5.1 Zero Import Values

The triple-difference empirical strategies use the log of imports as the dependent variable and drop observations with zero import values. The omission of zeros implies the focus is exclusively on the intensive margin. In other words, the focus is on how much more or less the US imports products with differing phase-in schedules relative to duty-free products. Excluding the extensive margin rules out the possibility of new products being imported by the US from PTA partners and could potentially bias the triple-difference estimates. This is especially important given approximately 40% of US tariffs from the PTA tariff data have imports values equal to zero. Thus, both positive and zero import values may be important to understanding the effects of phase-in tariffs on import growth.

To include zero trade flows we use PPML estimation made popular by Silva and Tenreyro (2006) in the gravity model literature. PPML allows for the level of the US imports, denoted M_{jpt}, to be the dependent variable. The estimator also better handles heteroskedasticity that is common with trade data. The PPML equivalents of Equations 1, 2, and 3 are the following, respectively:

$$M_{jpt} = exp\left[\beta^{Immediate} D_{jpt}^{Immediate} + \beta^{Phase} D_{jpt}^{Phase} + \gamma_{pt} + \gamma_{jt} + \gamma_{jp}\right] + \varepsilon_{jpt}, \tag{4}$$

$$M_{jpt} = exp\left[\sum_{s=-5}^{15} \beta_s^{Immediate} D_{jps}^{Immediate} + \sum_{s'=-5}^{15} \beta_{s'}^{Phase} D_{jps'}^{Phase} + \gamma_{pt} + \gamma_{jt} + \gamma_{jp}\right] + \varepsilon_{jpt}, \tag{5}$$

$$M_{jpt} = exp\left[\sum_{i=1}^{4} \sum_{s=-5}^{15} \beta_s^i D_{jps}^i + \gamma_{pt} + \gamma_{jt} + \gamma_{jp}\right] + \varepsilon_{jpt}. \tag{6}$$

The predictions for the triple-difference regressions that use OLS are the same for these PPML regressions. Mainly, after the PTA is active, the phase-in hypothesis suggests that the triple-difference coefficients should be positive and significant.

The homogeneous PPML estimates from Equation 4 are in the last four columns of Table 2. Compared to the OLS columns, the number of observations more than doubles. When looking at the pooled baseline sample in the first row, the estimates of immediately cut and phase-in products are now both positive but insignificant at the 10% level. Even though the estimates are now positive, the insignificance from zero implies there is no effect of immediately cut or phase-in tariffs on import growth relative to already duty-free products. This null effect is directly counter to the phase-in hypothesis. It also suggests that the additional import growth we estimated with OLS for the baseline sample is only with respect to the intensive margin and does not persist when including the extensive margin of trade adjustment. This implies the additional import growth due to phase-in tariffs is stemming from more imports of already imported products and not new products.

The country-specific estimates are in the remaining rows, where the majority of the estimates are also insignificant. For immediately cut products, Costa Rica is the only country to continue having a negative and significant estimate. Guatemala actually flips from negative with OLS, to positive and significant with PPML. Finally, Nicaragua is the only other country to have a positive and significant estimate. For phase-in products, Jordan continues to have a strong estimate that increases from 1.253 to 3.383 log points. Bahrain and Chile also have positive estimates that are now significant under PPML. In fact, Bahrain has the strongest estimate of 4.676 log points. In contrast, Costa Rica and Oman have strong downward effects of phase-in tariffs on import growth. Thus, while the inclusion of zero import values is able to provide an explanation for almost all of the negative OLS effects, there continues to not be strong support that phase-in tariffs yield additional import growth for a wide range of US PTAs.

The 95% confidence intervals for the time-varying PPML estimates from Equation 5 are represented by the dashed lines in Figure 2. Compared to the OLS results, the PPML confidence intervals are wider. After PTA signature, the PPML results are fairly similar to the null OLS results for immediately cut products. In addition, phase-in products are all mostly insignificant after PTA signature, but yield slight upward trends around year 10. The PPML pre-trends are also insignificant for the years prior to PTA signature, which provides additional support for the identification strategy.

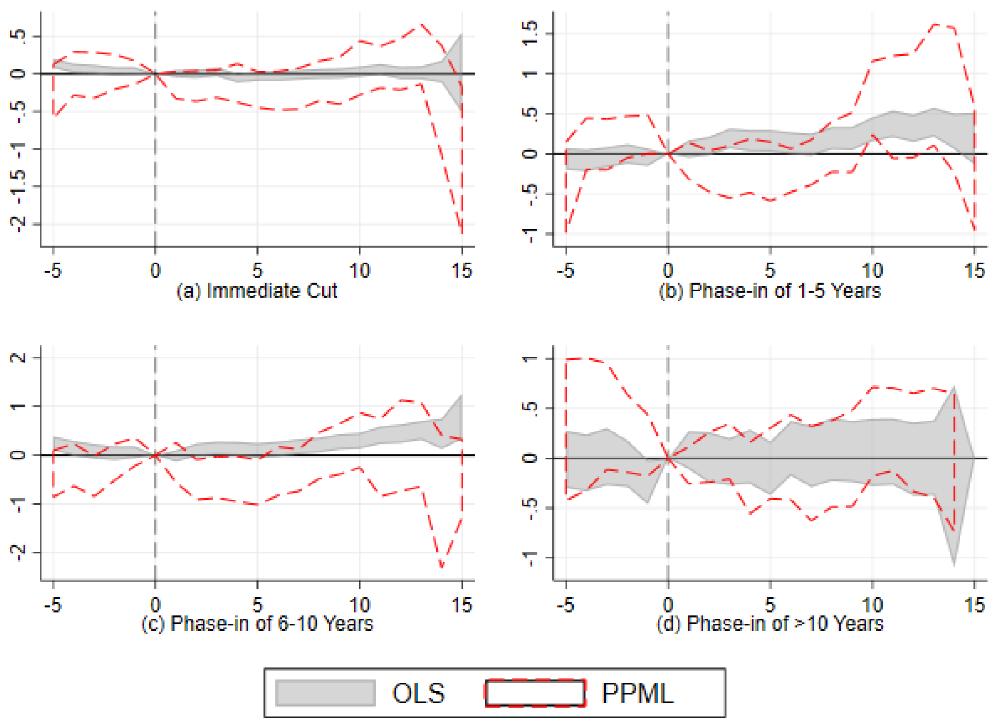
Figure 3 includes the dashed PPML country-specific estimates. In general, PPML results are similar to the OLS results and there are not clear trends of import growth as predicted by the phase-in hypothesis for a wide range of countries. Also, the pre-trends for many countries continue or become insignificant. For example, South Korea no longer has positive pre-trends for immediately cut products.

We also include the dashed PPML estimates of Equation 6 in Figure 4 and the country-specific estimates in Appendix Figures A1-A17. As with the event study, the confidence intervals increase for many of the country-specific estimates and the pre-trends are generally insignificant. There also continues to be similar trends in import growth following PTA signature for the OLS and PPML estimates.

5.2 Exclude China Sample

It is well documented that US imports from China have increased following China's accession to the WTO and the US granting China permanent normal trade relations (e.g., David et al., 2013; Pierce and Schott, 2016). There may be a concern that including China as one of the comparison countries that does not have a PTA with the US, listed in Appendix Table A1, may bias the triple-difference estimates. To address this point we also use a sample that excludes China and the previous results are robust. For ease of exposition, we present the baseline event study results with the sample that omits China in Figure 5. Results for the remaining empirical specifications are available upon request.

Figure 5: Heterogeneous Phase-In Estimates, Exclude China

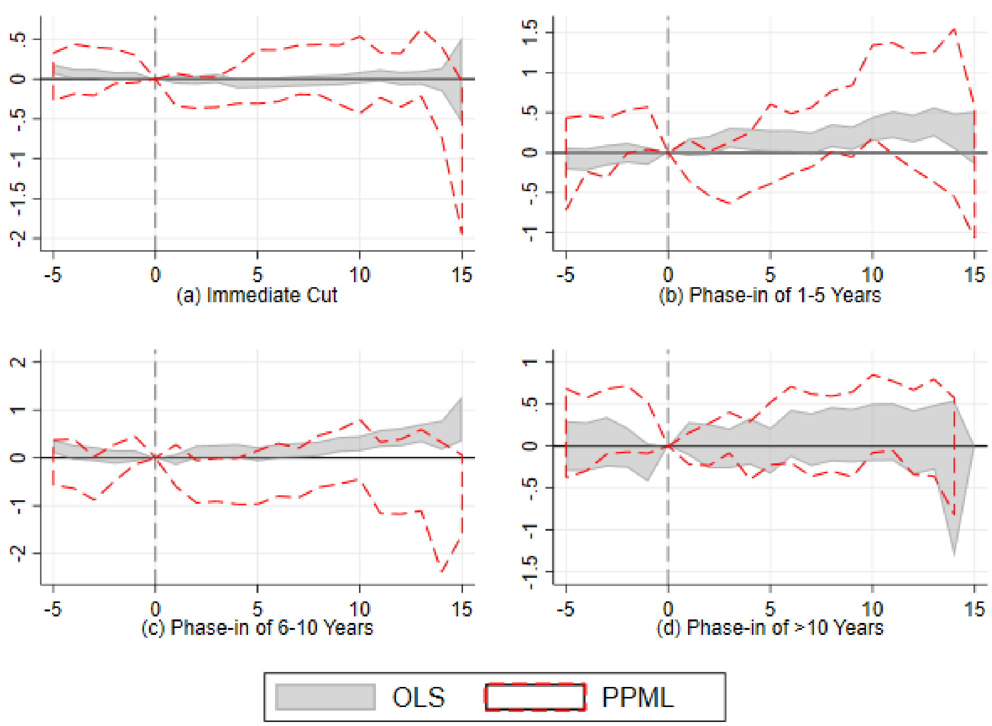


Notes: Plots represent 95% confidence intervals of the pooled baseline triple-difference estimates. Dashed vertical line at year zero is the signature year and serves as the reference year. Standard errors are clustered two-way by exporter-product and product-year.

5.3 Product Concordance

Concording products to the same HS6 1992 revision helps to account for changes in how products are classified over time. However, the concording results in some products being classified into the same HS6 code and requires a choice on how to aggregate them together. We use a simple average across products when this occurs. Another strategy is to not proceed with the concordance and use the HS6 products as listed. We also consider this alternative strategy and the triple-difference estimates are similar. As with the previous robustness check, we include the baseline event study results in Figure 6.

Figure 6: Heterogeneous Phase-In Estimates, No Concordance



Notes: Plots represent 95% confidence intervals of the pooled baseline triple-difference estimates. Dashed vertical line at year zero is the signature year and serves as the reference year. Standard errors are clustered two-way by exporter-product and product-year.

6 Conclusion

This paper provides evidence that US imports under the 12 PTAs since NAFTA are not consistent with the Baier and Bergstrand (2007) phase-in hypothesis. We show that phase-in tariffs do not necessarily yield additional import growth relative to already duty-free products. This implies that phase-in tariffs may not protect domestic industries from increased foreign competition in the short run. We also document the wide range of heterogeneity across US PTAs with country-specific results and include zero trade flows with PPML estimation.

There are several potential avenues for future research. This paper focuses exclusively on imports to the US. However, import growth of other importers may be in line with the phase-in hypothesis. For example, our analysis allows for comparison of North-North and North-South PTAs, but it does not include South-South PTAs. Another avenue of future research is to better understand what drives the use of phase-in tariffs and modeling the optimal phase-in tariff schedule.

References

Anderson, J. E. and Yotov, Y. V. (2016). Terms of trade and global efficiency effects of free trade agreements, 1990–2002. *Journal of International Economics*, 99:279–298.

Athey, S. and Imbens, G. W. (2022). Design-based analysis in difference-in-differences settings with staggered adoption. *Journal of Econometrics*, 226(1):62–79.

Baccini, L., Dür, A., and Elsig, M. (2018). Intra-industry trade, global value chains, and preferential tariff liberalization. *International Studies Quarterly*, 62(2):329–340.

Baier, S. L. and Bergstrand, J. H. (2007). Do free trade agreements actually increase members' international trade? *Journal of International Economics*, 71(1):72–95.

Besedes, T., Kohl, T., and Lake, J. (2020). Phase out tariffs, phase in trade? *Journal of International Economics*, page 103385.

Borusyak, K., Jaravel, X., and Spiess, J. (2021). Revisiting event study designs: Robust and efficient estimation. arxiv preprint arxiv:2108.12419.

Callaway, B. and Sant'Anna, P. H. (2021). Difference-in-differences with multiple time periods. *Journal of Econometrics*, 225(2):200–230.

Cipollina, M. and Salvatici, L. (2010). Reciprocal trade agreements in gravity models: A meta-analysis. *Review of International Economics*, 18(1):63–80.

David, H., Dorn, D., and Hanson, G. H. (2013). The china syndrome: Local labor market effects of import competition in the united states. *American Economic Review*, 103(6):2121–68.

De Chaisemartin, C. and d'Haultfoeuille, X. (2020). Two-way fixed effects estimators with heterogeneous treatment effects. *American Economic Review*, 110(9):2964–96.

Dutt, P. (2020). The wto is not passé. *European Economic Review*, 128:103507.

Gaulier, G. and Zignago, S. (2010). Baci: International trade database at the product-level. the 1994-2007 version. Working Papers 2010-23, CEPII.

Goodman-Bacon, A. (2021). Difference-in-differences with variation in treatment timing. *Journal of Econometrics*.

Gruber, J. (1994). The incidence of mandated maternity benefits. *American Economic Review*, pages 622–641.

Pierce, J. R. and Schott, P. K. (2016). The surprisingly swift decline of us manufacturing employment. *American Economic Review*, 106(7):1632–62.

Silva, J. S. and Tenreyro, S. (2006). The log of gravity. *Review of Economics and Statistics*, 88(4):641–658.

Sun, L. and Abraham, S. (2021). Estimating dynamic treatment effects in event studies with heterogeneous treatment effects. *Journal of Econometrics*, 225(2):175–199.

Teti, F. A. (2020). 30 years of trade policy: Evidence from 5.7 billion tariffs. ifo working paper.

WTO (2021). Regional trade agreements database. Retrieved from http://rtais.wto.org/UI/PublicMaintainRTAHome.aspx.

Appendix: Additional Tables and Figures

Table A1: Sample of Exporters Without US PTA

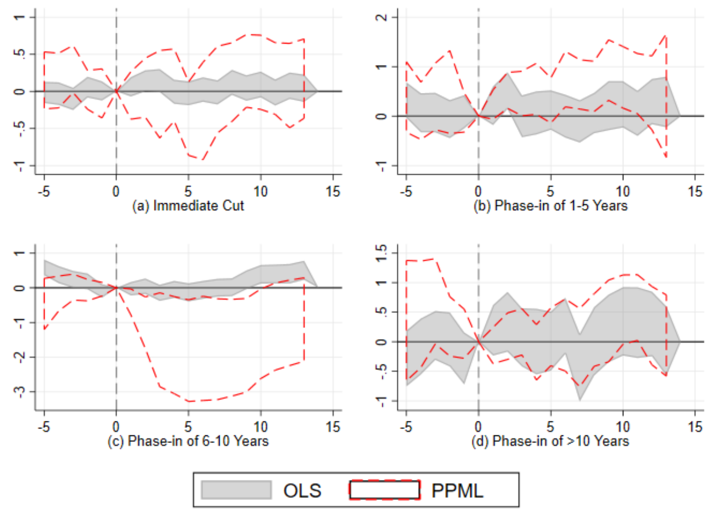
Afghanistan	Fr. South Antarctic Terr.	Paraguay
Albania	France	Philippines
Algeria	French Polynesia	Pitcairn
Andorra	Gabon	Poland
Angola	Gambia	Portugal
Anguilla	Georgia	Qatar
Antigua and Barbuda	Germany	Rep. of Moldova
Argentina	Ghana	Romania
Armenia	Gibraltar	Russian Federation
Aruba	Greece	Rwanda
Austria	Greenland	Saint Helena
Azerbaijan	Grenada	Saint Kitts and Nevis
Bahamas	Guinea	Saint Lucia
Bangladesh	Guinea-Bissau	Saint Maarten
Barbados	Guyana	Saint Pierre and Miquelon
Belarus	Haiti	Saint Vincent and the Grenadines
Belgium-Luxembourg	Hungary	Samoa
Belize	Iceland	San Marino
Benin	India	Sao Tome and Principe
Bermuda	Indonesia	Saudi Arabia
Bhutan	Iran	Senegal
Bolivia (Plurinational State of)	Iraq	Serbia
Bosnia Herzegovina	Ireland	Serbia and Montenegro
Br. Indian Ocean Terr.	Italy	Seychelles
Br. Virgin Isds	Jamaica	Sierra Leone
Brazil	Japan	Slovakia
Brunei Darussalam	Kazakhstan	Slovenia
Bulgaria	Kenya	So. African Customs Union
Burkina Faso	Kiribati	Solomon Isds
Burundi	Kuwait	Somalia
Cabo Verde	Kyrgyzstan	South Sudan
Cambodia	Lao People's Dem. Rep.	Spain
Cameroon	Latvia	Sri Lanka
Cayman Isds	Lebanon	State of Palestine
Central African Rep.	Liberia	Sudan
Chad	Libya	Suriname
China	Lithuania	Sweden
China, Hong Kong SAR	Madagascar	Switzerland
China, Macao SAR	Malawi	Syria
Christmas Isds	Malaysia	TFYR of Macedonia
Cocos Isds	Maldives	Tajikistan
Comoros	Mali	Thailand
Congo	Malta	Timor-Leste
Cook Isds	Marshall Isds	Togo
Croatia	Mauritania	Tokelau
Cuba	Mauritius	Tonga
Curaçao	Mongolia	Trinidad and Tobago
Cyprus	Montenegro	Tunisia
Czechia	Montserrat	Turkey
Côte d'Ivoire	Mozambique	Turkmenistan
Dem. People's Rep. of Korea	Myanmar	Turks and Caicos Isds
Dem. Rep. of the Congo	Nauru	Tuvalu
Denmark	Nepal	Uganda
Djibouti	Neth. Antilles	Ukraine
Dominica	Netherlands	United Arab Emirates
Ecuador	New Caledonia	United Kingdom
Egypt	New Zealand	United Rep. of Tanzania
Equatorial Guinea	Niger	Uruguay
Eritrea	Nigeria	Uzbekistan
Estonia	Niue	Vanuatu
Ethiopia	Norfolk Isds	Venezuela
FS Micronesia	Norway	Viet Nam
Falkland Isds (Malvinas)	Other Asia, nes	Wallis and Futuna Isds
Fiji	Pakistan	Yemen
Finland	Palau	Zambia
Fmr Sudan	Papua New Guinea	Zimbabwe

Table A2: Number of Products Per Phase-In Type

Phase-In Type	**Number of Products**	**Percent**
Duty Free	33,281	40.51
Immediate	41,375	50.37
1 year	1,333	1.62
2 years	138	0.17
3 years	1,534	1.87
4 years	991	1.21
5 years	756	0.92
6 years	31	0.04
7 years	311	0.38
8 years	62	0.08
9 years	856	1.04
10 years	488	0.59
11 years	69	0.08
14 years	194	0.24
17 years	45	0.05
18 years	69	0.08
19 years	108	0.13
Exempt	504	0.61
Total	82,145	

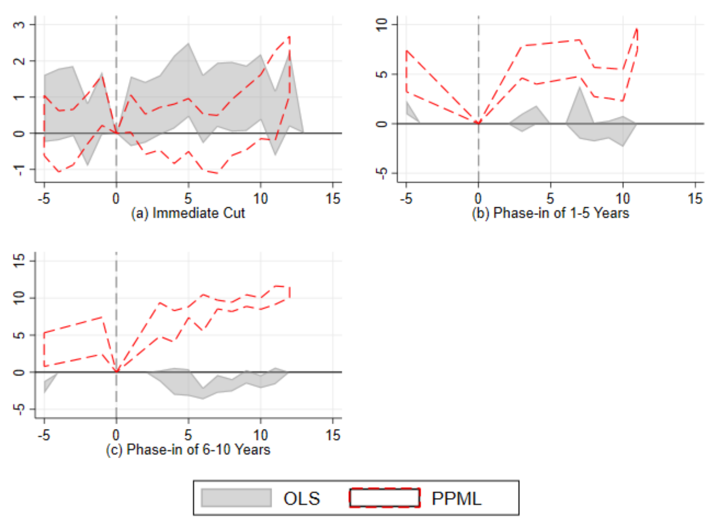
Notes: Each row counts the number of HS6 products per phase-in type. Duty Free denotes products which are products that have MFN tariffs equal to zero prior to the PTA. Immediate products are decreased to their final tariff in the first year of the PTA. Exempt products do not experience any tariff cut and have MFN tariffs greater than zero.

Figure A1: Heterogeneous Estimates for Australia



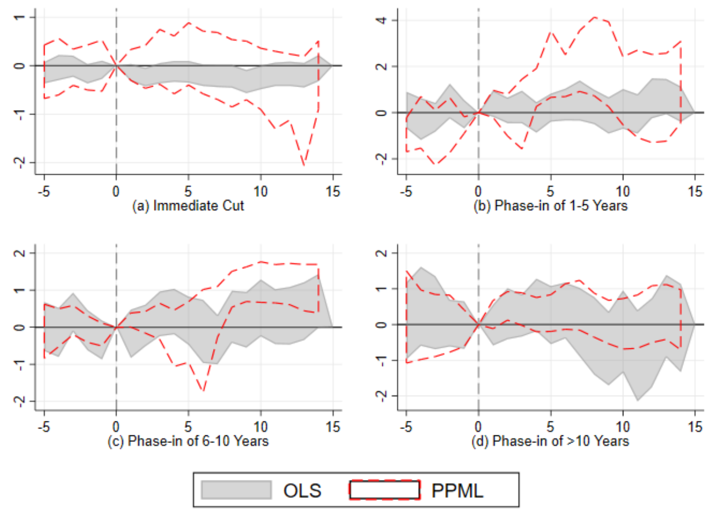
Notes: Plots represent 95% confidence intervals. Dashed vertical line at year zero is the signature year and serves as the reference year. Standard errors are clustered two-way by exporter-product and product-year.

Figure A2: Heterogeneous Estimates for Bahrain



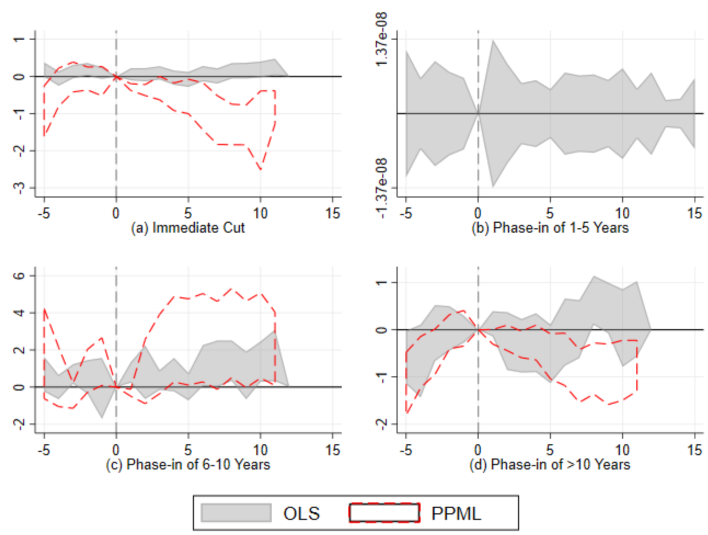
Notes: Plots represent 95% confidence intervals. Dashed vertical line at year zero is the signature year and serves as the reference year. Standard errors are clustered two-way by exporter-product and product-year.

Figure A3: Heterogeneous Estimates for Chile



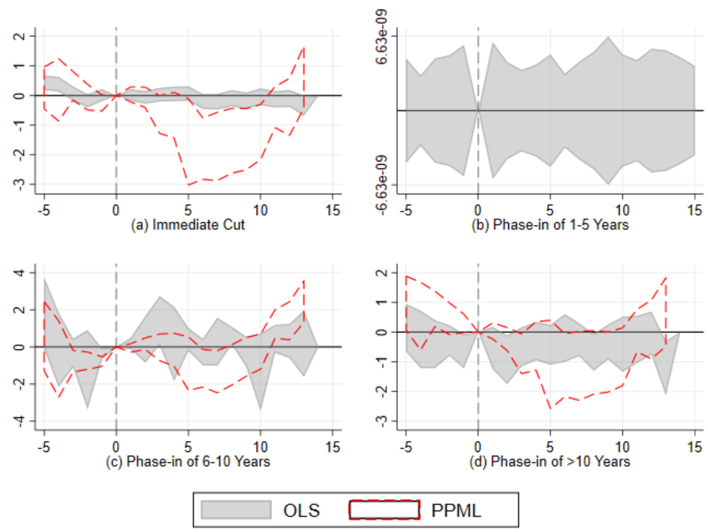
Notes: Plots represent 95% confidence intervals. Dashed vertical line at year zero is the signature year and serves as the reference year. Standard errors are clustered two-way by exporter-product and product-year.

Figure A4: Heterogeneous Estimates for Colombia



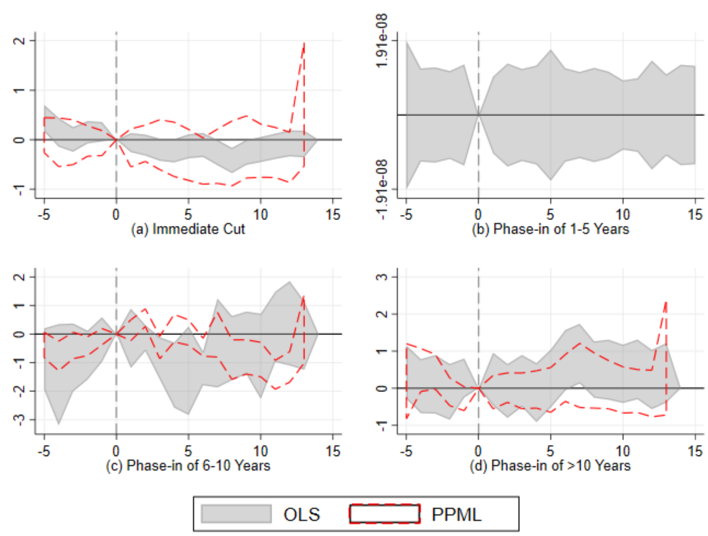
Notes: Plots represent 95% confidence intervals. Dashed vertical line at year zero is the signature year and serves as the reference year. Standard errors are clustered two-way by exporter-product and product-year.

Figure A5: Heterogeneous Estimates for Costa Rica



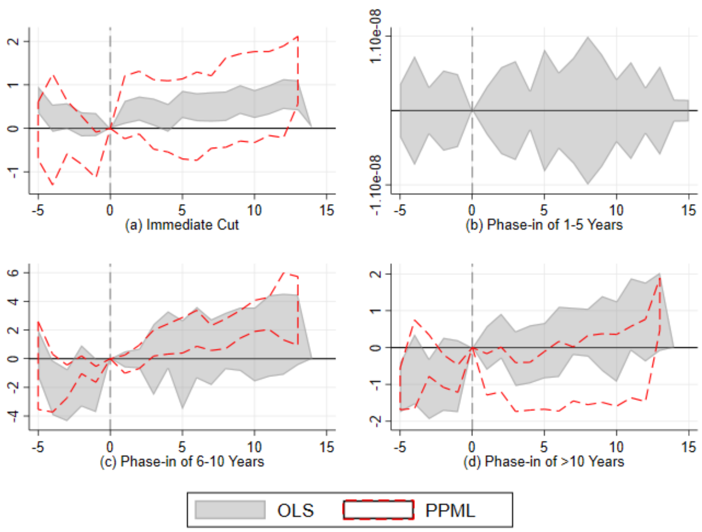
Notes: Plots represent 95% confidence intervals. Dashed vertical line at year zero is the signature year and serves as the reference year. Standard errors are clustered two-way by exporter-product and product-year.

Figure A6: Heterogeneous Estimates for Dominican Republic



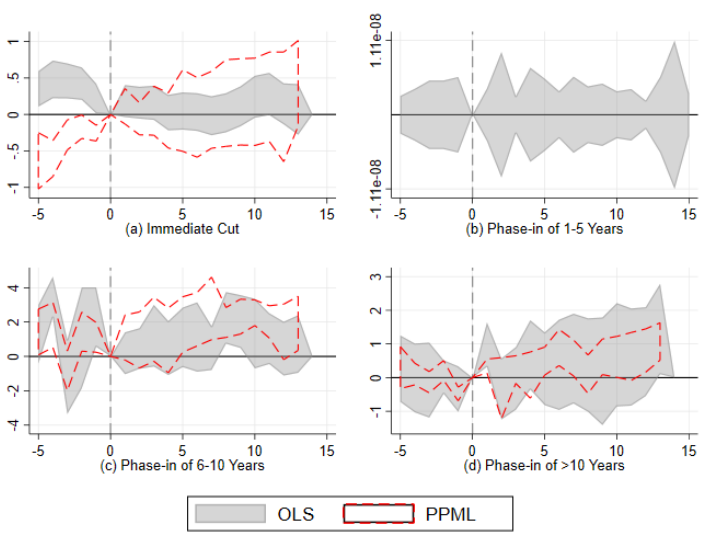
Notes: Plots represent 95% confidence intervals. Dashed vertical line at year zero is the signature year and serves as the reference year. Standard errors are clustered two-way by exporter-product and product-year.

Figure A7: Heterogeneous Estimates for El Salvador



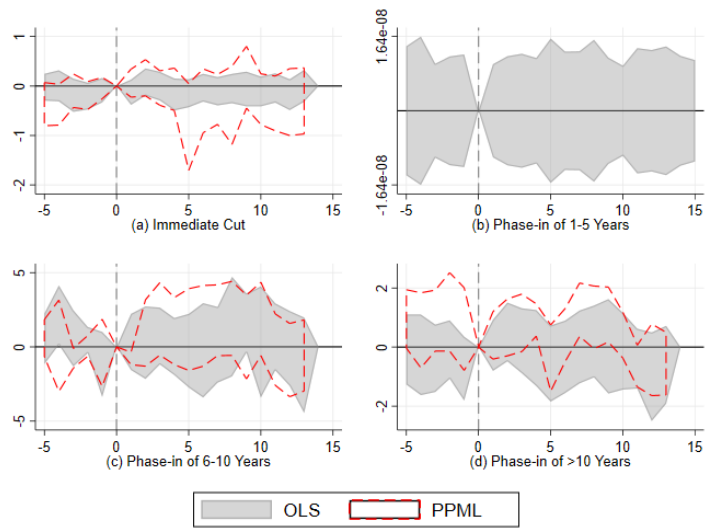
Notes: Plots represent 95% confidence intervals. Dashed vertical line at year zero is the signature year and serves as the reference year. Standard errors are clustered two-way by exporter-product and product-year.

Figure A8: Heterogeneous Estimates for Guatemala



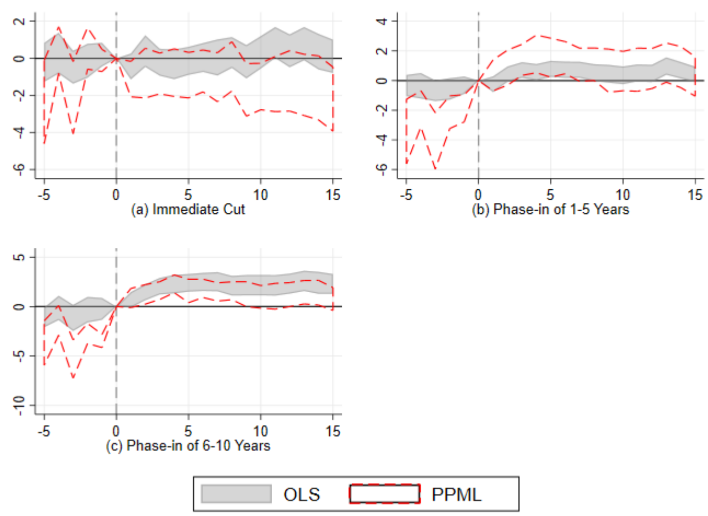
Notes: Plots represent 95% confidence intervals. Dashed vertical line at year zero is the signature year and serves as the reference year. Standard errors are clustered two-way by exporter-product and product-year.

Figure A9: Heterogeneous Estimates for Honduras



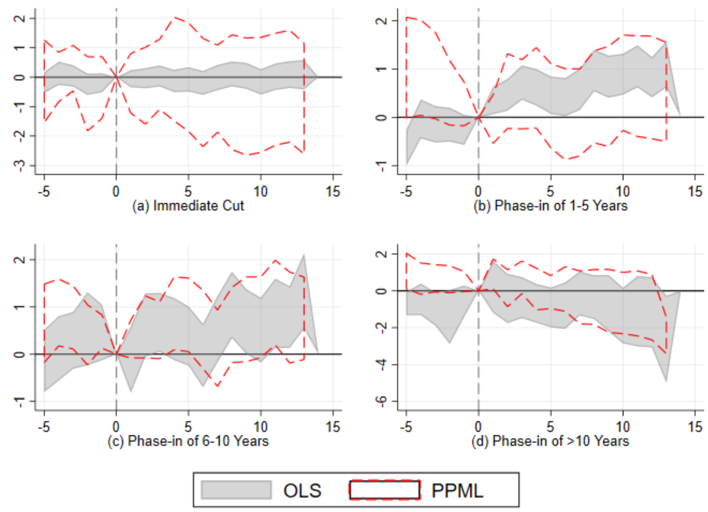
Notes: Plots represent 95% confidence intervals. Dashed vertical line at year zero is the signature year and serves as the reference year. Standard errors are clustered two-way by exporter-product and product-year.

Figure A10: Heterogeneous Estimates for Jordan



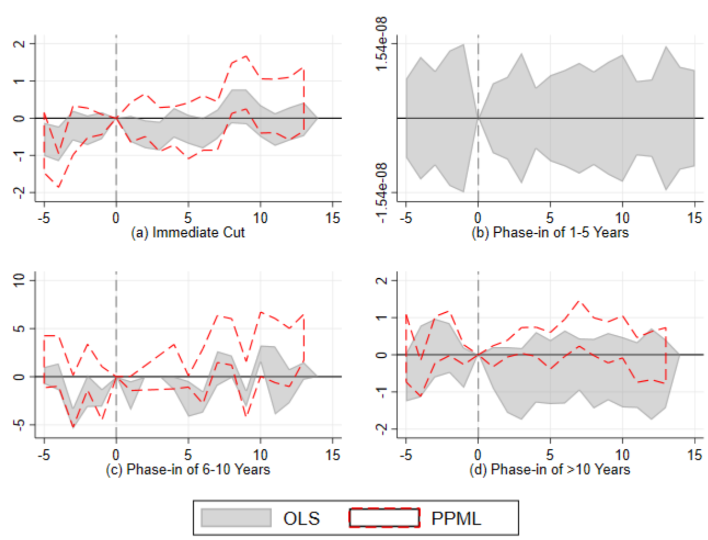
Notes: Plots represent 95% confidence intervals. Dashed vertical line at year zero is the signature year and serves as the reference year. Standard errors are clustered two-way by exporter-product and product-year.

Figure A11: Heterogeneous Estimates for Morocco



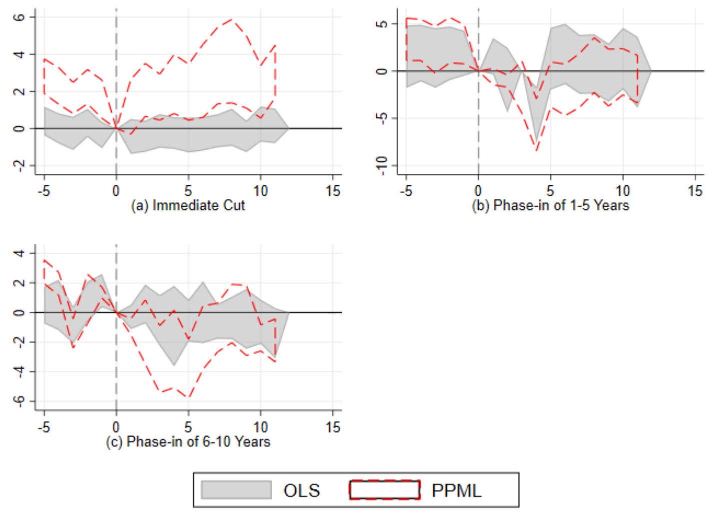
Notes: Plots represent 95% confidence intervals. Dashed vertical line at year zero is the signature year and serves as the reference year. Standard errors are clustered two-way by exporter-product and product-year.

Figure A12: Heterogeneous Estimates for Nicaragua



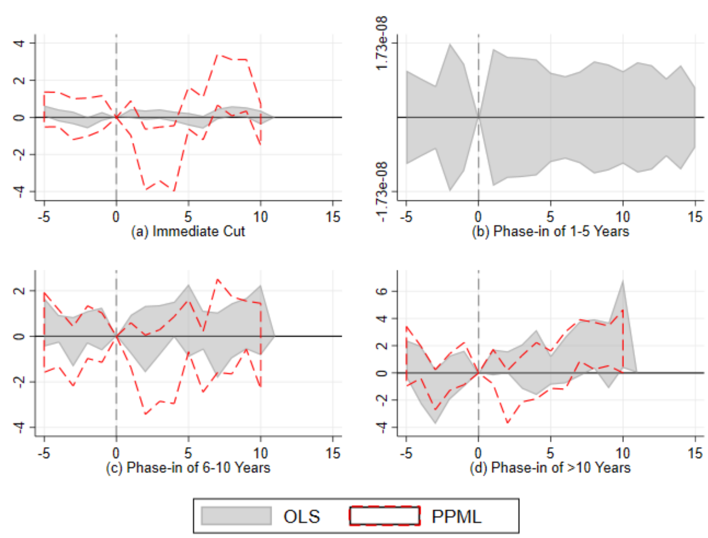
Notes: Plots represent 95% confidence intervals. Dashed vertical line at year zero is the signature year and serves as the reference year. Standard errors are clustered two-way by exporter-product and product-year.

Figure A13: Heterogeneous Estimates for Oman



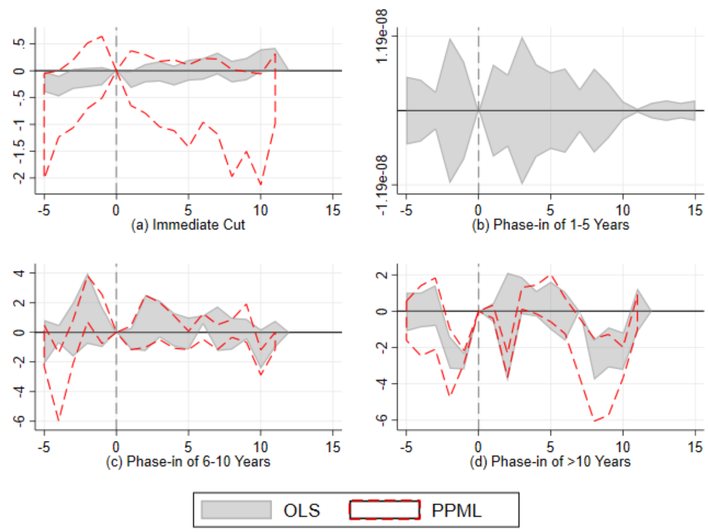
Notes: Plots represent 95% confidence intervals. Dashed vertical line at year zero is the signature year and serves as the reference year. Standard errors are clustered two-way by exporter-product and product-year.

Figure A14: Heterogeneous Estimates for Panama



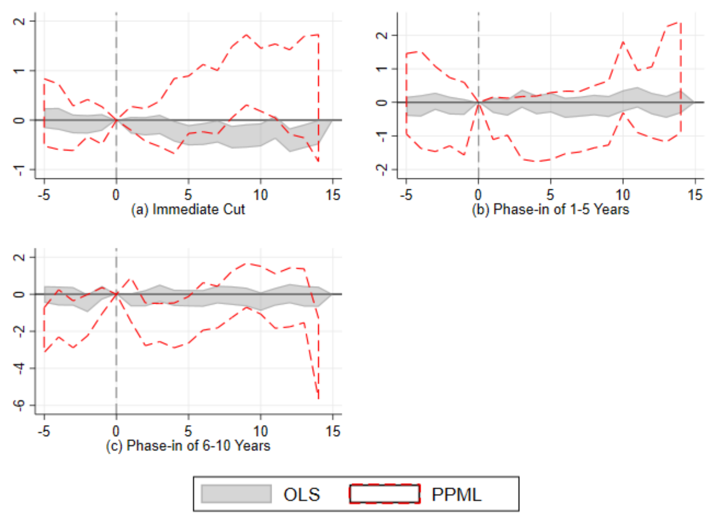
Notes: Plots represent 95% confidence intervals. Dashed vertical line at year zero is the signature year and serves as the reference year. Standard errors are clustered two-way by exporter-product and product-year.

Figure A15: Heterogeneous Estimates for Peru



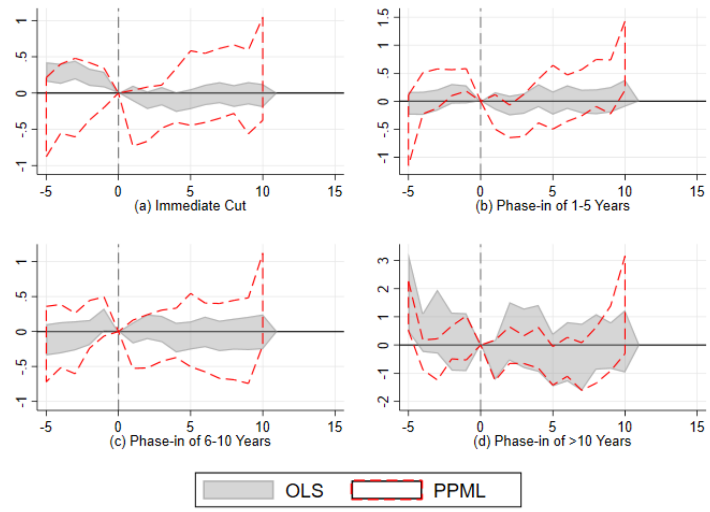
Notes: Plots represent 95% confidence intervals. Dashed vertical line at year zero is the signature year and serves as the reference year. Standard errors are clustered two-way by exporter-product and product-year.

Figure A16: Heterogeneous Estimates for Singapore



Notes: Plots represent 95% confidence intervals. Dashed vertical line at year zero is the signature year and serves as the reference year. Standard errors are clustered two-way by exporter-product and product-year.

Figure A17: Heterogeneous Estimates for South Korea



Notes: Plots represent 95% confidence intervals. Dashed vertical line at year zero is the signature year and serves as the reference year. Standard errors are clustered two-way by exporter-product and product-year.