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# Free Trade Agreements, Exports, and Structural Transformation

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# Free Trade Agreements, Exports, and Structural Transformation

Alberto Chong and Federico Corredor*

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## Abstract

This paper examines the effects of free trade agreements (FTAs) with the United States on the sectoral composition of exports in partner countries. Using a staggered difference-in-differences design that accounts for heterogeneous treatment effects, we document that FTAs induce a systematic shift in export composition away from primary commodities and toward manufacturing. This expansion is concentrated in low-technology, labor-intensive sectors, with no significant effects on high-technology industries, consistent with specialization along existing comparative advantage. Dynamic treatment effects indicate that these structural changes are persistent and continue to evolve over time. We further show that these effects are heterogeneous across countries, with stronger responses in smaller, trade-dependent economies and more limited or mixed effects in larger or resource-based economies. These findings contribute to the trade and development literature by providing causal evidence that deeply negotiated bilateral FTAs can reshape export structure in developing economies.

Keywords: free trade agreements, exports, structural transformation, development

JEL Codes: F13, F14, O14

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## 1. Introduction

In the context of a growing backlash against trade openness, a central question in international economics is how trade agreements shape economic structure in developing countries. While a large literature has examined the aggregate gains from trade, less is known about how deeply negotiated bilateral agreements, such as free trade agreements (FTAs) with the United States, affect the sectoral composition of economic activity. On the one hand, critics argue that FTAs expose workers in developing countries to increased competition, however, proponents emphasize their potential to generate employment and raise wages through expanded market access. Despite this extensive debate, less is known about the extent to which FTAs reshape the sectoral composition of economic activity.

The relationship between trade liberalization and structural transformation has generated a somewhat extensive empirical and theoretical literature. A central insight emerging from this work is that the consequences of trade depend critically on how liberalization reshapes the sectoral composition of economic activity, rather than on aggregate trade exposure alone. This mechanism is particularly relevant in the context of North–South trade. For instance, Zhu and Trefler (2005) show that trade can reduce inequality in developing countries even in the presence of skill-biased technological change, provided that comparative advantage operates strongly in low-skill-intensive sectors. In their framework, Southern countries specialize in goods intensive in their relatively abundant factor, unskilled labor, leading to a compression of wage differentials. Along the same lines, Feenstra and Hanson (1996) emphasize the role of international outsourcing, whereby firms in advanced economies relocate low-skill-intensive production stages to developing countries. In our setting, FTAs may facilitate such integration into global value chains, reinforcing the expansion of low-technology manufacturing in partner economies. This structural transformation perspective complements a broader literature that documents heterogeneous effects of trade liberalization. In this context, Goldberg and Pavcnik (2007) provide a comprehensive synthesis, highlighting that the effects of trade reforms vary substantially across countries and depend on sectoral composition, labor market conditions, and the nature of trade shocks. Winters et al. (2004) similarly emphasize that the impact of trade depends on how changes in relative prices interact with the structure of production and household income sources. Within the literature on trade agreements, Baier and Bergstrand (2007) establish that FTAs substantially increase bilateral trade flows, providing a foundation for analyzing their downstream effects. Caliendo and Parro

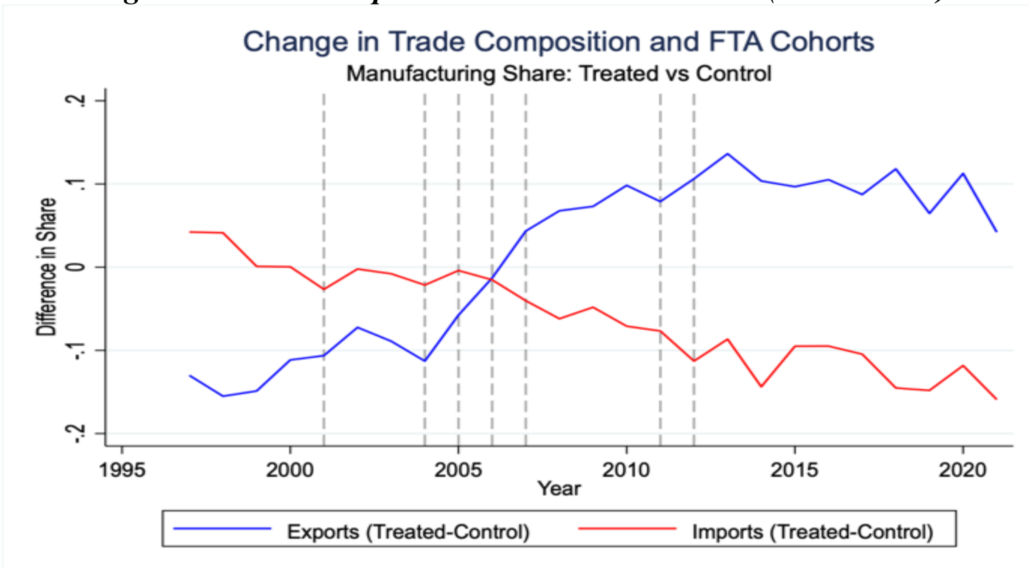
(2015) show that such agreements can generate welfare gains through inter-sectoral reallocation, with distributional implications that depend on sectoral characteristics. Complementing this perspective, Hakobyan and McLaren (2016) document that trade shocks can have asymmetric effects across countries, depending on whether they operate primarily through import competition or export expansion. Micro-level evidence further underscores the importance of sectoral channels. Additionally, Attanasio et al. (2004) find that tariff reductions in Colombia affected wage premia differently across sectors depending on their skill intensity, while Topalova (2010) shows that import competition slowed poverty reduction in exposed regions in India. In contrast, Porto (2006) finds that trade liberalization in Argentina reduced poverty through changes in relative prices and sectoral composition. Interestingly, most studies focus on distributional outcomes and collectively highlight that the direction and sectoral composition of trade shocks are central to understanding their broader economic effects.

Unlike most previous research, in our study, we focus on the extent to which free trade agreements operate particularly through an export-expansion channel in different sectors and how this may structurally impact specific industries and labor-related reallocation. Empirically, identifying these effects is challenging due to the endogeneity of agreement timing and the heterogeneity of treatment effects across countries and over time. This paper addresses these challenges by studying FTAs signed between developing countries and the United States, the world's largest consumer market and the most active bilateral FTA partner over the past three decades. We implement a staggered difference-in-differences design that allows for heterogeneous treatment effects across cohorts and over time.

For the sake of motivation, Figure 1 presents the stylized facts that motivate our empirical analysis. Countries that signed an FTA with the United States (treated) exhibit a clear structural transformation of exports over time, characterized by an increasing share of manufacturing, while countries without an agreement (controls) display a markedly different pattern.[1] Over the sample period, multiple cohorts of countries entered FTAs with the United States, raising the question of whether the observed patterns are causally driven by these agreements.

[1] Appendix A reports the list of countries in the sample that have entered into FTAs with the United States and the corresponding year of entry into force.

*Figure 1. Trade Composition Across FTA Cohorts (1996 – 2021)*




Sources: Authors' calculations based on World Bank and UN COMTRADE data. Notes: The figure plots the difference in manufacturing trade shares between countries that signed a U.S. FTA (treated) and those that did not (control). The blue line corresponds to exports and the red line to imports. Vertical dashed lines indicate the timing of FTA implementation for treated cohorts.

Our main finding is that FTAs with the United States induce a systematic structural transformation of exports in partner countries. Following entry into force, the share of primary goods declines, while manufacturing expands by a comparable magnitude, consistent with a reallocation of existing export capacity. These results are robust to alternative estimation approaches that account for heterogeneous treatment effects, the use of log outcomes, the exclusion of controls, jackknife procedures, placebo tests, and wild-bootstrap inference. Heterogeneity analysis shows that, on average, the expansion in manufacturing is driven by low-technology, labor-intensive sectors, with no significant effects on high-technology manufacturing. However, substantial differences emerge across cohorts: FTAs appear to facilitate structural transformation primarily in smaller, trade-dependent economies, while having more limited or heterogeneous effects in larger or resource-based economies.

Our findings contribute to the literature in several ways. First, we provide causal, cross-country evidence on the effects of FTAs on export composition, distinguishing them from unilateral trade liberalization. Second, we document that structural transformation operates through the expansion of low-technology manufacturing sectors. Third, we show that these effects are heterogeneous and depend on initial conditions, including economic size, sectoral composition, and integration into global markets. Finally, we document that these effects are persistent over time, suggesting that FTA-induced structural transformation evolves gradually.

The remainder of the paper is organized as follows. Section 2 reviews the relevant literature. Section 3 describes the data and empirical strategy. Section 4 presents the main results. Section 5 reports robustness checks. Section 6 concludes.

## 2. Data and Methodology

Our research combines data on international trade and macroeconomic controls from multiple sources. Data on international trade are obtained from the United Nations Comtrade database, which provides detailed bilateral trade statistics by product and trading partner for approximately 200 countries, covering the vast majority of global merchandise trade. Using Harmonized System (HS) classifications, we aggregate exports at the country-year level and construct measures of export composition at the 2-digit level. In particular, we compute the share of exports in primary goods and manufacturing, and further decompose manufacturing into low- and high-technology sectors. These measures allow us to capture structural transformation following trade liberalization.[2] Macroeconomic controls are obtained from the World Bank's World Development Indicators and include log GDP per capita, GDP growth, natural resource rents as a share of GDP, total population, and the urbanization rate. These variables account for differences in economic development, resource dependence, and demographic structure across countries.

Our final dataset is an unbalanced country-year panel covering the period 1996–2021, determined by the availability of trade data and the timing of FTA implementation. Treated countries are those that sign an FTA with the United States, while the control group consists of countries that do not enter into an FTA with the United States during the sample period. All variables are harmonized at the country-year level prior to estimation.

Table 1 presents summary statistics for the main outcome variables by treatment status in the pre-treatment period (i.e., prior to FTA entry into force). Treated countries exhibit a higher share of primary exports and a correspondingly lower share of manufacturing exports relative to the control group, suggesting a more commodity-oriented export structure prior to treatment. Appendix C reports summary statistics for the full set of covariates. Consistent with these patterns, treated

[2] See Appendix B for details on the specific digits assigned to each sector.

countries differ from control countries along several observable dimensions, underscoring the importance of accounting for pre-existing heterogeneity in the empirical analysis.

***Table 1: Descriptive Statistics by Treatment Status, 1996-2021***

| | Treated (Pre) | Control (Pre) |
|---|---|---|
| Primary Exports Share | 0.467 | 0.360 |
| | (0.323) | (0.344) |
| Manufacturing Exports Share | 0.527 | 0.622 |
| | (0.319) | (0.343) |
| Primary Sector Imports Share | 0.213 | 0.216 |
| | (0.133) | (0.175) |
| Manufacturing Imports Share | 0.777 | 0.772 |
| | (0.131) | (0.176) |
| Observations | 151 | 3352 |

Sources: Authors' calculations based on World Bank and UN COMTRADE. Notes: The table reports pre-treatment means with standard deviations in parentheses. For treated countries, observations correspond to years prior to FTA adoption. Control countries are never treated and include all available years.

Our empirical strategy exploits the staggered timing of FTA implementation across countries. We estimate treatment effects using the group-time average treatment effect framework of Callaway and Sant'Anna estimator (2021), and assess robustness using Sun and Abraham estimator (2021).[3] These methods are well suited to staggered adoption settings, as they avoid the negative-weighting problem inherent in conventional two-way fixed effects difference-in-differences estimators (Goodman-Bacon, 2021), which can assign non-convex weights and rely on comparisons between already-treated and newly treated units. This concern is particularly relevant in our context, where early FTA adopters may differ systematically from later adopters in their initial economic structure. Identification relies on comparisons between treated countries and those that never adopt an FTA with the United States during the sample period, which serve as the control group throughout the analysis.

[3] While both methods are designed to address limitations of standard DiD estimators, we prefer the Callaway and Sant'Anna framework because it directly estimates group-time average treatment effects and provides flexible aggregation across cohorts. The Sun and Abraham approach yields qualitatively similar results and is therefore used as a complementary robustness exercise.

Formally, let $G_i$denote the first year in which country $i$ adopts an FTA with the United States. The parameter of interest is the group-time average treatment effect:

$$ATT(g,t) = \mathbb{E}[\,Y_{it}(1) - Y_{it}(0) \mid G_i = g\,], \tag{1}$$

which is identified under a conditional parallel trends assumption using never-treated countries as the control group. We include as covariates log GDP per capita, GDP growth, natural resource rents as a share of GDP, log population, and the urbanization rate, and estimate effects using the doubly robust inverse probability weighting procedure proposed by Callaway and Sant'Anna (2021). Intuitively, the estimator relies on a sequence of two-by-two difference-in-differences comparisons between treated and control units across time, differencing out time-invariant country characteristics and common shocks without imposing the restrictive assumptions of a two-way fixed effects model. To examine dynamic effects, we aggregate treatment effects by event time:

$$ATT(k) = \mathbb{E}[\,ATT(g,t) \mid t - g = k\,], \tag{2}$$

and report coefficients over the window $k \in [-8,16]$, where negative values correspond to pre-treatment periods and positive values to post-treatment periods. Pre-treatment coefficients are used to assess the plausibility of the identifying assumption, and we formally test whether all pre-treatment effects are jointly equal to zero. Finally, we complement our baseline estimates with sensitivity analysis following Rambachan and Roth (2023), which allows us to assess how deviations from parallel trends would affect our conclusions. This approach is particularly informative in our setting, where pre-treatment trends may be noisy for some outcomes.

## 3. Results

Table 2 reports the estimated effects of FTAs with the United States on export composition. Panel A presents results for exports. Pre-treatment coefficients are small and statistically insignificant across all specifications, supporting the validity of the identifying assumption. Following FTA implementation, we observe a substantial and statistically significant reallocation of exports away from primary goods and toward manufacturing. Column (1) shows that the share of primary exports declines by 16 percentage points, while column (2) indicates a corresponding increase of 17 percentage points in the manufacturing share. These patterns are consistent with a reallocation of export activity across sectors rather than an expansion in overall trade. Panel B presents analogous results for imports. In contrast to exports, we find limited evidence of systematic changes in import composition following FTA implementation. While the share of primary imports increases modestly by 6 percentage points, this effect is not accompanied by corresponding changes in manufacturing imports or their technological composition. Overall, these results suggest that FTAs with the United States primarily operate through changes in export structure.

***Table 2: Effect of FTA on Export and Import Shares***

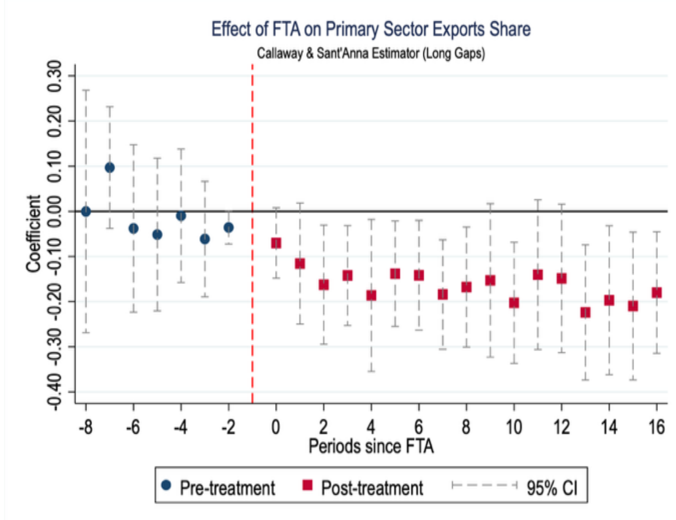
| | | Primary Sector Share | Manufacturing Share |
|---|---|---|---|
| *Panel A. Exports* | | | |
| | Pre-treatment effect | -0.002 | -0.002 |
| | | (0.08) | (0.08) |
| | Post-treatment effect | -0.16*** | 0.17*** |
| | | (0.06) | (0.06) |
| | Observations | 3,765 | 3,765 |
| *Panel B. Imports* | | | |
| | Pre-treatment effect | -0.02 | 0.03 |
| | | (0.02) | (0.02) |
| | Post-treatment effect | 0.06** | -0.04 |
| | | (0.03) | (0.03) |
| | Observations | 3,765 | 3,765 |

Sources: Authors' calculations based on World Bank and UN COMTRADE. Notes: The number of observations differs slightly between exports and imports due to asymmetric reporting and missing trade flows in COMTRADE. Results are robust to restricting the sample to common observations. Standard errors clustered at the country level in parentheses. *** p<0.01, ** p<0.05, *p<0.10

We estimate dynamic treatment effects using the Callaway and Sant'Anna group-time ATT estimator, plotting average treatment effects relative to the year of FTA entry into force. The event window spans from eight periods before to sixteen periods after treatment. We focus on four outcomes that jointly characterize changes in export composition: the share of primary goods, the aggregate share of manufacturing exports, and the shares of low- and high-technology manufacturing. These measures allow us to trace the sectoral reallocation associated with FTAs and to assess the timing and persistence of structural transformation. Pre-treatment coefficients provide a test of the identifying assumption, while post-treatment dynamics capture the evolution of the effects.

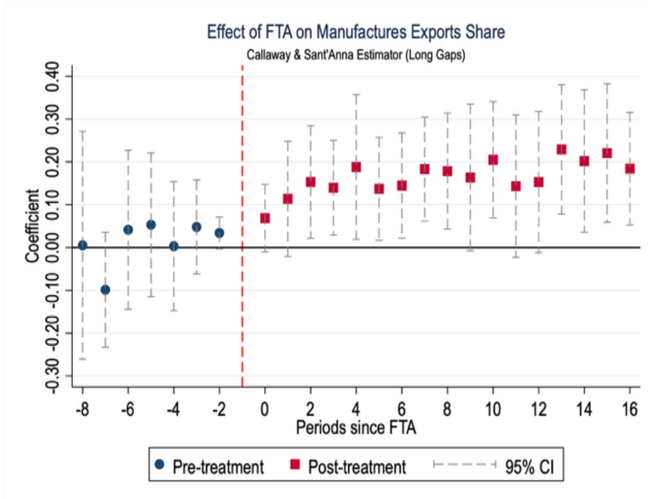
Figure 2 presents the dynamic effects of FTAs on primary and manufacturing export shares.[4] The left panel shows that the share of primary exports declines following FTA implementation, with effects stabilizing at approximately 15–20 percentage points below pre-treatment levels. The right panel shows a corresponding increase in the share of manufacturing exports, with effects of a similar magnitude that persist throughout the post-treatment period. In both cases, pre-treatment coefficients are close to zero and do not display systematic trends, supporting the plausibility of the identifying assumption. Taken together, these results indicate a sustained reallocation of export activity away from primary goods and toward manufacturing.[5]

***Figure 2. Dynamic Effect of FTA on Primary and Manufacturing Exports Shares***




[4] We report event-study estimates using long-gap specifications, which normalize outcomes relative to the last pre-treatment period and are more informative about cumulative deviations and standard event-study dynamics. Short-gap specifications, which capture period-to-period changes and are more sensitive to short-run fluctuations, are reported in Appendix F.

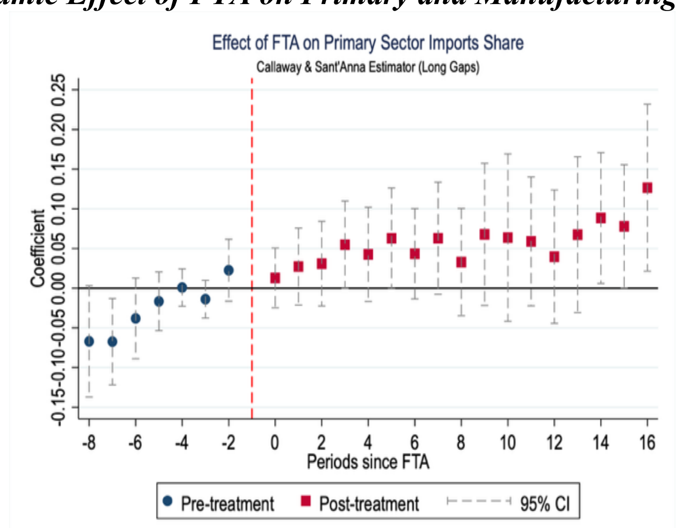
[5] Appendix D reports estimates excluding covariates. The results remain stable in direction, magnitude, and statistical significance, suggesting that the findings are not driven by the inclusion of control variables. Appendix G reports jackknife estimates excluding one country at a time. The results indicate that the main findings, namely, the increase in manufacturing export shares and the decline in primary export shares, are not driven by any single country.

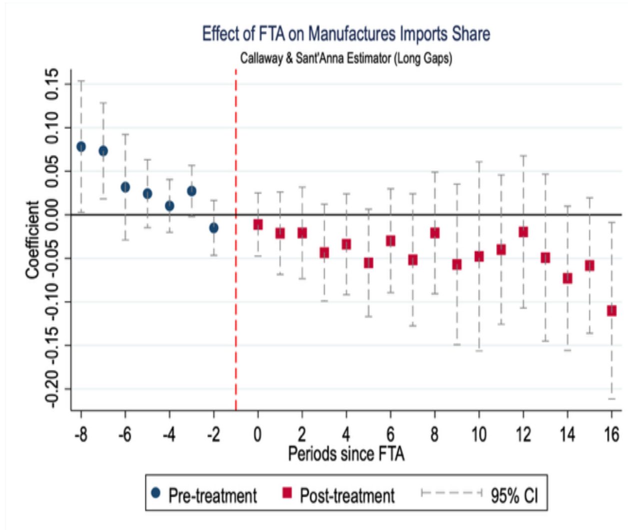



Sources: Authors' calculations based on World Bank and UN COMTRADE data. Notes: Estimates are based on the Callaway and Sant'Anna (2021) difference-in-differences framework with long-gap specifications.

Figure 3 presents the dynamic effects on import composition. In contrast to exports, we find limited evidence of discrete changes in import shares following FTA implementation. The share of primary imports increases gradually over time, while manufacturing import shares exhibit a modest decline. However, these patterns appear to reflect underlying trends rather than a clear shift at the time of treatment. Indeed, when a linear trend in event time is accounted for, these effects largely disappear (see Section 6.1). This contrast reinforces the interpretation that FTAs primarily affect export composition rather than import structure.

***Figure 3. Dynamic Effect of FTA on Primary and Manufacturing Imports Share***



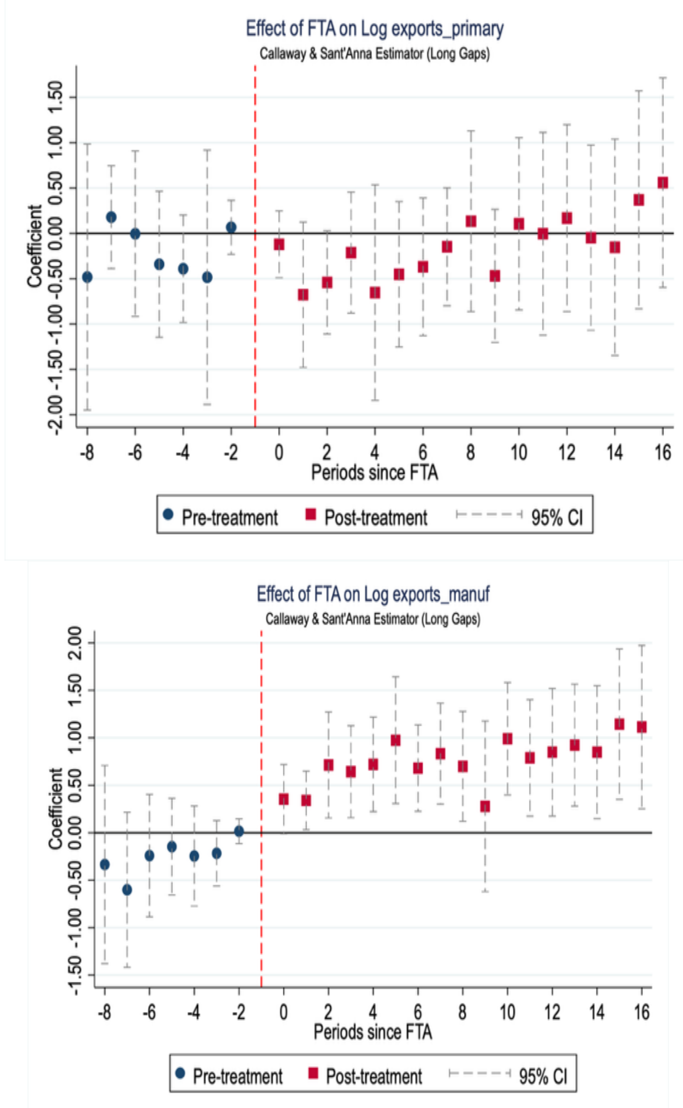



Sources: Authors' calculations based on World Bank and UN COMTRADE data. Notes: Estimates are based on the Callaway and Sant'Anna (2021) difference-in-differences framework with long-gap specifications.

To further interpret the share-based results, Figure 4 reports event-study estimates using log export levels for primary and manufacturing sectors.[6] Manufacturing exports increase significantly following FTA implementation, while primary exports do not exhibit a corresponding decline. This suggests that the observed changes in export shares are driven by faster growth in manufacturing rather than an absolute contraction in primary sectors. Taken together, these findings provide a consistent picture of how FTAs with the United States reshape export composition. Importantly, the similarity in magnitudes between the decline in primary shares and the increase in manufacturing shares reflects relative changes in composition rather than a strict one-for-one substitution across sectors. The evidence from log export levels further suggests that structural transformation is driven by differential growth across sectors, with manufacturing expanding more rapidly.

[6] Log outcomes capture overall trade expansion, by contrast, share-based measures isolate relative changes in composition, allowing us to more cleanly identify structural transformation across sectors. For this reason, we treat export shares as our primary specification. Shares provide a direct measure of sectoral reallocation, the key object of interest in our analysis, while being less sensitive to common shocks to total trade. The log-level results should therefore be interpreted as complementary evidence, confirming that the observed compositional shifts are accompanied by changes in levels, but not driving our main conclusions.

*Figure 4. Dynamic Effect of FTA on Primary and Manufacturing Log Exports*




Sources: Authors' calculations based on World Bank and UN COMTRADE data. Notes: Estimates are based on the Callaway and Sant'Anna (2021) difference-in-differences framework with long-gap specifications.

The dynamic treatment effects also indicate that this transformation is gradual and persistent. Manufacturing gains continue to accumulate throughout the post-treatment window, with no evidence of reversal. This pattern is consistent with an ongoing process of adjustment, potentially reflecting firm entry, learning-by-doing, and the deepening of trade relationships. As a result, the estimated effects may understate the long-run impact of FTAs on export structure. Given that FTAs are not randomly assigned, and that countries entering such agreements may already be undergoing structural changes prior to implementation, Figure E1 in Appendix E reports event-study estimates using a two-year anticipation structure, with $t = -2$ as the reference category. The patterns are consistent with the baseline estimates: primary export shares decline, while manufacturing export shares increase following FTA implementation. Pre-treatment coefficients remain stable, and post-treatment dynamics are similar in both magnitude and trajectory to those obtained in the main specifications. These results indicate that the findings are not driven by the choice of reference period or the inclusion of control variables.[7]

#### 4. Heterogeneity Analysis

We now examine heterogeneity in the effects of FTAs. First, we analyze which types of manufacturing drive the aggregate effects. Second, we explore product-level responses to identify which goods gain or lose importance following FTA implementation. Third, we investigate heterogeneity across FTA adoption cohorts. We further decompose manufacturing into low- and high-technology sectors. The estimates in Table 3 show that, on average, the increase in manufacturing is driven by low-technology, labor-intensive industries, which expand by 11 percentage points, while high-technology manufacturing shows no statistically significant response. Pre-treatment coefficients are small and statistically insignificant across specifications, supporting the plausibility of the identifying assumption. These results are consistent with a pattern of structural transformation toward labor-intensive production.

***Table 3: Effect of FTA on Low- and High-Tech Manufacturing Export Share***

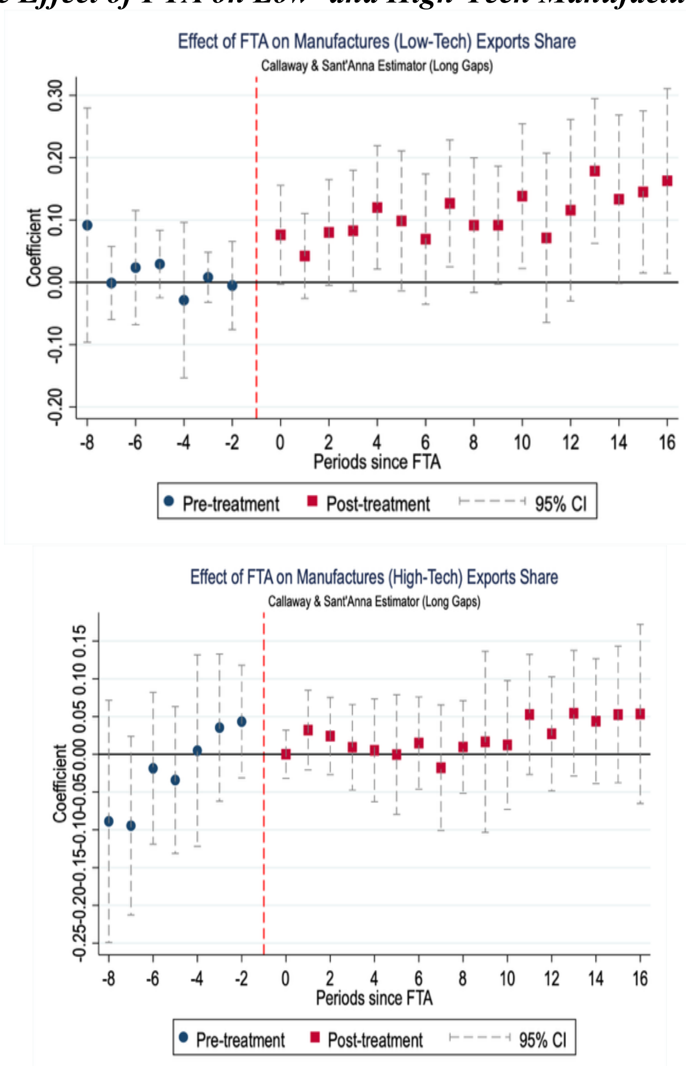
| | (Low-Tech) Manuf Share | (High-Tech) Manuf Share |
|---|---|---|
| *Panel A. Exports* | | |
| Pre-treatment effect | -0.02 | -0.04 |
| | (0.03) | (0.05) |
| Post-treatment effect | 0.11** | 0.02 |
| | (0.04) | (0.03) |
| Observations | 3,765 | 3,765 |

Sources: Authors' calculations based on World Bank and UN COMTRADE. Notes: The number of observations differs slightly between exports and imports due to asymmetric reporting and missing trade flows in COMTRADE. Results are robust to restricting the sample to common observations. Standard errors clustered at the country level in parentheses. *** p<0.01, ** p<0.05, *p<0.10

[7] Appendix H reports placebo event-study estimates for aggregate and disaggregated export outcomes. The coefficients fluctuate around zero and display no systematic pattern in either the pre- or placebo post-treatment periods. The absence of persistent trends or statistically meaningful effects supports the interpretation that the baseline results are not driven by spurious timing or pre-treatment dynamics.

Figure 5 presents the corresponding event-study estimates. The left panel shows a clear and persistent increase in the share of low-technology manufacturing exports following FTA implementation. As in previous specifications, pre-treatment coefficients are close to zero and do not display systematic trends. After treatment, low-technology manufacturing exports rise steadily, with effects reaching approximately 10–15 percentage points and continuing to grow over time. In contrast, we find no evidence of a systematic response in high-technology manufacturing exports. Pre-treatment coefficients are small, and post-treatment estimates remain close to zero and statistically insignificant throughout the event window.

***Figure 5. Dynamic Effect of FTA on Low- and High-Tech Manufacturing Export Shares***



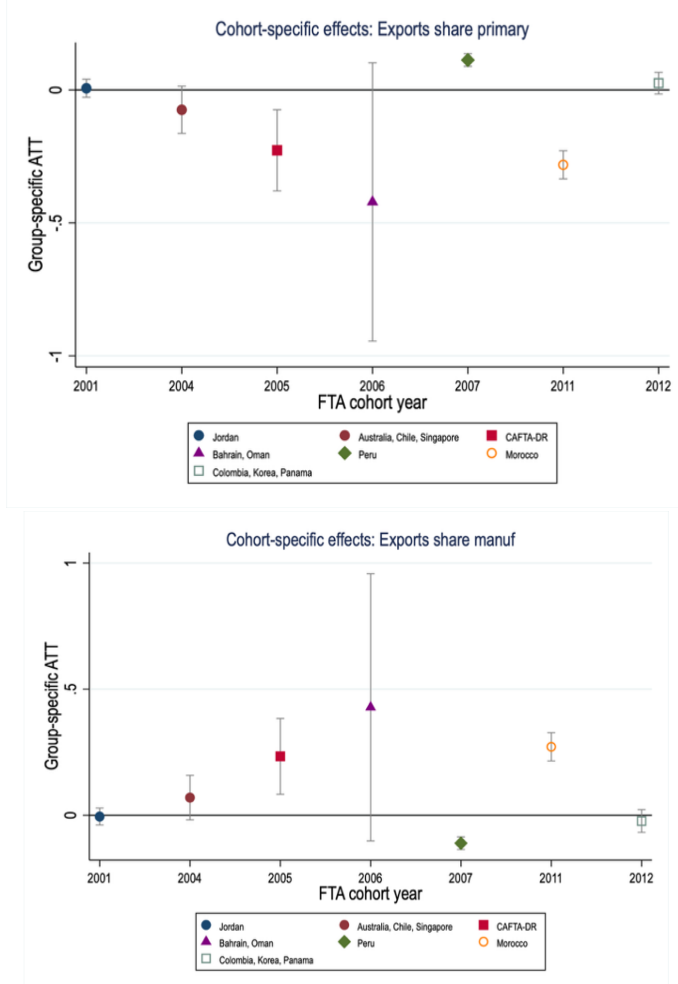

Sources: Authors' calculations based on World Bank and UN COMTRADE data. Notes: Estimates are based on the Callaway and Sant'Anna (2021) difference-in-differences framework with long-gap specifications.

Taken together, these results indicate that the expansion of manufacturing exports documented earlier is driven primarily by low-technology sectors. This pattern is consistent with specialization in labor-intensive production. While these findings align with standard comparative advantage arguments, they do not necessarily imply broad-based upgrading in export sophistication. Instead, the evidence points to selective expansion in sectors that are relatively intensive in lower-skill labor.

We next explore heterogeneity across FTA adoption cohorts by estimating cohort-specific treatment effects. Figure 6 and Figure 7 show that the impact of FTAs on export composition varies substantially across cohorts. While the average effect points to a reallocation toward manufacturing exports, this pattern is driven primarily by specific groups of countries. The strongest and most consistent effects are observed for the CAFTA-DR cohort, which comprises relatively small, export-oriented developing economies with strong trade linkages to the United States.

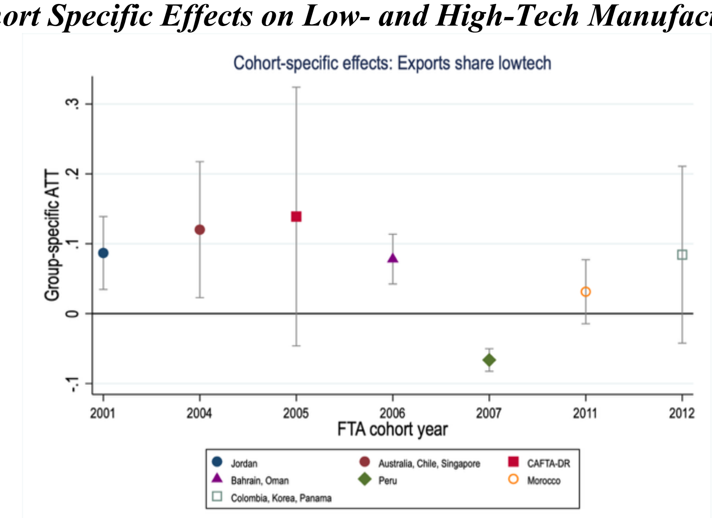
In contrast, other cohorts display more heterogeneous responses. For example, the 2006 cohort (Bahrain and Oman) exhibits relatively large, estimated effects, although these are accompanied by wide confidence intervals, reflecting the small size and volatility of these economies. The 2007 cohort (Peru), a resource-intensive economy, shows little evidence of a shift toward manufacturing, consistent with its initial comparative advantage. More recent agreements, such as the 2012 cohort (Colombia, Korea, and Panama), also yield mixed results, reflecting substantial differences in economic structure across countries. Overall, these findings suggest that the effects of FTAs on export composition are not uniform, but instead depend on initial conditions, including economic size, sectoral composition, and integration into global markets. In particular, FTAs appear to facilitate structural transformation primarily in smaller, trade-dependent economies, while having more limited or heterogeneous effects in larger or resource-based economies.

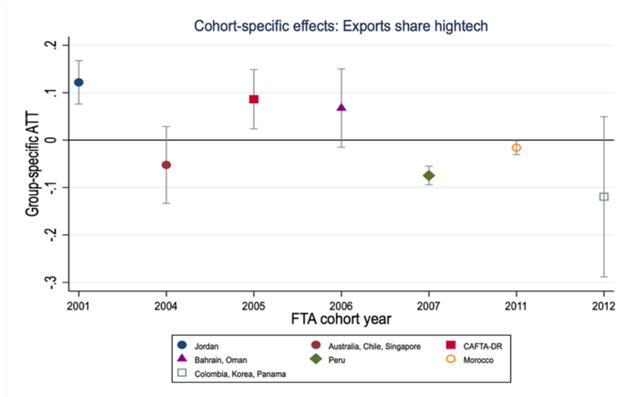
***Figure 6. FTA Cohort Specific Effects on Primary and Manufacturing Export Share***




Sources: Authors' calculations based on World Bank and UN COMTRADE data. Notes: Estimates are based on the Callaway and Sant'Anna (2021) difference-in-differences framework with long-gap specifications.

***Figure 7. FTA Cohort Specific Effects on Low- and High-Tech Manufacturing Exports Share***

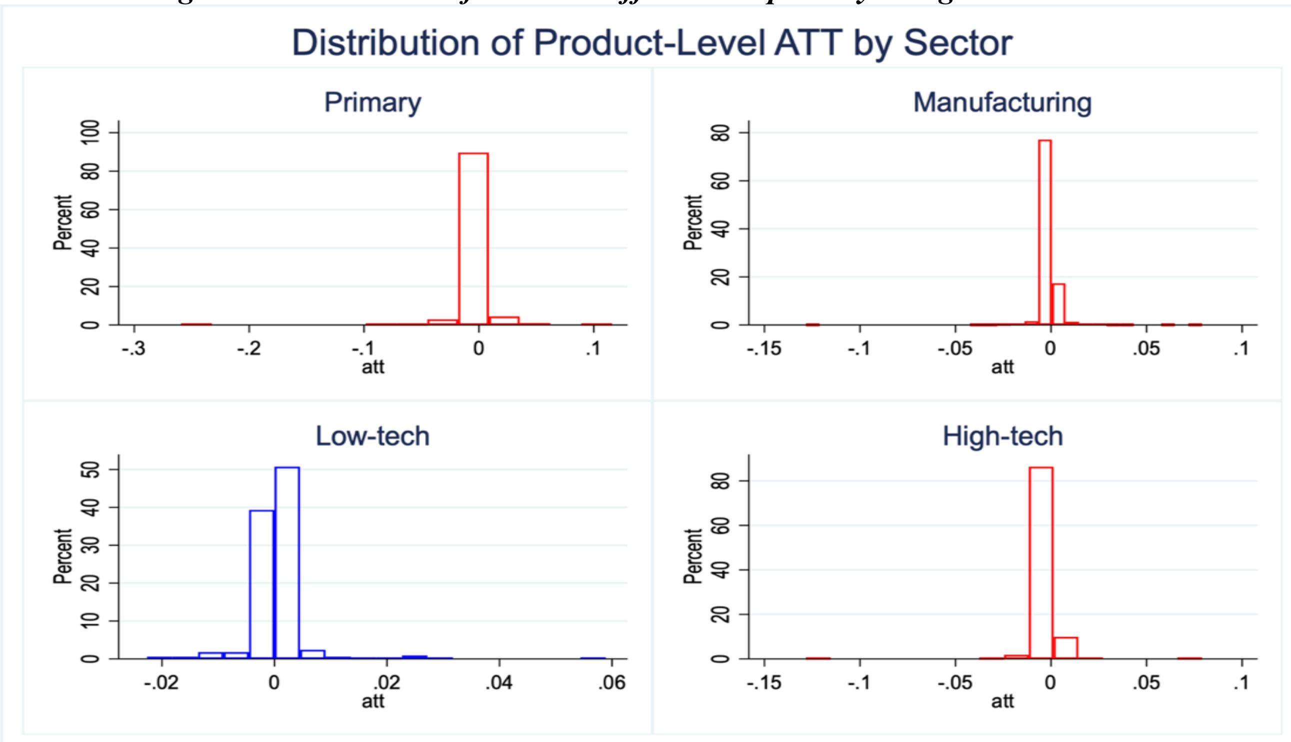





Sources: Authors' calculations based on World Bank and UN COMTRADE data. Notes: Estimates are based on the Callaway and Sant'Anna (2021) difference-in-differences framework with long-gap specifications.

To further explore the mechanisms underlying the aggregate results, we examine heterogeneous responses at the product level using 4-digit trade data. Figure 8 presents the distribution of estimated treatment effects across products, separately by broad sectoral categories. The results reveal substantial heterogeneity, with many products exhibiting no identifiable effect and others displaying sizable positive or negative changes in export shares. Consistent with the aggregate findings, primary products exhibit a wider dispersion, with a concentration of negative effects, while manufacturing outcomes are more tightly distributed around zero. Within manufacturing, the modest positive reallocation is driven primarily by low-technology industries, whereas high-technology products display little systematic response. Examining individual products further illustrates these dynamics. Among primary goods, some of the largest declines are observed in raw commodity sectors, including tungsten ores (HS 2611), natural gums and resins (HS 1301), and unmanufactured tobacco (HS 2401), all of which exhibit sizable negative effects on export shares. In contrast, positive responses are more prevalent among low-technology manufacturing products, such as garments (HS 6114) and aluminum products (HS 7605 and 7606), although these estimates are generally less precisely estimated. These findings suggest that the aggregate reallocation reflects a compositional shift driven by a subset of products rather than uniform adjustments across sectors. Declines are concentrated in primary commodities, while gains are driven by selected low-technology manufacturing activities, consistent with a shift toward labor-intensive export specialization.

*Figure 8. Distribution of the FTA Effect on Exports by 4-Digit Products*




Sources: Authors' calculations based on World Bank and UN COMTRADE data. Notes: The figure shows the distribution of estimated treatment effects on export shares at the HS 4-digit level, separately for primary, manufacturing, low-technology, and high-technology products. Estimates are based on the Callaway and Sant'Anna (2021) difference-in-differences framework with long-gap specifications.

## 5. Robustness

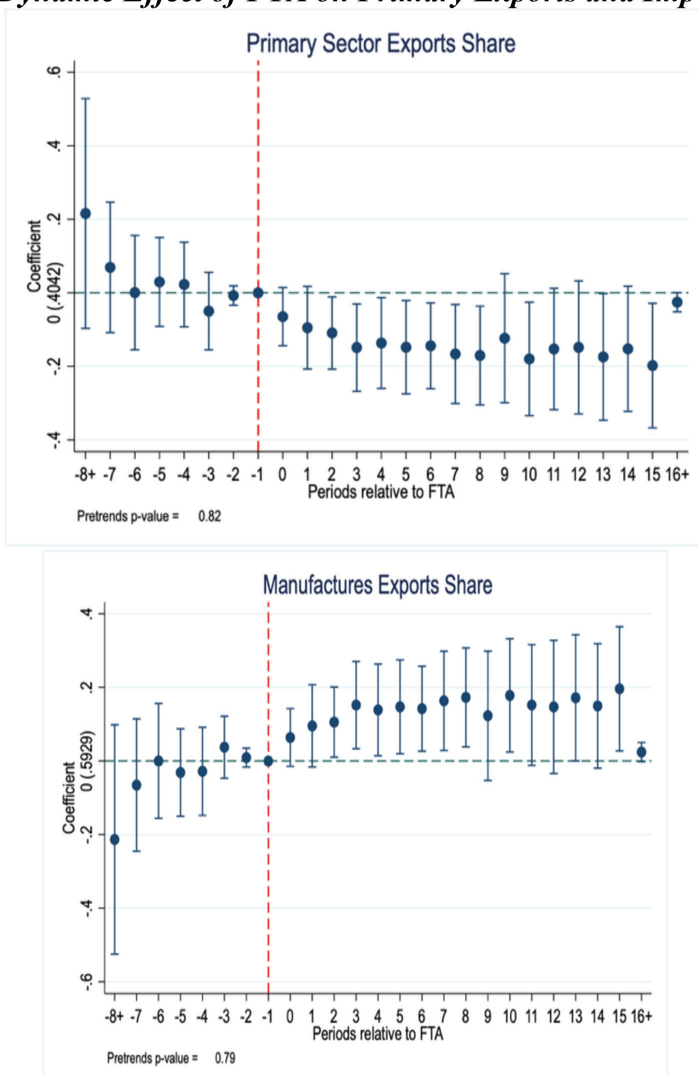
As a robustness check, we re-estimate the dynamic effects using the interaction-weighted event-study approach proposed by Sun and Abraham (2021), implemented through the *xtevent* framework (Freyaldenhoven et al., 2021). This approach provides an alternative way to address treatment effect heterogeneity in staggered adoption settings and serves as a complementary validation of our baseline estimates.[8]

Figure 9 reports the corresponding event-study results. The findings for exports are broadly consistent with our baseline estimates. For primary exports, we observe a persistent decline in export shares following FTA implementation, with no evidence of differential pre-trends. This is

[8] In event-study specifications estimated using the *xtevent* framework (Freyaldenhoven et al., 2021), the endpoints of the event window correspond to binned coefficients that aggregate all periods beyond the specified range. That is, the coefficient at the lower endpoint captures the average effect for all periods at or before the minimum event time, while the coefficient at the upper endpoint captures the average effect for all periods at or beyond the maximum event time. These estimates should therefore be interpreted as average effects over tail periods rather than point estimates for a specific event time.

supported by the joint test of pre-treatment coefficients, which yields a p-value of 0.82, failing to reject the null of parallel trends. Similarly, for manufacturing exports, we find a sustained increase in export shares after treatment, closely mirroring the baseline results. The joint test of pre-treatment coefficients yields a p-value of 0.79, again supporting the validity of the identifying assumption.

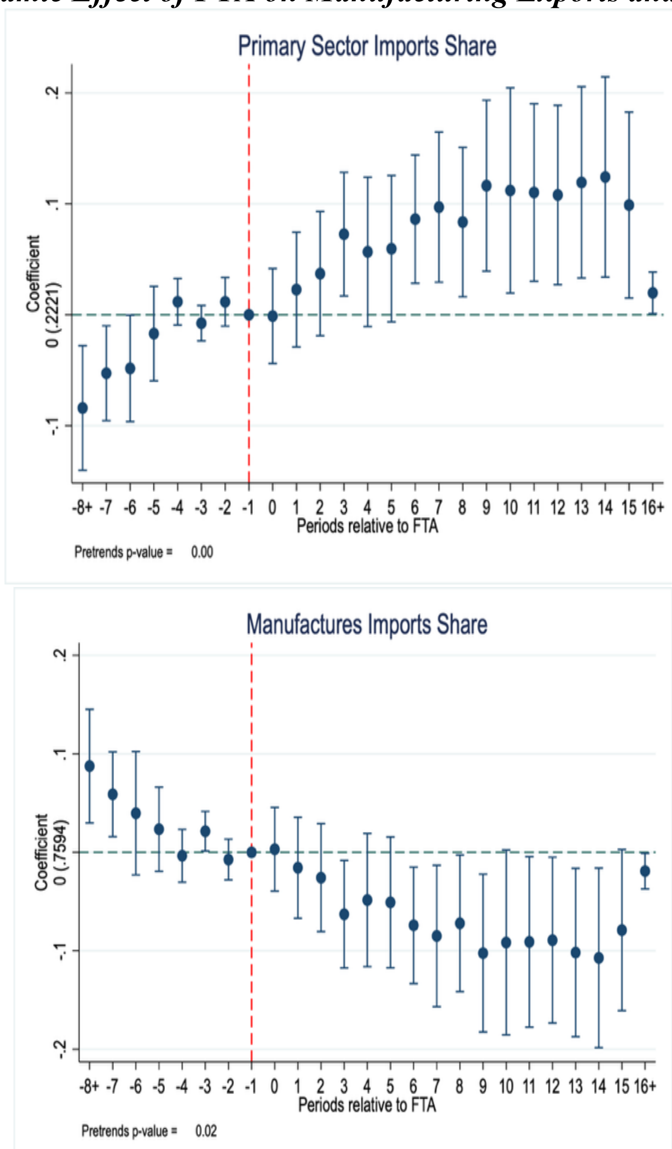
***Figure 9. Dynamic Effect of FTA on Primary Exports and Imports Shares***




Sources: Authors' calculations based on World Bank and UN COMTRADE data. Notes: Estimates are based on the Sun and Abraham (2021) difference-in-differences framework, using the xtevent framework (Freyaldenhoven et al. 2021).

In contrast, the import series exhibit clear trends in event time, both before and after treatment. The joint test of pre-treatment coefficients in Figure 10 strongly rejects the null of no pre-trends, indicating that the identifying assumption is less credible for these outcomes in their baseline specification. This pattern is consistent with the gradual dynamics observed in earlier results and suggests that the estimated post-treatment effects may partly reflect underlying trends rather than discrete treatment effects.

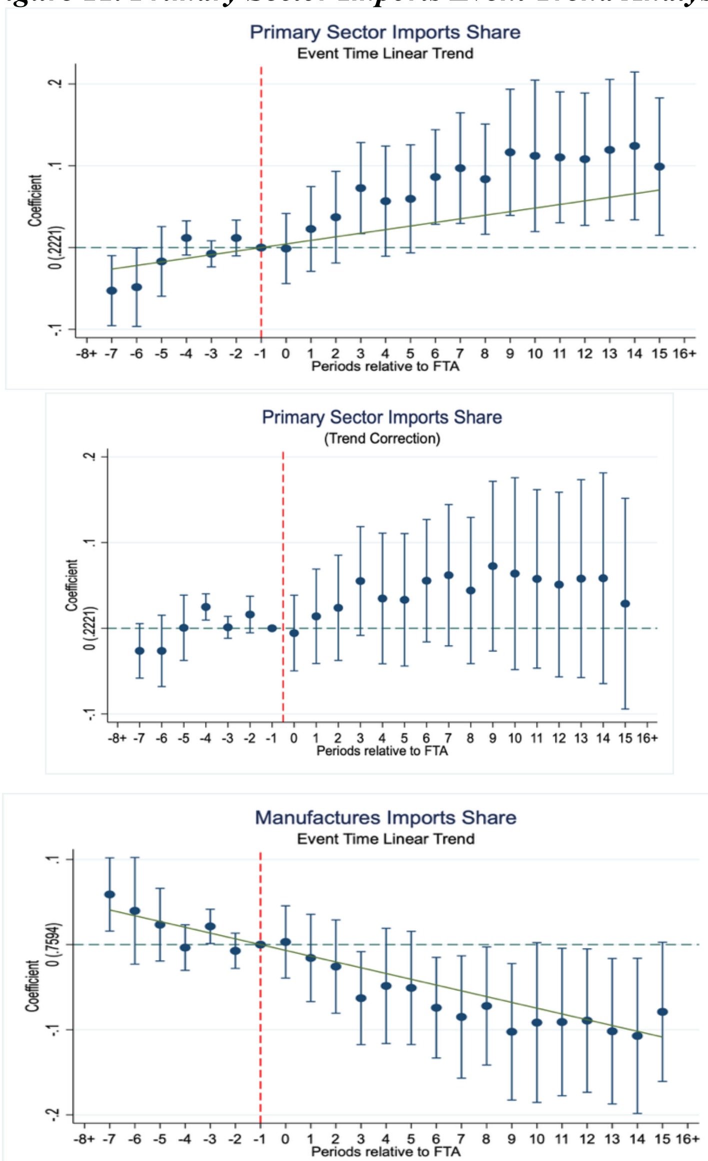
***Figure 10. Dynamic Effect of FTA on Manufacturing Exports and Imports Shares***

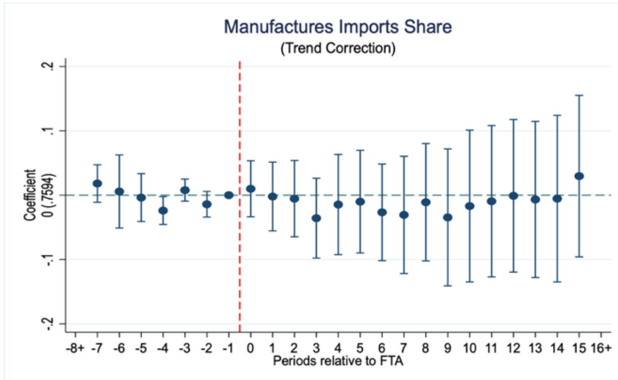



Sources: Authors' calculations based on World Bank and UN COMTRADE data. Notes: Estimates are based on the Sun and Abraham (2021) difference-in-differences framework, using the xtevent framework (Freyaldenhoven et al. 2021).

To address this concern, Figure 11 presents a detrended version of the manufacturing import event study. Following a Dobkin-style approach, we estimate and remove a linear event-time trend prior to re-estimating treatment effects. The detrended results display a substantially flatter profile, with no clear discontinuity at the time of FTA implementation. This suggests that the apparent post-treatment effects in imports are largely driven by pre-existing trends rather than causal effects of the agreement. Taken together, these results reinforce the interpretation that FTAs primarily affect export composition, while the evidence for imports is weaker and more sensitive to specification.

***Figure 11. Primary Sector Imports Event Trend Analysis***

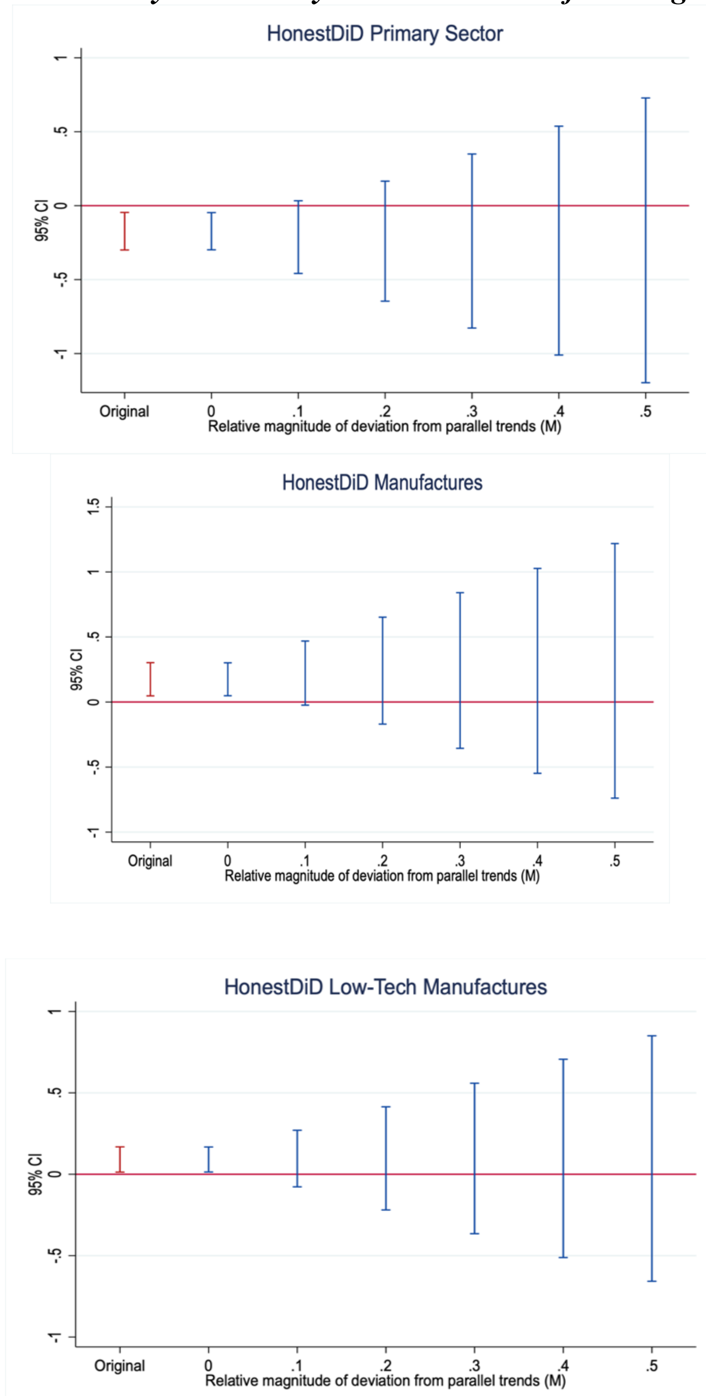


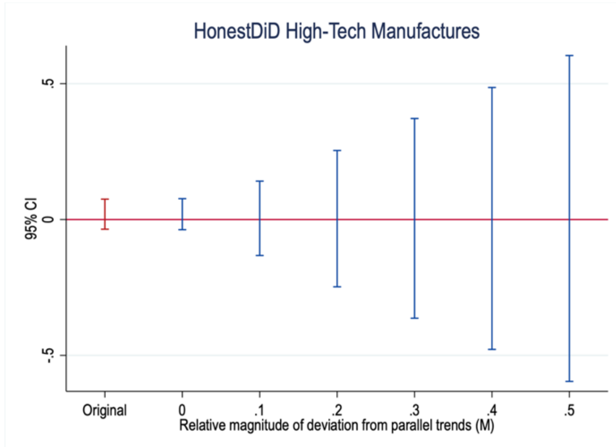



Sources: Authors' calculations based on World Bank and UN COMTRADE data. Notes: Estimates are based on the Sun and Abraham (2021) difference-in-differences framework, using the xtevent framework (Freyaldenhoven et al. 2021).

To assess the sensitivity of our results to potential deviations from the parallel trends assumption, we implement the HonestDiD procedure of Rambachan and Roth (2023). We focus on the average post-treatment effect over event times 1 to 10. This approach provides bounds on the estimated treatment effects under progressively more permissive assumptions about violations of parallel trends, indexed by the parameter $M$, which governs the relative magnitude of allowed deviations. Figure 12 reports the resulting confidence intervals for export outcomes. For primary and aggregate manufacturing exports, the baseline estimates remain stable and retain their sign under small deviations from parallel trends. In particular, the decline in primary exports and the increase in manufacturing exports, driven by low-technology sectors, persist when allowing for modest violations of the identifying assumption. As the magnitude of permissible deviations increases, confidence intervals widen substantially, reflecting a loss of precision rather than a systematic change in the underlying estimates. Importantly, we do not observe systematic sign reversals for primary or low-technology manufacturing outcomes, indicating that the main qualitative findings are robust to moderate departures from parallel trends. In contrast, estimates for high-technology manufacturing remain close to zero across all specifications and assumptions, reinforcing the absence of meaningful treatment effects in these sectors. Overall, these results indicate that the core findings, namely, the reallocation away from primary exports toward low-technology manufacturing, are robust to small and moderate violations of the parallel trends assumption, although inference becomes less precise under more permissive assumptions.

***Figure 12. Bounds Analysis: Primary Sector and Manufacturing Exports Share***






Sources: Authors' calculations based on World Bank and UN COMTRADE data. Notes: Estimates are based on the HonestDiD approach of Rambachan and Roth (2023).

## 6. Conclusions

Our research provides evidence that free trade agreements with the United States reshape the sectoral composition of exports in partner countries. We document that FTAs accelerate the relative growth of manufacturing, especially low-technology, labor-intensive manufacturing, while leaving high-technology sectors largely unaffected. This pattern is consistent with specialization along existing comparative advantage, rather than broad-based upgrading in export sophistication. The estimated effects are persistent and continue to evolve over a long post-treatment horizon, suggesting that the associated structural transformation is gradual and cumulative rather than a one-time adjustment. These findings contribute to the broader debate on globalization by highlighting the importance of sectoral reallocation in shaping the consequences of trade liberalization. In particular, the results indicate that FTAs can promote structural transformation in developing countries, but that this transformation is concentrated in labor-intensive industries. More broadly, the evidence underscores that trade policy has implications that depend on sectoral composition and comparative advantage.

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**Appendix A**

***Free Trade Agreements with the United States: Countries in Sample***

| Country | Year |
|---|---|
| Australia | 2004 |
| Bahrain | 2006 |
| Chile | 2004 |
| Colombia | 2012 |
| Costa Rica | 2005 |
| Dominican Republic | 2005 |
| El Salvador | 2005 |
| Guatemala | 2005 |
| Honduras | 2005 |
| Jordan | 2001 |
| Korea, Rep. | 2012 |
| Morocco | 2011 |
| Nicaragua | 2005 |
| Oman | 2006 |
| Panama | 2012 |
| Peru | 2007 |
| Singapore | 2004 |

Source: World Trade Organization. Note: The following countries with FTAs are excluded from the main analysis: Canada (1994) - FTA before sample period (1996); Israel (1985) - FTA before sample period (1996); Mexico (1994) - FTA before sample period (1996).

## Appendix B

### Trade Data and Sector Classification

We construct measures of export composition using bilateral trade data from the United Nations COMTRADE database for the period 1996–2021. Trade flows are classified according to the Harmonized System (HS) at the 2-digit level, which allows for a consistent aggregation of products across countries and time. To capture the relationship between trade integration and structural transformation, we group HS sectors into economically meaningful categories along two complementary dimensions: factor intensity and stage of production.

#### Sectoral (Structural Change) Classification

We group sectors into broader categories that capture the process of structural transformation:

- Primary sectors include agriculture, food products (HS 1–24), and extractive industries such as minerals and fuels (HS 25–27).
- Manufacturing sectors include all remaining HS chapters (28–96), representing industrial production.

Within manufacturing, we further distinguish between:

- Low-technology manufacturing, which includes traditional industries such as textiles, basic metals, wood products, and simple manufactures (e.g., HS 50–76, 82–83, 94).
- High-technology manufacturing, which includes sectors such as machinery, electronics, pharmaceuticals, and precision instruments (e.g., HS 84–93, 29–30).

This classification allows us to trace shifts not only between agriculture and manufacturing, but also within manufacturing toward more technologically advanced activities.

## Appendix C

***Pre-Treatment Descriptive Statistics***

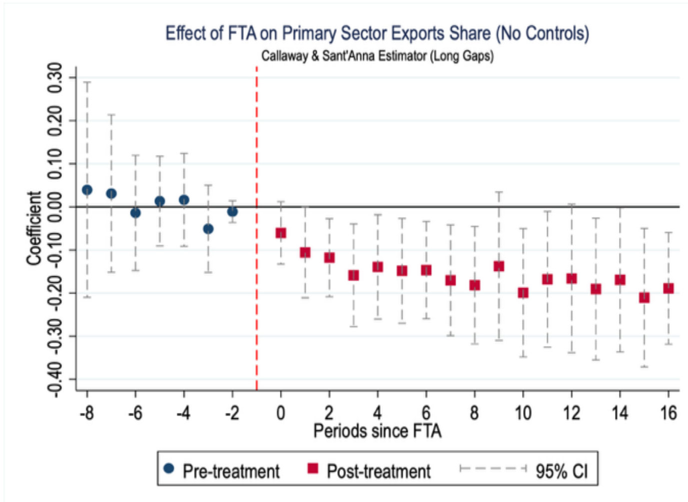
| | Treated (Pre) | Control (Pre) |
|---|---|---|
| Primary Exports Share | 0.467 | 0.360 |
| | (0.323) | (0.344) |
| Manufacturing Exports Share | 0.527 | 0.622 |
| | (0.319) | (0.343) |
| Manufacturing (Low-Tech) Exports Share | 0.244 | 0.260 |
| | (0.230) | (0.285) |
| Manufacturing (High-Tech) Exports Share | 0.214 | 0.255 |
| | (0.300) | (0.279) |
| Primary Sector Imports Share | 0.213 | 0.216 |
| | (0.133) | (0.175) |
| Manufacturing Imports Share | 0.777 | 0.772 |
| | (0.131) | (0.176) |
| Manufacturing (Low-Tech) Imports Share | 0.105 | 0.105 |
| | (0.080) | (0.092) |
| Manufacturing (High-Tech) Imports Share | 0.514 | 0.534 |
| | (0.145) | (0.191) |
| Log GDP per capita | 8.784 | 8.618 |
| | (1.005) | (1.440) |
| GDP growth rate (%) | 3.967 | 3.235 |
| | (2.756) | (5.037) |
| Natural resources rents (% of GDP) | 4.455 | 5.906 |
| | (9.114) | (9.361) |
| Trade openness (exports+imports/GDP) | 0.675 | 0.658 |
| | (0.511) | (0.424) |
| Log population | 16.155 | 15.564 |
| | (1.144) | (2.121) |
| Urban population (% of total population) | 69.082 | 55.452 |
| | (14.412) | (22.922) |
| Observations | 151 | 3352 |

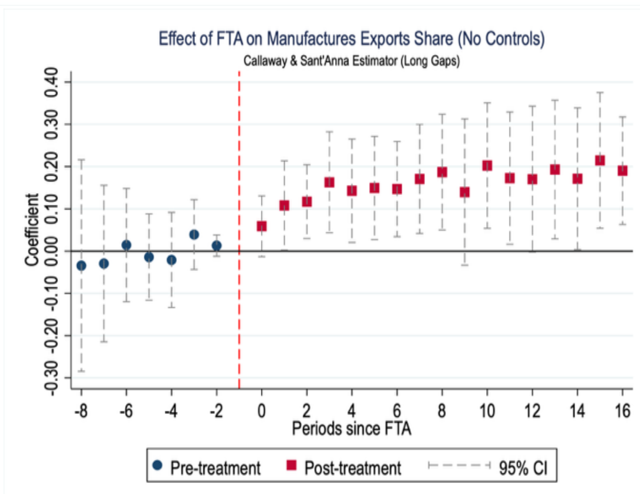
Mean with standard deviation in parentheses

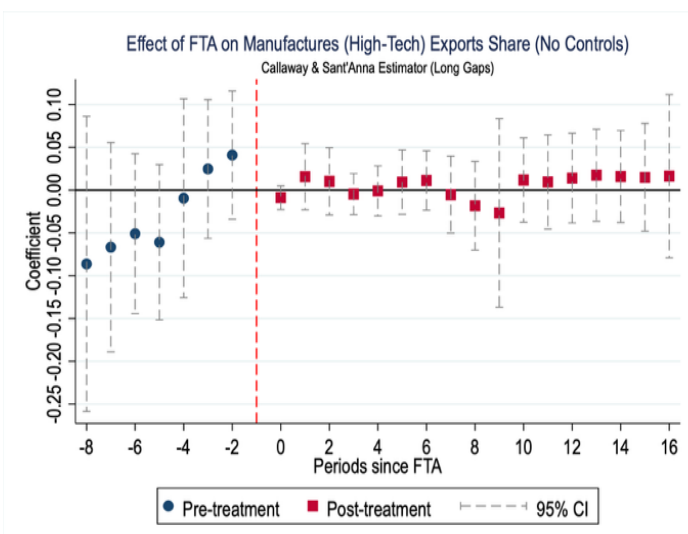
## Appendix D

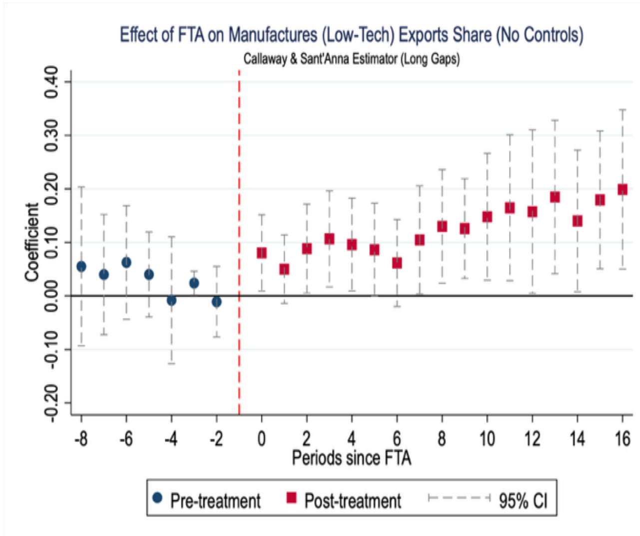
### I. Regression Analysis with no controls

ATTs without Controls



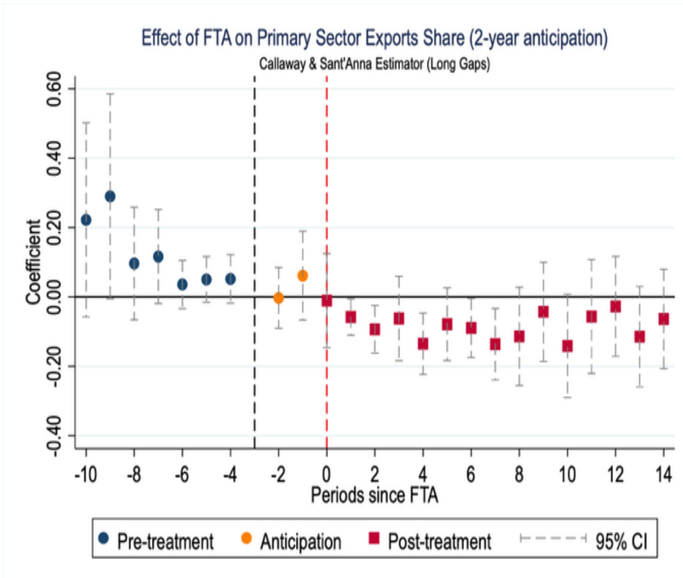


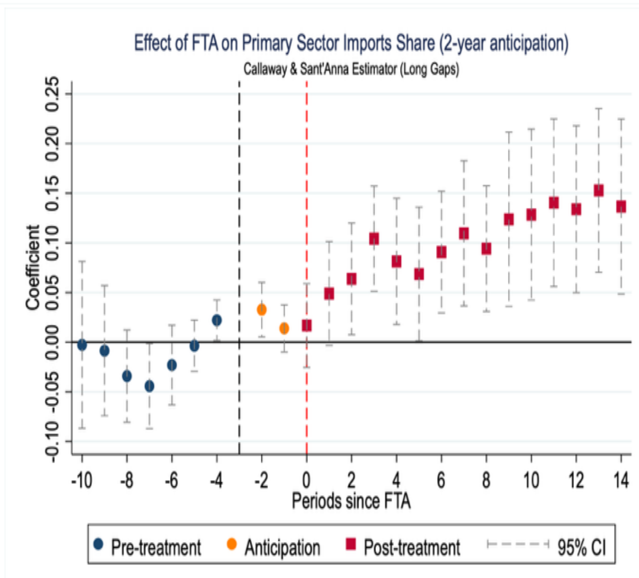

Sources: Authors' calculations based on World Bank and UN COMTRADE data.

## Appendix E

### II. Using -2 year of FTA as reference period

ATTs with Anticipation

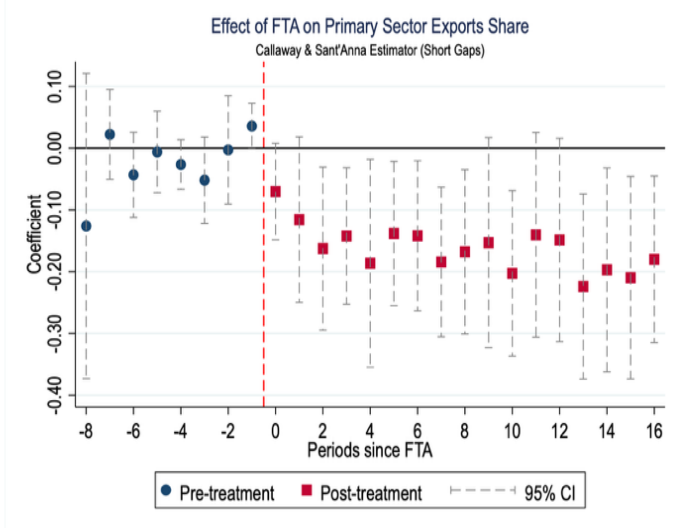


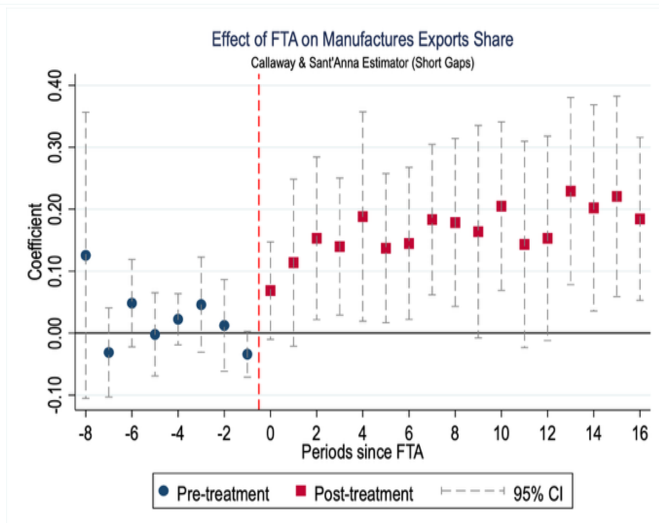



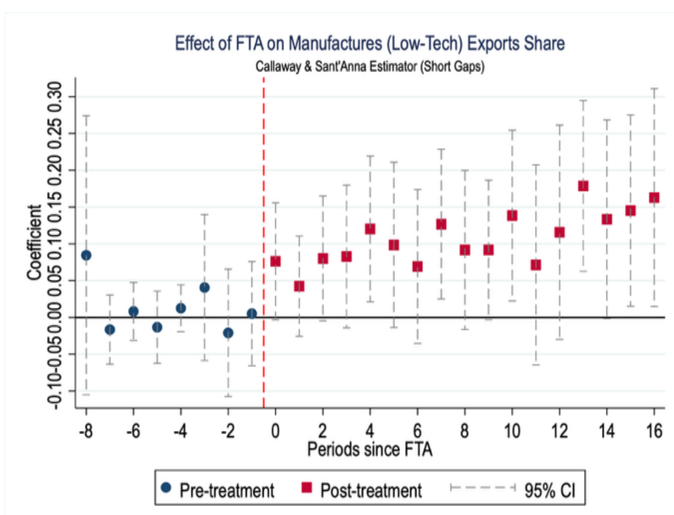

Sources: Authors' calculations based on World Bank and UN COMTRADE data.

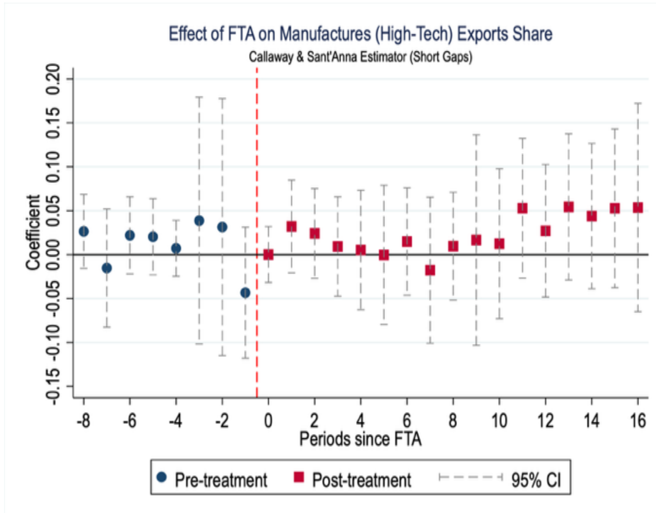
## Appendix F

**Dynamic Effect of FTA on Export Shares using Short Gaps**





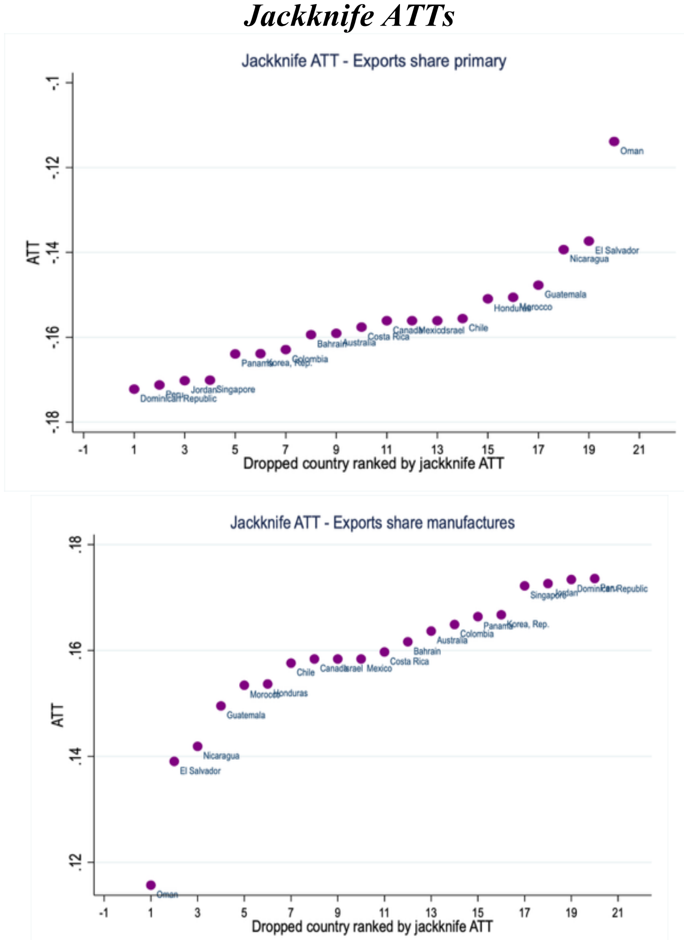

Sources: Authors' calculations based on World Bank and UN COMTRADE data. Notes: Estimates are based on the Callaway and Sant'Anna (2021) difference-in-differences framework with short-gap specifications.

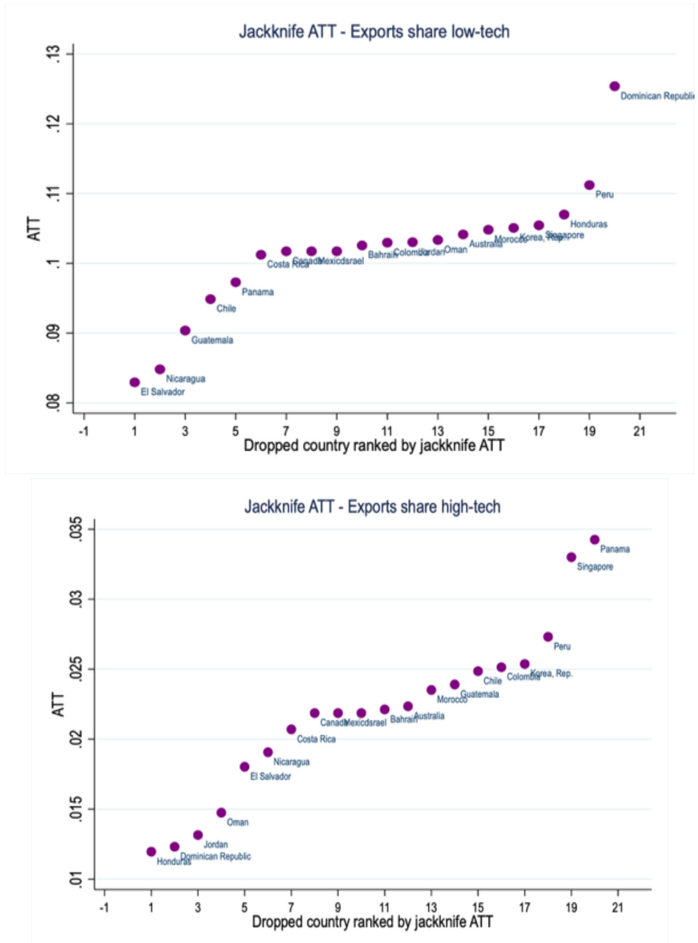
**Appendix G**

## Jackknife Approach

Figure G1 reports jackknife estimates obtained by sequentially excluding one treated country at a time and re-estimating the average treatment effect on export shares. The results show that the estimated effects are highly stable across all specifications. In particular, the increase in manufacturing export shares and the corresponding decline in primary export shares are not driven by any single country. The effects for low-technology manufacturing exports are especially stable, with limited variation in magnitude across exclusions. High-technology export shares also exhibit positive effects across most specifications, although the magnitude is smaller and displays slightly greater dispersion. Overall, the jackknife analysis confirms that the main results are not sensitive to the inclusion of any individual country in the sample.

***Jackknife ATTs***





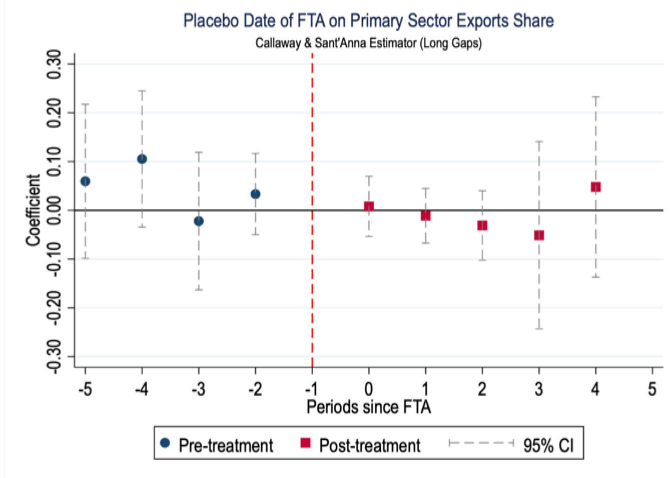

Sources: Authors' calculations based on World Bank and UN COMTRADE data.

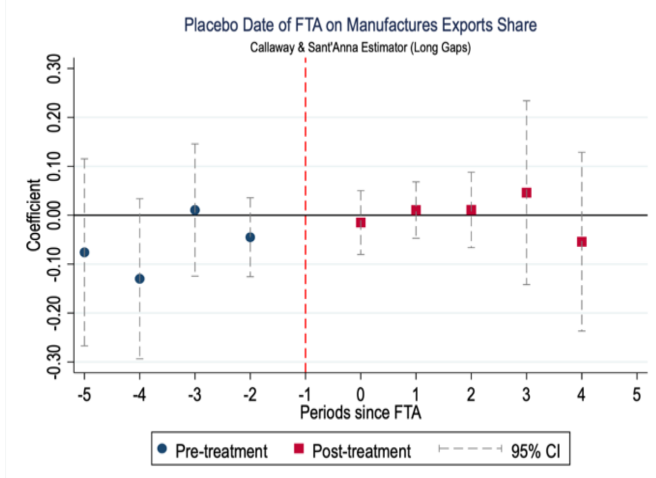
**Appendix H**

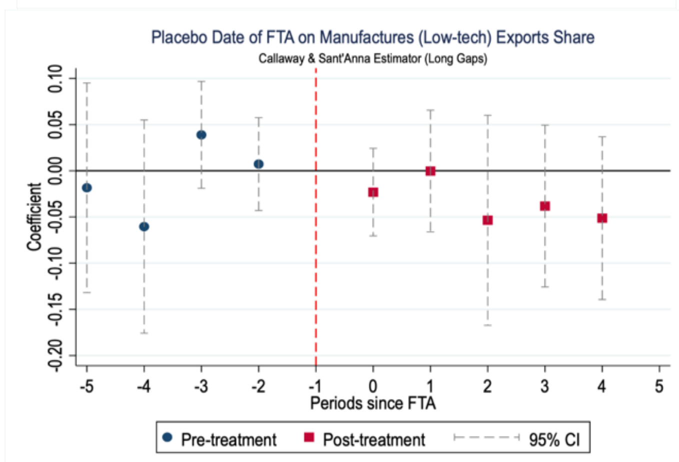
## Placebo Analysis with FTA Dates

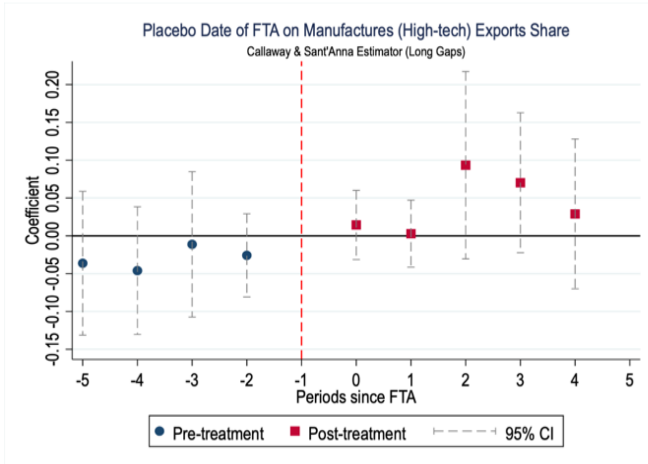
As an additional robustness check, we implement placebo timing tests by assigning treated countries false FTA adoption dates prior to the actual year of implementation. We restrict the sample to observations that precede the true treatment date, ensuring that placebo "post-treatment" periods do not overlap with years in which the agreement was in force. This design provides a direct test of whether the estimated effects are driven by spurious pre-existing dynamics rather than the timing of FTAs. Figure H1 reports the corresponding event-study estimates for aggregate and disaggregated export outcomes. Across all specifications, the estimated coefficients fluctuate around zero and display no systematic pattern in either the pre- or placebo post-treatment periods. In particular, we do not observe persistent trends or statistically meaningful deviations that would mirror the patterns found in the main results. These findings reinforce the credibility of our identification strategy by showing that the dynamic effects documented in the baseline analysis are not driven by spurious timing or underlying pre-treatment dynamics. Instead, the absence of placebo effects supports the interpretation that the observed structural transformation in export composition is associated with the actual implementation of FTAs.

***Placebo Date of FTA on Primary Sector and Manufacturing Export Share***






Sources: Authors' calculations based on World Bank and UN COMTRADE data.

**Appendix I**

**Wild Bootstrap Estimates**

We assess the robustness of inference using wild cluster bootstrap methods. The resulting confidence intervals are slightly wider than those obtained using conventional clustered standard errors, but the overall pattern of results remains unchanged. In particular, the main findings for export composition are robust to alternative inference procedures.

| Outcome | Pre ATT, clustered | Pre SE, clustered | Pre p-value, clustered | Pre ATT, wild bootstrap | Pre SE, wild bootstrap | Pre 95% CI lower, wild bootstrap | Pre 95% CI upper, wild bootstrap |
|---|---|---|---|---|---|---|---|
| Exports: Primary | -0.002 | 0.077 | 0.981 | 0.112 | 0.123 | -0.319 | 0.543 |
| Exports: Manufacturing | -0.002 | 0.076 | 0.983 | -0.113 | 0.122 | -0.568 | 0.341 |
| Exports: Low-tech | 0.025 | 0.034 | 0.475 | 0.014 | 0.031 | -0.074 | 0.103 |
| Exports: High-tech | -0.041 | 0.050 | 0.417 | -0.133 | 0.125 | -0.470 | 0.204 |
| Imports: Primary | -0.025 | 0.019 | 0.195 | -0.035 | 0.023 | -0.108 | 0.037 |
| Imports: Manufacturing | 0.032 | 0.020 | 0.110 | 0.038 | 0.028 | -0.045 | 0.120 |
| Imports: Low-tech | 0.002 | 0.012 | 0.883 | 0.000 | 0.009 | -0.028 | 0.028 |
| Imports: High-tech | 0.022 | 0.021 | 0.306 | 0.025 | 0.028 | -0.062 | 0.111 |
| Outcome | Post ATT, clustered | Post SE, clustered | Post p-value, clustered | Post ATT, wild bootstrap | Post SE, wild bootstrap | Post 95% CI lower, wild bootstrap | Post 95% CI upper, wild bootstrap |
| Exports: Primary | -0.163 | 0.060 | 0.007 | -0.131 | 0.046 | -0.294 | 0.031 |
| Exports: Manufacturing | 0.165 | 0.061 | 0.006 | 0.134 | 0.047 | -0.043 | 0.310 |
| Exports: Low-tech | 0.107 | 0.043 | 0.012 | 0.074 | 0.036 | -0.031 | 0.179 |
| Exports: High-tech | 0.023 | 0.027 | 0.396 | 0.055 | 0.025 | -0.012 | 0.121 |
| Imports: Primary | 0.057 | 0.028 | 0.046 | 0.080 | 0.025 | 0.002 | 0.158 |
| Imports: Manufacturing | -0.044 | 0.029 | 0.131 | -0.074 | 0.025 | -0.147 | 0.000 |
| Imports: Low-tech | -0.008 | 0.012 | 0.481 | -0.004 | 0.009 | -0.032 | 0.024 |
| Imports: High-tech | -0.036 | 0.025 | 0.160 | -0.056 | 0.022 | -0.126 | 0.014 |