Heterogeneous Trade Agreements and Adverse Implications of Restrictive Rules of Origin: Evidence from Apparel Trade*

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Abstract
We revisit the heterogeneous effects of regional trade agreements (RTAs) using a PPML gravity model and comparing apparel and total trade. The politically-sensitive apparel sector has specialized, usually restrictive, rules of origin (ROOs) clauses that vary considerably across RTAs. Our RTA estimates have a significantly higher variance for apparel trade than total trade, and ending temporary exceptions to apparel ROOs in U.S. trade agreements is associated with less apparel trade. We further illustrate how RTAs can be effective development policy instruments. For example, updating ROOs in the Dominican Republic-Central America Free Trade Agreement (CAFTA-DR) can significantly reduce Central American emigration.

Keywords: Regional trade agreements, apparel trade, rules of origin, gravity model, PPML

JEL classification: F13, F14, F63, O24

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1. Introduction

Trading partners enter regional trade agreements (RTAs) for many reasons including, but not limited to, promoting international trade and investment, protecting intellectual property rights, accelerating economic growth, and strengthening political ties. Proliferating since 2000, the number of RTAs in force reached 355 by the end of 2022 (WTO 2023).

Since RTAs vary by geography, signatories, product coverage, and “deep” content, it should not be surprising to find substantial variation in the significance and magnitude of the estimated RTA-trade relationship. Head and Mayer’s (2014) meta-analysis shows that the estimated RTA coefficients have a median of 0.47, mean of 0.59, and standard deviation of 0.50. Kohl (2014) documents that about half of the RTAs have no significant effect and only about a quarter of them increase trade. Furthermore, Bair et al. (2018, 2019) document heterogeneity within FTAs that depends on distance, prior agreements, and level of economic development.

Increasing complexity also potentially affects the RTA-trade relationship. Rodrik (2018) argues RTAs are no longer about mere market access. Trade-related intellectual property rights, cross-border capital flows, investment dispute settlement procedures, and harmonizing regulatory standards are now key issues. Studies focusing on agreement “depth” (either in terms of agreement provisions like technical barriers to trade, legal enforceability, or moving towards customs unions) find that more comprehensive RTAs are associated with significantly more trade (Baier et al. 2014, Kohl et al. 2016).

In this paper, we revisit the heterogeneous relationship between RTAs and trade. For a baseline, we combine datasets on bilateral trade, geographical distance, trade facilitation measures (GATT/WTO membership, RTAs), cultural proximity, and macroeconomic indicators. We compare these results with

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1 Other studies (e.g., Bair et al. 2019 and Yotov et al. 2017) report comparable estimates.
a standard gravity model with directional, high-dimensional fixed effects using the Poisson pseudo maximum likelihood (PPML) estimator that accounts for potential incidental parameters problems (Weidner and Zylkin 2021). Finding results consistent with previous studies,\(^2\) we note that estimated RTA effects are a composite across many sectors and that few studies, if any, explicitly account for the fact that RTAs cover different product mixes that may respond differently to RTAs. To highlight sector-specific heterogeneity, we examine whether the estimates for apparel are comparable to the estimates for total trade.\(^3\)

Apparel is especially interesting for at least three reasons. First, apparel trade is significant, both in terms of volume and political sensitivity.\(^4\) Because apparel is politically sensitive, apparel trade faces significant tariffs and other unique barriers including safeguards and quota restrictions (e.g., the Multifiber Arrangement (MFA)).\(^5\) Although trade barriers in textiles and apparel trade have fallen,

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\(^2\) See Baier et al. (2014); Bair et al. (2018); Bair et al. (2019); Head and Mayer (2014), Silva and Tenreyro (2006), and Yotov et al. (2017).

\(^3\) Note apparel (labor-intensive clothing assembly) is different from textiles (capital-intensive fabric production). We focus on apparel specifically, but textile trade is often affected by apparel clauses of RTAs. Because it is labor-intensive, we also include furniture as a comparator.

\(^4\) For instance, in the U.S. apparel sector, nominal exports and imports totaled about US$ 6 billion and US$ 82 billion in 2021, respectively (Office of Textiles and Apparel (OTEXA)).

\(^5\) Brambilla et al. (2007) show the constraining nature of the MFA particularly toward Chinese apparel. Similarly, Harrigan and Barrows (2009) document falling prices of Chinese apparel products that were constrained by the MFA while the prices of unconstrained products changed marginally. After the end
Frederik and Gereffi (2009) note that countries proposed and enforced several protectionist measures during the 2007-2008 financial crisis.

Second, because of their ubiquity in RTAs covering apparel trade, focusing on apparel allows us to contribute to the literature on rules of origin (ROOs). ROOs are integral component of RTAs, stipulating the conditions under which the traded products qualify for an RTA’s benefits when traded products might contain contents sourced externally. ROOs are key instruments through which countries protect certain products and sectors when entering RTAs. ROOs usually require a “significant transformation” linked to either a change in tariff classification, technical requirement, or value addition. ROOs can restrict trade if they are either complicated or narrowly specified (Angeli et al. 2020; Cadot et al. 2007).\footnote{Deardorf (2018) illustrates the proliferation of RTAs, each with its own ROOs, can render a worse outcome than if there were no RTAs or all parties face a common tariff.} RTAs often have apparel-specific ROOs that are more restrictive than ROOs found in other sectors (Estevadeordal et al. 2008; Manchin 2006; Sytsma 2020). Apparel ROOs in U.S. trade agreements, for example, often include the “yarn-forward” principle that involves a “triple transformation” that requires yarn, thread, fabric, and assembly originate within the RTA region to qualify for benefits. Variation in ROOs, therefore, can drive heterogeneity in the RTA-trade relationship.

Third, apparel trade has significant policy and economic development implications. Apparel draws developing-country workers from agriculture and informality. Apparel production is (less-skilled) labor-intensive, requires lower start-up costs, pays higher wages than other domestic alternatives, hires more female workers than other sectors, and can help mend the gender wage gap (Lopez-Acevedo and of the MFA, China and the United States have signed a bilateral agreement to impose quota limits on imports from China between 2006 and 2008 (OTEXA).}
Robertson 2016; Robertson et al. 2020; Robertson et al. 2022). As such, expanding apparel exports could also reduce migration flows.7

Directly measuring ROOs is highly subjective because the language used to describe ROOs is not standardized across trade agreements. To overcome this challenge, we take two approaches. The first is to infer the effects of ROOs by focusing on apparel trade because ROOs are arguably the most relevant and binding apparel-specific clauses in trade agreements. The second is to estimate the relationship between trade and tariff preference levels (TPLs), which are exceptions to the ROOs. Since TPLs are temporary, we can compare apparel trade when the TPLs were in place versus after they expired as a strategy to infer the effects of the ROOs. For this purpose, we use the apparel TPLs granted by the United States to Bahrain, Costa Rica, Morocco, Nicaragua, Oman, and Singapore.

To highlight RTA heterogeneity, we estimate separate gravity models with individual RTAs and produce three main findings. First, the sum of the average of the individual RTA estimates is comparable to those found in the baseline estimates. Second, the RTA estimates have a higher variance for apparel trade than for total trade. Lastly, restrictive ROOs are associated with lower apparel trade. For example, the Dominican Republic-Central America Free Trade Agreement (CAFTA-DR), which has the restrictive yarn-forward requirement, has a large negative RTA estimate. By contrast, the estimate for the U.S.-

7 Vice President Harris’ May 27, 2021 Call to Action to the Private Sector to Deepen Investment in Northern Central America builds on President Biden’s Plan to Build Security and Prosperity in Partnership with the People of Central America. The Vice President’s call was quickly followed by the G7’s June 12 2021 Build Back Better World (B3W) partnership. On July 29, 2021, Vice President Kamala Harris released a cover letter describing the U.S. Strategy for Addressing the Root Causes of Migration in Central America that focuses on private-sector investment in Central America.
Jordan agreement, which does not have yarn-forward requirement, is large and positive. In a differences-in-differences setting, we find ending TPLs is associated with significantly lower trade.

To illustrate why relaxing the restrictive apparel ROOs might be especially relevant for economic growth, development, and policy, we present a CES model following Feenstra and Markusen (1994). The key prediction is that exports, profits, output, and employment increase with the range of inputs. Hence, restricting the range of inputs (with ROOs) reduces apparel exports. Since 2000, technological advances have significantly expanded the set of threads, fibers, and fabrics used in modern clothing (e.g., consider “stretchy jeans”). While a trade agreement offers the possibility of a higher output price for exporters, an exogenous global expansion in the range of potential inputs implies that restrictive ROOs make the preferences in the RTAs less attractive. Hence, as the potential range of inputs increases, firms will increasingly opt out of using local agreement-restricted set of inputs, and the RTA will be associated with less trade.

Descriptive statistics are consistent with the model’s predictions. U.S.-destined Central American apparel exports, including the diversity and range of apparel goods, have been flat or declining. The share of Central American exports in the top ten most-exported categories rises over time, while the same measure for non-agreement countries (e.g., Vietnam) falls sharply. Furthermore, Central American apparel exports have lower unit values than U.S. imports from other apparel-exporting countries.

As for a developmental impact, since CAFTA-DR has restrictive (yarn-forward) ROOs, we demonstrate that expanding the set of inputs that qualify would increase Central American apparel exports, which, in turn, could create at least 120,000 jobs in the region. This implies that CAFTA-DR’s ROOs could be updated to address the “root causes” of Central American emigration.
The remainder of the paper is organized as follows. Section 2 presents the data and describes the empirical approach. Section 3 discusses the findings and illustrates how RTAs could be leveraged as development policy instrument by relaxing the restrictive apparel ROOs. Section 4 concludes.

2. Empirical Approach

2.1. Data

Baseline data come from CEPII and contain information about bilateral trade, distance, trade facilitation measures, cultural proximity indicators, and macroeconomic variables. The data contain 232 exporters and 179 importers for the 1948 - 2019 period. We add OTEXA data measuring U.S. apparel trade from 1989 to 2021. The export data cover five product categories to 236 destinations. The import data include import values, units, and square meters equivalent (SMEs) of 6,748 products (at Harmonized System (HS) 10-digit) from 208 exporters.

Additionally, we use the World Integration Trade Solution (WITS) to gather data on bilateral total trade, apparel trade (HS 61 and HS 62), and furniture trade (HS 94) from 1988 to 2021. We also use it as data source to compute MFN and applied preferential tariffs at different levels of product disaggregation. We introduce furniture as a potentially-comparable sector for apparel. Furniture is also labor-intensive, frequently traded, but not subject to the same kinds of ROO restrictions as apparel. Furthermore, we collect information on the implementation period and members from the Handbook of Deep Trade Agreements (2020), which covers 262 RTAs reported to the WTO from 1958 through 2017. We extend the period to 2019 by prolonging all RTAs except those that ended in 2018 and 2019. Whenever we observe multiple and overlapping RTAs, we take the most recent ones or those negotiated in smaller

8 The appendix gives further details on the data source and variable construction.
groups. The argument is that if RTAs negotiated at the multilateral level are insufficiently effective, then
countries consider negotiating regionally, and eventually bilaterally.

2.2. Estimation

The main objective of the paper is to estimate the relationship between RTAs and apparel exports and
assess whether its size and significance are heterogenous across different RTAs. As a starting point, we
specify and estimate a common gravity model given by:

\[ y_{i,j,t} = \beta_1 \log (distance)_{i,j} + \beta_2 \text{commonColonoy}_{i,j} + \beta_3 \text{contiguity}_{i,j} + \beta_4 \text{commonOfficialLan}_{i,j,t} + \beta_5 \text{RTA}_{i,j,t} + \beta_6 \text{tariff}_{i,j,t} + \tau_{i,t} + \delta_{j,t} + \epsilon_{i,j,t} \]

where \( y_{i,j,t} \) denotes the nominal US$ value of gross import from \( i \) to country \( j \) in year \( t \); \( distance_{i,j} \)
distance between country \( i \) and \( j \), and \( \text{commonColonoy}_{i,j}, \text{contiguity}_{i,j}, \text{commonOfficialLan}_{i,j,t}, \) and
\( \text{RTA}_{i,j,t} \) are binary variables taking a value of 1 if the country pairs are contiguous, share a common
official language, or belong to an RTA, respectively. The variable \( \text{tariff}_{i,j,t} \) is a trade-weighted tariff
duty at the MFN agreement level, and \( \tau_{i,t} \) and \( \delta_{j,t} \) are exporter and importer time trends.

The next step is to compare the effect of each individual trade agreement while controlling for other
potential agreements in force. This involves estimating the RTA-trade relationship for each agreement.
Hence, we modify the specification of equation (1) as follows:

\[ y_{i,j,t} = \beta_{k}^{RTA} \text{RTA}_{i,j,k,t} + \beta_{l}^{RTA} \text{RTA}_{i,j,l,t} + \mu_{i,j} + \tau_{i,t} + \delta_{j,t} + \epsilon_{i,j,t} \]

where \( \text{RTA}_{i,j,k,t} \) equals 1 if the country pairs belong to a specific RTA \( k \); \( \text{RTA}_{i,j,l,t} \) equals 1 if the country
pairs belong to any other trade agreements \( l(\neq k) \), and \( \mu_{i,j} \) are the country pair fixed effects. In the
estimation, we iterate equation (2) for each agreement \( k \) to get an agreement-specific estimate of \( \beta_{k}^{RTA} \).
We estimate equation (1) and (2) using the PPML estimator. This estimator appropriately addresses the main challenges and overcomes the weaknesses of other estimators (the presence of zero flows and heteroskedasticity in the trade data (Silva and Tenreyro 2006)). The exporter-year and importer-year variables control for time-varying country-specific characteristics while the country-pair fixed effects account for time-invariant pair-specific characteristics. The standard errors are clustered on country-pairs. We also follow Weidner and Zylkin (2021) and account for the incidental parameters problem due to the high dimensional fixed effects in the model.9

Note that we focus on estimating the RTA-trade relationship, but our identification strategy follows those found in other papers that claim to identify causal relationships. As in other papers, identification relies on the change in trade for a given country pair after the trade agreement goes into effect, holding constant the country-specific trends in trade (e.g., controlling for “pre-treatment trends”). This leaves little remaining variation aside from the trade agreement. The country-pair-specific variables help address the potential endogeneity of RTAs (Baier and Bergstrand 2007). The RTA coefficient captures the average change in trade following the implementation of a trade agreement relative to the change experienced by non-agreement countries.

3. Empirical Results

3.1. Main Results

9 We estimate equation (1) and (2) using the Stata packages –ppmlhdfe– and –ppml_fe_bias– by Correia et al. (2020 and 2021) and Weidner and Zylkin (2021), respectively.
Table 1 reports the baseline PPML estimates of equation (1). Column (1) implies that distance significantly reduces trade between trading partners. Additionally, sharing a common border, colonial history, and official language promote bilateral trade whereas high MFN tariff duties discourage it.\textsuperscript{10} Importantly, the estimated RTA-trade relationship is significant, large, and positive. The coefficient estimate indicates about 58 percent ($\approx e^{0.457} - 1$) increase in trade between 1988 and 2019. The estimated RTA effects are broadly consistent with previous studies. Head and Mayer’s (2014) meta-analysis shows that the estimated RTA coefficients have a median of 0.47, mean of 0.59, and standard deviation of 0.50. Silva and Tenreyro (2006) estimate on RTA effect of about 0.38 based on the PPML estimator. Baier et al. (2019) estimate agreement-specific effects of past RTAs and report average effects of between 0.20 and 0.49.

Columns (3) and (5) report similar regression results for apparel and furniture trade. Geographical and cultural factors have similar estimates as found in total trade. Having a common colony is associated with less a negative impact on apparel trade albeit only weakly significant while it is positive and significant for furniture trade. The RTA estimates are 67 and 96 percent for apparel and furniture trade, respectively. The positive and significant coefficient on MFN tariff for apparel reflects the elevated level of protection toward the apparel sector: the largest apparel exporters face high MFN tariffs. Some of the main apparel exporters are also beneficiaries of preferential trade agreements, and high MFN tariffs are

\textsuperscript{10} Alternatively, we run the model with tariff preference margins. However, they generally are not significant after controlling for RTAs. This is indicative of the substantial tariff reductions over time across many tariff lines.
associated with high preferential tariff margins.\textsuperscript{11}

We report in column (2), (4), and (6) the standard errors adjusted for potential bias and inconsistency. These standard errors are larger; nevertheless, the significance of the estimates remains unaffected except for the common colony in apparel trade.

Table 2 summarizes the distribution of RTAs coefficients from equation (2). If causal, individual RTAs increase apparel, furniture, and total trade by 45, 45, and 39 percent, respectively. Combining all trade agreements, the RTA estimates for apparel, furniture, and total trade are 52, 80, and 58 percent, respectively. The sum of the average RTA of the RTA estimates on all three (apparel, furniture, and total) RTAs are comparable with those found in the baseline estimates (Table 1).

The apparel estimates, however, have a higher variance than the estimates for total and furniture trade. This is consistent with the observed complexity and wide variation of apparel-specific provisions in the trade agreements that has been driven by the political sensitivity of the textile and apparel sectors.

Considering U.S. trade agreements, which involve multiple trading partners and ROOs with varying degrees of local and regional value content requirements, Figure 1 plots the apparel estimates of

\textsuperscript{11} A good example is Bangladesh whose apparel exports are subjected to high duty in the U.S. market but have duty-free access to the EU market under Everything but Arms (EBA) scheme. U.S. heavily taxes clothing from Bangladesh.
individual U.S. trade agreements. For instance, the estimated negative coefficient for CAFTA-DR suggests that apparel exports are about 58 percent less compared with what trade would have been without the agreement. By contrast, the estimate for the US-Jordan agreement, which does not have a yarn-forward rule and requires at least 35% regional content, is positive and large: 3,567 percent. Similarly, the U.S.-Morocco agreement estimate is positive (32 percent), perhaps because it has a long phase-in period with large exception levels. The North American Free Trade Agreement (NAFTA) is associated with an increase in apparel trade of about 640 percent.

3.2. **Proxy for ROOs: Tariff preference levels**

The results above infer the effect of ROOs as a residual because we do not measure ROOs directly. Measuring ROOs directly is subjective because agreement language is not standardized. An alternative is using the TPLs, which are temporary exceptions to the ROOs. Since these exceptions are temporary, we can compare the change in apparel trade when the TPLs were in place with the change in apparel trade when TPLs expire. For this purpose, we consider U.S. trade agreements that provided TPLs for Bahrain (2006-2016); Costa Rica (2009-2018); Morocco (2006-2015); Nicaragua (2006-2014); Oman (2009-2018), and Singapore (2004-2011). To the extent that we can infer causality from our differences-

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12 We also use the ROOs restrictiveness index from Estevadeordal et al. (2008). Unfortunately, this index is only available for few RTAs and HS sections. We run a weighted regression of RTA coefficient estimates for apparel trade (from equation 2) on ROOs restrictiveness index for textiles and apparel, where the weights are shares of apparel in total trade under the agreements. Based on a sample of 17 RTAs, we find a significant and negative coefficient (standard error) (=-0.315 (0.052)), implying lower RTA related trade associated with more restrictive ROOs.
in-differences setting in which the end of the TPLs is the treatment, we find a negative and significant effect of the end of the TPLs on apparel imports from these countries (Table 3).

U.S. apparel imports from Bahrain and Oman sharply declined following the end of the TPLs in 2016 (for Bahrain) and 2018 (for Oman). Bahrain’s and Oman’s apparel exports to the United States heavily depended on inputs sourced from countries outside of the agreement, and there has been limited investment in the yarn and fabric production (Khan 2018). Eliminating TPLs, therefore, make the ROOs binding, limit on inputs that qualify for preferential treatment, and reduce trade.

3.3. Why Do ROOs Affect Exports?

To illustrate why ROOs might restrict exports, consider production in sector \( y \) using labor \((l)\) and intermediate inputs \((m)\): 

\[
y = \delta l^{1-\beta} m^\beta \quad \text{where} \quad m = \left[ \sum_{i}^{M_o} a_i x_i^\theta \right]^{1/\theta}.
\]

\(M_o\) represents the range of inputs available for producing \(m\), and \(\theta = 1 - 1/\sigma\) in which \(\sigma\) is the elasticity of substitution between inputs \(x\). Consistent with Feenstra and Markusen (1994), this production function shows how profits and output increases with the range of intermediate inputs. As inputs become more differentiated (a smaller elasticity of substitution), the effects of expanding the range of inputs increases.

Firms consider two relevant input ranges. The first is the range limited by the agreement’s ROOs. The second is the range available globally through existing production technology. If these numbers are the same, then it is always more profitable to take advantage of the agreement. As the global range of potential inputs increases beyond the range allowed by the agreement (i.e., new threads, fibers, and fabrics due to new technology), it will eventually become more profitable to forgo agreement preferences.
and use the wider range of inputs. The implication is that firms will increasingly opt out of using local inputs and opt for higher tariff rates if the agreement does not adjust and continues to restrict the range of inputs that qualify for preferential treatment.

3.4. Application: CAFTA-DR

To showcase the policy relevance of apparel ROOs, we consider the Dominican Republic-Central America Free Trade Agreement (CAFTA-DR). CAFTA-DR became effective in El Salvador, Guatemala, Honduras, and the United States in 2006. The Dominican Republic joined in 2007 and Costa Rica in 2009. The terms of the agreement include significant trade liberalization, customs administration, and trade facilitation (International Trade Administration 2009). Apparel is the main manufacturing export from Central America to the United States.

From the U.S. perspective, the design of CAFTA-DR was to cultivate “Made-In-America” jobs, strengthen workers’ rights and conditions, and create opportunity for growth and stability in the region. At the time, the expectation was CAFTA-DR would increase market opportunities for U.S. yarn, fabric, apparel, and footwear manufacturers, superseding the unilateral Caribbean Basin Trade Partnership Act by providing duty-free market access for U.S. yarn and fabric (International Trade Administration 2009).

To create market opportunities for U.S. producers, CAFTA-DR included separate ROOs specific to textiles and apparel. The agreement allows producers to petition for exceptions. However, technology and consumer preference may move more quickly than the petition process. In 2007, the Short Supply Petition process was expected to take 30-44 business days, excluding time for preparing the petition and

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13 There have been major developments in the fabric composition (in range and complexity) of textile and apparel products. Since 2010, U.S. synthetic-fiber apparel imports have increased significantly.
the due diligence period in which petitioners should assess domestic production capacities (Robertson 2021). Further, about 10 percent of the U.S. apparel imports under CAFTA-DR fall under the short supply list item or regional cumulation (Lu 2021).  

Data from Central America are consistent with the prediction that tariff preference use falls over time. Specifically, Central American imports of U.S. textile materials have fallen over time in every country except Nicaragua (Figure 2). Because of limited domestic production of yarn and fabric, Nicaragua specialized in the limited range of apparel products made from U.S.-produced yarn and fabrics (Khan 2018), that are characterized by lower unit values.

The CAFTA-DR apparel trade estimate allows us to heuristically approximate the number of jobs that could be created by relaxing the exiting restrictive ROOs in CAFTA-DR. The estimate suggests that, on average, trade agreements usually increase apparel trade by at least 45 percent. In a sharp contrast, the estimate for CAFTA-DR is negative and suggests about 58 percent less apparel trade than between countries with no agreement at all. This implies that if we were to renegotiate CAFTA so that it resembles

14 In a survey of executives at the leading 31 U.S. fashion companies, Lu (2021) reports that 21 percent of the respondents source from CAFTA-DR countries without claiming the CAFTA-DR duty free benefits, suggesting complex and administratively burdensome procedures for producers to utilize the exception provisions.

15 Based on the mean value of $\beta^k_{RRA}$ in Table 2, which is 0.375. Coefficient for CAFTA-DR is -0.863 (bias corrected, -0.861).
the average agreement these estimates suggest that trade would increase by 103 percent (=45+58) or more than double the current apparel trade level.

The effect on employment depends on the strength of the relationship between exports and employment. Apparel is labor-intensive, so this relationship would be relatively high. Suppose it is low: say, a 10 percent increase in exports would increase employment by 2.5 percent. Using this assumption of 25 percent suggests that a 103 percent increase in exports would result in about 26 percent (=1.03*0.25) increase in employment. Assuming half a million current employees in the apparel sectors of Central America, we might expect an increase of about 120,000 jobs without considering the spillover effects of the indirect jobs created through additional consumption spending by the workers and services for the expanding industry. In 2021, Customs and Border Protection reported 495,276 encounters at the U.S. Southwest border with people from Northern Central America (Honduras, Guatemala, El Salvador) (Rosenblum et al. 2021). In terms of direct employment alone, adjusting CAFTA-DR’s ROOs could reduce migration by at least 25% if would-be migrants took new Central American apparel jobs instead.16

16 A simple analysis of U.S. apparel imports and U.S. remittances (as a proxy for migration) suggests that U.S. apparel imports are a substitute for immigration from Latin America. A panel regression using annual U.S. remittances and apparel imports from Latin American countries suggests that, while the “between” estimates (across countries) are positive, the “within” estimates (within country over time) are negative and grow with increasing lags. The cumulative estimate (standard error) with five lags is -0.171 (0.057) (period = 1989-2021, countries = 19, and observations=478). Similarly, Lu (2022) argues expanding U.S. apparel imports from Central America could generate jobs in the region and help solve the migration crisis.
4. Conclusions

RTAs have become important mechanisms through which countries have engaged and strengthened their economic partnerships. RTAs, especially preferential schemes, are also a key policy instrument to support economic development in low-income countries. Against this background, we revisit the heterogeneous effect of RTAs on trade. The key findings show substantial heterogeneity across RTAs and products, particularly in apparel trade, and that restrictive apparel ROOs lower apparel trade.

Importantly for policymaking, it seems worthwhile to consider upgrading the ROOs as an effective policy instrument to promote economic development in low-income countries and address the migration crisis in developed countries.
References


Electronic copy available at: https://ssrn.com/abstract=4376016


Figures

Figure 1 Effect of U.S. trade agreements: PPML estimates of apparel trade, 1988-2019

Source: Estimation based on the gravity model in equation (2) as shown in Table 2, column (1)-(4).
Figure 2 Changes in Central American use of U.S. textile inputs, 1989-2021

Source: Calculations based on the data from UN Comtrade.
### Table 1 Baseline Gravity Model

<table>
<thead>
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<th></th>
<th>Total trade</th>
<th>Apparel (HS 61 &amp; 62)</th>
<th>Furniture (HS 94)</th>
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<tbody>
<tr>
<td></td>
<td>(1) PPML</td>
<td>(2) PPML Bias corr.</td>
<td>(3) PPML</td>
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<td>-0.527***</td>
<td>-0.956***</td>
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<td></td>
<td>(0.057)</td>
<td>(0.076)</td>
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<td>0.562***</td>
<td>-0.358*</td>
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<td>(0.146)</td>
<td>(0.163)</td>
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<td>0.381***</td>
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</tbody>
</table>

*Note: Standard errors are given in parenthesis and clustered at the exporter-importer pairs. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The weighted MFN tariff is trade-weighted mean of product-level MFN duties. The regressions include a full set of interaction between time trends and exporter and importer fixed effects.*
Table 2 Heterogeneous effects of trade agreements, 1988-2019

<table>
<thead>
<tr>
<th></th>
<th>PPML</th>
<th>PPML – Bias corr.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Median</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\beta_{RTA}^k$</td>
<td>0.330</td>
<td>0.280</td>
</tr>
<tr>
<td>$\beta_{RTA}^l$</td>
<td>0.150</td>
<td>0.150</td>
</tr>
<tr>
<td>$\beta_{RTA}^k + \beta_{RTA}^l$</td>
<td>0.460</td>
<td>0.371</td>
</tr>
<tr>
<td><strong>Apparel</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\beta_{RTA}^k$</td>
<td>0.375</td>
<td>0.261</td>
</tr>
<tr>
<td>$\beta_{RTA}^l$</td>
<td>0.067</td>
<td>0.067</td>
</tr>
<tr>
<td>$\beta_{RTA}^k + \beta_{RTA}^l$</td>
<td>0.418</td>
<td>0.294</td>
</tr>
<tr>
<td><strong>Furniture</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\beta_{RTA}^k$</td>
<td>0.374</td>
<td>0.289</td>
</tr>
<tr>
<td>$\beta_{RTA}^l$</td>
<td>0.249</td>
<td>0.249</td>
</tr>
<tr>
<td>$\beta_{RTA}^k + \beta_{RTA}^l$</td>
<td>0.589</td>
<td>0.483</td>
</tr>
</tbody>
</table>

*Note:* Estimation based on the gravity model in equation (2). Due to presence of some extreme estimates, the summary statistics is computed on estimates in the range [-12, 12]. Columns (5) - (8) represent coefficient estimates based on Weidner and Zylkin (2021) approach, accounting for incidental parameter problems.
Table 3  Effect of the end of TPLs

<table>
<thead>
<tr>
<th></th>
<th>U.S. apparel imports (log)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
</tr>
<tr>
<td>TPLs country X TPLs ended</td>
<td>-2.088</td>
</tr>
<tr>
<td></td>
<td>(1.238)</td>
</tr>
<tr>
<td>Country FEs</td>
<td>No</td>
</tr>
<tr>
<td>Year FEs</td>
<td>No</td>
</tr>
<tr>
<td>Observations</td>
<td>92</td>
</tr>
</tbody>
</table>

Note: Standard errors in parentheses. Standard errors are clustered at exporter country. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Except for the result in column (1), the estimates are obtained using weighted least squares where larger weight is given to smaller countries (that is, the inverse of imports). This is because most of the eligible countries were rather small exporters in the U.S. and global apparel market.
Appendix

(Not for publication)
1. Data sources

The main data come from CEPII and contain information about bilateral trade flows (from IMF’s DOTS, UN’s Comrade, and CEPII’s BACI,) geographical distance, trade facilitation measures (GATT/WTO membership, RTAs), cultural proximity, and macroeconomic indicators. The data cover the period from 1948 to 2019 and contain 232 exporters and 179 importers.

Another data source is the Office of Textiles and Apparel (OTEXA), which provides highly disaggregated data on U.S.’s trade in textiles and apparel beginning from 1989. The export data are more aggregated, which are regrouped to five product categories, containing records of exports to 236 destinations. By contrast, the import data are rich and include information on import values of 6,748 products (Harmonized System (HS) 10-digit) from 208 trading partners. The data also contain information on the unit and square meters equivalent (SMEs) of textile and apparel imports.\(^1\) Using the bilateral fiber and textile concordance table provided by the U.S. Department of Agriculture, we categorize apparel products into three broad categories based on the fiber type used: natural (cotton and other natural fibers), synthetic, and blended fibers.\(^2\)

We also rely on the World Integration Trade Solution (WITS) to gather data on product-level (HS 2-digit) bilateral trade as well as bound and applied MFN and preferential tariff rates. By using trade flows as weights, the tariff rates are computed by taking the average at the product group (HS 2-digit) and aggregate levels. We also readjust the bilateral trade flows to create a balanced panel from 1988 to 2021.

\(^1\) Products in the textile and apparel category 900 cannot be converted into SMEs.

\(^2\) See the [concordance tables](https://ssrn.com/abstract=4376016) on bilateral fiber and textile trade by the U.S. Department of Agriculture.
Furthermore, we use data from the Handbook of Deep Trade Agreements (2020) to collect information on the beginning and end date of the RTAs and the signatory countries. It provides detailed information on 262 RTAs reported to the WTO from 1958 through 2017. We extend the period to 2019 by prolonging all the agreements except those that ended in 2018 and 2019 (see Table A. 1). In the dataset, we observe multiple and overlapping agreements between trading partners at the same time. Under such circumstances, we take the most recent ones or those negotiated in smaller groups. The argument is that if RTAs negotiated at the multilateral level are not effective, then countries consider negotiating regionally, and eventually bilaterally. For example, instead of looking at the ASEAN-Japan agreement, we recode the bilateral RTAs between Brunei Darussalam–Japan, Japan–Indonesia, and Japan–Philippines. Finally, when it is necessary for the analysis, we convert nominal values into real terms using the CPI extracted from the World Bank’s World Development Indicators database with 2010 as a base year.

Table A. 1 RTAs that ended between 2017 and 2019, WTO Regional Trade Agreements database

<table>
<thead>
<tr>
<th>RTA Name</th>
<th>Date of Entry into Force (Goods)</th>
<th>Date of Entry into Force (Services)</th>
<th>End of implementation period (Goods/Services)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asia Pacific Trade Agreement (APTA)</td>
<td>17-Jun-76</td>
<td>17-Sep-13</td>
<td>2018</td>
</tr>
<tr>
<td>Chile - El Salvador (Chile - Central America)</td>
<td>01-Jun-02</td>
<td>01-Jun-02</td>
<td>2017</td>
</tr>
<tr>
<td>Chile - Honduras (Chile - Central America)</td>
<td>19-Jul-08</td>
<td>19-Jul-08</td>
<td>2017</td>
</tr>
<tr>
<td>China - New Zealand</td>
<td>01-Oct-08</td>
<td>01-Oct-08</td>
<td>2019</td>
</tr>
<tr>
<td>EFTA - Bosnia and Herzegovina</td>
<td>01-Jan-15</td>
<td></td>
<td>2018</td>
</tr>
<tr>
<td>EFTA - Georgia</td>
<td>01-Sep-17</td>
<td>01-Sep-17</td>
<td>2018</td>
</tr>
<tr>
<td>EFTA - Montenegro</td>
<td>01-Sep-12</td>
<td></td>
<td>2018</td>
</tr>
<tr>
<td>EU - Albania</td>
<td>01-Dec-06</td>
<td>01-Apr-09</td>
<td>2019</td>
</tr>
<tr>
<td>EU - Algeria</td>
<td>01-Sep-05</td>
<td></td>
<td>2017</td>
</tr>
<tr>
<td>Region/Merchandise</td>
<td>Start Date</td>
<td>End Date</td>
<td>Year</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>------------</td>
<td>----------</td>
<td>------</td>
</tr>
<tr>
<td>EU - Egypt</td>
<td>01-Jun-04</td>
<td>2019</td>
<td></td>
</tr>
<tr>
<td>Eurasian Economic Union (EAEU) - Iran</td>
<td>27-Oct-19</td>
<td>2019</td>
<td></td>
</tr>
<tr>
<td>Gulf Cooperation Council (GCC) - Singapore</td>
<td>01-Sep-13</td>
<td>01-Sep-13</td>
<td>2018</td>
</tr>
<tr>
<td>Hong Kong, China - Georgia</td>
<td>13-Feb-19</td>
<td>13-Feb-19</td>
<td>2019</td>
</tr>
<tr>
<td>Hong Kong, China - Macao, China</td>
<td>27-Oct-17</td>
<td>27-Oct-17</td>
<td>2018</td>
</tr>
<tr>
<td>India - Malaysia</td>
<td>01-Jul-11</td>
<td>01-Jul-11</td>
<td>2019</td>
</tr>
<tr>
<td>Indonesia - Pakistan</td>
<td>01-Sep-13</td>
<td>2019</td>
<td></td>
</tr>
<tr>
<td>Korea, Republic of - India</td>
<td>01-Jan-10</td>
<td>01-Jan-10</td>
<td>2019/2010</td>
</tr>
<tr>
<td>Trans-Pacific Strategic Economic Partnership</td>
<td>28-May-06</td>
<td>28-May-06</td>
<td>2017</td>
</tr>
<tr>
<td>Türkiye - Chile</td>
<td>01-Mar-11</td>
<td>2017</td>
<td></td>
</tr>
<tr>
<td>Türkiye - Syria</td>
<td>01-Jan-07</td>
<td>2018</td>
<td></td>
</tr>
<tr>
<td>United States - Oman</td>
<td>01-Jan-09</td>
<td>01-Jan-09</td>
<td>2018</td>
</tr>
<tr>
<td>ASEAN Free Trade Area (AFTA)</td>
<td>01-Jan-93</td>
<td>2018</td>
<td></td>
</tr>
<tr>
<td>EU - Armenia</td>
<td>01-Jun-18</td>
<td>-/2018</td>
<td></td>
</tr>
<tr>
<td>EU - Serbia</td>
<td>01-Feb-10</td>
<td>01-Sep-13</td>
<td>2014/2018</td>
</tr>
<tr>
<td>Türkiye - Serbia</td>
<td>01-Sep-10</td>
<td>01-Jun-19</td>
<td>2015/2019</td>
</tr>
</tbody>
</table>

Source: WTO Regional Trade Agreements Database.

2. Patterns of U.S. apparel trade

Figure A. 1 reveals that most U.S. apparel imports originate from East and Southeastern Asia. Central America has experienced a rise in its share in the U.S. apparel market, but this declined starting from late 1990s. On the other hand, imports from the South America have remained stagnant at low levels. Figure A. 2 plots the shares in total U.S. imports originating from CAFTA-DR countries. It is shown that Cost Rica and Dominican Republic have lost significant market shares whereas Honduras and Nicaragua have gained market shares between 1989 and 2021.
A recent development in the production and trade of apparel is the change in the fabric composition of textile and apparel products. Apparel products can be differentiated depending on the material they are made of natural (cotton, plant-based, and animal-derived), synthetic, and blend of natural-synthetic fibers. Since 2000, technological advances in threads, fibers, and fabrics have significantly expanded the range and complexity of apparel inputs. Accordingly, since 2010, U.S. synthetic-fiber apparel imports have increased significantly (Figure A. 3). More specifically, Figure A. 4 shows the fiber content of U.S. apparel imports from selected regions. Recently, synthetic-based apparel products have overtaken that of their natural-based counterparts on imports coming from the main trading regions, East and Southeast Asia. Among CAFTA-DR countries, this has occurred in El Salvador and Guatemala, and it is trending that way in Honduras (Figure A. 5).

Similarly, examining the Herfindahl-Hirschman-style concentration index of the share of exports in the top ten most-exported categories to the U.S. apparel market shows that Central America stands out as a region of rising concentration (Figure A. 6). In terms of the number of apparel products exported, which is another measure of export diversification, CAFTA-DR countries have experienced a declining or stagnant pattern; the only exception since 2010 is Nicaragua (Figure A. 7). Furthermore, Figure A. 8 and Figure A. 9 show the lack of dynamism as reflected in terms of weak performances in their relative market shares and average unit values of their exports to the U.S. market. Hence, the narrow range of inputs are likely linked with the limited diversification and product upgrading observed in these countries.
Figure A. 1 U.S. apparel imports by source region, 1989-2021

Source: Calculations based on the data from OTEXA.
Figure A. 2 Shares in total U.S. imports from CAFTA-DR countries, 1989 -2021

Source: Calculations based on the data from OTEXA.

Figure A. 3 U.S. apparel imports by fiber type, 1989-2021

Source: Calculations based on the data from OTEXA.
Figure A. 4 U.S. apparel imports source region and by fiber type, 1989 -2021

Source: Calculations based on data from OTEXA.

Figure A. 5 Shares in total U.S. imports from CAFTA-DR countries by fiber type, 1989 -2021

Source: Calculations based on data from OTEXA.
Figure A. 6 Concentration of exports in the top 10 products (at HS 6-digit) to the United States, 1989-2021

Source: Calculations based on data from UN Comtrade. Note: China's import share in 2020 is an average of the import shares of the top 10 products in 2019 and 2020. The original value is about 44 percent, which is due the import of medical masks due to COVID-19.
Figure A. 7 Number of products (at HS 6-digit) by fiber type in U.S. apparel imports from CAFTA-DR countries, 1989-2021

Source: Calculations based on data from OTEXA.

Figure A. 8 U.S. apparel import share, 1989-2021

Source: Calculations based on data from OTEXA. Notes: Import shares are the ratio of apparel imports from each region/country to the total apparel imports each year.
Figure A. 9 Average unit value of U.S. imports, 1989-2021

Source: Calculations based on data from OTEXA. Note: Unit values are computed by dividing import value by units of import at product level (at HS10-digit). To account for extreme values, the unit values are trimmed at 5 and 95 percentiles.

3. U.S. Tariff preference levels in textiles and apparel trade

One of the key features of any RTAs are the rules of origin (ROOs) requirements to determine whether traded products qualify the agreement benefits. At least on a temporary basis, RTAs provide exceptions to these requirements called tariff preference levels (TPLs). TPLs allow imported products enter the U.S. market at the preferential tariff rates even though the imported products do not fulfill the requirements to benefit under the agreements. TPLs are usually implemented to facilitate progress toward full
implementation of the terms of the RTAs. Table A. 2 presents the TPLs coverage in recent U.S. trade agreements pertaining to textiles and apparel.

Table A. 2 Tariff preference levels in U.S. trade agreements

<table>
<thead>
<tr>
<th>Country</th>
<th>TPL Coverage</th>
<th>Years in effect</th>
<th>TPL limit ranges (SMEs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bahrain</td>
<td>Cotton and manmade fiber fabric, apparel, and made ups</td>
<td>2006–16</td>
<td>65 million</td>
</tr>
<tr>
<td>Nicaragua&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Cotton and manmade fiber apparel; sublimit for certain wool suit coats</td>
<td>2006–14</td>
<td>100 million</td>
</tr>
<tr>
<td>Costa Rica&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Tailored wool woven apparel; certain tailored wool woven fabric; certain swimwear</td>
<td>2009–18</td>
<td>100,000–500,000</td>
</tr>
<tr>
<td>Oman</td>
<td>Cotton and manmade fiber apparel</td>
<td>2009–18</td>
<td>50 million</td>
</tr>
<tr>
<td>Singapore&lt;sup&gt;c&lt;/sup&gt;</td>
<td>Cotton and manmade fiber apparel</td>
<td>2004–11</td>
<td>3.125– 25</td>
</tr>
</tbody>
</table>


*Note:* (a) A shortfall in matching the one-for-one sourcing arrangement, which required matching amounts of U.S. and foreign fabrics in a given year, would count against the TPL in the following year.

(b) Under CAFTA-DR, Costa Rica’s TPL limits vary by item.

(c) The U.S.-Morocco FTA had TPL provisions with phased out annual limits. The limit of the FTA was 30 million SMEs in the first year and 4.285 million SMEs in the last year of the TPL provision.
(d) The U.S.-Singapore FTA contained a TPL limit of 25 million SMEs for the first year and 3.125 million SMEs for the last year of the TPL provision.

4. Agreement Text for ROOs in CAFTA-DR

**CAFTA-DR Rules of Origin**

Revised section Notes 2, 3, and 4 to Section XI of the agreement state:

**Note 2**: “A textile good of Chapters 50 through 60 of the Harmonized System shall be considered originating if it is wholly formed in the territory of one or more of the Parties from:

(a) One or more fibers and yarns listed in the (the Short Supply List); or
(b) A combination of the fibers and yarns referred to in subparagraph (a) and one or more fibers and yarns originating under this Annex.
(c) The originating fibers and yarns referred to in the subparagraph (b) may contain up to ten percent by weight of fibers and yarns to that do not undergo an applicable change in tariff classification set out in this Annex. Any elastomeric yarn contained in the originating yarns referred to in subparagraph (b) must be formed in the territory of one or more of the Parties.”

**Note 3**: An apparel good of chapter 61 or 62 of the Harmonized System shall be considered originating if it is cut or knit to shape, or both, and sewn or otherwise assembled in the territory of one or more of the Parties, and if the fabric of the outer shell, exclusive of collars, cuffs, and ribbed
waistbands (only if the ribbed waistband is present in combination with cuffs and identical in fabric contribution to the cuffs), where applicable, is wholly of:

(a) One or more fabrics listed in Annex 3.25 (Short Supply List)

(b) One of more fabrics or knit to shape components formed in the territory of one or more of the Parties from one or more the yarns listed in Annex 3.25 (Short Suppl List); or

(c) Any combination of the fabrics referred to in subparagraph (a), the fabrics or knit to shape components referred to in subparagraph (b), or one or more fabrics or knit to shape components originating under this Annex.

The originating fabrics referred to in subparagraph (c) may contain up to ten percent by weight of fibers or yarns that do not undergo an applicable change in tariff classification set out in this Annex. Any elastomeric yarn (except latex) contained in an originating fabric or knit to shape component referred to in subparagraph (c) must be formed in the territory of one or more the Parties.

**Note 4:** A textile of good of chapter 63 or 94 of the Harmonized System shall be considered originating if it is cut or knit to shape, or both, and sewn or otherwise assembled in the territory of one or more of the Parties, and if the component that undermines the tariff classification of the good is wholly of:

(a) One or more fabrics listed in Annex 3.25 (Short Supply List);

(b) One or more fabrics or knit to shape components formed in the territory of one or more the Parties from one or more the yarns listed in Annex 3.25 (Short Supply List); or
(c) Any combination of the fabrics referred to in subparagraph (a), the fabrics or knit to shape components referred to in subparagraph (b), or one or more fabrics or knit to shape components originating under this Annex.

The originating fabrics referred to in subparagraph (c) may contain up to ten percent by weight of fibers or yarns that do not undergo an applicable change in tariff classification set out in this Annex. Any elastomeric yarn (except latex) contained in an originating fabric or knit to shape component referred to in subparagraph (c) must be formed in the territory of one or more of the Parties.

**CAFTA-DR Exceptions**

1. **De Minimis**: Found in Article 3.3 of US-Colombia, Section G Article 3.25 of CAFTA-DR, and Article 6.1 of USMCA, the “De Minimis” exception provides that a good may still be subject to preferences within the trade agreement as long as no more than 10% of its materials contain non-originating materials that do not satisfy the rules of origin.

2. **Short Supply List**: Found in Annex 3.25 of CAFTA-DR, Annex 3-B of US-Colombia, and a topic that requires special review and consultation by all parties and subsequent trilateral agreement to modify, as stipulated in Article 6.4 of USMCA, a trade agreement’s “Short Supply List” allows for fibers, yarns, and fabrics deemed to be in short supply within the countries party to the agreement to be (1) sourced externally and (2) still receive duty preference.
3. **Regional Cumulation**: This mechanism found in Article 3.4 of US-Colombia, which has yet to be fully implemented, and within Appendix 4.1-B of CAFTA-DR which came into effect in 2008, allows for “…materials that are goods of countries in the region…” to be “…counted for purposes of satisfying the origin requirement…” CAFTA-DR’s cumulation provision relates solely to chapter 62 of the Harmonized System and incorporates only Mexico and Canada.

4. **Cut and Assemble or Cut and Sew**: Built into the specific rules of origin for each good in Annex 4-B of USMCA and outlined in Annex 4.1 of CAFTA-DR in Notes 3 and 4, Cut and Assemble allows for a good to be considered originating if it is “…cut or knit to shape, or both, and sewn or otherwise assembled in the territory of one or more of the Parties…”

5. **Fabric-Forward**: Built into the specific rules of origin for each good in Annex 4-B of USMCA and applied to specific products of CAFTA-DR and US-Colombia, fabric-forward allows for yarn in the initial stages of production to be sourced from anywhere.

Below are items in the latest short supply list. The updated [Annex 3.25](https://ssrn.com/abstract=4376016) (from International Trade Administration) contains a list of more items.
Table A. 3 Latest CAFTA-DR short supply list

<table>
<thead>
<tr>
<th>Product Description</th>
<th>HTSUS Number</th>
<th>Product Type</th>
<th>Effective date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Certain 100% Polyester 3-Layered Bonded Fabric</td>
<td>6001.22</td>
<td>Fabric</td>
<td>12/23/2021</td>
</tr>
<tr>
<td>Fabric Type: 3-layered bonded fabric with woven outer layer and knit pile inner layer, bonded with plastic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>FACE FABRIC</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fiber Content: 100% Polyester</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yarn Size: 290D – 350D / 144F</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thread Count:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Warp: 55-67 warp ends per inch</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Filling: 50-60 filling picks per inch</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fabric Construction: Plain weave</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fabric Weight: 175.7 – 214.5 g/m²</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coloration: Dyed and/or printed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>BACK FABRIC</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fiber Content: 100% Polyester</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yarn Size: 70D – 95D (before pile process)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fabric Construction: Pile knit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fabric Weight: 145.5 – 181.5 g/m²</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coloration: Dyed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>COMPOSITE FABRIC</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight: 336.6 – 412.5 g/m²</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bonding: Full or dot contact bonding meeting 2.5 Lbf/inch (Initial and 5x wash) per ASTM D2724</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air Permeability: Initial ≤ 1.0 cfm per ASTM D737</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Durable Water Repellency: Initial ≥ 90 Points per AATCC 22</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Range Hydrostatic: Initial 8,000 mm - 30,000 mm per AATCC 127</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Certain Polyester/Spandex 3-Layered Bonded Fabric</td>
<td>6001.22</td>
<td>Fabric</td>
<td>12/23/2021</td>
</tr>
<tr>
<td>Fabric Type: 3-layered bonded fabric with woven outer layer and knit pile inner layer, bonded with plastic</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
FACE FABRIC

Fiber Content: 81-91% Polyester / 9-19% Spandex
Yarn Size: 85D – 110D / 148F
Thread Count:
  Warp: 107.1 – 130.9 warp ends per inch
  Filling: 90 - 110 filling picks per inch
Fabric Construction: Plain weave
Fabric Weight: 111.6 – 136.4 g/m²
Coloration: Dyed and/or printed

BACK FABRIC

Fiber Content: 100% Polyester
Yarn Size: 70D – 95D (before pile process)
Fabric Construction: Pile knit
Fabric Weight: 145.5 – 181.5 g/m²
Coloration: Dyed and/or printed

COMPOSITE FABRIC

Weight: 315.9 – 386.1 g/m²
Bonding: Full or dot contact bonding meeting 2.5 Lbf/inch (Initial and 5x wash) per ASTM D2724
Air Permeability: Initial ≤ 1.0 cfm per ASTM D737
Durable Water Repellency: Initial ≥ 90 Points per AATCC 22
Low Range Hydrostatic: Initial 8,000 mm - 30,000 mm per AATCC 127

REMARKS

NOTE: The yarn size designations describe a range of yarn specifications for yarn before knitting, dyeing, and finishing of the fabric. They are intended as specifications to be followed by the mill in sourcing yarn used to produce the fabric. Dyeing, finishing, and knitting can alter the characteristic of the yarn as it appears in the finished fabric. This specification therefore includes yarns appearing in the finished fabric as finer or coarser than the designated yarn sizes provided that the variation occurs after processing of the greige yarn and production of the fabric. The specifications for the fabric apply to the fabric itself prior to cutting and sewing of the finished garment. Such processing may alter the measurements.
References

