Improving Preferential Market Access Through Rules of Origin: Firm-level Evidence from Bangladesh

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Abstract

In countries where there exist limited opportunities to source inputs locally, rules of origin undermine access to preferential trade agreements for final-goods exporters. I analyze the 2011 revision to the rules of origin associated with the EU's Generalized System of Preferences, which allowed apparel producers in least-developed countries (LDCs) to use internationally-sourced textiles in exported products. Using transaction-level data on Bangladeshi apparel firms, I find the rules of origin effectively cut the preferential margin by three-fourths. Liberalizing the rules of origin resulted in firm-level revenue growth, which was driven by the intensive margin through increased shipment sizes and quality upgrading.

Keywords: rules of origin, market access, least-developed countries, firm-level exports, trade agreements, GSP
JEL Codes: F13, F14, L25, O24, O19

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1 Introduction

Every preferential trade agreement requires criteria by which a product's origin is determined, known as the rules of origin, to prevent tariff fraud.[1] Fragmented production processes can make it difficult to establish where a product is made. Even simple products, like t-shirts, can cross international borders multiple times during production.[2] Yet, a product's "origin" is crucial in the context of preferential trade agreements, which provide tariff relief to goods made in some countries but not others. The standard convention is to define a product's origin based on the last country in which it underwent a sufficient transformation. Sufficient transformations can be defined in multiple ways, but one common practice is requiring that products are made from locally-sourced intermediate inputs.[3] By varying how much local content is required, countries use rules of origin to control access to trade preferences. However, when rules of origin are too restrictive, they can harm countries that were intended to receive preferential treatment under the trade agreement.

I study how revisions to rules of origin in potential export destinations influence firm- and industry-level export behavior. Specifically, I analyze the changes to the rules of origin in the EU's Generalized System of Preferences (GSP). This non-reciprocal trade agreement grants preferential status to imports from developing countries. An essential component of the EU's GSP offers tariff-free market access to apparel products, an important export sector, from the 48 least-developed countries (LDCs) conditional on satisfying rules of origin that required the use of locally-

[1]For example, to prevent trans-shipment– where a country outside of a trade agreement trans-ships a product through a participating nation to get access to preferential tariff rates in a destination market.

[2]"Planet Money Makes A T-Shirt." NPR. NPR, n.d. https://apps.npr.org/tshirt/#/title.

[3]Other standard rules of origin take the form of value-added thresholds and changes in tariff classifications (Augier, Gasiorek, and Tong 2005).

sourced textiles. However, capacity constraints in the production of textiles in LDCs kept apparel producers from utilizing the preferential tariffs. Failure to satisfy the rules of origin meant the product was imported under non-preferential tariffs, known as Most Favored Nation (MFN) tariffs, which are roughly 13.5% for apparel products (Demidova, Kee, and Krishna. 2012). In 2011, the EU reformed the rules of origin for a number of products to improve market access for all 48 LDCs. The revised rules allowed apparel producers in LDCs to use imported textiles in their exported products. The preferential tariff rates for apparel products in the EU were not adjusted when the rules of origin were revised. Thus, this setting offers a unique opportunity to analyze how exporters respond to rules of origin in the absence of changes to tariff rates.

Manufacturing firms in LDCs cite rules of origin applied by trade partners as a key difficulty in serving export markets due to the limited availability of locally-sourced inputs and burdensome paperwork required to document that the rules have been satisfied (ITC 2015). The hope that requiring locally-sourced inputs would create backward-linkages within essential sectors, like apparel, have fallen flat (Brenton and Imagawa 2005). Instead, local content requirements have resulted in low preference utilization rates among LDCs. Thus, rules of origin impede export-oriented growth policies. The Doha Development Round of global trade negotiations have sparked debates about the role of rules of origin in trade policy (Fergusson 2008), and calls to liberalize rules of origin such that they account for global value chains have grown (Geraets, Carroll, and Willems 2015). The United Nations Sustainable Development Goals directly address the restrictive nature of rules of origin, stating that *"ensuring that preferential rules of origin applicable to imports from least developed coun-*

tries are transparent and simple" is a critical component of trade-related goals (Rosa 2017).

Even with the increased policy attention, rules of origin have been an understudied component of trade policy (Conconi et al. 2018).[4] For example, a large body of economic literature focuses on the firm-level responses to tariff liberalization policies in developing countries (Pavcnik 2002; Amiti and Konings 2007; Bustos 2011; Bas and Strauss-Kahn 2015), yet the firm-level responses to rules of origin liberalization have not been studied. Given that firm-level responses to tariff liberalization are implicitly conditional on rules of origin, understanding how firms respond to rules of origin revisions provides additional information on the broader impact of trade agreements in developing countries. Development-oriented trade policies that continue to reduce tariffs on goods from LDCs may not be sufficient to encourage export growth if rules of origin are a significant barrier to preferential market access for exporting firms.

I use transaction-level customs data on the universe of Bangladeshi apparel exporting firms to analyze how the EU's rules of origin revision influenced firm-level outcomes. Unlike the apparel industries in other LDCs, which effectively function as trans-shipment locations for Chinese apparel firms (Rotunno, Vézina, and Wang 2013), the apparel industry in Bangladesh is almost entirely locally-owned (Bakht et al. 2006; Lopez-Acevedo and Robertson. 2016). I exploit variation in the input-cost differentials across apparel products and export destinations, before and after the EU's policy change to control for the potential endogeneity of the 2011 rules of origin revision. This set up allows me to provide new

[4]Reasons for the lack of empirical attention paid to rules of origin in the economic literature range from their perceived banality (Augier, Gasiorek, and Tong 2005), to their legal complexity (Cadot, Estevadeordal, and Suwa-Eisenmann 2005). Historically, rules of origin policy have remained static within existing trade agreements, and their lack of variation has made it difficult to isolate their influence on trade flows.

insights into the relationships between trade policy, market access, and firm-level export performance. For example, several studies provide evidence that country- and industry-level trade flows respond to changes in rules of origin (e.g., Andersson 2016; Curran and Nadvi 2015; Bombarda and Gamberoni 2013; Conconi et al. 2018; Tanaka 2020; De Melo and Portugal-Perez 2014; Brunelin, De Melo, Portugal-Perez, et al. 2018), but they are unable to distinguish between within-firm and across-firm responses.[5] Understanding the channels through which export growth occurs in LDCs has important implications for designing effective trade policy.

To identify the effects of the rules of origin revision, I use a triple-difference empirical approach. The low start-up costs associated with producing knit textiles have allowed Bangladesh to become largely self-sufficient in knit fabrics (Ahmad et al. 2005). However, the significant capital requirements necessary to begin weaving at a large scale have meant that the apparel industry must rely on imported woven textiles (Frederick and Staritz 2012; Masum 2016; Habib 2016). Thus, the EU's initial rules of origin, which required locally sourced textiles, constrained preferential access for woven apparel considerably more than knit apparel. Using variation in export destinations (EU versus non-EU) and policy timing (pre- versus post-2011), I construct two difference-in-differences estimates: one for woven apparel and one for knit apparel. The triple-difference effect is then the difference between these two estimates and accounts for product- and destination-specific shocks.

[5] Several studies use cross-sectional firm-level data to analyze how firms endogenously sort across export markets based on differences in rules of origin across destination markets (Demidova, Kee, and Krishna. 2012; Cherkashin et al. 2015). Using variation in the restrictiveness of rules of origin over time within an existing agreement allows me to analyze how this endogenous sorting changes, and whether the changes make the industry more or less productive. Further, I am able to decompose total firm-level export growth, and total industry-level export growth into intensive and extensive margins.

I find evidence that the relaxation of the EU's rules of origin resulted in substantial revenue gains for exporting apparel firms. Average annual firm-level export revenue in the EU increased by approximately 30% after the rules of origin revision. Firm-level export revenue growth was driven by growth in shipment sizes, rather than firms introducing new products or entering new EU countries. The market access gains in the EU did not appear to result in firms shifting export activity away from other markets, indicating firms had the capacity to increase production without raising marginal costs.

Additionally, I find evidence that apparel firms took advantage of the new rules of origin to upgrade their exported products' quality and reduced their quality-adjusted prices. This is consistent with research that links input-tariff liberalization and output quality (Pavcnik 2002; Bas and Strauss-Kahn 2015; Fan, Li, and Yeaple 2015; Manova and Yu 2017) and provides new evidence on the relationship between input costs and export product quality. Quality-upgrades account for approximately 40% of the within-firm intensive margin export growth.

Across firms, total industry-level export revenue increased by 46%.[6] A decomposition of industry-level export growth, using the methods suggested in Bernard et al. (2009), reveals that the intensive margin largely drives the response. This result is consistent with empirical work that shows the intensive margin of trade responds more quickly than extensive

[6]The industry-level effect is smaller in magnitude than what is estimated in Tanaka (2020), who studies the EU's rules of origin revision in the context of the Cambodian apparel industry and finds Cambodian apparel exports increase by over 100%. The Cambodian industry is different from the Bangladeshi industry in several key ways. For example, the Cambodian industry is almost entirely owned by foreign firms, while the Bangladeshi industry is almost entirely locally owned. Bangladesh is also more established in global apparel markets than Cambodia. Bangladesh is the largest LDC producer of apparel, while Cambodia is a relatively small producer. While Tanaka (2020 is unable to distinguish between intensive and extensive margin responses, it is possible that entry into the Cambodian market is less competitive than Bangladesh, making extensive margin responses more important in that context.

margins to trade shocks (Bernard et al. 2009), and that intensive margin effects are larger than extensive margin effects in response to economic integration agreements (Baier, Bergstrand, and Feng 2014). An analysis of market share reallocation across different types of apparel producers indicates that incumbent firms gained market share after the rules of origin revision.

These firm- and industry-level responses to the rules of origin liberalization can be interpreted through the lens of standard heterogeneous firm models (Melitz 2003; Chaney 2008). Using the derivation of the elasticity of the intensive margin of trade with respect to trade costs in Chaney (2008), and the methods in Kee, Nicita, and Olarreaga (2009), I estimate the initial rules of origin had an equivalent effect on trade as a 10% ad-valorem tariff.[7] This tariff-equivalence is over half of the difference between the LDC-specific preferential tariffs (0 percent) and MFN tariff rates that are applied if rules of origin are not satisfied. MFN tariffs on apparel in the EU were between 12% and 15% (Demidova, Kee, and Krishna. 2012). Thus, the rules of origin effectively cut the preferential margin by approximately three-fourths.

The remainder of this paper is organized as follows. In Section 2, I discuss the context in which this study takes place. In Section 3, I describe the data and empirical framework. Section 4 presents the empirical results. Finally, Section 5 concludes.

2 Institutional Context

This section provides a brief overview of the institutional context of market access to the EU for LDC apparel exporters, the apparel produc-

[7]See Section 4.6.1 for the explanation of the ad-valorem tariff equivalent and a description of how it is calculated.

tion process, and the economic importance of the apparel export industry in Bangladesh.

2.1 The EU's Everything But Arms Agreement

The EU's Generalized System of Preferences (GSP) is a unilateral agreement that grants preferential tariff treatment for imports of goods from many developing countries. Within the GSP, the "Everything But Arms" (EBA) arrangement allows for duty-free and quota-free trade in all products, except arms and ammunition, between EU countries and the 48 LDCs. Many industrialized and newly-industrialized countries have similar non-reciprocal trade arrangements with LDCs that grant tariff-free, or nearly tariff-free access to apparel produced in LDCs (Tavares 2019).

The EBA went into effect in 2001 with the stated goal of helping LDCs integrate further into the global economy. Initially, for an apparel product to qualify for the EBA, the product had to be assembled from domestically produced fabric.[8] This style of rule of origin is commonly referred to as a "double-transformation" and refers to a production process where imported inputs are transformed at least two times before being exported as final goods. In the context of apparel, the double-transformation rule allowed for the use of imported thread in clothing, but not imported textiles. Apart from the local content requirements, exporters must declare a "statement of origin" with documentation supporting their claim. The statement of origin is verified by customs authorities in the importing EU country (European Commission 2019).

[8]Other products in the EU's GSP have different rules of origin. For example, some products have a local value-added threshold that must be satisfied. Other products, like agriculture must be entirely produced in the exporting country. The rules of origin for apparel products require the use of locally-sourced intermediate inputs (textiles). Requiring the use of local inputs is a common method of determining the origin of apparel products, and is also used in the United States' GSP.

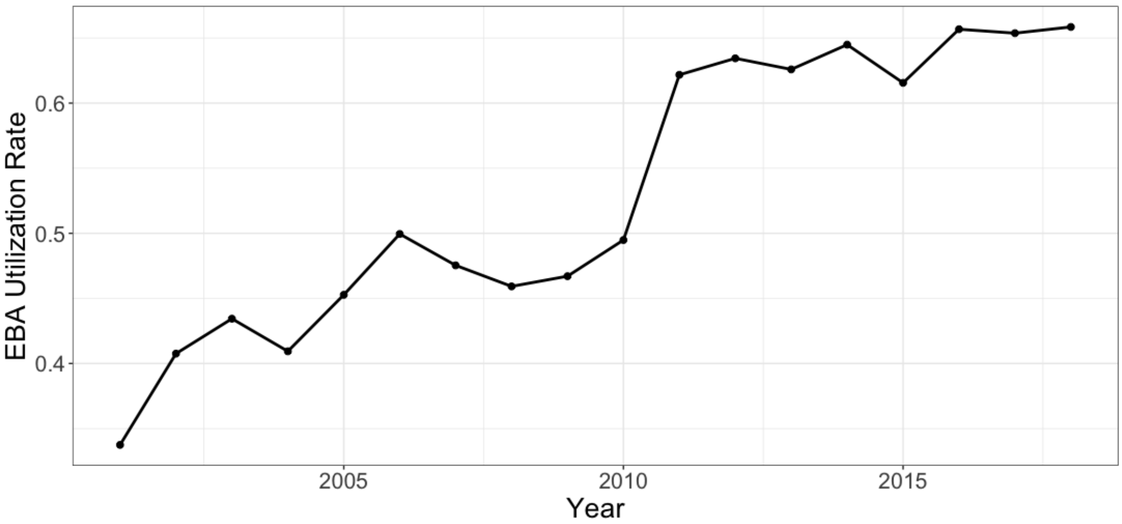
The local fabric requirement was designed to be easy to understand for exporters and encourage backward-linkages in developing economies. However, LDCs were critical of the rule for being too difficult for many producers to satisfy due to capacity constraints and lack of investment capital in the production of textiles (Barber et al. 2004). Small concessions were made in the EBA when it was ratified to allow garments made from textiles imported from other LDCs or the EU to qualify (Sekkel 2009).[9] However, even with these concessions, it remained difficult for apparel producers to satisfy the rules. Apparel products made from textiles imported from major textiles producers like China, Hong Kong, India, and Pakistan would not qualify for the EBA, as these countries were not LDCs as determined by the United Nations. The vast majority (roughly 70%) of textile imports come from China and Hong Kong. Most Favored Nation (MFN) tariffs of between 12% and 15% was applied to apparel goods that were not able to satisfy these rules of origin (Demidova, Kee, and Krishna. 2012). Between 2001 and 2010, an average of 45% of apparel from LDCs entered the EU under the EBA each year, with the remaining 55% entering under MFN tariffs (EuroStat 2020).

Citing the qualms raised by LDCs at the Doha Development Round of global trade negotiations, the EU announced there would be a revision of the rules of origin associated with the EBA for several products.[10] The

[9] The EU GSP also allowed for regional cumulation across South Asian countries, which would permit countries like Bangladesh to use imported textiles from India in their exported products. However, under pressure from domestic textile producers, Bangladesh never ratified this component of the agreement (Rahman et al. 2014).

[10] In the November 18th, 2010, Commission Regulation, the European Commission states, “In the context of the Doha Development Agenda, the need to ensure better integration of developing countries into the world economy has been recognized, in particular through improved access to the markets of developed countries.”. Further, the commission highlights the difficulty LDCs have in gaining access to preferential rates: “The rules of origin should reflect the features of specific sectors but also allow beneficiary countries a real possibility to access the preferential tariff treatment granted”. (“Commission Regulation (EU) No 1063/2010 of 18 November 2010 Amending Regulation (EEC) No 2454/93 Laying down Provisions for the Implementation of Council Regulation (EEC) No 2913/92 Establishing the Community Customs Code”).

Figure 1: Utilization of the EBA by LDCs



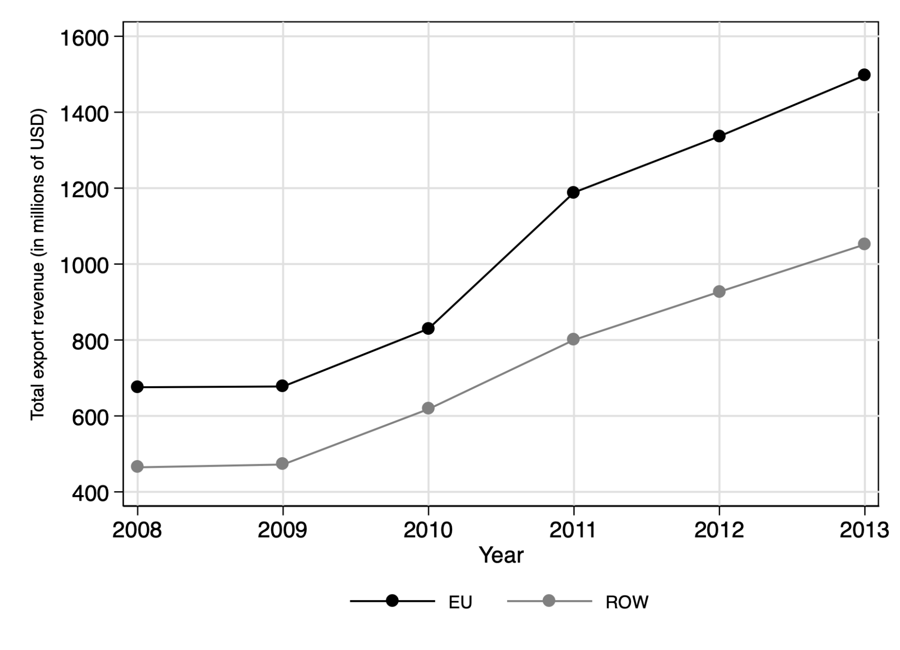
Notes: This figure displays the average annual utilization rate of the EBA for LDC apparel exports. Data for the figure comes from EuroStat (2020).

announcement came in November 2010, then, on January 1st, 2011, the new rules of origin were put into effect. One of the most significant changes came in the form of a relaxation of the local fabric requirement for apparel. The new rules allowed apparel producers in LDCs to source textiles globally, de-coupling the apparel production sector from the capacity-constrained textile production sectors in these countries.

The effect of the policy change on EBA utilization rates was substantial. Figure 1 displays the fraction of apparel imports from LDCs that entered under the EBA over time. Between 2010 and 2011, the fraction of apparel products that entered the EU tariff-free under the EBA increased by 20 percentage points (EuroStat 2020).

After the EU's rules of origin revision, exports of apparel from Bangladesh to the EU increased. Figure 2 displays the change in total annual exports of apparel from Bangladesh. The figure shows that total export revenue to the EU increased after 2011, when the EU's rules changed. Total export revenue to the rest of the world (ROW) continued to increase over the

Figure 2: Total Apparel Exports from Bangladesh



Notes: This figure displays total apparel exports from Bangladesh to EU or ROW destinations over time.

sample period, however it did not appear to respond to the EU's rules of origin revision in 2011.

2.2 Apparel production

Apparel production is a labor-intensive process. However, the full production process of turning raw materials into clothing involves several capital-intensive stages. Apparel manufacturing takes place in three broad steps: (1) spinning of yarn from natural or human-made fibers, (2) the production of fabric or textiles, and (3) the production of final apparel goods. While the third stage is a labor-intensive process, the first two are more capital-intensive. In the case of Bangladesh (and many other LDCs), apparel products are mainly produced for export markets, not domestic consumption.

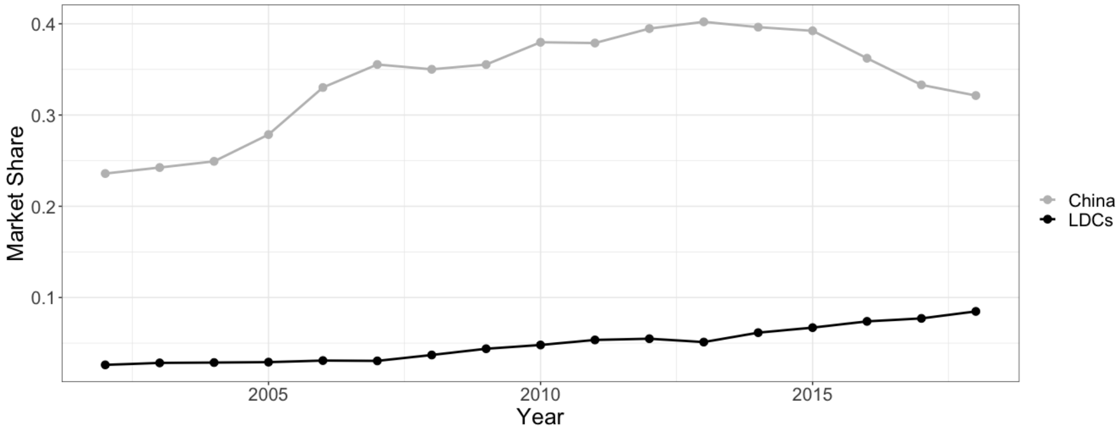
The general process outlined above is similar for all apparel. However, there is heterogeneity in the amount of capital needed to produce different fabrics. This difference can be seen in the production of woven versus knitted fabric. Production of woven fabric requires weaving multiple threads over and under each other in a criss-cross pattern, and is done in large plants. Producing woven fabrics is an energy-intensive process, and while labor-intensive hand-looms can create woven fabric, they are typically too inefficient to use at a large scale (Frederick and Staritz 2012). Dying and treating woven textiles is also capital-intensive. Knit fabric is much less capital-intensive to produce. Knit fabric can be produced at a smaller scale using small circular knit machines (Curran and Nadvi 2015). Many knitted apparel products are made directly from pre-dyed yarn, which cuts down on production costs.

China is the largest global exporter of apparel products. Figure 3 displays the market share of China and LDCs in global apparel exports over time. China's market share increased from 24% in 2002 to 33% in 2018. Market share for LDCs is substantially smaller, growing from roughly 3% in 2002 to approximately 8% in 2018. However, apparel production comprises a significant fraction of manufacturing employment in LDCs. In a survey of apparel industries in LDCs, Keane and Velde (2008) find that the sector accounts for roughly 60% of total manufacturing employment across these countries. Naturally, the change to the EU's rules of origin had the potential to influence LDC exports significantly, and, given the reliance on the sector, the entire economies of these countries.

2.3 The Apparel Export Industry in Bangladesh

In Bangladesh, the garment industry accounts for roughly 13% of GDP (Heath 2018) and employs approximately 40% of the country's manufac-

Figure 3: Market Share in Global Apparel Exports



Notes: This figure displays the market share in global apparel exports for China and all LDCs combined. Data from UN Comtrade (United Nations 2020) and the Bangladesh Garment Manufacturers and Exporters Association (BGMEA, n.d.) was used to create this figure.

turing labor force (Curran and Nadvi 2015). The vast majority of workers associated with the garment industry in Bangladesh produce clothing, rather than textiles. Apparel accounts for roughly 80% of Bangladesh's average annual export volume. In 2010, the textile and apparel industries in Bangladesh employed approximately 2.5 million people combined, of which 70% worked in the apparel industry (International Labor Organization, 2020). Unlike other garment-producing LDCs, apparel production is mainly locally owned and financed. In 2005, roughly 97% of apparel firms only sourced capital locally (Bakht et al. 2006). By 2016, this number had only fallen to 91% (Lopez-Acevedo and Robertson. 2016).[11]

Like other LDCs, Bangladesh relies heavily on imported textiles from China, Hong Kong, and India for apparel production. However, given the relative capital intensity of woven textiles, woven apparel products rely

[11]Other LDCs do not have a large fraction of firms that are locally owned. For example, approximately 80% of ownership in the average Cambodian apparel firm belongs to foreign private firms (Sytsma 2020). Tanaka (2020) finds that the EU's rules of origin revision increased industry-level export revenue in Cambodia, but it is unclear how much of this revenue gain was retained within the local economy.

Table 1: Textile Sourcing in by Apparel Firms in LDCs

Study	% Knit Textiles Locally Sourced	% Woven Textiles Locally Sourced
Habib 2016	65%	15%
Frederick and Staritz 2012	60-70%	12-15%
Masum 2016	90%	40%

Notes: This table displays the fraction of apparel firms in LDCs that source textiles locally. Statistics presented are from the sources listed in the table.

more heavily on imported textiles than knitted apparel products. Figure A1, in the appendix, displays where Bangladesh sourced textiles pre- and post-2011. Initially, textiles from other LDCs and the EU – which were permitted under the initial rules of origin – were the 9th largest source of textiles in Bangladesh. After the rules of origin revision, imports from these sources virtually ceased entirely. Total textile imports of woven apparel increased after the rules of origin revision as well. Figure A2 displays total imports of textiles over the sample period, broken down by textile type. Post-2011, there was an increase in woven textile imports from international sources. On the other hand, knit textiles did not respond drastically to the relaxed sourcing constraints under the new rules of origin.

Several studies provide estimates of the ability of LDC's textile industries to supply the apparel industry. Table 1 displays survey estimates from three studies on the percent of textiles sourced locally in LDCs for woven and knitted apparel products. In all cases, the percent of locally sourced textiles used in woven apparel production is substantially lower than locally sourced knitted textiles. In terms of prices, Bangladeshi-made woven cloth was approximately 20% more expensive than similar imported cloth in 2005 (Demidova, Kee, and Krishna. 2012). However, since then electricity costs in Bangladesh have driven up the local textile production costs (Islam, Khan, and Islam 2013).

Given these differences in the production process of woven versus knitted apparel, the change in the rules of origin was likely to affect woven apparel exports more than knitted apparel exports.[12] Evidence of this discrepancy can be seen in the change in EBA utilization rates in Figure 4, which displays the utilization rate of the EBA by Bangladeshi apparel exporters. The utilization rate is calculated as the fraction of EU apparel imports from Bangladesh processed under the EBA, relative to the total EU apparel imports from Bangladesh. The data from the figure comes from Eurostat's Imports by Tariff Regime database.[13]

The utilization rate for knit apparel products is near 100% over the sample period, indicating that almost all knit apparel products from Bangladesh used locally-produced knit textiles. The utilization for woven apparel products was initially quite low, roughly 20% when the EBA began. Woven apparel products responded dramatically to the policy change in 2011, while knitted products did not respond to the policy change. Relative to the change in the utilization rate for knitted products, the utilization rate for woven products increased by roughly 55 percentage points. This difference helps inform the empirical framework used in this paper.

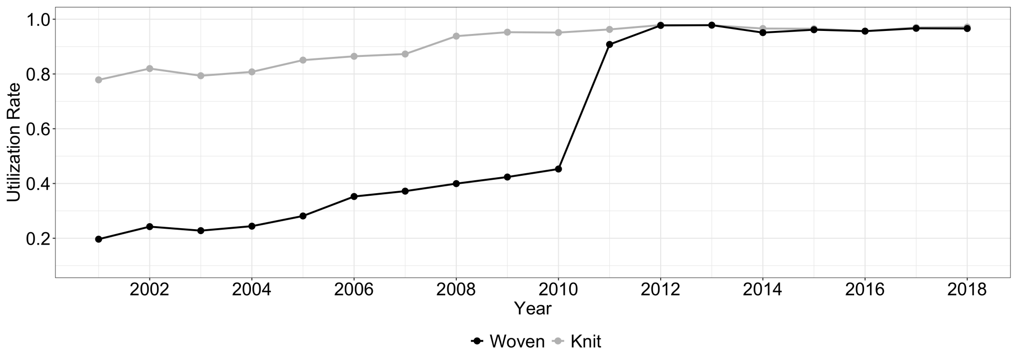
3 Data and empirical framework

In this section, I describe the data and outline the empirical framework used to analyze the firm-level responses to the rule of origin revision.

[12] Recognizing the reliance of the ready-made-garment sector on imported intermediate inputs, Bangladesh has a duty-free policy of their own for imports of textiles used in exported apparel products (Kabir et al. 2019). Thus, for export-oriented firms, a significant cost associated with imported textiles came from the inability of exporters to utilize preferential trade agreements like the EBA.

[13] European Statistical Office. (2020). Adjusted EU-EXTRA Imports by tariff regime, by HS6. Retrieved from http://epp.eurostat.ec.europa.eu/newxtweb/

Figure 4: Change in EBA utilization rate for apparel products



Notes: This figure displays the utilization rate of the EBA for Bangladeshi apparel products. The data comes from EuroStat. The utilization rate is calculated as the value of imports into the EU that were processed under the EBA, relative to the total value of imports into the EU regardless of how the imports were processed.

3.1 Data and Summary Statistics

The primary data source used in this project comes from The Bangladesh National Bureau of Revenue, made available by the International Growth Center (International Growth Center 2020). This panel data set contains information on the universe of export transactions by Bangladeshi firms collected from the bill of entry associated with each export shipment. Firm-level shipment values and quantities by export destination are included in the data set, as is the day of the shipment at the HS8-digit product level. I collapse the data to the annual level, as the change in the rules of origin occurred on January 1st, 2011. The sample used in this study covers transactions between 2008 to 2013, which allows me to focus on the relevant period and include three pre-treatment years (2008-2010), and three post-treatment years (2011-2013).[14] Over the sample period, the EU accounts for roughly 60% of annual export revenue. Finally, I focus specifically on the change from a double-transformation to

[14]Ashan and Iqbal (2017) show that this customs data set is reliable by demonstrating that the ratio of annual exports from the customs data to the annual exports from the World Bank data is 0.99 over the sample period.

a single-transformation rule of origin, which only applied to exporters of apparel. Apparel products are defined as exports in HS heading 61 (knitted products), and HS heading 62 (woven products) and account for roughly 80% of the annual export value from Bangladesh. There are 243 unique HS8-digit products in these two categories, and 202 unique export destination countries. The EU is considered a single market, since the rules of origin applied to the entire Union, and there are 173 export markets to which Bangladeshi firms sell.

Table 2 presents summary statistics of the data. The table is broken into two panels, one that displays the summary statistics for woven apparel products and one that displays the summary statistics for knitted apparel products. Averages and standard deviations are shown in the table. The statistics in the table are calculated for 2010, the year before the change in the rules of origin.

Average annual export revenue (in $1,000) is highest for knit apparel sold to the EU. LDCs were competitive in this market due to the reduced tariff rates offered under the EBA and the relative ease of producing knit apparel. Average unit-prices (in USD) are lower in the ROW than they are in the EU for both product types, which is consistent with predictions made in heterogeneous firm models where more restrictive trade policies result in lower price indices (Melitz and Ottaviano 2008). Firms export an average of two HS8 products in each HS2-export market.

Firm-level exports are highly skewed towards its top product, as shown in Table 3. The table shows information for firms that produce between one and ten products and displays the share of total output attributed to each product sold, descending from the firm's largest (in terms of export revenue) to the tenth largest product. The average output share of the largest product is approximately 3.5 times larger than the second-largest

Table 2: Summary statistics

	EU Average	ROW Average	Overall Average
Woven			
Export revenue	153.70	197.73	177.03
	(403.27)	(610.53)	(523.80)
Unit prices	1.46	1.21	1.32
	(0.99)	(1.27)	(1.16)
Products exported	2.42	2.40	2.41
	(1.92)	(2.06)	(2.00)
Knit			
Export Revenue	216.74	70.25	137.30
	(545.66)	(226.16)	(411.47)
Unit prices	1.34	1.10	1.21
	(0.85)	(1.09)	(0.99)
Products exported	2.44	1.89	2.14
	(2.06)	(1.48)	(1.79)

Notes: This table displays the summary statistics for the sample. These statistics are calculated in 2010, the year prior to the rules of origin change. EU refers to EU destinations and ROW refers to the "Rest of the World". Woven products refer to exports from HS heading 62, and knitted products refer to exports from HS heading 61. EU Exports refers to exports to EU member countries. Means are presented in the table, with standard deviations in parentheses below. Firm-level revenue is reported in 1,000 USD, and prices are in USD.

product, although this ratio declines with the number of products sold by the firm.

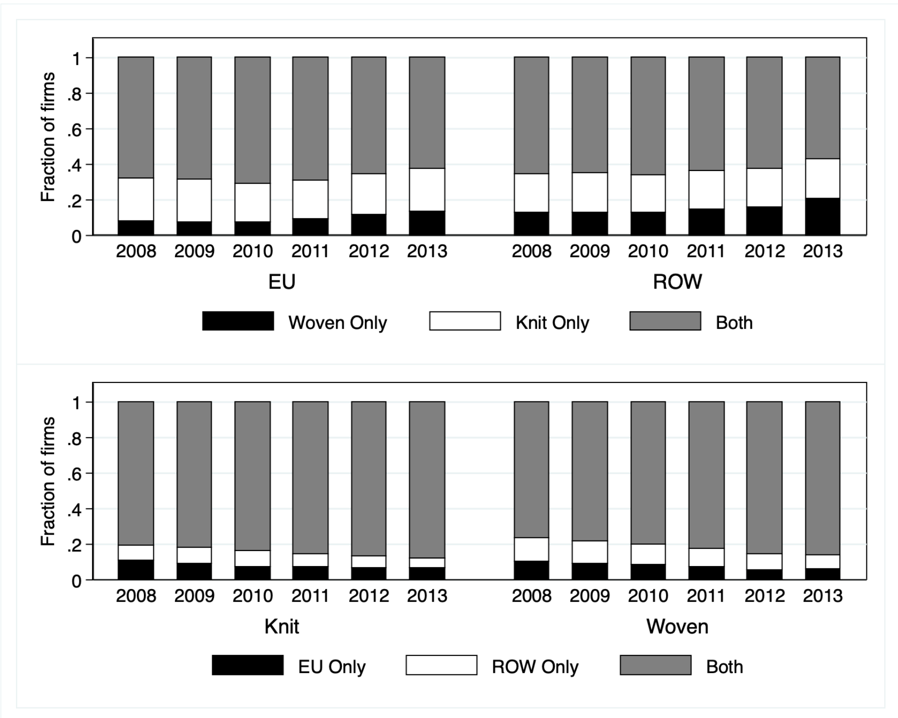
Across firms, there is relatively little specialization. The top panel of Figure 5 displays the fraction of firms that export only woven apparel, only knit apparel, and both woven and knit apparel. The majority of firms produce both woven and knit apparel products. The composition of firms is similar across destinations and over time. There is even less specialization in where firms ship products. The bottom panel of the figure shows that the vast majority of firms sell to both the EU and the ROW.

Table 3: Within-firm export share by product

Rank of Product in Firm's Output	Number of Products Sold by Firm: 1	2	3	4	5	6	7	8	9	10
1	1.000	0.800	0.732	0.687	0.658	0.632	0.610	0.595	0.563	0.547
2		0.199	0.200	0.198	0.195	0.193	0.191	0.188	0.190	0.188
3			0.067	0.081	0.085	0.088	0.089	0.092	0.095	0.097
4				0.034	0.042	0.048	0.051	0.053	0.057	0.059
5					0.019	0.027	0.031	0.033	0.037	0.039
6						0.012	0.018	0.021	0.025	0.027
7							0.009	0.012	0.017	0.019
8								0.006	0.010	0.013
9									0.005	0.008
10										0.004

Notes: The columns of the table report the number of products sold by the firm, while the rows display the share of firm-level output for each product. The rows are in descending order of product rank in output share.

Figure 5: Specialization across product types and destinations



Notes: This figure displays the fraction of firms that specialize in the production of one type of product (top panel), or specialize in where they sell products (bottom panel).

3.2 Endogeneity concerns and the triple-difference approach

A threat to the identification of the effect of the rules of origin revision in the EU stems from the potential endogenous nature of the policy change itself. For example, EU policymakers may have foreseen an increase in demand for apparel products from LDCs for EU consumers and responded by revising the rules of origin for these products. As a result, any change in LDC exports of apparel products to the EU may be driven by underlying changes in economic conditions or demand rather than the revision to the rules of origin. If this demand shock differentially affected the EU relative to other markets, a difference-in-difference estimator exploiting variation in the export destination before and after the policy change will not recover an unbiased estimate of the effect of the policy change.

To control for potential unobserved destination-specific and product-specific shocks, I exploit additional variation in the cost of producing textiles. As discussed earlier in this paper, the initial rules of origin were particularly constricting for woven apparel products due to the capacity constraints in the woven textile production industry. I use a triple-difference approach, exploiting variation in input-cost differentials across woven and knitted apparel and export destination, before and after the EU policy change.

The triple-difference can be expressed as:

$$\overbrace{[\Delta Y_{EU,WOVEN} - \Delta Y_{ROW,WOVEN}]}^{\text{Woven Difference-in-Differences}} - \underbrace{[\Delta Y_{EU,KNIT} - \Delta Y_{ROW,KNIT}]}_{\text{Knit Difference-in-Differences}}$$

where ΔY refers to a change in outcome Y after the rules of origin liberalization. The first term in brackets is the woven apparel difference-in-difference, and the second term in brackets is the knitted difference-in-difference. This is a sharp design, and the stable groups assumption is satisfied (i.e., there are product-destination groups for which the rules of origin did not change).

The common trends assumption requires that the expectation of the difference in the woven and knitted difference-in-differences evolves similarly over time in the absence of the EU's rules of origin reform. The woven and knit difference-in-differences control for global trends in sales of the two types of apparel products, while their difference controls for destination-specific shocks. A violation of the identifying assumption under the triple-difference requires there to have been a post-2011 shock to demand that differentially affected woven apparel relative to knit apparel, and differentially affected the EU relative to the ROW. Given the global nature of fashion trends, it is unlikely that an increase in demand for woven apparel in the EU would not have also occurred in non-EU countries.[15]

The top panel in Figure 6 displays the trends in total firm-level woven and knitted apparel export revenue, to the EU and the rest of the world (ROW), over the sample period.[16] The solid lines represent the (log) average annual firm-level export revenue for woven apparel exports. The dashed lines represent the (log) average annual firm-level export revenue

[15]Further, given the persistence of the effect estimated later in the paper, this sort of violation of the identifying assumption would require a long-term, persistent shock to demand that differentially affected woven apparel products in the EU.

[16]This figure displays changes in average total export revenue at the firm level. Export revenue across products within HS2 headings and across destination countries within the EU/ROW are summed by firm and year, then the average across firms is taken and a natural log transformation is applied. Figure A5 displays the trends in total industry-level export revenue, where export revenue is summed across products within HS2 categories, countries within EU/ROW, and across firms.

for knitted apparel. The gray lines indicate exports to the ROW, while black lines indicate exports to the EU.

The export revenue of both types of products sold to both destinations is increasing over the sample period. Many factors could drive this. For example, the recovery from the great recession occurred within the sample time frame. Thus, the upward trend in the sales of all apparel products to both destinations could be a response to higher consumer income in the latter half of the sample.[17]

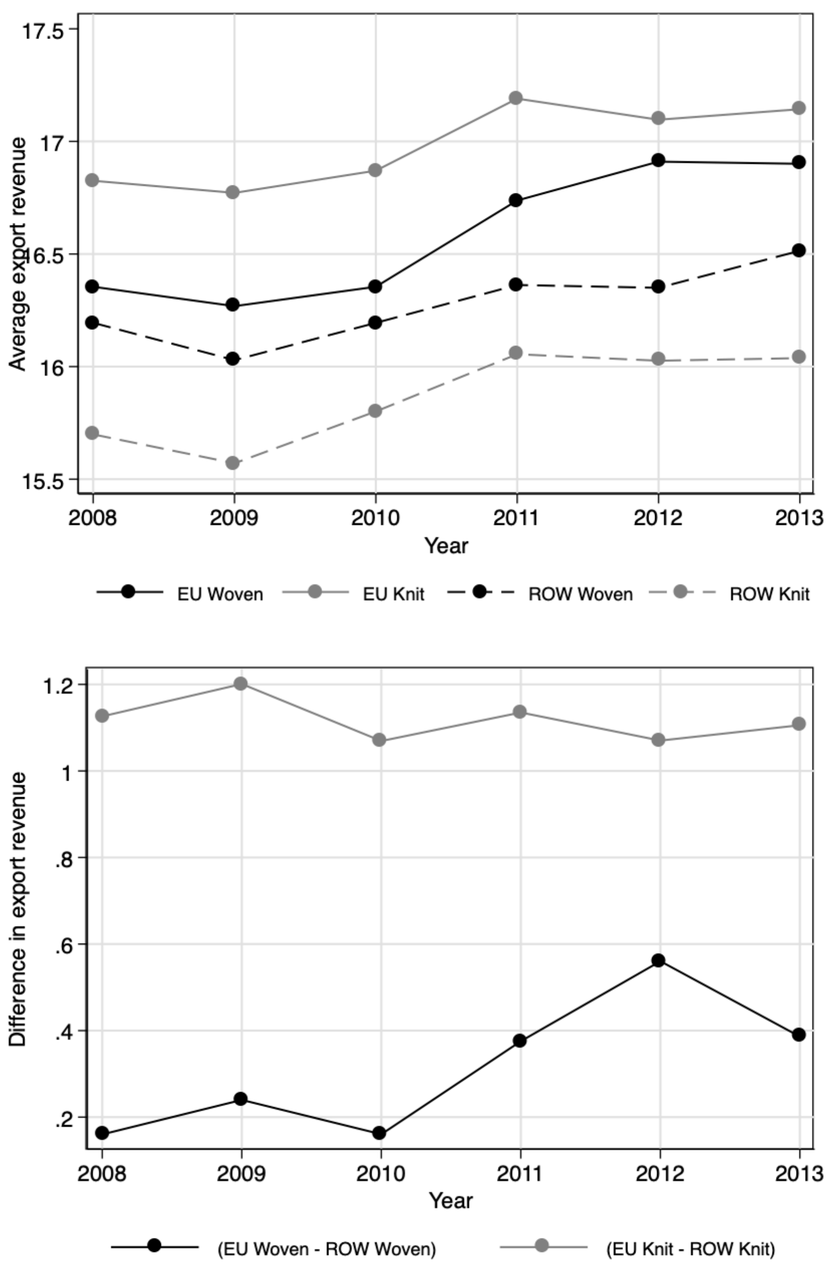
The bottom panel of Figure 6 displays the trends in the difference between the solid lines in the top panel of Figure 6, and the difference between the dashed lines in the top panel over time. The jump in the gap in export revenue for woven apparel is apparent in the data, while the does not appear to be any change in the difference in export revenue for knit clothing. The triple-difference is formed by estimating the difference between the two trends in the bottom panel of Figure 6.

4 Empirical results

This section presents the results from estimating the triple-difference. First, firm-level export growth is analyzed. Next, the effect of the rules of origin on product quality is studied, using the product quality measures from Khandelwal, Schott, and Wei (2013). Then, total-firm level export growth and total bilateral-export growth are decomposed into intensive and extensive margins, using the methods recommended in Bernard et al. (2009). Finally, an analysis of how the rules of origin revision impacted market shares for different types of firms is conducted.

[17]The growth in exports of all products to all destinations over this period indicates that Bangladeshi apparel firms were not capacity constrained. I show that exports of woven apparel to non-EU countries and exports of knit clothing to EU countries did not change by a statistically meaningful amount in Section 4.5.

Figure 6: Trends in Total Export Sales



Notes: This figure shows the trends in log average export value of firm-level exports to the EU and ROW in knit and woven apparel over time. The solid lines represent woven apparel exports (HS 62), while the dashed lines represent knitted apparel exports (HS 61). The change in the rules of origin for EU countries occurred on January 1st, 2011.

4.1 Firm-level export growth

I begin by examining the response of export revenue to the EU's 2011 rules of origin liberalization at the firm-product-export market level. I first estimate the woven and knit difference-in-differences (DD) specifications, then estimate the triple-difference. The product-specific DD specifications are given by:

$$\text{Woven DD: } ln(r_{ijkt}) = \phi_{ikt} + \gamma_{ijk} + \beta_1(EU_j * Post_t) + \epsilon_{ijkt}, \quad \text{if } k \in HS62 \tag{1}$$

$$\text{Knit DD: } ln(r_{ijkt}) = \phi_{ikt} + \gamma_{ijk} + \beta_1(EU_j * Post_t) + \epsilon_{ikjt},, \quad \text{if } k \in HS61 \tag{2}$$

where the outcome is the natural log of export revenue for a firm i selling product k to export market j in year t. The difference-in-differences estimate is given by β_1, the coefficient on two interacted dummy variables, EU_j, and $Post_t$, that take the value one if market j is the EU and the year is 2011 or later, respectively. Firm-product-year fixed effects, ϕ_{ikt}, are included to control for idiosyncratic shocks to firm-level productivity in product k. The inclusion of firm-product-destination fixed effects, γ_{ijk}, controls for static differences in firm-product revenue between destinations (EU and ROW). Finally, the error term, ϵ_{ijkt}, allows for clustering at the export market level.

The estimates of β_1 are presented in the first two columns of Table 4. As expected, the difference in exports of woven apparel between the EU and the ROW increased, while the difference in exports of knit apparel between the EU and the ROW did not change by a statistically significant amount.

The triple-difference is the difference between the two product-specific DDs. This is estimated as:

$$ln(r_{ijkt}) = \phi_{ikt} + \gamma_{ijk} + \delta_{jt} + \beta_1(EU_j * Woven_k * Post_t) + \epsilon_{ijkt} \quad (3)$$

where the variable $Woven_k$ is a dummy variable that takes the value one if product k is a woven product, and zero for knit products. This specification also includes market-year fixed effects to control for annual expenditures and price indices across export markets. The error term allows for clustering at the export market level. This flexible triple-difference controls for all relevant double-interacted dummy variables and single dummy variables with the sets of interacted fixed effects.[18]

Column (3) of Table 4 displays the results from estimating equation 3. The estimate is the difference between the estimates of the two product-specific DDs. After the EU's rules of origin revision, woven apparel exports to the EU increased by 29%.[19] When evaluated at the 2010 average, this comes to an increase in average annual export revenue of approximately $44,000 (32 million in Bangladeshi Taka).[20]

The results are robust to a number of other fixed-effect and error clustering specifications. These results are presented in Table A1, in the Appendix, and summarized in Figure 7. In the figure, the gray bar represents the 95% confidence interval around the estimate of β_1 from equation

[18] For example, the firm-product-year fixed effects control for the $WOVEN_k$, $POST_t$, and $WOVEN_k * POST_t$ dummy variables and interactions. The firm-product-destination fixed effects control for the $EU_j * WOVEN_k$ interaction, and the market-year fixed effects control for the EU_j, and $EU_j * POST$ fixed effects. The use of interacted fixed effects in place of interacted dummy variables in a triple difference framework is similar to what is used in Frazer and Biesebroeck (2010), who study industry-level responses to the implication of the African Growth and Opportunities Act.

[19] Marginal effects can be transformed into percentages using $100 * [exp(\hat{\beta}_1) - 1]$.

[20] This is calculated from Table 2.

Table 4: Export Revenue

	(1) Woven DD	(2) Knit DD	(3) DDD	(4) DDDD	(5) Response in other markets	(6)
$EU_j * POST_t$	0.271***	0.009			0.030	
	(0.104)	(0.075)			(0.076)	
$WOVEN_k * EU_j * POST_t$			0.258***	0.256***		
			(0.053)	(0.054)		
$WOVEN_k * EU_j * POST_t * Coated_k$				2.787***		
				(0.897)		
$WOVEN_k * POST_t$						0.062
						(0.041)
Observations	73,009	79,032	151,847	151,847	27,041	72,071
R-squared	0.550	0.644	0.720	0.720	0.715	0.586
firm-prod-year fe	y	y	y	y	y	
firm-prod-dest fe	y	y	y	y	y	y
market-year fe			y	y		y

Notes: The first column of the table presents the results from estimating equation 1. The second column presents the results from estimating equation 2. The results from estimating equation (3) are shown in column 3. The variable EU_j is a dummy variable for the EU as a destination, the variable $WOVEN_K$ is a dummy variable for woven apparel products, and the variable $POST_T$ is a dummy variable for post-2011. Column 4 presents the results of the heterogeneity analysis, where the variable $Coated_k$ is a dummy variable that takes the value 1 if product k is made from coated woven textiles. Columns 5 and 6 displays the results from estimating equations 4 and 5, respectively. Errors allow for clustering at the export market level. Marginal effects are calculated as 100*[$exp(\hat{\beta}_1) - 1$].

3, shown in column (3) of Table 4. Nine difference specifications of the triple-difference are estimated and the coefficient on the three interacted dummy variables ($EU_j * WOVEN_k * POST_t$) is displayed along with its 95% confidence interval.

The first specification contains no fixed effects, and is estimated with the full set of interacted dummy variables. Specification 2 contains firm fixed effects, and specification 3 contains firm-year fixed effects. The magnitude of the triple-difference is smaller than the preferred specification, but remains positive and statistically significant.

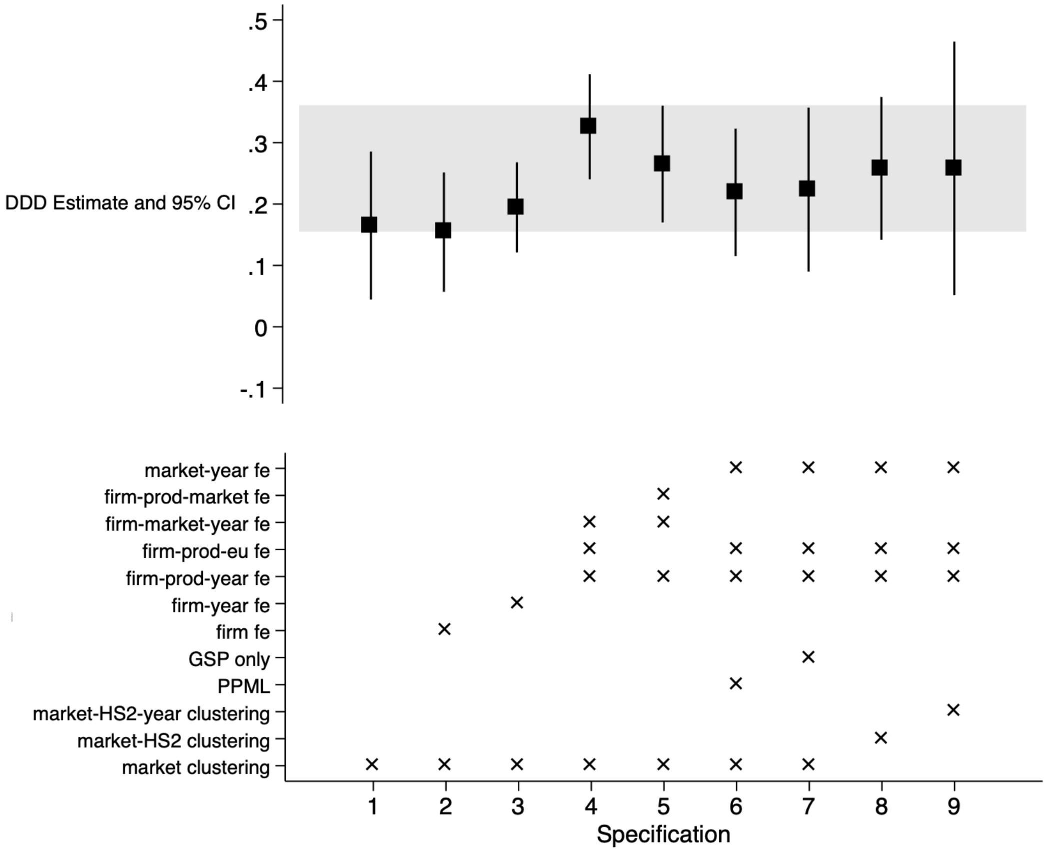
Specification 4 is the same as equation 3 but replaces market-year fixed effects with firm-market-year fixed effects, which control for potential shocks to a firm's relationship with an export market over time. Specification 5 repeats the exercise in specification 4 but also contains firm-product-market fixed effects, which control for additional static heterogeneity in firm-product revenue across ROW markets. The results are similar in magnitude to the main results in Table 4.

Specifications 6 through 9 are all estimated using the same fixed effects as equation 3, but use different methods and samples. Specification 6 is estimated using pseudo-Poisson maximum likelihood, which corrects for potential bias in the estimates arising from heteroskedasticity (Silva and Tenreyro 2006). The results are very similar in magnitude to those shown in Table 4, although the standard errors increase. Specification 7 is identical to equation 3 but is only estimated using the EU market and other markets that also have GSP programs.[21] These countries are the most similar to the EU in terms of market size and have similar trade preferences for apparel as the EU. The results remain robust to this exercise. Finally, specifications 8 and 9 allow for the errors in equation 3 to cluster at the market-HS2 and market-HS2-year level, respectively. Naturally, the standard errors grow when clustering is allowed at this level. However, the results remain statistically different from zero at the 5% significance level.

The results are also robust to using inference based on the non-parametric calculation of p-values. Table A6 displays the p-values from several permutation tests. The p-values are all less than 0.05. Section A3, in the appendix, discusses how these tests are implemented in detail.

[21]These markets include: Australia, Canada, Chile, China, Iceland, India, Japan, South Korea, Morocco, Montenegro, New Zealand, Norway, Russia, Kazakhstan, Belarus, Switzerland, Thailand, Turkey, the United States, and the EU. The preferential tariff rates offered under each country's GSP differ slightly, but all generally offer large concessions for apparel products. For more information on each GSP program, see Tavares (2019)

Figure 7: Specification tests



Notes: This figure displays estimates of the triple-difference for nine specifications. The gray bar represents the 95% confidence interval around the estimate from the preferred specification in column (3) of Table 4. The full results are shown in Table A1.

4.2 Quadruple difference

Despite the robustness of the triple difference to product-specific shocks that are common across destinations and destination-specific shocks that are common across products, the estimate of β_1 in equation 3 may be potentially confounded by omitted variables that differentially affected the sales of woven apparel in the EU after 2011. If the estimate of β_1 is driven by the rules of origin revision, there should be heterogeneity in the effect of the revision as a function of textile production costs. Products that require special woven textiles should respond more to the rules revision than other woven apparel products. Analyzing heterogeneity in the effect of a policy based on a triple-difference estimation strategy in this way is similar to what is done in Muralidharan and Prakash (2017).

Woven textiles that must be coated in various polymers are particularly costly to produce (US EPA 2003; Billah 2019). To produce these fabrics, a coating must be rolled, or laminated on to an existing woven textile. These technical fabrics are often used in specialized performance apparel. Woven apparel products made up of coated textiles fall under the HS 6210 category.[22] Given the additional capital required to produce this type of fabric, apparel made of these coated woven textiles should respond more to the rules revision than other woven apparel. Figure A3 displays the trends in export revenue from woven apparel made from coated textiles sold in the EU and ROW. The figure shows a clear increase in exports to the EU relative to the ROW in these products after 2011.

Column 4 of Table 4 displays the results from estimating a "quadruple-difference", which allows for heterogeneity in the estimate of β_1 in equation

[22]This category includes products like waxed cotton jackets, raincoats, and other garments made of rubberized or coated textile fabrics. These products accounted for roughly 15% of the average firms woven apparel export revenue in the EU in 2010, and faced a 12% ad-valorem MFN tariff if rules of origin were not satisfied.

3 for woven apparel made of coated textiles. The dummy variable $Coated_k$ takes the value one if woven product k is made of coated textiles, and zero otherwise. The results suggest that exports of these specific woven apparel products increased substantially after the rules of origin revision. The estimate of the effect for woven apparel made of coated textiles is statistically different from the effect for other woven apparel at the 1% level. These results lend additional support to the identifying assumption that the increase in export revenue was driven by the relaxation of the rules of origin, rather than demand factors.[23]

4.3 Effects in other markets

The EU's rules of origin revision may have influenced exports to other markets. For example, if Bangladeshi firms face capacity constraints, an increase in sales of apparel to EU countries may have come at the expense of exports to other countries. Similarly, an increase in the sales of woven clothing in the EU may have come at the expense of exports of knit apparel in the EU. As resources are reallocated within the firm, an increase in quantity sold in one market could increase the marginal cost of production for other markets.

To examine the response of the quantity of knit apparel sold to EU countries after the rules of origin liberalization, the following specification is estimated:

$$ln(q_{ijkt}) = \phi_{ikt} + \gamma_{ijk} + \beta_1(EU_j * POST_t) + u_{ijkt} \quad \text{if } k \in HS61 \tag{4}$$

[23]Recall, the identifying assumption is that there was no post-2011 demand shock that differentially affected sales in the EU relative to the ROW, and differentially affected sales of woven relative to knit apparel. The results from this exercise add an additional requirement for a violation of the identifying assumption. Specifically, that there was no additional contemporaneous shock that differentially affected demand for apparel made from specialized woven fabric.

where q_{ijkt} is the quantity of exports of product k sold by firm i to market j in year t. The sample is limited to incumbent firms – firms that exported a product to an import market before and after 2011 – and limited to firms that also exported woven apparel products in year t. Thus, this specification examines how the quantity of knit products exported to the EU responded within firms that also exported woven products.[24]

To examine how the response of woven products in non-EU countries, I estimate the following specification:

$$ln(q_{ijkt}) = \delta_{jt} + \gamma_{ijk} + \beta_1(WOVEN_k * POST_t) + u_{ijkt} \quad \text{if } j \neq EU \tag{5}$$

Equation 5 is estimated on a sample of incumbent firms that also exported products to the EU in year t. Therefore, this specification allows for an examination of the change in the quantity of woven apparel exported to non-EU countries within firms that also exported to the EU. If firms face capacity constraints, or if firms substitute one market or product for another following a change in trade policy for any other reason, estimates of β_1 in equation (4) or (5) would be negative.

The results from estimating equation 4 are shown in column 5 of Table 4. Firms that exported woven products in year t did not appear to reduce their exports of knit apparel to the EU after the rules of origin revision. A similar result is found from estimating equation 5, the results of which are shown in column 6 of the table. Firms that exported woven apparel to the EU did not reduce their exports of woven apparel to the ROW after the rules of origin revision. Figure A5, in the appendix, plots the total exports of woven and knit products to the EU and ROW. This figure shows that

[24]The results are quantitatively similar if export revenue, rather than export quantity, is used as a dependent variable.

there was not an industry-wide substitution away from knit products in the EU, or the ROW after the rules of origin revision.

4.4 Event Study

The identifying assumption underlying the triple-difference model in equation 3 is that the difference in woven apparel revenue between the EU and ROW would have followed the same trajectory as the difference in knit apparel sold between the EU and the ROW had the rules of origin not been revised. Evidence of common trends prior to the rules revision would be consistent with this assumption holding.

To estimate the dynamic response of firm-level export revenue following the rules of origin revision, the $Post_t$ variable in the product-specific DDs (equations 1 and 2), and the triple-difference (equation 3) is replaced with individual year dummy variables. The year 2010 is used as a reference category. Other than replacing the $Post_t$ dummy variable, the specifications remain identical to equations 1, 2, and 3. For example, the triple-difference event study is given by:

$$ln(r_{ijkt}) = \phi_{ikt} + \lambda_{ijk} + \delta_{jt} + \sum_{t=2008/2010}^{t=2013} \beta_t(EU_j * Woven_k * Year_t) + \epsilon_{ijkt} \qquad (6)$$

Thus, the difference in export revenue between woven and knit products and EU and ROW destinations is estimated each year.

The event-study results are shown graphically in Figure 8, and in Table A2 in the appendix. The figure plots the estimates of the β_ts along with a 95% confidence interval. The top panel of the figure displays the two product-specific results. Prior to 2011, the difference in export revenue between the EU and ROW were similar for both products. After the rules of origin revision, exports of woven apparel to the EU increased while exports of knit apparel did not. The bottom panel displays the triple-difference estimates. The pre-2011 estimates are not statistically different from zero, which is consistent with the parallel trends assumption holding.

Figure A4, in the appendix, displays the robustness of the event study results to the use of alternative sets of fixed effects. The triple-difference results are highly robust across a number of specifications. In all cases, the pre-2011 differences are not statistically significant while the post-2011 differences are positive and remain statistically significant at traditional levels. The product-specific event study results are generally robust to the use of alternative fixed effects as well, and in all cases woven apparel responds more than knit apparel.[25]

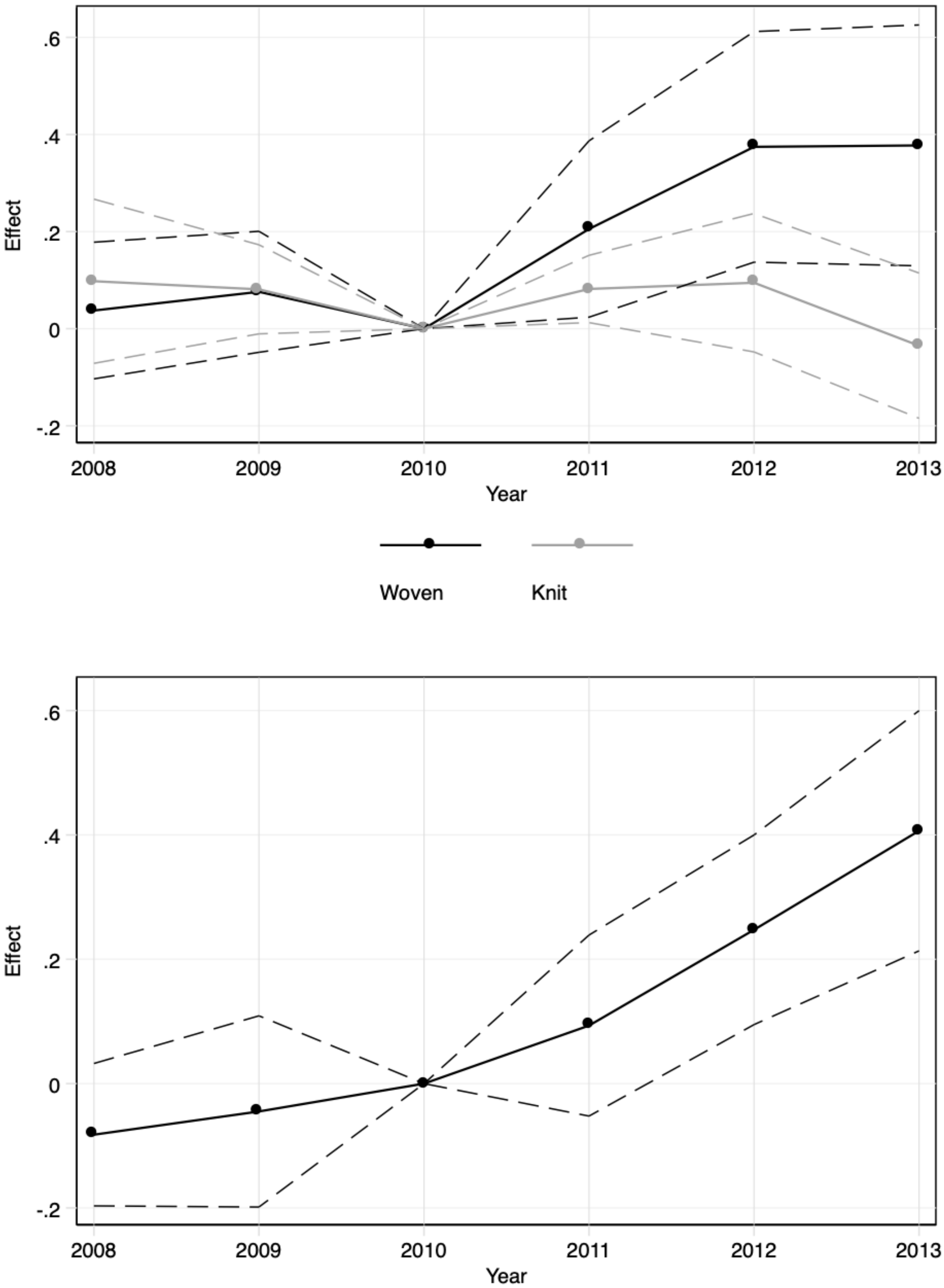
4.5 Prices and product quality

Recent empirical work suggests that firms take advantage of input-tariff cuts to upgrade export product quality (Bas and Strauss-Kahn 2015; Fan, Li, and Yeaple 2015; Manova and Yu 2017). The EU's rules of origin revision likely had a similar effect on exported apparel quality as it allowed apparel firms to source from a wider range of global suppliers. Evidence from Khandelwal (2010) suggests that the scope for quality differentiation among apparel products is relatively high.[26] Given that imported woven

[25]In some specifications, the trends in the product-specific difference-in-differences event studies change from those shown in the top panel of Figure 8. For example, when no fixed effects are included both woven and knit apparel sales in the EU increased after 2011, with woven apparel sales increasing more. When firm-product-year and market fixed effects are included, the pre-2011 trends in woven and knit apparel are decreasing, but sales of woven apparel levels off post-2011 and sales of knit apparel continues to decline. These differences in pre-2011 and post-2011 trends are implicitly controlled for in the triple-difference. The results are presented in table form in Table A3, in the appendix.

[26]Among the 19 2-digit STIC industries studied in Khandelwal (2010), apparel had the 7th longest quality ladder.

Figure 8: Response of Export Revenue



Notes: The top panel of the figure displays the results of estimating equations 1, and 2. The bottom row displays the triple-difference results, as specified in equation 3. Errors allow for clustering at the export market level and 95% confidence intervals are shown. The estimates used to create the figure are shown in the appendix in Table A2.

textiles are higher quality than those produced in LDCs, and the fact that the quality of an apparel product relies heavily on the quality of the textiles used (Rahman et al. 2014), a quality response would suggest that firms did shift input sourcing following the revision.

Following the methods in Khandelwal, Schott, and Wei (2013), a measure of product quality can be structurally motivated from a model of demand with CES preferences and constant mark-ups (i.e. the Melitz (2003), or Chaney (2008) framework). This demand-side derivation of product quality has been used extensively in the trade literature (Fan, Li, and Yeaple 2015). See section A3, in the appendix, for an explanation of the demand-side derivation of product quality.

Raw prices, quality, and quality-adjusted prices are then used as a dependent variable in the triple-difference specification outlined in equation 3. Table 5 displays the results. The first column shows the response of un-adjusted prices. I do not find evidence that export prices respond in a meaningful way to the rules of origin revision. This is consistent with empirical work by Hayakawa et al. (2018), who find that differences in rules of origin compliance costs across different trade agreements do not result in a price response.[27]

The response of product quality is shown in column 2 of Table 5. The results suggest that firms increased export product quality in response to the rules of origin revision. Specifically, the quality of woven apparel sold in the EU increased by approximately 10% after the rules of origin revision. This result is consistent with the literature that links input cost reductions and output product quality (Bas and Strauss-Kahn 2015 ;

[27]It should be noted that the response to the EU's rules of origin liberalization is a combination of a tariff cut, for firms that were previously not complying, and a cost reduction, for firms that previously were complying. Fully disentangling these events is difficult without data on firm-level inputs. The price response for the average firm depends on both of these events.

Table 5: Response of price, quality, and quality-adjusted price

	(1) Prices	(2) Quality	(3) Quality-adjusted prices
$EU_j * WOVEN_k * POST_t$	0.008	0.094***	-0.086***
	(0.010)	(0.022)	(0.018)
Observations	151,847	151,847	151,847
R-squared	0.769	0.620	0.677
firm-prod-year fe	y	y	y
firm-prod-dest fe	y	y	y
market-year fe	y	y	y

Notes: This table presents the results from estimating equation 3 using prices ($ln(p_{ijkt})$), quality ($ln(\lambda_{ijkt})$), and quality-adjusted prices ($ln(p_{ijkt}/\lambda_{ijkt})$) as dependent variables. An elasticity of $\sigma = 4$ is used to construct the measure of quality and quality adjusted prices. Errors allow for clustering at the export market level. Marginal effects are calculated as $100 * [exp(\hat{\beta} - 1]$.

Fan, Li, and Yeaple 2015). Quality-adjusted prices fell by roughly 9% as well.[28]

4.6 Export growth decomposition

To further examine the mechanisms behind the export growth documented in Table 4, total firm-level exports are decomposed into one intensive and two extensive margins. Following Bernard et al. (2009), total firm exports in year t, aggregated to the EU/ROW-woven/knit level, can be decomposed into the number of unique destination countries within the EU and ROW served by the firm in each HS2 category, C_{iJKt}, the number of distinct HS8 products within woven and knit apparel exported by the firm to EU and ROW countries, P_{iJKt}, the average exports per product-country,

[28]The robustness of these results is shown in Table A4. The results are similar if estimated using only incumbent firms, where incumbents are defined as a firms that exported a given product to a given market before and and after the rules of origin revision. Given that prices are driven, in part, by firm productivity, the results suggest that that lack of a price response is not due to low productivity firms entering and pulling down average prices. The results are also robust to the inclusion of alternative fixed effects.

$\bar{X}_{iJKt}$, and a measure of density that corresponds to the share of a firms exported products sent to the average destination country, D_{iJKt}:

$$X_{iJKt} = \sum_{j \in J} \sum_{k \in K} x_{ijkt} = C_{iJKt} P_{iJKt} D_{iJKt} \bar{X}_{iJKt}, \quad \text{where } D_{iJKt} = \frac{o_{iJKt}}{C_{iJKt} P_{iJKt}} \quad (7)$$

where o_{iJKt} is the number of positive firm-level export transactions at the EU/ROW-woven/knit level.[29] Then, with each margin, including total firm exports (X_{iJKt}), the following triple-difference specification is estimated:

$$ln(Y_{iJKt}) = \alpha_{iKt} + \gamma_{iJK} + \delta_{Jt} + \beta_1(EU_J * Woven_K * Post_t) + \epsilon_{iJKt} \quad (8)$$

where $ln(Y_{iJKt})$ is the log of a given margin as defined in equation 7, α_{iKt} is a firm-product-year fixed effect, γ_{iJk} is a firm-product-destination fixed effect, and δ_{Jt} is an destination-year fixed effect. Huber-White standard errors are used when estimating equation 8.[30]

The results are presented in the first five columns of Table 6. The sum of the response of each margin is equal to the response of total firm-level export growth, shown in column 1. The two extensive margins both increased, however, neither are statistically significant. Together, the extensive margin response account for approximately 28% of total firm-level export growth. The main response comes at the intensive margin. In total, the intensive margin (average exports per product-country served)

[29]The density measure considers how many country-product combinations are being actively served by the firm. The measure is bounded above at one and bounded below by $min\{1/C_{iJKt}, 1/P_{iJKt}\}$.

[30]Given that the data in this analysis have been aggregated to the EU/ROW-HS2 level, clustering at the market level is not possible. The results are also robust to the use of errors that allow for clustering at the firm level. However, the standard errors are marginally larger when Huber-White errors are used.

Table 6: Within-firm margins of adjustment

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Total	Decomposition of total				Decomposition of intensive margin		
		Extensive margins		Intensive margin	Density	Quantities	Price	Quality
	$ln(X_{iJKt})$	$ln(C_{iJKt})$	$ln(P_{iJKt})$	$ln(\bar{X}_{iJKt})$	$ln(D_{iJKt})$	$ln(\bar{q}_{iJKt})$	$ln(\bar{p}_{iJKt})$	$ln(\bar{\lambda}_{iJKt})$
$EU_j * WOVEN_K * POST_t$	0.209***	0.028	0.032	0.146***	0.003	0.128**	-0.039**	0.059***
	(0.0612)	(0.0223)	(0.0254)	(0.0493)	(0.0161)	(0.0513)	(0.0173)	(0.0223)
% of total response		13%	15%	70%	1%			
% of intensive margin response						87%	-27%	40%
Observations	30,268	30,268	30,268	30,268	30,268	30,268	30,268	30,268
Adj R2	0.764	0.756	0.674	0.677	0.585	0.655	0.560	0.580
firm-prod-dest FE	y	y	y	y	y	y	y	y
firm-prod-year FE	y	y	y	y	y	y	y	y
dest-year FE	y	y	y	y	y	y	y	y

Notes: This table displays the results from estimating equation 8, where the outcome is a given margin as described in (7). The data are aggregated to the firm-EU/ROW-HS2-year level. X_{iJKT} is total export revenue, C_{iJKt} is the number of unique destination countries within the EU and ROW served by the firm in each HS2 (woven or knit) category, P_{iJKt} is the number of distinct HS8 products within woven and knit apparel exported by the firm to EU and ROW countries, $\bar{X}_{iJKt}$ is the average exporter per HS2-EU/ROW, and D_{iJKt} is a measure of density that corresponds to the share of a firms exported products sent to the average destination. The last three columns decompose the firm-level intensive margin into shipment quantities ($\bar{q}_{iJKt}$), and quality adjusted prices ($\bar{p}_{iJKt}$), and quality ($\bar{\lambda}_{iJKt}$) as described in the text. Huber-White standard errors are reported. The percentage of the total response is calculated as the coefficient for a given margin divided by the coefficient for total. The percentage of the intensive margin response is calculated as the coefficient on the given margin divided by the coefficient for the intensive margin.

accounts for 70% of total export growth in woven apparel sold to the EU for the average firm.

The intensive margin can be decomposed further into contributions by quantities, quality-adjusted prices, and quality. Specifically, $\bar{X}_{iJKt} \equiv \bar{p}_{iJKt}\bar{q}_{iJKt}\bar{\lambda}_{iJKt}$, where $\bar{p}_{iJKt}$ are average quality-adjusted prices, $\bar{q}_{iJKt}$ are average quantities, and $\bar{\lambda}_{iJKt}$ is average product quality. This is similar to the decomposition of the intensive margin used in Behrens, Corcos, and Mion (2013), but also allows for adjustments in product quality. The results from estimating equation 8 with these outcomes are shown in columns 6 through 8 of Table 6. Changes in quantities account for 87% of the intensive margin response, changes in quality-adjusted prices account for approximately -27%, while changes in product quality account for the remaining 40%.

Total destination country-level exports, aggregated to the HS2-level across firms, can also be decomposed into different margins. Again, following Bernard et al. (2009), total bilateral exports to country j in year t are comprised of the number of firms exporting woven or knitted products, F_{jKt}, the number of distinct woven or knit products exported, P_{jKt}, the density of trade as a fraction of firm-product combinations with positive exports D_{jKt}, and average firm-product exports, $\bar{X}_{jKt}$.

$$X_{jKt} = \sum_{i} \sum_{k \in K} x_{ijkt} = F_{jKt} P_{jKt} D_{jKt} \bar{X}_{jKt}, \quad \text{where } D_{jKt} = \frac{o_{jKt}}{P_{jKt} D_{jKt}} \tag{9}$$

where o_{jKt} is the number of active firm-products selling to destination country j in year t. Each margin is then used as an outcome in the following triple-difference specification:

$$ln(Y_{jKt}) = \alpha_{jK} + \gamma_{Kt} + \delta_{jt} + \beta_1 (EU_j * Woven_K * Post_t) + \epsilon_{jkt} \tag{10}$$

where, $ln(Y_{jKt})$ is a given margin of adjustment, α_{jK} is a destination country-product fixed effect, γ_{Kt} is a product-year fixed effect, and δ_{jt} is a destination country-year fixed effect. Errors allow for clustering at the export market level.

The results from estimating equation 10 are displayed in Table 7. Total bilateral exports increase by 46%.[31] Similar to the firm-level decomposition, the majority of the response comes at the intensive margin. Average firm-product exports increase by 36% and account for over 80% of total export growth. Also similar to the firm-level decomposition, neither extensive margin response is statistically significant nor large in magnitude.

Additional information can be extracted from the decomposition in (9). Noting that the decomposition is log-linear, the contribution from

[31]This increase is smaller than the industry level export gains found in Tanaka (2020), who studies the EU's rules of origin revision in the context of the Cambodian apparel industry. The revenue gains in Cambodia were larger in magnitude than those in Bangladesh. This could be attributed to the large fraction of foreign-owned apparel firms in Cambodia. Apparel multinationals may have already had textile production facilities or strong and links with third country producers. Shifting production to Cambodia may have been easier for such companies.

Table 7: Across-Firm Margins of Adjustment

	(1)	(2)	(3)	(4)	(5)
	Total	Decomposition of total			
		Extensive margins		Intensive margin	Density
	$ln(X_{jKt})$	$ln(F_{jKt})$	$ln(P_{jKt})$	$ln(\bar{X}_{jKt})$	$ln(D_{jKt})$
$EU_j * WOVEN_k * POST_t$	0.379**	0.071	-0.028	0.306***	0.031
	(0.1471)	(0.0572)	(0.0423)	(0.1164)	(0.0371)
% of total response		19%	-7%	81%	8%
Observations	1,314	1,314	1,314	1,314	1,314
Adj R2	0.924	0.966	0.938	0.732	0.931
destination country-prod fe	y	y	y	y	y
prod-year	y	y	y	y	y
destination country-year fe	y	y	y	y	y

Notes: This table displays the results from estimating equation 10, where the outcome is a given margin as described in (10). Here, X_{jKt} total bilateral exports of HS2 (woven or knit) products, F_{jKt} is the number of firms exporting HS2 products, P_{jKt} is the number of distinct (HS8) woven or knit products exported, and D_{jKt} is a density measure equal to the fraction of firm-product combinations with positive exports. Errors allow for clustering at the export market level. The percentage of the total response is calculated as the coefficient for a given margin divided by the coefficient for total.

the number of firms-per-product exported in positive amounts can be calculated as the sum of the coefficients on density and the number of firms.[32] Similarly, the contribution by the number of products per firm can be calculated as the sum of the coefficients on density and number of products. The summation of the coefficients on density and number of firms produces an elasticity of approximately 0.1, indicating that approximately 26% of the increase in export growth after the rules of origin revision can be attributed to the extensive margin of firms per exported product.[33] The extensive margin of products per exporting firm produces a much smaller elasticity. This suggests that the main margin of entry comes from new firms exporting woven products to the EU, rather than firms adding new woven products.

[32]To see this, note that $D_{jkt} = \frac{o_{jkt}}{F_{jkt}P_{jkt}}$. Multiplying by the number of firms, for example, produces $\frac{o_{jkt}}{P_{jkt}}$, which is the number of firms per product.

[33]This is calculated as $\frac{0.1}{0.379} = 0.263$.

4.6.1 Tariff Equivalence

To put the magnitude of the results in perspective, the ad-valorem tariff equivalence of the rules of origin can be calculated from the results in Table 7. Tariff equivalence calculations are commonly used in the trade literature to put the effect of different trade policies into common units of measurement. The tariff equivalents represent the ad-valorem tariff that would be needed to generate the observed level of trade (Hoekman and Nicita 2008).

Under the assumption of CES preferences and monopolistic competition, the elasticity of the intensive margin of bilateral trade with respect to variable trade costs is given by $(\sigma - 1)$, where σ is the elasticity of substitution across product varieties (Chaney 2008).[34] The empirical trade literature often models trade costs as a log-linear function of bilateral frictions, and the elasticity of trade costs with respect to a specific factor is commonly referred to as the factors "ad-valorem tariff equivalent" (Burlando, Cristea, and Lee 2015; Henderson and Millimet 2008).[35] Thus, through the chain rule, the elasticity of the intensive margin of aggregate bilateral trade with respect to a bilateral friction is given by $\xi(\sigma - 1)$, where ξ is the ad-valorem tariff equivalent.[36] Relying on this theoretical structure, the estimate of β_1 in column 4 of Table 7 captures the combination

[34]See Chaney (2008) for a derivation of the response of the intensive margin of aggregate bilateral trade to a marginal change in trade costs from a heterogeneous firms model. A similar result can be obtained from a gravity model (see, Anderson and Van Wincoop 2003).

[35]For example, variable trade costs between countries i and j, τ_{ij}, are commonly modeled as $\tau_{ij} = \Pi_{f=1}^{K} t_{fij}^{\xi_f}$ where t_{fij} are observable trade frictions and ξ_f are tariff-equivalents. Common observable trade frictions include factors like distance, common languages, whether i and j share a border, and technical barriers to trade.

[36]This approach is similar to Cadot and Ing (2016), who embeds rules of origin as a trade cost in a gravity model of trade using the framework of Anderson and Van Wincoop (2003). Rules of origin can influence trade costs through either their effect on input costs or their effect on export tariffs.

of ξ and $(\sigma - 1)$. For a given value of σ, the ad-valorem tariff equivalent can be calculated using the expression $\xi = \frac{\hat{\beta}_1}{\sigma - 1}$.

Using the estimates in column 4 of Table 7, and assuming $\sigma = 4$ – the median value for apparel products in Broda and Weinstein (2006) – the EU's initial rules of origin had an equivalent effect as a 10.3% tariff on Bangladesh's apparel export sector. To put this result in perspective, Kee, Nicita, and Olarreaga (2009) estimate that the average non-tariff barrier has a tariff equivalence of 10% for manufactured goods. Carrère and De Melo (2011) estimate that technical regulations, which includes a broad range of non-tariff trade barriers, are equivalent to a 35% ad-valorem tariff for apparel products.

4.7 Market share reallocation

Next, I analyze how market share was reallocated across different types of apparel exporters. Following Khandelwal, Schott, and Wei (2013), I break down total export growth by incumbents, entrants, and exiting firms. Incumbent firms are defined as firms that exported a product to the same export market before and after the 2011 policy change. Entrants consist of firms that began exporting a product to an export market after the policy change, and Exiters are firms that stopped exporting a product to an export market after the policy change.

I then break the Entrants and Exiters down further. Within Entrants, I define "destination adders" as firms that exported a product during the pre- and post-policy change period, but began exporting the product to a new market after the policy change. Next, I define "product adders" as firms that exported a product to an export market during the pre- and post-policy change period, but began exporting a new product to the market after the policy change. Finally, I define a group of firms called "brand new" firms. These firms began exporting a new product to a new market after the policy change. Exiters are decomposed similarly, except rather than adding products or destinations, "destination droppers" drop destinations, "product droppers" drop products, and "complete exiters" drop a product-destination pair after the policy change.

For each category of firms (m), I calculate the market share across export market-HS2 products (jk) in each year across all firms i in each category. These market shares are defined by:

$$\Phi_{mjkt} = (\sum_{i \in m} Y_{ijkt} / \sum_{m} \sum_{i} Y_{ijkt}) \tag{11}$$

where Y refers to the value of export shipments. I then estimate the following triple-difference regression model for each margin separately:

$$\begin{aligned} \Phi_{jkt} = \alpha_0 + \beta_1(EU_j * WOVEN_k * POST_t) + \\ \beta_2(EU_j * WOVEN_k) + \beta_3(WOVEN_k * POST_t) + \beta_4(EU_j * POST_t) + \\ \beta_5(EU_j * WOVEN_k) + \beta_6 EU_j + \beta_7 WOVEN_k + \beta_8 POST_t + \epsilon_{jkt} \end{aligned} \tag{12}$$

while allowing the errors to cluster at the export market level. For all variants of entrants and exiters, the $Post_t$ variable is irrelevant, as it always equals one for entrants and always equals zero for exiters. Table 8 displays the estimates of the triple-difference, β_1. The full estimates with standard errors are presented in Table A5, in the appendix.

The results in Table 8 show that incumbents gained market share. The increase in incumbent market share is, by definition, offset by a decline in net entry (entry - exit), for an overall change of zero. Of the 4.5 percentage point decline in net entry, exiters account for -9.6 percentage points and entrants account for 5 percentage points. Within entrants, brand new

Table 8: Market Share Reallocation

Firm type	Market share change
Incumbent	0.045*
Net Entry (Entry - Exit)	-0.045*
Entry	0.050*
Prod Adders	0.006
Dest Adders	-0.021
Brand New	0.065***
Exit	-0.096***
Prod Droppers	-0.007
Dest droppers	-0.057**
Complete Exit	-0.032

Notes: This table displays the results from estimating equation (12) for each margin, shown in equation (11), separately. The full table can be found in the Appendix (Table A5). *p-value≤ 0.1, **p-value≤ 0.05, ***p-value≤ 0.01.

firms saw a 6.5 percentage point gain in woven apparel sold in the EU after the rules of origin revision, while the market shares of product adders and destination adders did not change by a statistically significant amount. Among exiters, the largest declines in market share come from destination droppers and complete exiters. Taken together these results suggest that the main mode of entry was completely new firms starting to export woven apparel to the EU, and that the main mode of exit was through firms dropping the EU as a destination for their woven apparel.

To gain additional insights into how firms responded to the rules of origin revision, the Product Adder category can be broken down into two mutually exclusive groups: those with previous experience exporting woven products, and those without. The contribution of these two types of product adders to the overall Product Adder response is shown in Table 9. The results show that firms without any prior experience exporting woven apparel were not able to gain market share in the EU by adding woven apparel after the policy change. On the other hand, firms with experience exporting woven products prior to the rules change saw a small increase in their market share in the EU by adding additional woven products. These results suggest that adding new products to existing destinations may have substantial fixed costs.

Table 9: Decomposition of Product Adders

Product Adders Total =	0.006
Woven Experienced +	0.010**
No Woven Experience	-0.004

Notes: This table displays the decomposition of "Product Adder" firms into those with and without experience exporting woven apparel prior to 2011. *p-value$\leq$ 0.1, **p-value$\leq$ 0.05, ***p-value$\leq$ 0.01.

5 Conclusion

This paper studies how rules of origin in potential export markets influence the export behavior of firms in LDCs. Access to preferential tariffs is conditional on satisfying rules of origin. When rules of origin require capital-intensive transformations of imported intermediate inputs, they can be costly for exporting LDC firms to comply with. In this sense, rules of origin undermine market access for exporters in LDCs. Exploiting technical differences in the production of different types of textiles, and a revision to the rules of origin governing preferential access to the EU market for apparel producers in LDCs, I find rules of origin not only restrict firm-level and industry-level export growth, but also make it more difficult for firms to move up the quality ladder.

The results highlight that in the context of a labor-abundant country (like many LDCs), firms that must rely on capital-intensive inputs are put at a disadvantage under strict rules of origin. Given the small amount of textile production in Bangladesh (and other LDCs), the potential losses from this policy change for Bangladeshi woven textiles producers are likely second-order in terms of magnitude, although data limitations restrict me from directly analyzing this. From a policy perspective, the results shed light on an under-studied trade barrier that is typically embedded within preferential trade agreements. Policymakers attempting to improve conditions in developing countries through trade policy may be able to affect outcomes without lowering traditional barriers like tariffs or quotas by adjusting the rules of origin.

Additionally, the results in this paper underscore the implicit trade-off between trade preferences and rules of origin. Deep trade preferences with restrictive rules of origin can provide similar market access as shallow trade preferences and more permissive rules of origin. This trade-off is especially critical because preference depth cannot increase indefinitely. The preference depth, or the difference between preferential tariffs and MFN tariffs, is bounded below at zero. Even the upper bound of the difference has been falling as MFN tariffs have declined over time.[37] In the face of preference erosion, rules of origin offer a potential policy tool that may be used to continue to improve or restore market access for LDCs.

Lastly, this paper offers additional context to debates regarding the trade relationships between high- and low-income countries. Flentø and Ponte (2017) note that while there is a consensus in trade and development policy circles that trade negotiations between more-developed countries and LDCs should aim to reduce trade barriers for exporters in LDCs, there is less consensus on how this should be achieved. The results of this study show that revising rules of origin is a viable option within this debate.

[37] World Bank. "Tariff rate, most favored nation, simple mean, all products (%)". *Integrated Data Base*. https://data.worldbank.org/indicator/TM.TAX.MRCH.SM.FN.ZS. Accessed on 06/10/2019.

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Appendix for: Improving Preferential Market Access Through Rules of Origin: Firm-level Evidence from Bangladesh

A1 Additional Tables

Table A1: Specification tests

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$WOVEN_k$	0.234	0.040	0.092						
	(0.191)	(0.129)	(0.124)						
EU_j	1.056***	1.142***	1.200***						
	(0.252)	(0.172)	(0.185)						
$WOVEN_k * EU_j$	-0.358*	-0.321**	-0.343**						
	(0.191)	(0.143)	(0.138)						
$POST_t$	0.078	0.192**							
	(0.105)	(0.082)							
$WOVEN_k * POST_t$	-0.023	-0.012	-0.122***						
	(0.062)	(0.056)	(0.042)						
$EU_j * POST_t$	0.305***	0.193**	0.173**						
	(0.105)	(0.080)	(0.073)						
$WOVEN_k * EU_j * POST_t$	0.165***	0.154***	0.195***	0.326***	0.265***	0.219***	0.224***	0.258***	0.258**
	(0.062)	(0.050)	(0.037)	(0.044)	(0.049)	(0.053)	(0.068)	(0.059)	(0.105)
Observations	275,577	273,615	269,409	104,803	61,730	151,847	104,863	151,847	151,847
R-squared	0.064	0.202	0.246	0.903	0.954		0.742	0.720	0.720
firm fe		y							
firm-prod-year fe				y	y	y	y	y	y
firm-prod-dest fe				y		y	y	y	y
market-year fe						y	y	y	y
firm-market-year fe				y	y				
firm-prod-market fe					y				
firm-year fe			y						
GSP Only							y		
PPML						y			
cluster	market	market	market	market	market	market	market	market-HS2	market-HS2-year

Notes: This table presents the results from estimating equation 3 using alternative sets of fixed effects, estimation procedures, samples, and error cluster specifications. Column 7 is estimated using pseudo-Poisson maximum likelihood. Column 8 is estimated using only destinations with GSP programs.

Table A2: Event Study

	(1) Woven products DD	(2) Knit products DD	(3) DDD
$EU_j * 1(Year_t = 2008)$	0.0374	0.0978	
	(0.0718)	(0.0863)	
$EU_j * 1(Year_t = 2009)$	0.0760	0.0811*	
	(0.0636)	(0.0468)	
$EU_j * 1(Year_t = 2010)$	0.205**	0.0818**	
	(0.0927)	(0.0354)	
$EU_j * 1(Year_t = 2012)$	0.374***	0.0947	
	(0.121)	(0.0728)	
$EU_j * 1(Year_t = 2013)$	0.378***	-0.0350	
	(0.127)	(0.0763)	
$EU_j * WOVEN_k * 1(Year_t = 2008)$			-0.0822
			(0.0584)
$EU_j * WOVEN_k * 1(Year_t = 2009)$			-0.0448
			(0.0785)
$EU_j * WOVEN_k * 1(Year_t = 2011)$			0.0934
			(0.0743)
$EU_j * WOVEN_k * 1(Year_t = 2012)$			0.247***
			(0.0778)
$EU_j * WOVEN_k * 1(Year_t = 2013)$			0.407***
			(0.0986)
Observations	73,009	79,032	151,847
R-squared	0.550	0.644	0.720
firm-prod-year fe	y	y	y
firm-prod-dest fe	y	y	y
market-year fe			y

Notes: This table presents the results from estimating the event study versions of equations (1), (2), and (3), respectively. Errors allow for clustering at the market level. The year 2010 is used as a reference category.

Table A3: Event Study Robustness

	(1) Woven DD	(2) Knit DD	(3) DDD	(4) Woven DD	(5) Knit DD	(6) DDD	(7) Woven DD	(8) Knit DD	(9) DDD	(10) Woven DD	(11) Knit DD	(12) DDD	(13) Woven DD	(14) Knit DD	(15) DDD	(16) Woven DD	(17) Knit DD	(18) DDD
$EU_j * (Year_t = 2008)$	-0.00819	0.00244		-0.000189	0.0464		0.0298	0.0456		0.0855	0.0298		0.233***	0.150**		0.0714	0.0747	
	(0.108)	(0.0870)		(0.103)	(0.0862)		(0.0834)	(0.0903)		(0.0872)	(0.0856)		(0.0590)	(0.0584)		(0.0474)	(0.0640)	
$EU_j * (Year_t = 2009)$	0.0659	0.0998**		0.0178	0.127***		0.0390	0.126***		0.0835	0.121***		0.101*	0.153***		0.0760	0.0656*	
	(0.0455)	(0.0414)		(0.0433)	(0.0401)		(0.0494)	(0.0410)		(0.0579)	(0.0428)		(0.0542)	(0.0378)		(0.0607)	(0.0367)	
$EU_j * (Year_t = 2011)$	0.209***	0.156***		0.140**	0.136***		0.153***	0.0999**		0.220***	0.0798		0.0747	-0.0231		0.110	0.0292	
	(0.0697)	(0.0535)		(0.0627)	(0.0488)		(0.0496)	(0.0458)		(0.0831)	(0.0568)		(0.0577)	(0.0374)		(0.0697)	(0.0421)	
$EU_j * (Year_t = 2012)$	0.469***	0.275***		0.313***	0.213**		0.368***	0.183**		0.434***	0.0950		0.133*	-0.0969		0.0852	-0.0852	
	(0.114)	(0.0980)		(0.0947)	(0.0851)		(0.0724)	(0.0746)		(0.114)	(0.0867)		(0.0696)	(0.0722)		(0.0968)	(0.0737)	
$EU_j * (Year_t = 2013)$	0.686***	0.510***		0.482***	0.381***		0.518***	0.350***		0.501***	0.198**		0.0782	-0.0647		-0.0428	-0.234***	
	(0.135)	(0.114)		(0.106)	(0.103)		(0.0951)	(0.0936)		(0.142)	(0.0996)		(0.0826)	(0.0775)		(0.137)	(0.0834)	
$EU_j * WOVEN_K * (Year_t = 2008)$			-0.0106			-0.0285			-0.00207			0.0557			0.0138			-0.00807
			(0.0639)			(0.0629)			(0.0592)			(0.0487)			(0.0342)			(0.0622)
$EU_j * WOVEN_K * (Year_t = 2009)$			-0.0339			-0.0547*			-0.0522			-0.0378			-0.0627			-0.0112
			(0.0294)			(0.0302)			(0.0371)			(0.0492)			(0.0407)			(0.0784)
$EU_j * WOVEN_K * (Year_t = 2011)$			0.0536			0.0376			0.0438			0.140***			0.131***			0.0526
			(0.0355)			(0.0363)			(0.0301)			(0.0369)			(0.0449)			(0.0428)
$EU_j * WOVEN_K * (Year_t = 2012)$			0.194***			0.169***			0.248***			0.339***			0.305***			0.141***
			(0.0677)			(0.0608)			(0.0450)			(0.0730)			(0.0572)			(0.0519)
$EU_j * WOVEN_K * (Year_t = 2013)$			0.176**			0.158**			0.211***			0.304***			0.254***			0.164***
			(0.0786)			(0.0665)			(0.0587)			(0.0950)			(0.0880)			(0.0616)
Observations	127,378	148,199	275,577	125,598	146,365	273,615	121,627	142,025	269,409	80,784	89,659	170,443	80,756	89,629	170,419	46,912	48,992	95,752
R-squared	0.046	0.084	0.066	0.218	0.241	0.203	0.265	0.293	0.246	0.478	0.554	0.517	0.649	0.645	0.642	0.893	0.898	0.899
firm-prod-year fe										y	y	y	y	y	y	y	y	y
firm-prod-market fe																y	y	y
market-year fe																		y
market fe													y	y	y			
firm-year fe							y	y	y									
firm fe				y	y	y												

This table displays the results from estimating the event-study difference-in-differences and triple-difference specifications with alternate sets of fixed effects. The year 2010 is used as a reference category. Errors allow for clustering at the market level.

Table A4: Robustness of prices, quality, and quality-adjusted price response

	(1) price	(2) qual	(3) adj price	(4) price	(5) qual	(6) adj price	(7) price	(8) qual	(9) adj price	(10) price	(11) qual	(12) adj price	(13) price	(14) qual	(15) adj price
$EU_j * WOVEN_k * POST_t$	0.016	0.063**	-0.047***	0.003	0.112***	-0.109***	0.016	0.096***	-0.080***	0.014	0.102***	-0.088***	0.007	0.096***	-0.089***
	(0.010)	(0.024)	(0.017)	(0.013)	(0.023)	(0.015)	(0.016)	(0.026)	(0.017)	(0.017)	(0.026)	(0.016)	(0.017)	(0.026)	(0.016)
Observations	60,919	60,919	60,919	104,803	104,803	104,803	38,065	38,065	38,065	61,730	61,730	61,730	37,662	37,662	37,662
R-squared	0.797	0.663	0.699	0.896	0.856	0.884	0.909	0.879	0.898	0.940	0.926	0.944	0.937	0.922	0.940
firm-prod-year fe	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y
firm-prod-dest fe	y	y	y	y	y	y	y	y	y						
dest-year fe	y	y	y												
firm-dest-year fe				y	y	y	y	y	y	y	y	y	y	y	y
firm-prod-market fe										y	y	y	y	y	y
incumbents only	y	y	y				y	y	y				y	y	y

Notes: This table presents the results from estimating the response of prices, product quality, and quality-adjusted prices. Incumbent firms are defined as firms that exported a HS8 product to an export market at some point before and after the rules of origin revision in 2011. Errors allow for clustering at the export market level.

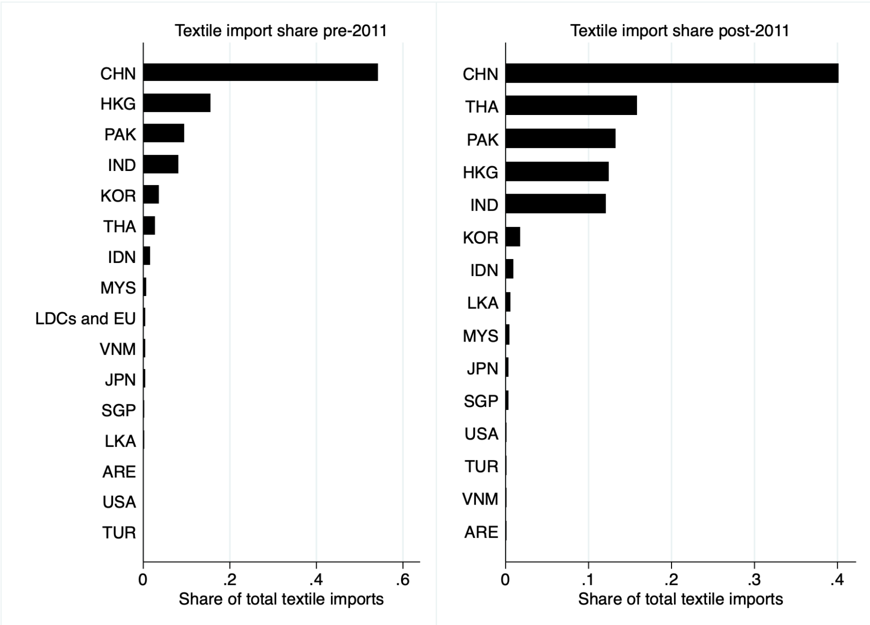
Table A5: Reallocation of market share across firm types

	(1) Incumbent	(2) Net entry	(3) Exit	(4) Prod Droppers	(5) Dest Droppers	(6) Complete Exit	(7) Entry	(8) Prod Adders	(9) Dest Adders	(10) Brand New
EU_j	0.549***	-0.549***	0.549***	0.014***	0.469***	0.067***	-0.502***	-0.010**	-0.422***	-0.070***
	(0.029)	(0.029)	(0.029)	(0.004)	(0.028)	(0.016)	(0.024)	(0.004)	(0.025)	(0.018)
$WOVEN_k$	0.070**	-0.070**	0.070**	-0.006	0.048*	0.028	-0.044	-0.002	0.023	-0.065***
	(0.029)	(0.029)	(0.029)	(0.009)	(0.027)	(0.020)	(0.027)	(0.005)	(0.030)	(0.023)
$EU_j * WOVEN_k$	-0.096***	0.096***	-0.096***	-0.007	-0.057**	-0.032	0.050*	0.006	-0.021	0.065***
	(0.029)	(0.029)	(0.029)	(0.009)	(0.027)	(0.020)	(0.027)	(0.005)	(0.030)	(0.023)
$POST_t$	-0.104***	0.104***								
	(0.019)	(0.019)								
$EU_j * POST_t$	-0.047**	0.047**								
	(0.019)	(0.019)								
$WOVEN_k * POST_t$	-0.026	0.026								
	(0.026)	(0.026)								
$EU_j * WOVEN_k * POST_t$	0.045*	-0.045*								
	(0.026)	(0.026)								
Observations	1,626	1,626	792	792	792	792	834	834	834	834
R-squared	0.285	0.285	0.269	0.006	0.212	0.011	0.263	0.003	0.219	0.011

Notes: This table presents the results from estimating equation 12. The dependent variable is the market share of a given type of firm, as described in the text and by equation 11. Errors allow for clustering at the export market level.

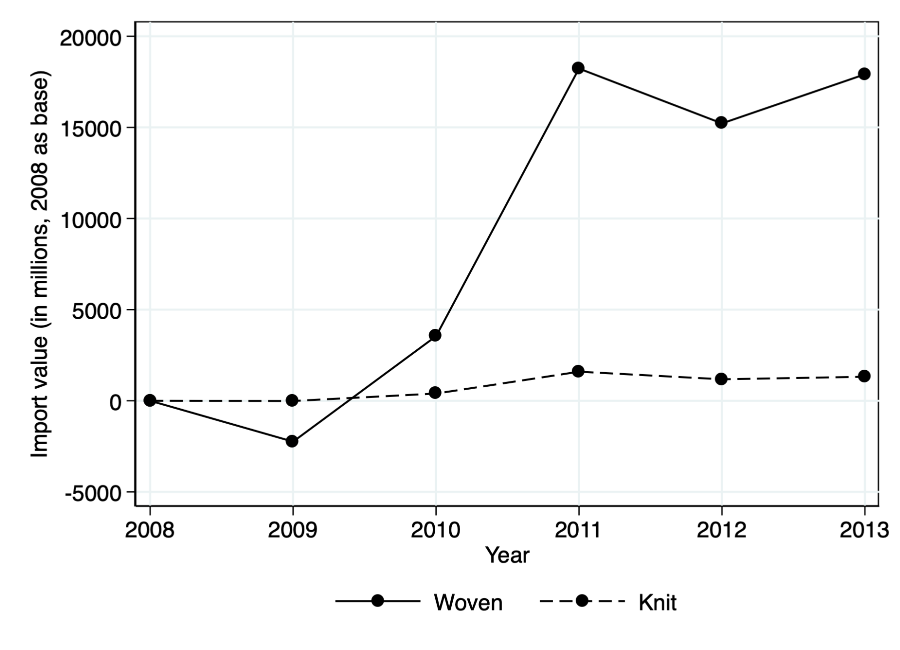
A2 Additional Figures

Figure A1: Textiles sourcing before and after the rules of origin revision in 2011



Notes: This figure displays the share of Bangladesh textile imports (based on import value) from different source countries. The EU and all LDCs are grouped together. The panel on the left displays the pre-2011 average annual shares, and the right panel displays the post-2011 average shares. Textiles fall under the HS2 heading HS60 (knit), and HS4 headings (woven): 5007, 5111, 5112, 5113, 5208, 5209, 5210, 5211, 5212, 5309, 5310, 5311, 5407, 5408, 5512, 5513, 5514, 5515, 5516, 5602, 5603, 5801, 5802, 5809, 5903, 5906, and 5907.

Figure A2: Textile imports



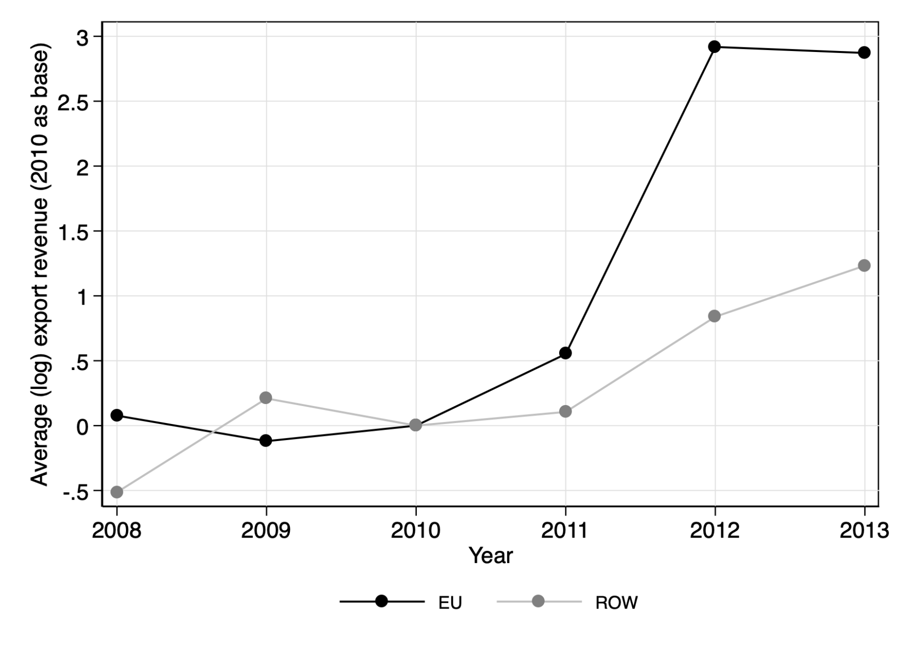
Notes: This figure displays the change in total woven and knit textile imports over time. 2008 is used as a base year. The data come from the UN's Comtrade database. Knit textiles fall under the HS2 heading HS60, and woven textiles have HS4 headings: 5007, 5111, 5112, 5113, 5208, 5209, 5210, 5211, 5212, 5309, 5310, 5311, 5407, 5408, 5512, 5513, 5514, 5515, 5516, 5602, 5603, 5801, 5802, 5809, 5903, 5906, and 5907.

A3 Additional tests and information

A3.1 Permutation tests

As an additional test, I use randomization inference to calculate the probability of observing the effect magnitudes I estimate in the previous section, conditional on fixed effects, under the null of no effect. This application of exact inference in the context of a difference-in-differences framework is similar to exercises in Conley and Taber (2011), and Bertrand, Duflo, and Mullainathan (2004). For each margin (export revenue, product-level extensive, and firm-level extensive), I conduct three tests. First, I randomly shuffle which products are classified as woven and which are classified as knit while ensuring that the number of woven and knit products in the randomized sample is the same as the actual sample. I then

Figure A3: Coated Sales

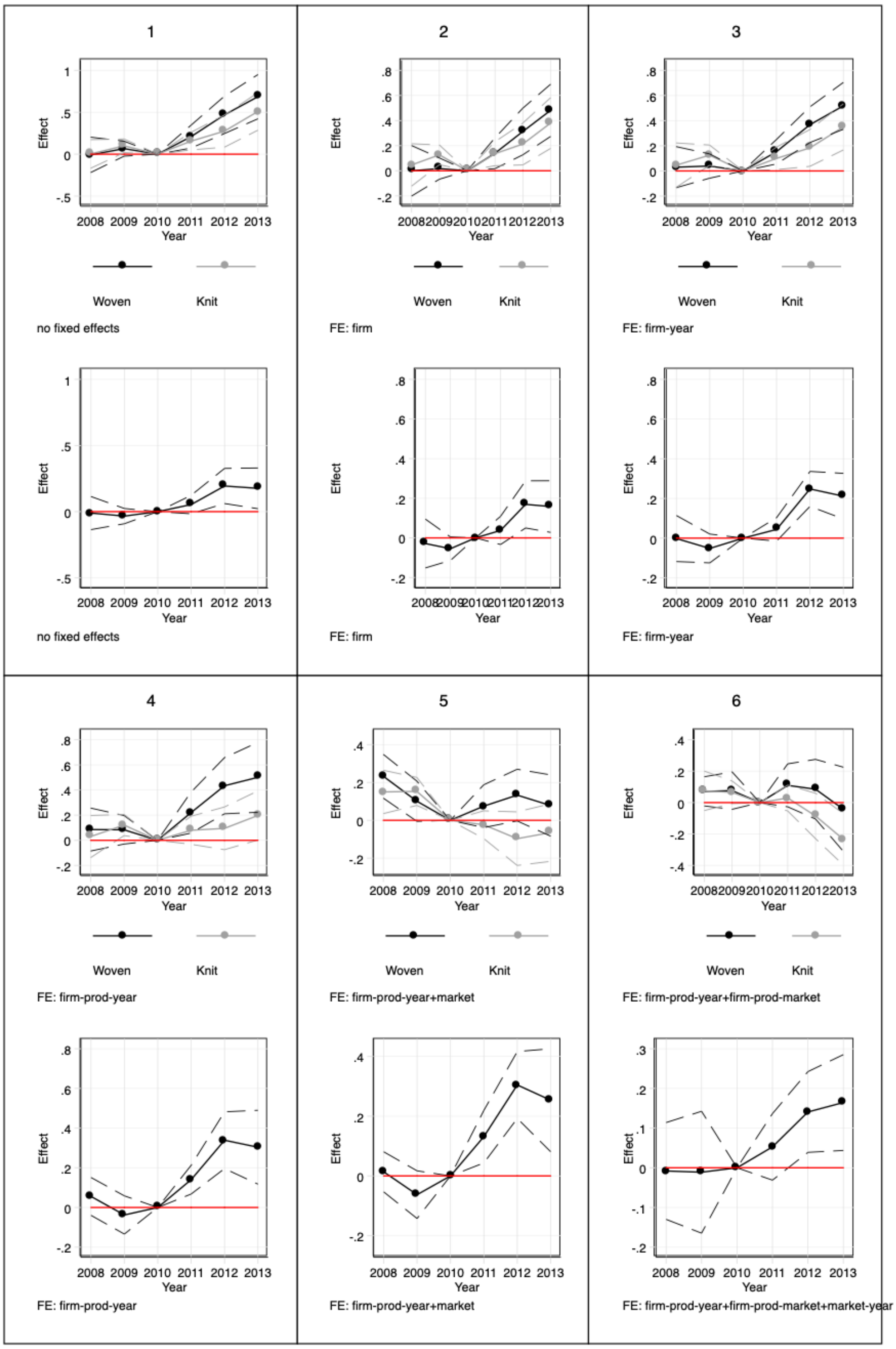


Notes: This figure displays the trends in export revenue for woven apparel made from coated woven textiles (HS 6210), relative to sales in 2010. Sales are broken up by EU/ROW destinations.

re-estimate equation 3 using this created data set. I repeat this process 5,000 times, each time storing the estimate of β_1, the coefficient on $EU_j * WOVEN_k * POST_t$. Then, I shuffle which years are classified as pre and post the rules of origin revision, and which destinations are EU using a similar process.

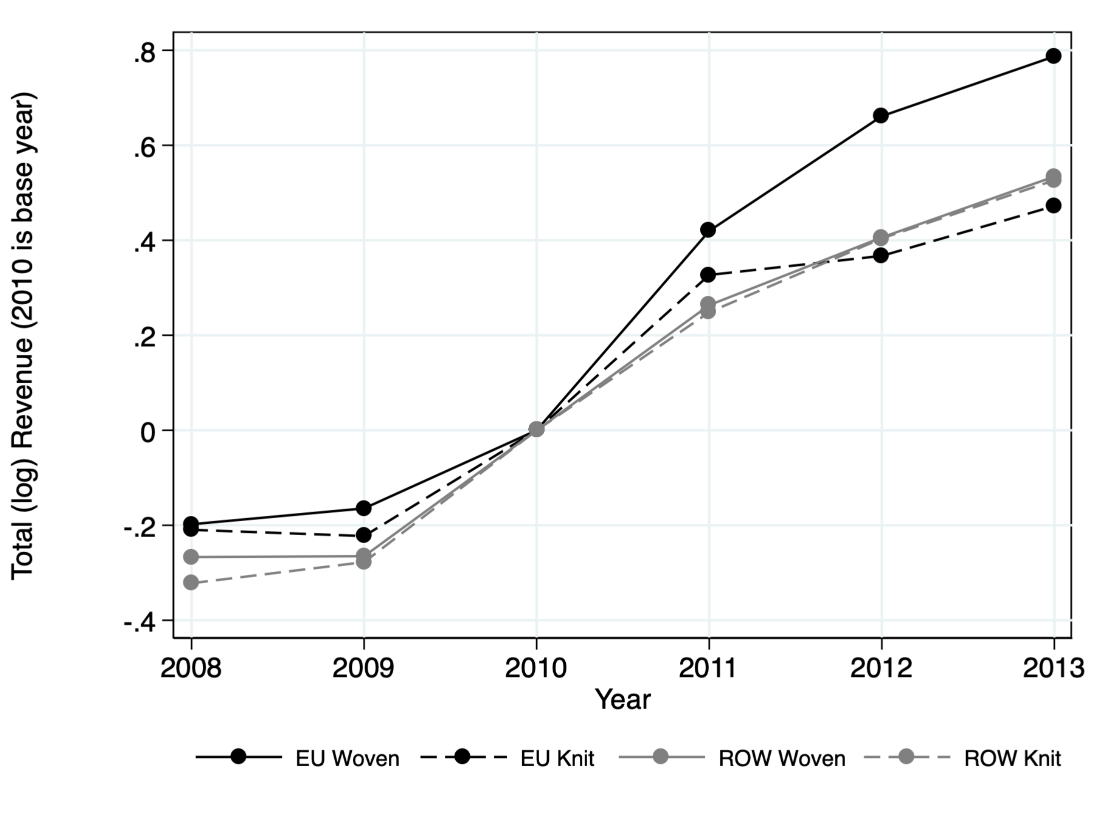
P-values are calculated under the sharp null of no effect ($\beta_1 = 0$) non-parametrically from the empirical null distribution as the ratio of the number of times the estimate under randomization was at least as large as the actual estimate relative to the total number of randomized evaluations of the triple-difference. Column (1) of Table A6 presents the results. I show the results when products are randomized, when destinations are randomized, and when years are randomized. In all cases, these p-values are less than 1%.

Figure A4: Event Study Robustness



This figure displays the DD and DDD event studies with different sets of fixed effects. The fixed effects included are shown in each panel. Estimates and 95% confidence intervals are show. Errors allow for clustering at the market level.

Figure A5: Trends in total export revenue



This figure displays the trends in total bilateral export revenue for woven and knit apparel between destinations, relative to the level in 2010.

MacKinnon and Webb (2019) note that when treated groups have a different number of observations as control groups randomization inference based on beta coefficients can over-reject. This may be relevant in the context of this study. For example, 53% of HS8 level products are woven products and there are more non-EU countries than EU countries in the sample. As a secondary test, it is recommended to use t-statistics rather than coefficients. Randomization inference based on t-statistics tend to under-reject, making this a more conservative test (MacKinnon and Webb 2019). I examine the probability of observing a t-statistic of at least 2 using the same permutation procedure described above. Column (2) of Table A6 presents the results of the permutation test based on t-statistics. Across all sources of randomization, the p-values are larger than the β_1 based p-values. In all cases, even these conservative p-values are less than 0.05.

Table A6: Permutation Tests

	p-value based on β_1	p-value based on t-statistic
Product randomization	< 0.001	0.007
Destination randomization	< 0.001	< 0.001
Year randomization	< 0.001	0.0132

Notes: This table presents the results from permutation tests. Non-parametric p-values are calculated based on random permutations of which products are classified as woven, or which destinations are classified as EU, or which years are classified as post-2011. The first column show the p-values based on estimates of the triple-difference effect (β_1 in equation 3). The second column presents p-values based on t-statistics. There were 5,000 replications used to produce results in both columns.

A3.2 Product quality

Following Khandelwal, Schott, and Wei (2013), product quality enters consumer utility as an unobserved attribute of a variety that increases consumer willingness to purchase relatively large quantities of the variety despite the relatively high prices charged. The derivation begins with the assumption that there exists a representative consumer with CES utility given by: $U = (\int_{k\in\Omega}(q_k\lambda_k)^{\frac{\sigma-1}{\sigma}}dk)^{\sigma/(\sigma-1)}$, where q_k and λ_k represent the quantity and quality of product k, respectively. The elasticity of substitution across varieties is given by $\sigma > 1$, and Ω is the set of all products available.

From this set up, the demand for firm ϕ's specific variety of product k can be expressed as a function of the price, as well as its quality: $q_{jk}(\phi) = \lambda_{jk}(\phi)^{\sigma-1}p_{jk}(\phi)^{-\sigma}P_j^{\sigma-1}E_j$, where $p_{jk}(\phi)$ is the price of the variety, and P_j and E_j are the price index and expenditures. Taking logs, quality can be estimated at the firm-product-destination-year level as the residual of the OLS regression:

$$ln(q_{ijkt}) + \sigma ln(p_{ijkt}) = \alpha_k + \alpha_{jt} + \eta_{ijkt}$$

where α_{jt} controls for export market price indices and expenditures. Because prices and quantities are not necessarily comparable across apparel products, a product fixed effect (α_k) is included as well. Using $\sigma = 4$, the median elasticity for apparel products estimated in Broda and Weinstein (2006), and the elasticity used in Khandelwal, Schott, and Wei (2013) to study Chinese apparel firms, product quality can be recovered from the residual: $\hat{\lambda}_{ijkt} = \hat{\eta}_{ijkt}/(\sigma - 1)$. The quality-adjusted price is given by $ln(p_{ijkt}) - ln(\hat{\lambda}_{ijkt})$.