Do US Exporters Take Advantage of Free Trade Agreements? Evidence from the US-Colombia FTA

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Abstract

Using novel transaction-level data, I study the determinants of the utilization among US exporters of preferential treatment under the US-Colombia free trade agreement. I find FTA use is incomplete and increases based on the magnitude of duty savings, which suggests the existence of a fixed cost to taking advantage of these preferences. To shed light on the nature of this fixed cost, I show that, after controlling for duty savings FTA use increases over time, is higher among larger exporters, and is positively associated to an exporter's past experience in using the FTA. This suggests the fixed cost of using the FTA falls over time and with exporter size and experience. Finally, I construct a measure of the restrictiveness of rules of origin specific to this FTA and find that more restrictive rules of origin lead to a lower use of the FTA, especially among producers of differentiated goods.

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1. Introduction

In recent decades, free trade agreements (FTAs) have been the most prominent tool used across the world to further globalization. To what extent these agreements actually liberalize world trade depends crucially on whether firms are able to access the preferential treatment granted. It is well known that there are barriers to using FTAs stemming from administrative costs and rules of origin, and that FTA use is only partial [Anson et al., 2005, Ulloa and Wagner, 2012].

This is the first paper to study the extent and determinants of the use of a free trade agreement by US exporting firms. To do so, I depart from most of the literature and use a granular approach based on transaction-level indicators of FTA use tied to the firms involved in each transaction. Lack of previous evidence in this regard might be due to the fact that studying FTA use by individual US exporters requires unique data. First, FTA use is recorded by customs in the destination country, not in the US. Consequently, in addition to reporting FTA use at the transaction level, said customs data must report the identity of the foreign (i.e. US) exporter. Only recently, such data identifying both sides of each transaction has become available for a handful of countries, among which Colombia is the only one with which the US has signed a free trade agreement. I combine these transaction-level customs data with the tariff liberalization schedule for thousands of HS10 products, plus newly digitized product-level data on the rules of origin in this FTA. Overall, the US-Colombia FTA is an ideal setting to explore the determinants of FTA use, given that it provides large tariff cuts that vary substantially across products, most of which were immediately and fully liberalized starting from different initial rates.

Understanding the extent and determinants of FTA use has important implications. First, it sheds light on the true extent of globalization. While, on paper, tariffs under the FTA reach zero for almost all products, a very sizable fraction of firms still pay pre-FTA tariffs (which average 7.3% and are as high as 15%) several years after the implementation of the agreement.[1] The difficulties or reluctance to take advantage of FTAs can be interpreted as a subtle yet important barrier to globalization. In addition, understanding the determinants of FTA use can be helpful to improve the design of future agreements.

A second implication concerns how trade liberalization affects different types of firms, which is an issue to which the literature has paid much attention to in the last two decades [Melitz, 2003]. In a canonical model, all exporting firms benefit from trade liberalization. The evidence provided in this paper indicates that even within an industry, only some exporters do. Exporting firms that do not use

[1] The average MFN (most favored nation) tariff paid by US exporters not using the FTA is weighed by value and is calculated over the baseline sample of fully and immediately liberalized product categories used in the paper.

an FTA can actually see their exports *reduced* because exporters that do benefit from the agreement can offer lower prices and gain market share at the expense of firms that do not use the agreement.

I start by documenting the extent to which the FTA is used. In 2016, more than three years after the FTA was implemented in May 2012, 43.6% of transactions and 74.2% of value are exported taking advantage of the preferential treatment. At the same time, 40.0% of US exporting firms and 44.3% of Colombian importers have at least one transaction benefiting from the FTA. I then examine the determinants of FTA use at the transaction level. The empirical analysis is guided by a simple conceptual framework in which the decision to use the FTA weighs benefits and costs. The benefit of using it corresponds to the duties avoided, which is equal to the product of the MFN tariff rate and the transaction value.[2] Using a linear probability model, I show that duty savings are indeed a determinant of the probability that a transaction uses the FTA. I also find that controlling for transaction value, there is not much difference between products facing 5% and 10% rates, but an important increase in FTA use for products facing the highest (15%) MFN rates.

The next results provide insights regarding the cost of using the FTA. First, controlling for duty savings, I find that FTA use increases over time. This suggests that the fixed cost of using the FTA falls as time goes by, which could be interpreted as learning by firms on how to use the agreement. Second, I find that larger US exporters are more likely to use the FTA, keeping duty savings constant. This suggests that the fixed cost of using the FTA might be smaller for larger firms. Larger firms might have capabilities that make the administrative burden associated to the FTA less onerous. In addition, larger firms are more likely to survive longer as exporters, making the cost of adjusting to the FTA requirements more profitable.[3]

Another finding that sheds light on the nature of the cost of using the FTA is that exporters with more experience using it are more likely to keep using it. Controlling for the duty savings facing a transaction and for the size of the exporting firm, exporters with a large number of past transactions using the FTA are substantially more likely to use the FTA. This is true when considering the total number of past transactions using the FTA, as well as the number of past transactions in different products. This last result suggests that there is a firm–wide component and not just a product–specific component of the fixed cost of using the FTA.

[2] In general, the duty savings from using the FTA are equal to the value of the transaction times the difference between the MFN tariff and the reduced tariff under the FTA. In the case of products facing zero tariffs under the FTA (which is the baseline sample in my analysis), duty savings are equal to the transaction value times the MFN tariff rate.

[3] Adjusting to the FTA might imply legal or administrative fixed costs, or supply chain adjustments to meet rules of origin.

In the last part of the paper, I examine the role played by rules of origin, which could be an important barrier to FTA use. The FTA applies rules of origin to all products exported by the US. This implies that US exports must be manufactured using local inputs or with imported inputs that are substantially transformed. Following Anson et al. [2005], I construct a measure of the restrictiveness of these rules of origin, which is a function of how substantial the required transformation of imported inputs is. To this end, I digitize the schedule of rules of origin of the FTA. Using again a linear probability model, I find that more restrictive rules of origin do lead to a lower probability of using the FTA by US exporters. This result is stronger among differentiated products. In addition, I find that the negative effect of rules of origin on FTA utilization is present only for large exporters. These results are consistent with the fact that both producers of differentiated goods and large firms are more likely to source inputs through complex global supply chains.[4] The purpose of rules of origin is to avoid trade deflection, such that non-members channel their exports to Colombia through the US. However, many US exporters form part of supply chains, and due to rules of origin, would have to modify their production process to take advantage of the FTA. My results give support to the arguments in favor of reforming rules of origin, as they act as significant barriers to trade liberalization [Cadot and De Melo, 2008].

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Contribution to the Literature The paper contributes to the literature on the utilization of preferential treatment under international trade agreements. This literature has exploited variation across products in utilization rates and established that these are positively associated to preference margins (i.e. the gap between MFN and preferential tariffs). This work includes Ulloa and Wagner [2012]'s analysis of Chilean exports to the US under the US-Chile FTA, Keck and Lendle [2012]'s analysis of US, EU, Canadian and Australian import flows, and Hakobyan [2015]'s study of the underutilization of the Generalized System of Preferences in US imports from developing countries, among others.

There is also work that provides estimates of the cost of FTA utilization. For example, Cadot and De Melo [2008] indicate this cost is equivalent to an ad-valorem tariff of between 3% and 5%. A recent approach to estimating this cost using firm–level data is based on the assumption that this is a fixed cost and that there is a pecking order such that firms with productivity above a certain cutoff all use the

[4]While I find that controlling for duty savings FTA use is higher among larger exporters, I also find that rules of origin restrictiveness has a negative impact on FTA use only among larger firms. The most plausible interpretation is that considering *all* the barriers to using an FTA (including administrative costs and adjustments to the supply chain to comply with rules of origin), these are easier to overcome for larger exporters, but that the part of the cost associated to rules of origin is more burdensome for larger firms.

FTA. This implies that the firm with the lowest productivity among firms using the FTA breaks even, and so does the firm with the highest productivity among those not using the agreement. Based on this idea, Hayakawa et al. [2016] estimates this cost ranges between $1000 or $2000 USD, while Ulloa and Wagner [2012] emphasize a cost of about $3000 at the 75th percentile.[5]

Much of the related literature has focused on the effect of rules of origin on preferential treatment utilization.[6] Anson et al. [2005] and Carrere and De Melo [2006] find a meaningful negative effect of rules of origin on the utilization of Mexico's preferential access to the US market following NAFTA. In related work, Cadot et al. [2014] show that preference utilization boosts firms' exports, using rules of origin stringency as a first stage instrument in the context of Colombia's FTAs with other South American countries. Finally, Conconi et al. [2018] establish that rules of origin distort input sourcing, also in the context of NAFTA.

This paper departs from the literature by providing the first systematic evidence of FTA utilization based on transaction-level data, including the identity of exporting and importing firms. The paper thus provides the first evidence on the utilization of an FTA by US exporting firms. The substantially more granular approach used in the paper allows me to elucidate several mechanisms including the finding that larger firms are more likely to benefit from FTAs, which can further the large degree of concentration of trade flows among the largest firms. Finally, the finding regarding the negative association between rules of origin restrictiveness and FTA utilization consolidates the evidence showing that rules of origin act as an important trade barrier.

2. Context and Data Sources

In this section, I describe the US-Colombia FTA, the transaction-level customs data used, and the data on MFN tariffs and rules of origin.

Context: The US-Colombia Free Trade Agreement The US – Colombia free trade agreement became operational on May 15th 2012. At that time, the US was Colombia's largest source of imports, and Colombia was the 22nd largest market for the US. To date, the US has implemented FTAs with 20 trading partners, among which Colombia is one of the largest. Benguria [2021] documents a substantial

[5] An earlier approach based on more aggregate data estimates threshold regression models [Francois et al., 2006, Hayakawa, 2011]. In related work, Cherkashin et al. [2015] estimates costs of compliance with rules of origin of about $4240 for Bangladeshi apparel exports to the European Union using a structural model.

[6] Cadot et al. [2006] provides an essential overview of rules of origin. Krishna [2006] surveys the theoretical literature on rules of origin.

increase in US exports to Colombia as a result of this tariff liberalization.

The schedule of Colombia's tariff cuts for US exports splits products into several categories. Products in category A goods were liberalized fully and immediately, such that tariffs were reduced to zero as the agreement became operational. Products in categories B and C faced gradual liberalization over time, leading to zero tariffs at different horizons.[7] Category F represents products that were already facing zero tariffs before the agreement, and shall continue to do so. There are also a number of smaller categories and exceptions. Table 1 reports the share of HS10 products, the share of value, average transaction size and average MFN tariff rates in each category. The largest share of products (71.6%) and value (48.7%) falls under category A. Average transaction size is relatively similar across categories. MFN tariff rates are also similar across categories A, B and C (ranging between 6.89% and 9.84%) and somewhat higher for the 'other' category. Throughout the paper, most of the analysis focuses on products liberalized fully and immediately (i.e. category A products) given that they provide a cleaner experiment.[8] However, I show that key results are valid also for category B and C products.

Table 1: Tariff liberalization categories.

Category	% of Products	% of Value	Av. Transaction Value (log)	Av. MFN Tariff Rate
A	71.6%	48.7%	7.36	6.89%
B	5.1%	4.5%	6.32	8.52%
C	17.7%	41.8%	6.42	9.84%
F	2.0%	0.7%	8.14	0%
Other	3.6%	4.3%	7.47	13.30%

Notes: This table reports the share of HS10 products, share of US exports to Colombia, average transaction value, and average MFN tariff rate (across HS10 products) under each liberalization category. Category A corresponds to immediate and full liberalization. Categories B and C correspond to gradual liberalization over 5 and 10 year horizons respectively. Category F corresponds to products already duty free, which keep that status under the agreement.

Transaction-level customs data The main source of data is administrative transaction-level data collected by Colombian customs during 2013-2016. These data have two distinguishing features. First, they report not only the identity of the Colombian importer, but also the identity of the foreign exporter. Such data, which enables me to study *firm-to-firm trade*, have been available only recently and only for a handful of countries, and Benguria [2021] uses these data for Colombia. The second rare and

[7] Category B products are duty free after 5 years, while category C products are duty free after 10 years.

[8] A potential concern with restricting the analysis to category A products is that some exporting firms might export products in different categories. However, Appendix Figure A.1 shows that almost all firms that export category A products do not export products in other categories.

essential feature is that each transaction has an indicator of the free trade agreement used, if any.[9]

Colombian importers are characterized by their tax ID number. Foreign exporters are defined by their name, city and street address. I follow Benguria [2021] in creating a foreign exporter identifier based on this information. This procedure follows the practice of the US and Canadian statistical agencies as described by Kamal et al. [2015] for the US case. The details are described in Appendix Section A.1. Other variables included in the data include the year and month of the transaction, the HS10 product code, the exporting country, the FOB value and the quantity.

The baseline sample used in the analysis, which consists of US exports to Colombia in fully and immediately liberalized categories includes 1697 HS10 products and 21700 US exporting firms over the 2013-2016 period.[10]

MFN tariffs MFN (most favored nation) tariffs are the tariffs set by Colombia for countries with which it does not have free trade agreements. These are the tariffs that US exporters pay when not using the FTA. The schedule of MFN tariffs for Colombia, by HS10 product of the Colombian product nomenclature, are obtained and digitized from Decree 4927 of December 2011, and were valid from 2012 through 2016.

Among category A products, there are only three MFN tariff rates faced by exporters not using the FTA. As Table 2 shows, 63.6% face a 5% tariff rate, 14.6% face a 10% rate, and 21.9% face a 15% rate.

Table 2: Summary statistics by MFN tariff rates among fully and immediately liberalized products.

MFN Rate	% of Products	% of Value
5%	63.6%	72.5%
10%	14.6%	14.7%
15%	21.9%	12.8%

Notes: This table reports the share of HS10 products and share of US exports to Colombia under each MFN tariff rate among products in liberalization category A (fully and immediately liberalized products).

[9] I exclude from the sample transactions which do not use the FTA but pay zero tariffs (even though they face positive MFN tariffs) based on other forms of preferential treatment, such as a program that allows for duty free imports of inputs used to produce exports. I also limit the sample to products produced in the US *and* shipped from the US (both the country of origin and shipment are available in the data).

[10] Category B consists of 177 HS10 products and 9399 US exporters, while category C includes 618 HS10 products and 20580 US exporters.

Rules of Origin I also construct new measures, specific to this FTA, on the restrictiveness of the rules of origin faced by US exporters to Colombia. These rules of origin imposed by Colombia are contained in Chapter 4, Annex 4.1 of the agreement, which I have digitized. All HS10 products are subject to these rules of origin. These rules are typically established at the HS4 and HS6 level, and then assigned to all the underlying HS10 products. In most cases, rules of origin require a "substantial transformation" of non-originary inputs, and such transformation is stipulated as a change of chapter (HS2), heading (HS4) or subheading (HS6) according to the Harmonized System. For example, a US exporter cannot benefit from the FTA exporting steel already imported from a third country. It can benefit from the FTA if it exports cars made of imported steel, because cars and steel belong to different HS categories.[11] Following Anson et al. [2005], I define a product-level measure of the *restrictiveness* of rules of origin such that requirements of changes in chapter (i.e. HS2 classification) are more demanding than requirements of changes in headings (HS4), which in turn are more demanding than changes in subheadings (HS6). This means that there are three levels of restrictiveness. Anson et al. [2005] and Carrere and De Melo [2006] use this approach to assess the effect of rules of origin on the utilization of NAFTA in Mexican exports to the US in 2001.

As Table 3 shows, among fully and immediately liberalized products 4.9% fall under the most restrictive category (change in HS2), 28.2% fall under the next category (change in HS4), and 66.9% are subject to the least restrictive transformation requirement (change in HS6).

Table 3: Measure of restrictiveness of rules of origin.

Type of ROO	% of Products	% of Value
Change of Chapter (HS2)	4.9%	1.2%
Change of Heading (HS4)	28.2%	27.3%
Change of Subheading (HS6)	66.9%	71.6%

Notes: This table reports the share of HS10 products and the share of US exports to Colombia under each type of rule of origin based on their restrictiveness (see text). This is based on fully and immediately liberalized (category A) products.

[11] A small number of products have more complex rules of origin. These rules of origin are not necessarily more restrictive; they are more complex in that their restrictiveness is difficult to index. Some of these rules require a non-originating product to be subject to a specific transformation (such as a chemical reaction). Others require a product to meet a certain percentage of local value.

3. Do US Exporters Take Advantage of the Free Trade Agreement?

Data overview I start by documenting the extent to which US exporters use the FTA. Table 4 reports FTA use among fully and immediately liberalized (i.e. category A) products for years 2013 and 2016. The first row shows that, in 2013 and 2016, the share of transactions taking advantage of the FTA is only 38.0% and 43.6% respectively. Splitting the sample based on the products' MFN tariff rates, FTA use is higher among products facing higher tariff rates. In 2016, FTA use goes from 38.5% among products facing a 5% (i.e. the lowest) tariff rate to 62.6% among products facing the highest tariff rate (15%). This fraction increases moderately as the MFN tariff rate increases from 5% to 10%, and jumps by much more as the tariff rate increases to 15%. The second row indicates that, between 2013 and 2016, the share of exported value using the FTA goes from 66.4% to 74.2%. In 2016, FTA use is 69.5% for the lowest rate to 88.4% among products facing the highest (15%) rate. The table also shows what fraction of exporting firms have at least one transaction taking advantage of the FTA. Only 32.4% (in 2013) or 40.0% (in 2016) of US exporters use the FTA at all. In 2016, this goes from 39.7% (for products facing the 5% rate) to 46.1% (for the 15% MFN rate). This pattern is similar for importing firms, among which FTA use is 37.1% in 2013 and 39.7% in 2016, and also increases slightly as the MFN rate increases.[12]

Table 4: FTA use by year and MFN tariff rate.

	2013				2016			
	Total	5%	10%	15%	Total	5%	10%	15%
Share of transactions	38.0%	30.7%	33.0%	64.1%	43.6%	38.5%	42.7%	62.6%
Share of value	66.4%	61.6%	72.5%	84.2 %	74.2%	69.5%	81.2%	88.4%
Share of exporters	32.4%	31.7%	28.5%	39.4%	40.0%	39.7%	35.6%	46.1%
Share of importers	37.1%	38.2%	32.2%	39.7%	44.3%	45.3%	40.4%	46.3%

Notes: This table reports the share of transactions, share of value, share of exporters and share of importers using the FTA by year (for 2013 and 2016) and MFN tariff rate. An exporter or importer is considered to use the FTA in one of these categories if it uses the FTA in at least one transaction.

To put in perspective the role of products, exporting and importing firms in explaining FTA use, Table 5 reports R-squared coefficients from transaction-level regressions of a dependent variable which is equal to one if the FTA is used and zero otherwise on various sets of fixed effects. A regression on HS10 product and year–month fixed effects yields an R-squared of 0.27. This increases to 0.62 when including exporting firm fixed effects, and to 0.70 when also including importing firm fixed effects.

[12] Appendix Table A.1 reports the shares of transactions, value, exporters and importers using the FTA in 2013 and 2016 for category B and category C products.

This highlights the importance of *both* products and firms in accounting for variation in FTA use. While the literature, due to data limitations, has focused primarily in variation across products, abstracting from the firm dimension leaves much variation unexplored. The data used in this paper will enable me to explore both dimensions.

Table 5: Determinants of FTA use: variance decomposition.

	R-squared
HS10 and year–month	0.271
HS10 and exporter and year–month	0.617
HS10 and exporter and importer and year–month	0.703

Notes: This table reports the R-squared coefficient from a regression in which the dependent variable is equal to one if the FTA is used and zero otherwise. The regression includes the set of fixed effects named in each row.

It is also the case that keeping the MFN tariff rate constant, larger transactions are more likely to use the FTA. To show this, Figure 1 plots kernel density estimates of the distribution of transaction values separately for different MFN tariff rates (5% in panel a) and 15% in panel b)). In each case, the distribution for transactions that do use the FTA is shifted to the right relative to transactions that don't use it. The shift is largest among products facing 15% MFN tariff rates, which is consistent with the fact that duty savings from using the FTA are larger among that group. Panels c) and d) in the same figure compare transactions under the 15% MFN tariff rate in 2013 and 2016, showing a larger difference between the two distributions in the final year of the sample, which could imply some learning over time on how to use the agreement.

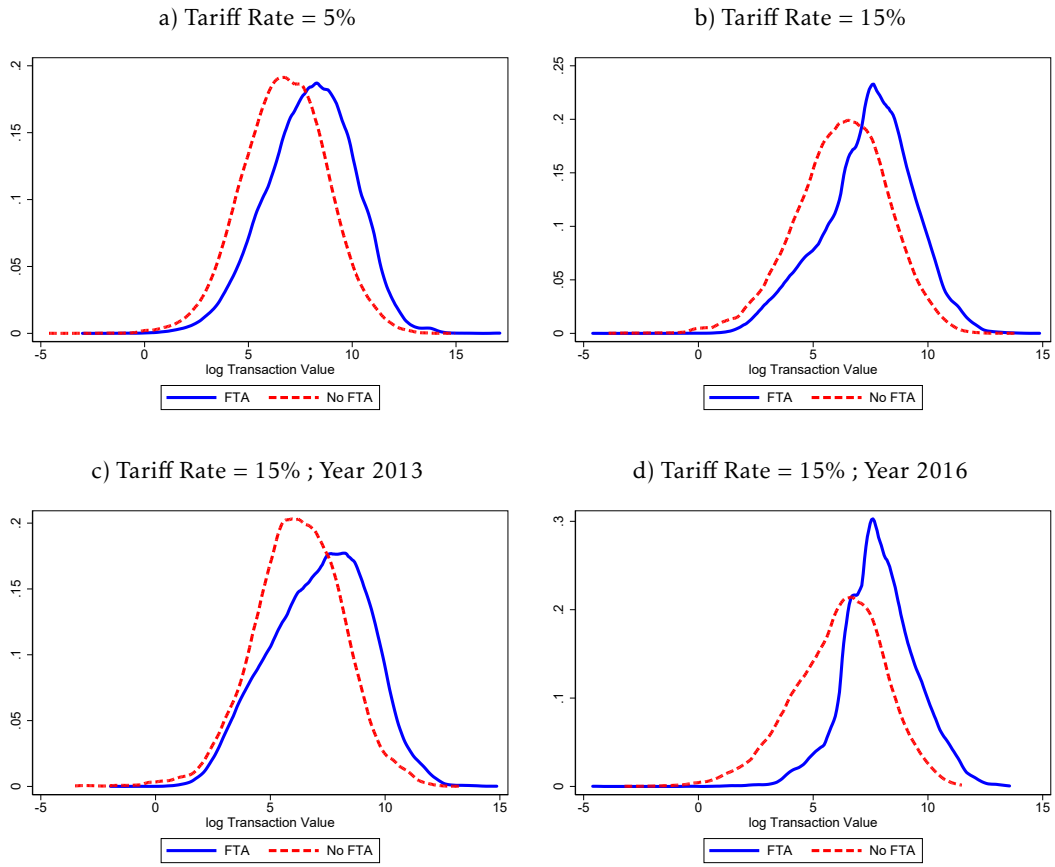
Economic logic suggests that the probability of using the FTA is a function of the amount of money saved from using it, which is equal to the product of the MFN tariff rate and the transaction value. Figure 2 bins transactions into percentiles based on the amount saved from using the FTA, and plots the share of transactions using the FTA in each percentile. There is clearly a positive slope, with usage shares going from less than 20% for the bottom percentile to more than 80% near the highest percentiles. The increase in FTA use is monotonic in the percentiles of the amount of duty savings obtained from using it.[13,14]

Exploring this pattern in more detail, Figure 3 sorts transactions into percentiles by transaction value

[13] A similar pattern is found for category B and category C products in Appendix Figure A.2.

[14] Appendix Figure A.3 plots FTA use separately for differentiated and nondifferentiated goods. It shows that, controlling for duty savings, differentiated goods have lower FTA use, which is consistent with the fact that these products require more complex supply chains, and thus exporters of these products might have more difficulty meeting rules of origin.

Figure 1: Distribution of transaction size by FTA use.



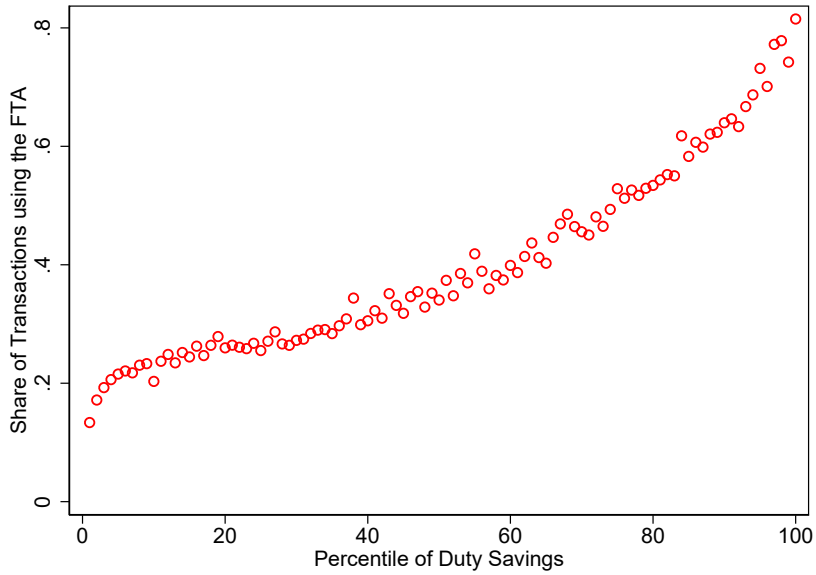
Notes: These figures show kernel density estimates of the distribution of log transaction value separately for transactions using and not using the FTA (marked with the blue solid line and the red dashed line respectively).

separately for each MFN tariff rate, and shows that among each rate, FTA use is higher as transaction size increases. For products facing a 5% rate, FTA use goes from about 15% to 60% going from the lowest to the highest percentile of transaction size. In contrast, for products facing a 15% rate, FTA use goes, approximately, from 50% to 90%. FTA use for transactions facing a 10% rate is very similar to that for transactions with a 5% rate, except for transactions above the 80% percentile of transaction value, which see a steep increase in FTA use.

With this overview of essential patterns in the data, I procede to a conceptual discussion of the decision of an exporting firm regarding FTA utilization, which guides the subsequent regression analysis.

Conceptual framework Conceptually, exporting firms decide whether to use the FTA balancing the benefit (duties avoided) and the cost of doing so. The cost of utilization has been described in the literature as a fixed cost [Ulloa and Wagner, 2012, Hayakawa et al., 2016], which is consistent with the fact

Figure 2: FTA use by percentiles of duty savings.



Notes: This figure shows the share of transactions using the FTA for each percentile of the MFN tariff rate times the transaction value (i.e. the amount of duties paid if the FTA is not used).

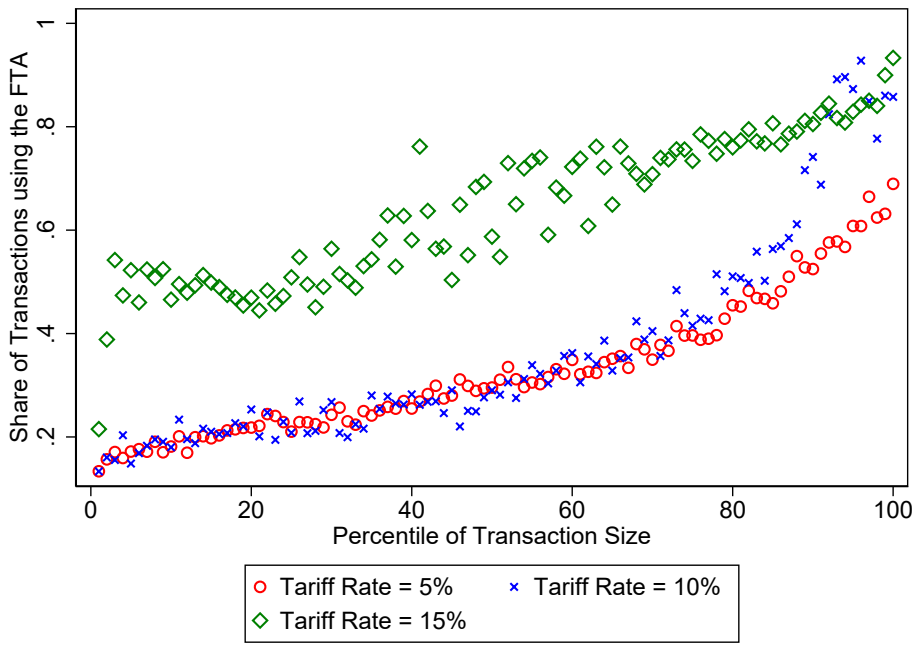
that not all exporters use the FTA.[15] Consider the case in which exporting under the FTA and exporting without it both dominate not exporting. In choosing whether to use the FTA, a firm of productivity φ compares profits when using it, which include paying the fixed cost f_{FTA} but under which there are no duties, against the profits obtained when not using it, which include MFN duties but no fixed cost.[16] In this simple framework, keeping the fixed cost constant, firms are more likely to adopt the FTA when their productivity is higher, given that highly productive firms export more, and thus benefit more from using the FTA. In an extension of this framework to a setting with multiproduct firms following Bernard et al. [2011], a firm's productivity depends on that firm's 'ability' φ (which is common across all the firm's products) and the firm's product attributes λ, which vary across products. This implies that there could be variation in FTA use within a given firm, that will choose to use the FTA for its products with higher attributes but not for its products with lower attributes.[17] Note finally that the fixed cost of

[15]The arguments in this framework will also apply to a case in which the cost of using the FTA is partly a fixed cost and partly a variable cost.

[16]In a Melitz [2003] framework with a Pareto distribution of firm productivities, an exporting firm using the FTA would have profits $\pi = B \cdot \varphi^{\sigma-1} - f - f_{FTA}$, while an exporting firm not using it would have profits $\pi = B \cdot \tau^{1-\sigma} \cdot \varphi^{\sigma-1} - f$, where $B = \frac{(\sigma-1)^{\sigma-1}}{\sigma^{\sigma}} \cdot A$, the term A is the demand level in the destination market, $\sigma > 1$ is the constant elasticity of substitution, and f represents the fixed cost of exporting (aside from the cost uf using the FTA). This implies that firms with productivity $\varphi \geq \left(\frac{f_{FTA}}{B \cdot (1-\tau^{1-\sigma})}\right)^{\frac{1}{\sigma-1}}$ prefer to use the FTA.

[17]In the case of multiproduct firms, profits obtained from exporting a given product using the FTA are $\pi = B \cdot \varphi^{\sigma-1} \cdot \lambda^{\sigma-1} - f - f_{FTA}$, while an exporting firm not using it would have profits $\pi = B \cdot \tau^{1-\sigma} \cdot \varphi^{\sigma-1} \cdot \lambda^{\sigma-1} - f$. For a given firm with ability φ,

Figure 3: FTA use by percentiles of transaction size, separately by MFN tariff rate.



Notes: This figure shows the share of transactions using the FTA for each percentile of the transaction value, separately for the three MFN rates of 5%, 10% and 15% faced by category A products.

using the FTA (f_{FTA}) could depend on product characteristics (which determine the cost of compliance, such as product–specific rules of origin), firm productivity (which empirically I proxy by firm size), the time that goes by since the start of the agreement, which could reduce the cost if there is learning over time, and the exporter's past experience using the FTA. The analysis below provides evidence in favor of this framework, and sheds light on the nature of the cost of using the FTA.

Regression analysis I start by exploring more formally the relationship between the probability of using the FTA and the duty savings from using it, which capture the benefit of using it.[18] Duty savings are equal to the product of the transaction value and the MFN tariff rate. To this end I estimate the following linear probability model with OLS. Each observation corresponds to a transaction m in month t sold by exporter e to importer i in HS10 product category p.

$$\text{FTA}_m = \eta_e + \delta_t + \beta \cdot \log(\tau_p \times \text{X}_m) + \epsilon_m \tag{1}$$

only products with an attributes parameter $\lambda \geq \frac{1}{\varphi}\left(\frac{f_{FTA}}{B\cdot(1-\tau^{1-\sigma})}\right)^{\frac{1}{\sigma-1}}$ would use the FTA.

[18]The empirical analysis uses duty savings as a proxy for the benefit of using the FTA because I do not observe the difference in operating profits with vs. without the FTA.

The dependent variable is equal to one if a transaction uses the FTA and zero otherwise. I include exporter fixed effects (or alternatively exporter-importer pair fixed effects) and time fixed effects. The regressor $\tau_p \times X_m$ is the product of the MFN tariff rate τ_p and the value of the transaction X_m, which as explained earlier, is the monetary benefit from using the FTA. I cluster standard errors by HS10 product. Table 6 reports the results. Columns 1 and 2 correspond to equation (1). Column 1 includes exporter fixed effects, while column 2 includes exporter-importer pair fixed effects. Both columns yield very similar results. The probability of using the FTA is increasing in the duty savings obtained from doing so (i.e. the tariff rate times the transaction value). Based on column 2, a one standard deviation increase in the regressor is associated to a 5.0 percentage point higher probability of using the FTA.[19,20] As an alternative and more flexible specification under the same principle, I also report results for the following regression in which the log of tariff rates and transaction value are included separately:

$$\text{FTA}_m = \eta_e + \delta_t + \beta_1 \cdot \log(\tau_p) + \beta_2 \cdot \log(X_m) + \epsilon_m \tag{2}$$

This is shown in columns 3 and 4 in the same table. Consistent with the conceptual framework discussed earlier, both the tariff rate and the transaction value have a positive impact on FTA use. Further, while the coefficients in columns 3 and 4 are standardized, Appendix Table A.6 shows that one cannot reject the null hypothesis that the coefficients (before standardizing) are statistically equal, which is again consistent with the conceptual framework.

Finally, given that MFN rates only take three values among the immediately and fully liberalized category A products in the sample used, I also report results using dummy variables corresponding to each tariff rate:[21]

$$\text{FTA}_m = \eta_e + \delta_t + \gamma_1 \cdot 1[\tau_p = 10] + \gamma_2 \cdot 1[\tau_p = 15] + \gamma_3 \cdot \log(X_m) + \epsilon_m. \tag{3}$$

The results are shown in columns 5 (with exporter fixed effects) and 6 (with exporter-importer fixed effects). Based on column 6, transactions falling under the 15% rate are 5.7 percentage points more likely to use it relative to transactions under the 5% rate, while there is not a statistically significant

[19] For ease of interpretation, the regressor is standardized to have mean zero and standard deviation equal to one.

[20] Appendix Table A.2 shows these results are robust to alternative ways of clustering standard errors. Appendix Table A.3 shows the results are robust to controlling for product fixed effects. Appendix Section A.2.6 indicates that similar results are found when using category B and category C products. Finally, Appendix Section A.2.7 documents that a more aggregate firm–level regression yields the same conclusion.

[21] Note that MFN tariff rates are 5%, 10% and 15%. In equation (3), the 5% MFN tariff rate is the omitted category.

difference between the 5% and 10% rate.[22] The results also show that larger transactions in terms of value also have a higher probability of using the FTA. A one standard eviation in the transaction value is associated to a 4.8 percentage point increase in the probability of using the preferential treatment.[23]

Table 6: FTA use and duty savings.

	(1)	(2)	(3)	(4)	(5)	(6)
log(Tariff Rate × Value)	0.054***	0.050***				
	(0.004)	(0.004)				
log(Value)			0.053***	0.048***	0.053***	0.048***
			(0.004)	(0.004)	(0.004)	(0.004)
log(Tariff Rate)			0.013*	0.014*		
			(0.008)	(0.008)		
1[Tariff Rate = 10]					-0.001	0.003
					(0.019)	(0.019)
1[Tariff Rate = 15]					0.059**	0.057**
					(0.025)	(0.026)
Exporter F.E.	Yes	No	Yes	No	Yes	No
Exporter-Importer F.E.	No	Yes	No	Yes	No	Yes
Year-Month F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Observations	328697	323789	328697	323789	328697	323789

Notes: Columns 1 and 2 report the results of the estimation of equation (1). Columns 3 and 4 report the results of the estimation of equation (2). Columns 5 and 6 report the results of the estimation of equation (3). The dependent variable is a dummy variable equal to one if the FTA is used in a transaction and zero otherwise. The variables log(Tariff Rate × Value), log(Value), and log(Tariff Rate) are standardized to have mean zero and standard deviation one. Standard errors are clustered by HS10 product. ***, **, and * indicate statistical significance at the 1%, 5% and 10% level.

Having established that exporters respond to the benefit of using the FTA (the duty savings associated to it), the next results provide insights into the nature of the fixed cost of using it. First, one could assume that there is a dynamic aspect to the decision of using the FTA, and that as time goes by, the fixed cost of using it (f_{FTA}) falls.[24] For example, while documentation regarding rules of origin compliance has to be submitted with every shipment, this might be easier once the firm learns how to do it. In fact, as mentioned earlier, Table 4 shows an increase from 38% to 43.6% in the raw share of transactions using the FTA between 2013 and 2016.To explore this hypothesis, I revisit equation (1) reporting year dummy variables:

$$\begin{aligned} \text{FTA}_m = \eta_e + \beta \cdot \log(\tau_p \times \text{X}_m) + \gamma_1 \cdot 1[\text{year}_t = 2014] + \\ \gamma_2 \cdot 1[\text{year}_t = 2015] + \gamma_3 \cdot 1[\text{year}_t = 2016] + \epsilon_m \end{aligned} \tag{4}$$

[22]Note that a nonlinear effect of tariff rates on FTA use is a possibility under the conceptual framework discussed earlier.

[23]For ease of interpretation, in Table 6 all the continuous variables are standardized to have mean zero and standard deviation equal to one.

[24]Appendix Figure A.4 provides suggestive evidence in this direction. Plotting average FTA use for transactions in 2013 and 2016 by percentile of duty savings, it shows higher FTA use in 2016, especially among larger transactions.

Table 7: FTA use over time after controlling for duty savings.

	(1)	(2)	(3)	(4)
log(Tariff Rate × Value)	0.055***	0.050***	0.055***	0.050***
	(0.004)	(0.004)	(0.004)	(0.004)
1[year=2014]	0.023***	0.017***	0.024***	0.019***
	(0.005)	(0.005)	(0.006)	(0.005)
1[year=2015]	0.005	0.016**	0.007	0.020**
	(0.009)	(0.008)	(0.009)	(0.008)
1[year=2016]	0.028***	0.036***	0.031***	0.039***
	(0.009)	(0.009)	(0.009)	(0.009)
Exporter F.E.	Yes	No	Yes	No
Exporter-Importer F.E.	No	Yes	No	Yes
Month F.E.	No	No	Yes	Yes
Observations	328697	323789	328697	323789

Notes: This table reports the results of the estimation of equation (4). The dependent variable is a dummy variable equal to one if the FTA is used in a transaction and zero otherwise. The variable log(Tariff Rate × Value) is standardized to have mean zero and standard deviation one. Standard errors are clustered by HS10 product. ***, **, and * indicate statistical significance at the 1%, 5% and 10% level.

In this regression, the duty savings capture the benefit of using the FTA. Changes over time in the cost of using the FTA would be reflected in the year dummy variables. The results are shown in Table 7 and include specifications with exporter fixed effects or with exporter–importer pair fixed effects, and with or without month fixed effects to control for seasonality. Consider column 4, which includes exporter–importer pair and month fixed effects. There is an increase over time in the impact of duty savings on FTA use. Relative to the omitted category (year 2013), FTA use increases by 1.9 percentage points in 2014, and by 3.9 percentage points in 2016.[25,26] The interpretation of these results is that the cost of using the FTA may be falling over time, due to learning by firms on how to use it.

It is also possible that the fixed cost of using the agreement, f_{FTA}, depends on the size of exporting firms. To test this, I study whether, controlling for duty savings, firm size influences the probability of using the FTA. Keeping the duty savings constant, large firms might already have the capabilities to deal with the administrative burden implied by the fixed cost of using the FTA, such that it is less onerous for them. Alternatively, pointing in the opposite direction, larger firms might have more complex international supply chains, which would be more affected by rules of origin and would imply a higher fixed cost of using the FTA. Appendix Figure A.5 provides suggestive evidence in this regard. Plotting average FTA use for large and small firms by percentile of duty savings, it shows that large exporting

[25]Note that the coefficient for the dummy variable equal to one in 2016 is statistically different than the omitted category (2013) and statistically different from the coefficients for 2014 and for 2015 (Wald tests reject the null hypothesis of equality in both cases with F–statistics of 5.6 and 10.3 respectively).

[26]Appendix Table A.7 shows these results are robust to controlling for product fixed effects.

Table 8: FTA use and firm size after controlling for duty savings.

	(1)	(2)	(3)	(4)
log(Tariff Rate × Value)	0.148***	0.063***	0.149***	0.065***
	(0.009)	(0.004)	(0.010)	(0.004)
log(Exporter Size)	0.028***	0.042***		
	(0.010)	(0.003)		
1[Large Exporter]			0.035**	0.020***
			(0.018)	(0.007)
Importer F.E.	No	Yes	No	Yes
Year-Month F.E.	Yes	Yes	Yes	Yes
Observations	337954	334871	337954	334871

Notes: This table reports the results of the estimation of equation (5). The dependent variable is a dummy variable equal to one if the FTA is used in a transaction and zero otherwise. The variables log(Exporter Size) and log(Tariff Rate × Value) are standardized to have mean zero and standard deviation one. Standard errors are clustered by HS10 product. ***, **, and * indicate statistical significance at the 1%, 5% and 10% level.

firms are more likely to use the agreement. To further test this hypothesis, I estimate the following regression:

$$\text{FTA}_m = \delta_t + \beta_1 \cdot \text{Exporter Size}_{et} + \beta_2 \cdot \log(\tau_p \times \text{X}_m) + \epsilon_m \tag{5}$$

This regression adds exporter size to equation (1), and thus I remove the exporter fixed effects. I measure the size of each US exporter in terms of total exports to Colombia in the year in which the transaction occurs.[27] The results are shown in Table 8. Column 1 includes only exporter size, and shows that, controlling for duty savings, larger firms are more likely to use the FTA. The magnitude is such that a one standard deviation in exporter size leads to a 2.8 percentage point increase in the probability of using the FTA. Column 2 adds importer fixed effects, such that the identification is based on variation across exporters selling to a same importing firm. In this case, the magnitude of the coefficient on exporter size is larger, as a one standard deviation increase is associated to a 4.2 p.p. higher probability of FTA use. To alleviate endogeneity concerns, I replace the continuous measure of exporter size by a dummy variable equal to one for firms with above–median size. In this case, the positive effect of exporter size still holds. Controlling for duty savings, large firms have a 3.5 p.p. higher probability of using the FTA (or a 2.0 p.p. higher probability when including importer fixed effects).[28] These results support the view that larger exporters face a smaller fixed cost of using the FTA.[29]

[27] Recall that given the nature of the data, I don't observe world exports or total sales of US exporting firms.

[28] Appendix Table A.8 shows that these results are robust to controlling for product fixed effects.

[29] While the conceptual framework presented earlier does not include importing firms, it is possible that FTA use could be a function not only of exporter size, but also of importer size. Appendix Table A.9 explores this issue, finding that the fixed cost of using the FTA is not systematically associated to importer size.

Another hypothesis is that past experience in using the FTA might reduce the cost of using it. To test this, I define, for each transaction, a measure (Past FTA Use_m) counting the number of past transactions in which the corresponding exporting firm has used the FTA. I then estimate the following regression in which FTA use is a function of duty savings (capturing the benefit of using the FTA) and the measure of past use of the FTA:

$$\text{FTA}_m = \delta_t + \beta_1 \cdot \text{Past FTA Use}_m + \beta_2 \cdot \log(\tau_p \times \text{X}_m) + \epsilon_m \tag{6}$$

Alternatively I estimate this equation controlling for exporter size, given that larger firms have more past transactions.[30] The results are reported in columns 1 and 2 in Table 9. Both columns show a similar pattern. The coefficient in column 2 (which controls for exporter size) indicates that a one standard deviation in past FTA use is associated to a 9.1 percentage point higher probability of using the FTA. In columns 3 and 4, I modify the measure of past FTA use, such that it counts the exporting firm's number of past transactions using the FTA in HS10 products different than the current transaction. The results show a very similar pattern. This indicates that the probability of FTA use is higher if the firm has past experience in using the FTA in other products. This suggests that the cost of using the FTA is not only product specific, but has a common firm–level component.[31]

Table 9: FTA use and past experience using the FTA after controlling for duty savings.

	(1)	(2)	(3)	(4)
log(Tariff Rate × Value)	0.146***	0.146***	0.142***	0.142***
	(0.009)	(0.009)	(0.009)	(0.009)
Past FTA Use	0.088***	0.091***	0.084***	0.083***
	(0.010)	(0.011)	(0.025)	(0.026)
Control for Exporter Size.	No	Yes	No	Yes
Year–Month F.E.	Yes	Yes	Yes	Yes
Observations	337954	337954	337954	337954

Notes: This table reports the results of the estimation of equation (6). The dependent variable is a dummy variable equal to one if the FTA is used in a transaction and zero otherwise. In columns 1 and 2, the variable Past FTA Use counts the previous transactions using the FTA in any product, while in columns 3 and 4 this is restricted to FTA use in different products. The variables Past FTA Use and log(Tariff Rate × Value) are standardized to have mean zero and standard deviation one. Standard errors are clustered by HS10 product. ***, **, and * indicate statistical significance at the 1%, 5% and 10% level.

The Impact of Rules of Origin A key barrier that can deter US exporters from using the FTA consists of the rules of origin, which require exports to be manufactured to a certain extent in the US. These rules of origin apply to all product categories. To measure the effect of rules of origin on FTA use, I

[30] Exporter size, as before, is measured as (log) total exports to Colombia in the year in which the transaction occurs.

[31] Appendix Table A.10 shows that these results are robust to controlling for HS10 product fixed effects.

take advantage of the fact that different products are subject to rules of origin of different restrictiveness. The most common type of rule of origin requires a transformation of non-originary inputs. The extent of the transformation is defined as a change of chapter, heading or subheading according to the Harmonized System. Following Anson et al. [2005], it is clear that changes to the HS2 chapter are more demanding than changes to the HS4 heading, which are in turn more demanding than changes to the HS6 subheading. If rules of origin are indeed important barriers to FTA use, one would expect that more restrictive rules of origin lead to less FTA use. To test this point, I digitized the rules of origin in the agreement (see the details in Section 2) and define dummies for each type of rule of origin.[32]

I estimate the following equation, in which as before, the dependent variable is equal to one for transactions using the FTA and zero otherwise. I include dummy variables capturing the restrictiveness of the rules of origin, with the "change of subheading (HS6)" case as the omitted category. In addition, I control for duty savings (the product of the MFN tariff rate and transaction value) which capture the benefit of using the FTA.

$$FTA_m = \eta_{ei} + \delta_t + \beta_1 \cdot \text{Change of Chapter}_p + \beta_2 \cdot \text{Change of Heading}_p + \beta_3 \cdot \log(\tau_p \times \text{X}_m) + \epsilon_m \qquad (7)$$

The regression controls for exporter-importer and time fixed effects, and is estimated by OLS as a linear probability model, with standard errors clustered by HS10 product.

The results are reported in Table 10. Column 1 shows negative coefficients on the "change of heading (HS4)" and "change of chapter (HS2)" variables. This indicates that more restrictive rules of origin (relative to the omitted category) imply a lower probability of using the FTA. The coefficient is much larger for the "change of chapter (HS2)" variable compared to the "change of heading (HS4)" variable, and statistically significant only for the former. The magnitude of the effect is such that in products under the "change of chapter (HS2)" requirement, the probability of using the FTA is 9.6 percentage points lower relative to products under the least restrictive requirement ("change of subheading (HS6)").[33]

Columns 2 and 3 split the sample into differentiated and nondifferentiated goods. The results show negative coefficients for the ("change of chapter (HS2)") requirement in both cases, but the coefficient is larger and statistically significant only among differentiated goods, such that products in that category

[32] Recall that a relatively smaller number of products face more complex rules of origin, for which it is difficult to assess their restrictiveness. This was discussed in Section 2.

[33] Appendix Table A.11 shows that these results are robust to alternative specifications, including replacing exporter–importer fixed effects by exporter fixed effects or replacing the measure of duty savings ($\log(\tau_p \times \text{X}_m)$) by dummies for tariff rates and (log) transaction value.

experience a 5.0 percentage points lower probability of using the FTA relative to the omitted category.[34] This is reasonable since nondifferentiated goods (such as agricultural or mineral commodities) do not require inputs in their production process, whereas differentiated goods (such as many manufactured products) do use inputs in the production process and thus might require a redesign of their supply chains to meet the rules of origin criteria.

Next, I examine whether rules of origin restrictiveness have a differential effect on FTA use based on firm size. In columns 4 and 5, I split the sample into above-median and below-median exporter size.[35] The results indicate that the negative impact of rules of origin restrictiveness is only seen for large exporters. In this group of large exporters, products under the most restrictive category ("change of chapter (HS2)") have a 16.2 percentage points lower probability of using the FTA relative to products under the least restrictive requirement ("change of subheading (HS6)"). The coefficients are close to zero and not statistically significant among small US exporters. The most likely interpretation of this result is that large exporters are more likely to be part of global supply chains, which might not meet rules of origin.[36] Recall that the results in Table 8 earlier showed that larger US exporters are more likely to use the FTA after controlling for duty savings. Combined with these results, the most plausible interpretation is that considering *all* the barriers to using an FTA (including administrative costs and adjustments to the supply chain to comply with rules of origin), these are easier to overcome for larger exporters, but that the part of the cost associated to rules of origin is more burdensome for larger firms.

Finally, column 6 allows for a different effect of rules of origin over time, by interacting each regressor in equation (7) with year dummy variables. The coefficients on the interaction terms with the "change of chapter (HS2)" variable are negative in all years, while the coefficients on the interactions with the "change of heading (HS4)" variable are closer to zero. Overall, there is no apparent pattern of an increasing or decreasing effect of the impact of rules of origin on FTA use over time.

4. Conclusions

This paper has provided the first analysis of the determinants of the use of a free trade agreement by US exporting firms. The analysis is based on the US-Colombia FTA implemented in 2012, and leverages novel data with two key features: FTA use at the transaction level and the identity of the US exporter

[34] This finding is consistent with the evidence in Appendix Figure A.3 , discussed in the data overview earlier.

[35] Above and below median exporter size are computed based on US exporters' total exports to Colombia in each year.

[36] It is a well-established fact in the literature has established that larger firms are more likely to import [Bernard et al., 2009].

Table 10: FTA use and rules of origin restrictiveness.

	(1)	(2)	(3)	(4)	(5)	(6)
				Large	Small	
	All	Differentiated	Nondifferentiated	Exporters	Exporters	All
1[Change of Chapter (HS2)]	-0.096**	-0.050*	-0.029	-0.162**	0.003	
	(0.049)	(0.027)	(0.069)	(0.075)	(0.011)	
1[Change of Heading (HS4)]	-0.005	-0.012	-0.007	-0.009	-0.004	
	(0.014)	(0.013)	(0.054)	(0.021)	(0.006)	
log(Tariff Rate × Value)	0.049***	0.047***	0.078***	0.060***	0.034***	
	(0.005)	(0.005)	(0.020)	(0.008)	(0.003)	
1[Change of Chapter (HS2)] × 1[year=2013]						-0.111**
						(0.044)
1[Change of Chapter (HS2)] × 1[year=2014]						-0.079
						(0.049)
1[Change of Chapter (HS2)] × 1[year=2015]						-0.119*
						(0.072)
1[Change of Chapter (HS2)] × 1[year=2016]						-0.060
						(0.039)
1[Change of Heading (HS4)] × 1[year=2013]						-0.003
						(0.017)
1[Change of Heading (HS4)] × 1[year=2014]						-0.007
						(0.016)
1[Change of Heading (HS4)] × year=2015]						0.013
						(0.016)
1[Change of Heading (HS4)] × 1[year=2016]						-0.029
						(0.019)
Exporter-Importer F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Year-Month F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Observations	223997	216739	5306	111887	111966	223997

Notes: This table reports the results of the estimation of equation (7). The dependent variable is a dummy variable equal to one if the FTA is used in a transaction and zero otherwise. The variable log(Tariff Rate × Value) is standardized to have mean zero and standard deviation one. Standard errors are clustered by HS10 product. ***, **, and * indicate statistical significance at the 1%, 5% and 10% level.

involved in each transaction. These data are complemented with detailed product-level data on tariff liberalization, MFN tariffs, and rules of origin.

Overall, FTA use is incomplete. Three years after the implementation of the FTA, among fully and immediately liberalized product categories, 43.6% of transactions and 74.2% of the value exported use the FTA. Further, only 40.0% of US exporters to Colombia and 44.3% of Colombian importers from the US have at least one transaction benefiting from the FTA.

I have analyzed the key determinants of FTA use guided by a simple conceptual framework, in which exporting firms use an FTA if the benefit in terms of duty savings is larger than the fixed cost of using it. The first empirical finding shows that larger duty savings indeed increase FTA use: transactions facing higher MFN rates, and transactions of higher value, are both more likely to use the FTA.

The next set of empirical findings provide insights on the fixed cost of using the FTA. First, controlling for duty savings (i.e. for the benefit of using the FTA), FTA use increases over time. This suggests that the fixed cost of using it falls as firms 'learn' how to use it. In addition, again controlling for duty savings, larger exporters are more likely to use the FTA, which suggests that larger firms have capabilities that reduce the fixed cost of using the FTA. Third, FTA use is more likely among exporters with more experience using the FTA in the past. This holds even regarding past use in different products, suggesting there is a firm–wide component, and not just a product–specific component of the fixed cost of using the FTA.

Finally, I have also examined the role of rules of origin, which the literature identifies as a key barrier to FTA use. Constructing a measure of the restrictiveness of rules of origin from the FTA's text, I have established that more restrictive rules of origin are associated to lower FTA use. This effect, intuitively, is driven by differentiated goods and by larger exporters, which are more likely to use imported inputs and would require a redesign in their supply chains to be able to use the FTA.

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A. Appendix

A.1. Definition of US exporter IDs

In the Colombian customs data, the information on foreign suppliers includes the firm name, address, city, and country. I construct an identifier for US exporters following Benguria [2021], who uses the approach used in US and Canadian customs data, among others. This consists in combining a substring of the foreign exporter's name, address and city.

The procedure is as follows:

- First, I remove common symbols (such as "+", "-", ".", ",", "(", "#", etc.)
- Second, I remove common prefixes or suffixes such as "inc" or "llc" among others.
- Third, I standardize commonly used terms (such as "Manufacturing", "International", etc.)
- Last, I construct the foreign supplier ID ("MID"). Quoting Kamal et al. [2015], this is defined as a string such that:

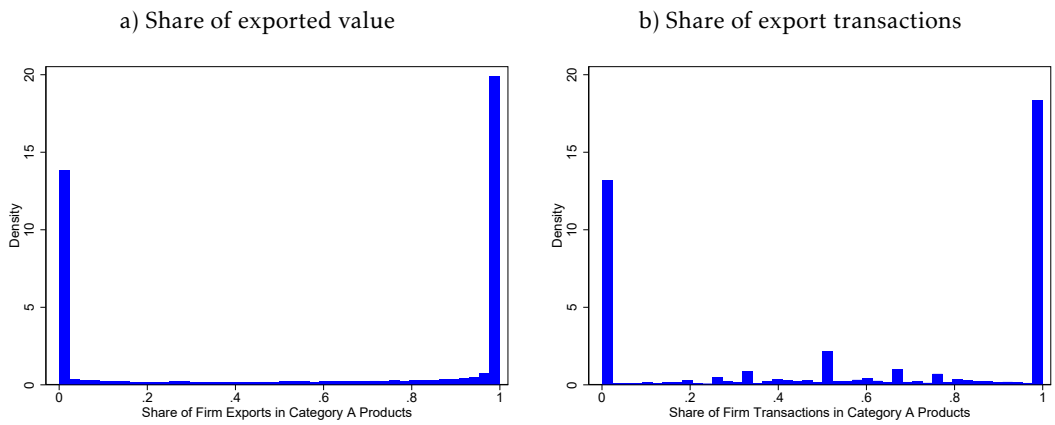
  "The first two characters of the MID must contain the two-digit International Organization for Standardization (ISO) country code of the supplier, the next three characters the start of the first word of the exporter's name, the next three characters the start of the second word, the next four characters the beginning of the largest number of the street address of the foreign exporter, and the last three characters the start of the foreign exporter's city. The MID has a maximum length of 15 characters."

A.2. Extensions and Robustness Checks

A.2.1 Firm specialization in category A products

The following histograms show that almost all firms that export category A products do not export products in other categories. Similarly, almost all firms that export products in other categories do not export category A products.

Figure A.1: Firm specialization in category A products.



Notes: Panel a) is an histogram of the share of a firm's exports associated to category A products. Panel b) is an histogram of the share of a firm's transactions associated to category A products. Both panels use data for 2013.

A.2.2 Descriptive statistics: other product categories

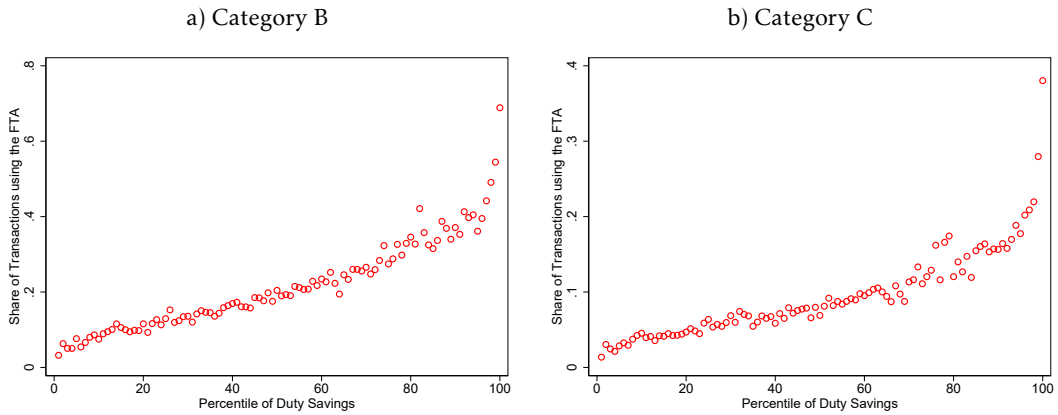
In this section I document that basic patterns in the data found for category A products in the main text are also valid for category B and category C products, which were gradually liberalized.

Table A.1: FTA use by year and product category.

	Category B		Category C	
	2013	2016	2013	2016
Share of transactions	13.2%	32.7%	3.1%	19.1%
Share of value	24.9%	75.4%	2.6%	37.5%
Share of exporters	11.4%	34.5%	4.3%	21.9%
Share of importers	14.8%	41.3%	5.6%	28.2%

Notes: This table reports the share of transactions, share of value, share of exporters and share of importers using the FTA by year (for 2013 and 2016) for category B and category C products. An exporter or importer is considered to use the FTA in one of these categories if it uses the FTA in at least one transaction.

Figure A.2: FTA use by percentiles of duty savings.

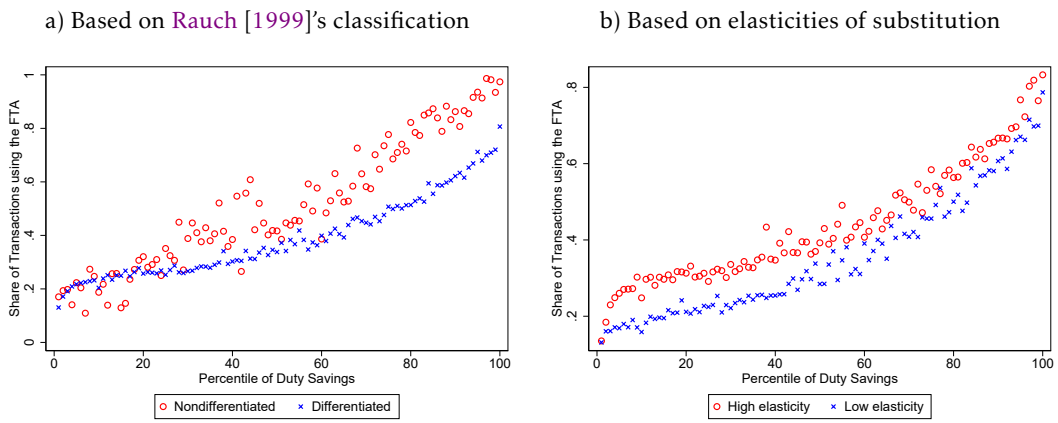


Notes: This figure shows the share of transactions using the FTA for each percentile of the tariff differential (MFN tariff rate minus FTA tariff rate) times the transaction value (i.e. the amount of duties paid if the FTA is not used) for category B and category C products.

A.2.3 Duty savings, FTA use and product differentiation

Appendix Figure A.3 shows that controlling for duty savings, transactions of differentiated products are less likely to use the FTA than transactions of nondifferentiated products. The figure bins transactions into percentiles by duty savings. For each percentile, it computes the share of transactions using the FTA separately for differentiated and nondifferentiated goods. In panel a), differentiated and nondifferentiated goods are distinguished using Rauch [1999]'s classification. In panel b), differentiated and nondifferentiated goods are those with below– or above–median elasticities of substitution respectively. Given the conceptual framework discussed in Section 3, the fact that differentiated goods are less likely to use the FTA controlling for duty savings could be interpreted as meaning that differentiated goods face a higher fixed cost of using the FTA. This is consistent with the notion that differentiated goods are more likely to require imported inputs and rely on complex supply chains. This is also consistent with the findings in Table 10 showing that rules of origin restrictivenss has a larger negative impact on FTA use among differentiated goods.

Figure A.3: FTA use by percentiles of duty savings and by product differentiation.



Notes: This figure shows the share of transactions using the FTA for each percentile of the MFN tariff rate times the transaction value (i.e. the amount of duties paid if the FTA is not used) separately for nondifferentiated and differentiated products. Panel a) is based on Rauch [1999]'s classification. Panel b) distinguishes between products with above–median and below–median elasticity of substitution. Elasticities of substitution are obtained from Soderbery [2018].

A.2.4 Duty savings and FTA use: alternative clustering

In Appendix Table A.2 I revisit the results in Table 6 in the main text, showing that FTA use depends positively on duty savings. I show that these results are robust to alternative choices for clustering standard errors, including clustering by exporting firm, by exporting firm and HS10 product (using multiway clustering), and by exporter–importer pair and HS10 product (also using multiway clustering).

Table A.2: FTA use and duty savings: alternative clustering.

	(1)	(2)	(3)	(4)
log(Tariff Rate × Value)	0.054***	0.054***	0.054***	0.054***
	(0.004)	(0.010)	(0.010)	(0.010)
Exporter F.E.	Yes	Yes	Yes	Yes
Year-Month F.E.	Yes	Yes	Yes	Yes
Observations	328697	328697	328697	328697

Notes: This table reports the results of the estimation of equation (1). The dependent variable is a dummy variable equal to one if the FTA is used in a transaction and zero otherwise. The variable log(Tariff Rate × Value) is standardized to have mean zero and standard deviation one. Standard errors are clustered by HS10 product in column 1 (which is equivalent to column 1 in Table 6), by exporting firm in column 2, by exporter and HS10 product using multiway clustering in column 3, and by exporter-importer pair and product using multiway clustering in column 4 . ***, **, and * indicate statistical significance at the 1%, 5% and 10% level.

A.2.5 Duty savings and FTA use: alternative fixed effects

In Appendix Table A.3 I revisit the results in Table 6 in the main text, showing that FTA use depends positively on duty savings. I show that these results are robust to including product fixed effects at the HS4, HS6 and HS10 level (in columns 2, 3 and 4 respectively). Note that column 1 is equivalent to column 1 in Table 6. Note also that the with HS10 fixed effects in column 4 the effect of duty savings in FTA use is identified only based on variation in transaction value within HS10 products, as variation in tariff rates is absorbed entirely by the fixed effects.

Table A.3: FTA use and duty savings: alternative fixed effects.

	(1)	(2)	(3)	(4)
log(Tariff Rate × Value)	0.054***	0.048***	0.049***	0.047***
	(0.004)	(0.004)	(0.004)	(0.004)
Exporter F.E.	Yes	Yes	Yes	Yes
HS4 F.E.	No	Yes	No	No
HS6 F.E.	No	No	Yes	No
HS10 F.E.	No	No	No	Yes
Year-Month F.E.	Yes	Yes	Yes	Yes
Observations	328697	328625	328410	328345

Notes: This table reports the results of the estimation of equation (1). The dependent variable is a dummy variable equal to one if the FTA is used in a transaction and zero otherwise. The variable log(Tariff Rate × Value) is standardized to have mean zero and standard deviation one. Standard errors are clustered by HS10 product. ***, **, and * indicate statistical significance at the 1%, 5% and 10% level.

A.2.6 Duty savings and FTA use: other product categories

The baseline sample used in the main text considers products in category A, which are liberalized fully and immediately. In this section I show that the result in Table 6 indicating that FTA use depends positively on duty savings is also valid for product categories B and C, which are liberalized gradually over time. Recall that category B products are duty free after 5 years, while category C products are duty free after 10 years. In this case, the duty savings are equal to the transaction value times the difference between the MFN tariff and the tariff paid when using the FTA. Recall that for category A products considered in the main text (eq. (2)) the tariff paid when using the FTA is zero, so this difference is equal simply to the MFN tariff. I estimate the following regression, which is otherwise identical to equation (2) in the main text.

$$\text{FTA}_m = \eta_e + \delta_t + \beta_1 \cdot \log(\Delta\tau_p) + \beta_2 \cdot \log(X_m) + \epsilon_m \tag{A.1}$$

Table A.4: FTA use and duty savings among other liberalization categories.

	(1)	(2)	(3)	(4)	(5)	(6)
	Category B		Category C		Categories A+B+C	
Log(Δ Tariff Rate)	0.080***	0.078***	0.088***	0.088***	0.100***	0.098***
	(0.009)	(0.009)	(0.007)	(0.007)	(0.005)	(0.005)
log(Value)	0.032***	0.029***	0.013***	0.012***	0.038***	0.035***
	(0.008)	(0.008)	(0.002)	(0.003)	(0.003)	(0.003)
Exporter F.E.	Yes	No	Yes	No	Yes	No
Exporter-Importer F.E.	No	Yes	No	Yes	No	Yes
Year-Month F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Observations	119436	117755	277247	273033	733469	725779

Notes: This table reports the results of the estimation of equation (A.1). The dependent variable is a dummy variable equal to one if the FTA is used in a transaction and zero otherwise. The variables log(Δ Tariff Rate) and log(Value) are standardized to have mean zero and standard deviation one. Standard errors are clustered by HS10 product. ***, **, and * indicate statistical significance at the 1%, 5% and 10% level.

A.2.7 FTA use and duty savings: firm–level regression

In the main text I estimate a transaction–level regression showing that duty savings are associated to a higher probability of FTA use (see Table 6). In this section, I complement that evidence with a more aggregate firm-level regression.

In equation (A.2) below, each observation corresponds to a firm–year pair. The dependent variable is the share of value exported by a firm in a given year using the FTA. The regressor Duty Savings$_{ft}$ is the sum of duty savings across all of the firm's transactions in a given year, defined as Duty Savings$_{et}$ = $\sum_{m \in et} \tau_p \cdot X_m$.

$$\text{Share FTA}_{et} = \beta_1 \cdot \log(\text{Duty Savings}_{et}) + \delta_t + \epsilon_{et} \tag{A.2}$$

The results are shown in column 1 in Appendix Table A.5. Similarly to the findings in the main text, larger duty savings are associated with higher FTA use. I also estimate a similar regression in which each observation corresponds to an exporting firm. The dependent variable and the regressor are the same as above but computed pooling all years.

$$\text{Share FTA}_{e} = \beta_1 \cdot \log(\text{Duty Savings}_{e}) + \epsilon_{e} \tag{A.3}$$

The results, in column 2 in Appendix Table A.5, are very similar to those in column 1.

Table A.5: FTA use and duty savings: firm–level regression.

	(1)	(2)
Duty Savings	0.029***	0.027***
	(0.001)	(0.001)
Year FE	Yes	No
Observations	67623	41194

Notes: Column 1 reports the results of the estimation of equation (A.2). Column 2 reports the results of the estimation of equation (A.3). In both cases the regressor is standardized to have mean zero and standard deviation one. Standard errors are clustered by HS10 product exporter. ***, **, and * indicate statistical significance at the 1%, 5% and 10% level.

A.2.8 FTA use and duty savings: equality of coefficients in equation (2)

Columns 1 and 2 in Appendix Table A.6 are equivalent to columns 3 and 4 in Table 6 but displaying coefficients which are not standardized. A Wald test cannot reject the null hypothesis that the coefficients on log(Value) and log(Tariff rate) are statistically equal (the F–statistic is 0.21 and the p–value is 0.65 based on the coefficients in column 2). This is consistent with the conceptual framework discussed in the main text.

Table A.6: FTA use and duty savings.

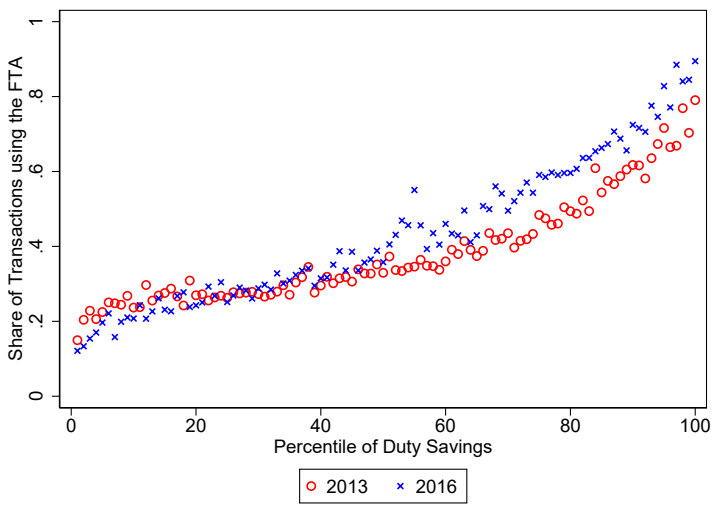
	(1)	(2)
log(Value)	0.025***	0.023***
	(0.002)	(0.002)
log(Tariff Rate)	0.029*	0.031*
	(0.016)	(0.017)
Exporter F.E.	Yes	No
Exporter-Importer F.E.	No	Yes
Year-Month F.E.	Yes	Yes
Observations	328697	323789

Notes: Columns 1 and 2 report the results of the estimation of equation (2). The dependent variable is a dummy variable equal to one if the FTA is used in a transaction and zero otherwise. Standard errors are clustered by HS10 product. ***, **, and * indicate statistical significance at the 1%, 5% and 10% level.

A.2.9 FTA use by percentiles of duty savings and year

Appendix Figure A.4 shows that controlling for duty savings, transactions in 2016 are more likely to use the FTA than transactions in 2013. The figure bins transactions into percentiles by duty savings. For each percentile, it computes the share of transactions using the FTA separately for 2013 and 2016. Given the conceptual framework discussed in Section 3, the fact that 2016 transactions are more likely to use the FTA relative to 2013 transactions controlling for duty savings could be interpreted as meaning that the fixed cost of using the FTA has fallen over time.

Figure A.4: FTA use by percentiles of duty savings and year.



Notes: This figure shows the share of transactions using the FTA for each percentile of the MFN tariff rate times the transaction value (i.e. the amount of duties paid if the FTA is not used) separately for 2013 and 2016.

A.2.10 FTA use over time after controlling for duty savings: robustness

In Appendix Table A.7 I show that the results in Table 8 in the main text are robust to adding product fixed effects at the HS10 level. Note that in this case, instead of controlling for (log) duty savings (equal to the MFN tariff rate times the transaction value), it is sufficient to include (log) transaction value to control for duty savings, given that variation in tariff rates is absorbed by the HS10 fixed effects.

Table A.7: FTA use over time after controlling for duty savings.

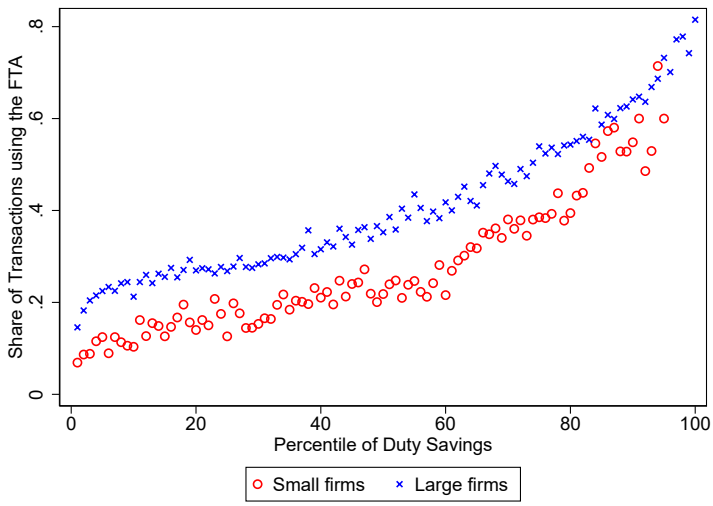
	(1)	(2)
log(Value)	0.041***	0.041***
	(0.004)	(0.004)
1[year=2014]	0.022***	0.024***
	(0.005)	(0.005)
1[year=2015]	0.021**	0.025***
	(0.008)	(0.008)
1[year=2016]	0.037***	0.042***
	(0.009)	(0.009)
HS10 F.E.	Yes	Yes
Exporter-Importer F.E.	Yes	Yes
Month F.E.	No	Yes
Observations	323440	323440

Notes: This table reports the results of the estimation of equation (4). The dependent variable is a dummy variable equal to one if the FTA is used in a transaction and zero otherwise. The variable log(Value) is standardized to have mean zero and standard deviation one. Standard errors are clustered by HS10 product. ***, **, and * indicate statistical significance at the 1%, 5% and 10% level.

A.2.11 FTA use by percentiles of duty savings and firm size

Appendix Figure A.5 shows that controlling for duty savings, transactions of larger firms are more likely to use the FTA than transactions of smaller firms. The figure bins transactions into percentiles by duty savings. For each percentile, it computes the share of transactions using the FTA separately for large and small exporters. Large exporters are those with above–median exports to the US in a given year. Given the conceptual framework discussed in Section 3, the fact that larger firms are more likely to use the FTA controlling for duty savings could be interpreted as meaning that larger firms face a lower fixed cost of using the FTA.

Figure A.5: FTA use by percentiles of duty savings and by firm size.



Notes: This figure shows the share of transactions using the FTA for each percentile of the MFN tariff rate times the transaction value (i.e. the amount of duties paid if the FTA is not used) separately for below–median ("small") and above–median ("large") firms.

A.2.12 FTA use and firm size after controlling for duty savings: robustness

In Appendix Table A.8 I show that the results in Table 7 in the main text are robust to adding product fixed effects at the HS10 level. Note that in this case, instead of controlling for (log) duty savings (equal to the MFN tariff rate times the transaction value), it is sufficient to include (log) transaction value to control for duty savings, given that tariff rates are absorbed by the HS10 fixed effects.

Table A.8: FTA use and firm size after controlling for duty savings.

	(1)	(2)
log(Value)	0.051***	0.053***
	(0.005)	(0.005)
log(Exporter Size)	0.038***	
	(0.003)	
1[Large Exporter]		0.016**
		(0.007)
HS10 F.E.	Yes	Yes
Importer F.E.	Yes	Yes
Year-Month F.E.	Yes	Yes
Observations	334534	334534

Notes: This table reports the results of the estimation of equation (5). The dependent variable is a dummy variable equal to one if the FTA is used in a transaction and zero otherwise. The variables log(Exporter Size) and log(Value) are standardized to have mean zero and standard deviation one. Standard errors are clustered by HS10 product. ***, **, and * indicate statistical significance at the 1%, 5% and 10% level.

A.2.13 FTA use and importing firm size after controlling for duty savings

Appendix Table A.9 examines whether controlling for duty savings, FTA use is associated to the size of the importing firm. I estimate the following regression, which is equivalent to equation (5) in the main text used to analyze the effect of exporter size:

$$\text{FTA}_m = \eta_e + \delta_t + \beta_1 \cdot \text{Importer Size}_{it} + \beta_2 \cdot \log(\tau_p \times \text{X}_m) + \epsilon_m \tag{A.4}$$

Note that the exporter fixed effects imply that the identification is based on variation across importers selling to a same exporting firm. I measure the size of each Colombian importer as total imports from the US in the year in which the transaction occurs.[37] To alleviate endogeneity concerns, in column 2 I replace the continuous measure of importer size by a dummy variable equal to one for firms with above–median size. In both columns, I find that FTA use is not associated to importer size.

[37] Using world imports instead of US imports to measure the size of Colombian importers, I find very similar results.

Table A.9: FTA use and importing firm size after controlling for duty savings.

	(1)	(2)
log(Tariff Rate × Value)	0.065***	0.065***
	(0.004)	(0.004)
log(Importer Size)	-0.002	
	(0.011)	
1[Large Importer]		-0.022
		(0.015)
Exporter F.E.	Yes	Yes
Year-Month F.E.	Yes	Yes
Observations	334871	334871

Notes: This table reports the results of the estimation of equation (A.4). The dependent variable is a dummy variable equal to one if the FTA is used in a transaction and zero otherwise. The variables log(Importer Size) and log(Tariff Rate × Value) are standardized to have mean zero and standard deviation one. Standard errors are clustered by HS10 product. ***, **, and * indicate statistical significance at the 1%, 5% and 10% level.

A.2.14 FTA use and past experience using the FTA after controlling for duty savings: robustness

In Appendix Table A.10 I show that the results in Table 9 in the main text are robust to adding product fixed effects at the HS10 level. Note that in this case, instead of controlling for (log) duty savings (equal to the MFN tariff rate times the transaction value), it is sufficient to include (log) transaction value to control for duty savings, given that tariff rates are absorbed by the HS10 fixed effects. In column 1 the measure of past FTA use counts the exporting firm's number of past transactions using the FTA. In column 2 the measure of past FTA use counts the exporting firm's number of past transactions using the FTA in HS10 products different than the current transaction.

Table A.10: FTA use and past experience using the FTA after controlling for duty savings.

	(1)	(2)
log(Value)	0.089***	0.087***
	(0.008)	(0.008)
Past FTA Use	0.055***	0.069***
	(0.010)	(0.023)
Control for Exporter Size.	Yes	Yes
HS10 F.E.	Yes	Yes
Year–Month F.E.	Yes	Yes
Observations	337629	337629

Notes: This table reports the results of the estimation of equation (6).
The dependent variable is a dummy variable equal to one if the FTA is used in a transaction and zero otherwise. In column 1, the variable Past FTA Use counts the previous transactions using the FTA in any product, while in column 2 this is restricted to FTA use in different products. The variables Past FTA Use and log(Value) are standardized to have mean zero and standard deviation one. Standard errors are clustered by HS10 product. ***, **, and * indicate statistical significance at the 1%, 5% and 10% level.

A.2.15 FTA use and rules of origin restrictiveness

In this section I show that the results in column 1 in Table 10 are robust to alternative specifications. In column 1, I replace the exporter–importer pair fixed effects by exporter fixed effects. In columns 2 and 3 I estimate the following equation in which instead of controlling for duty savings (log(Tariff Rate × Value)) I include log(Value) and dummy variables for tariff rates (such that the tariff rate of 5% is the omitted category).

$$FTA_m = \eta_{ei} + \delta_t + \beta_1 \cdot \text{Change of Chapter}_p + \beta_2 \cdot \text{Change of Heading}_p + \\ \gamma_1 \cdot 1[\tau_p = 10] + \gamma_2 \cdot 1[\tau_p = 15] + \gamma_3 \cdot \log(X_m) + \epsilon_m \tag{A.5}$$

Column 2 includes exporter fixed effects, while column 3 includes exporter–importer fixed effects.

Table A.11: FTA use and rules of origin restrictiveness: robustness.

	(1)	(2)	(3)
1[Change of Chapter (HS2)]	-0.091**	-0.091**	-0.096**
	(0.046)	(0.046)	(0.049)
1[Change of Heading (HS4)]	-0.005	-0.005	-0.005
	(0.014)	(0.014)	(0.014)
log(Tariff Rate × Value)	0.054***		
	(0.005)		
1[Tariff Rate = 10]		0.010	0.016
		(0.029)	(0.030)
1[Tariff Rate = 15]		0.100**	0.098**
		(0.039)	(0.041)
log(Value)		0.052***	0.048***
		(0.005)	(0.005)
Exporter F.E.	Yes	Yes	No
Exporter–Importer F.E.	No	No	Yes
Year-Month F.E.	Yes	Yes	Yes
Observations	223997	223997	223997

Notes: This table reports the results of the estimation of equation (7). The dependent variable is a dummy variable equal to one if the FTA is used in a transaction and zero otherwise. The variables log(Tariff Rate × Value) and log(Value) are standardized to have mean zero and standard deviation one. Standard errors are clustered by HS10 product. ***, **, and * indicate statistical significance at the 1%, 5% and 10% level.