Entering the Major Leagues: The Effect of Import Competition from the United States on Workers and Firms in an Emerging Economy

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Abstract

Though abundant evidence shows that import competition from low-wage countries decreases manufacturing employment and wages of high-wage countries, less is known about the reverse: the impact of import competition from high-wage countries on emerging economies. This paper uses a natural experiment to examine the effects of import competition from the United States on workers and firms in Colombia. We exploit industry variation in import exposure and regional variation in import access in the wake of a free trade agreement that increased import competition in Colombia but left its exports unaffected. Using administrative employer-employee data to identify proxies for productivity and skills, we find that a 10 percent increase in import competition from the United States decreases employment in Colombia by 6.4 percent in affected industries and states. The impacts are driven largely by the exit and shrinking of less-productive firms. Less-skilled workers experience the greatest impacts, with effects on employment lasting for at least four years. Import competition induces workers to shift from affected to unaffected industries and states, and decreases the wage of workers employed in less-productive firms.

JEL Classification: J21, J30, F14, O15
Keywords: Free-trade Agreements, Import Shocks, Employment, Wages, Firms, Reallocation

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1. Introduction

Emerging economies are plagued by a glut of persistently low-productivity firms, which can decrease total factor productivity up to 60 percent compared to developed countries (Busso, Madrigal, and Pagés, 2013; Hsieh and Klenow, 2009, 2014). A less dynamic exit of firms can therefore affect economic development and explain cross-country differences in employment growth (Eslava, Haltiwanger, Kugler, and Kugler, 2004; Eslava, Haltiwanger, and Pinzón, 2019). Lack of market competition may induce slow firm exit, and enable less productive firms to coexist with more productive ones. Trade barriers and protectionist policies in emerging countries, for instance, are one way in which competition is hindered, benefiting unproductive firms and reducing productivity and employment (Eslava, Haltiwanger, Kugler, and Kugler, 2013). Import competition from low-wage countries such as China has also been shown to reduce manufacturing employment and wages in low- and high-wage countries.[1] However, it is still not clear if import competition from high-wage countries induces firm exit and employment growth within emerging economies.

Estimating the effects of increased competition on firms and workers in emerging economies has proved challenging, especially because of difficulties in separating the effects of imports from the effects of exports. Trade is widely believed to increase competition and induce firm exit (Melitz, 2003; Melitz and Ottaviano, 2008), usually by highlighting the positive effects of exports, but the role of imports is ambiguous. Several developing countries have adopted measures to increase trade with developed countries in an effort to increase productivity and employment. Multiple free trade agreements have been signed between emerging countries and the United States to induce a more dynamic trade. At the same time, tensions over free trade between countries of differing economic development levels have emerged, as evidenced by the U.S.-China tariff wars beginning in 2018.

[1] For effects among high-income countries, see Autor, Dorn, and Hanson (2013), Autor, Dorn, Hanson, and Song (2014), Bloom, Handley, Kurman, and Luck (2019) ,Bernard, Jensen, and Schott (2006) and Pierce and Schott (2016). For the effects among low-income countries, see Dix-Carneiro and Kovak (2017), Jenkins, Peters, and Moreira (2008), Moreira (2007).

In this paper, we analyze how an increase in import competition from the United States affects the distribution of firms and employment in Colombia. As opposed to previous work (such as Autor et al. (2013)), we focus on a setting in which import competition from a high-wage country affects the local labor market effects of a lower-wage country, and use a novel identification strategy. To the best of our knowledge we are the first to analyze the effect of imports from a developed country on an emerging economy. Previous literature has struggled to analyze such a phenomenon due to: 1) empirical difficulties in the identification of an import competition shock that does not affect exports; and 2) data restrictions that do not allow longitudinal tracking of firms and workers. This paper overcomes these two difficulties.

First, we use exogenous variation induced by a free trade agreement implemented between the United States and Colombia, and regional variation in access to imports, to evaluate the effects of U.S. import competition. The agreement, which took effect in 2010, affected imports but not exports. Tariffs charged by Colombia fell, but tariffs imposed by the United States were unaffected because they were already low (or zero) due to previous trade agreements.[2] We combine the variation induced by the free trade agreement at the industry level with state variation across states with and without customs ports. Transportation within Colombia, which lacks train and river transportation options, relies on an underdeveloped road system to trade across states. Political neglect and civil conflict hindered historical construction of roads within the country (Bushnell, 1993; Duranton, 2015), and, as a result, 90 percent of incoming products from the United States stay within eight states that have customs ports. We design a triple-difference model by combining variation across industries that reduced tariffs, variation between states with and without customs ports, and time variation before and after the implementation of the free trade agreement. We find that the agreement increases import competition from the United States in around 15 to 18 percent, but, as expected, does not affect exports. We additionally show that imports increase exclusively among states with customs ports, which gives strong empirical support to our triple-difference estimates.

[2]The free trade agreement mainly reduced Colombian tariffs on manufacturing and service goods. It left in place protections for certain agriculture products for longer periods of time, with protections lasting five years for most products, but continuing for up to 20 years for some products, such as rice.

Second, we take advantage of administrative matched, formal-sector employer-employee data that allow us to identify which firms employ which workers, for what extent of time, and at what wage level.[3] These data include longitudinal earnings records for all workers that contribute to health or pensions in a given month. The data include firm, municipality, and four-digit industry identifiers, and are ideal to study the effects of import competition from the United States on workers and firms in Colombia. We further combine these records with administrative trade data on Colombian imports and exports at the industry and state levels, and with information on tariffs charged by Colombia and the United States. Our final data track individuals and firms from 2008 to 2014 (four years after the tariff reductions in 2010), and are merged with four-digit industry- and state-level imports and exports.

The data allow us to study the role of employers and employees by estimating high-dimensional worker and firm-fixed effects models, and identifying low- and high-paid workers and low- and high-paying firms. We follow Abowd, Kramarz, and Margolis (1999) (here onward called AKM) –and further Card, Cardoso, Heining, and Kline (2018) and Card, Heining, and Kline (2013)– to estimate the *ex-ante* distribution of worker- and firm-specific wage premiums using the years previous to the tariff reduction. The firm-specific wage premiums quantify the amount each employer pays to their workers irrespective of the type of workers hired. This wage premium can be interpreted as a combination of firm-specific productivity and rent-sharing elasticities (Card, Cardoso, Heining, and Kline, 2018). We consider it to be a good proxy for firm productivity since these two measures strongly correlate (Alvarez, Benguria, Engbom, and Moser, 2018; Card, Cardoso, Heining, and Kline, 2018). The worker-specific wage premium quantifies the amount earned by a given worker irrespective of where he/she works. We interpret this as a measure of worker skill. From here onward we refer

[3]The data, accessed through the Colombian central bank, extend through 2016. However, due to confounding reasons involving currency devaluations and oil prices (explained in greater detail in Section 3.1), we exclude data from 2015 and 2016 in our main analysis. We note, however, that results are unchanged when we do include these data. In addition, we cannot distinguish if the flows out of the firms go to informality or unemployment since the data only include formal workers. We observe steady (or even decreasing) informality rates for agriculture, manufacturing, mining, and services during the analyzed period (2007-2014). Thus, we do not have strong evidence to suspect that our results are driven by informality, and even if this were the case, we still consider the results to reflect interesting dynamics across good-quality jobs.

to the firm-specific wage premium as productivity, and the worker-specific wage premium as skill. To the best of our knowledge we are the first to estimate the heterogeneous effects of import competition on wage premiums across the distribution of specific firms and workers.

Our empirical analysis yields three main results. First, we find that a 10 percent increase in import competition from the United States decreases Colombian employment in around six percent, a magnitude that is similar to that of Chinese imports on employment in the United States (Autor, Dorn, and Hanson, 2013). We additionally find that the decrease in employment is explained by a decrease in both extensive margin (the number of firms) and intensive margin (the average firm size). These results are driven by low-skilled workers who are more likely to lose their jobs, whereas more skilled workers remain unaffected.

Second, the decrease in employment is explained by low-productivity firms, which are more likely to shrink or exit the market. We do not observe any effect on high-productivity firms, suggesting that missing production from low-productivity firms is not reallocated to more-productive firms within Colombia. Instead, consumers likely substitute to imports from the United States. These results contrast to that of Chinese imports on firms in the United States, where losses in employment were mainly driven by high-wage multinational firms (Bloom, Handley, Kurman, and Luck, 2019).

Third, we do not find an effect of import competition on wages, but we do find evidence that import competition induces reallocation of workers from affected to unaffected industries or states (i.e., from industries that reduced tariffs, and from states with customs ports, to industries that did not reduce tariffs, and to states without customs ports). However, for workers originally employed in low-productivity firms (that were most likely to close or shrink), exclusively, we observe a wage reduction of around 0.75 percent. We interpret this as workers in affected industries and states shifting into other positions, and moving down the job ladder by accepting lower-paid offers after a job loss. (Haltiwanger, Hyatt, Kahn, and McEntarfer, 2017).

We address two potential threats to identification that could undermine our results. First, firm- and worker-level regressions would be subject to selection bias if the sample were not constant in time, and some particular types of workers or firms could be more likely to lose their jobs, or to exit the market. To deal with this we follow Autor, Dorn, Hanson, and Song (2014) and restrict the sample to a panel of incumbent workers and firms. We track them over time by keeping the sample constant. Second, our empirical strategy relies on the assumption of no differential trends between treated (workers and firms in industries that reduced tariffs, and in states with customs ports) an untreated (all the rest) units before the tariff reduction. We estimate event study models around the implementation of the free trade agreement using imports, employment, number of firms, and firm size as dependent variables. We do not find evidence of any pre-trends for any of these outcomes

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In addition, we conduct a large number of robustness checks that highlight the stability of our results. The estimates include a considerable amount of fixed effects, and the main results may change depending on the specification chosen. We show, however, that our results do not change when considering alternative structures of fixed effects, or when using a difference-in-difference model that accounts only for the changes in tariffs, and excludes variation across states with and without customs ports. We also control for the value of imported inputs, which, if omitted, could confound our estimations; our results are robust to this. Finally, we include the mining sector and two additional years in the sample.[4] The results again remain unchanged.

This paper contributes to a large literature quantifying the effects of import competition on local labor markets. Most of this literature has focused on the effect of low-price imports from China (an emerging economy) on industries in high-income countries, such as the United States or countries within Europe.[5] Other analysis that does focus on the effect of Chinese

[4]The mining sector is excluded because of confounding issues with oil prices, whereas the years 2015 and 2016 are excluded because of a great devaluation of the Colombian peso.

[5]The effect on the United States see: Autor, Dorn, and Hanson (2013), Autor, Dorn, and Hanson (2015), Pierce and Schott (2016), Autor, Dorn, Hanson, and Song (2014), Feenstra and Hanson (1999), Bloom, Handley, Kurman, and Luck (2019), Bernard, Jensen, and Schott (2006).For the effect on Europe, see: Bloom, Draca, and Van Reenen (2016), Branstetter, Kovak, Mauro, and Venancio (2019), Hummels, Jørgensen, Munch, and Xiang (2014)

imports on emerging economies are largely descriptive, and they do not provide any causal estimates (Jenkins, Peters, and Moreira, 2008; Moreira, 2007; Wood and Mayer, 2011). In addition, Dix-Carneiro and Kovak (2017), Dix-Carneiro (2014), and Attanasio, Goldberg, and Pavcnik (2004) study how unilateral liberalization decreases employment and earnings in Brazil and Colombia. However, these papers explore incoming import competition from all types of countries including, for example, China. We contribute directly to this literature in two ways. First, we analyze patterns by low- and high-productivity firms and low- and high-skilled workers using the wage premiums estimated from the AKM model. Second, we analyze the effect of imports coming from the United States, and complement the results by understanding the importance of firm exit.

We also contribute to the literature that studies the effects of trade on firm productivity and exit. Melitz (2003) and Melitz and Ottaviano (2008) show theoretically that an increase in trade increases the productivity of firms by motivating low-productivity firms to exit the market and high-productivity firms to export. Furthermore, Pavcnik (2002), Forlani (2017), Halpern, Koren, and Szeidl (2015), and Olper, Curzi, and Raimondi (2017) empirically evaluate this result finding strong evidence for Chilean, Irish, Hungarian, Italian, and French firms. Fieler, Eslava, and Xu (2018), Medina (2018), and Bas and Strauss-Kahn (2015) additionally find that an increase in trade motivates quality upgrading, whereas Egger and Kreickemeier (2009) theoretically analyze the effect of trade on profits and unemployment. Goldberg, Khandelwal, Pavcnik, and Topalova (2010) analyze the effects of imported intermediate inputs on firms' production. Our results contribute to this literature by showing how imports from the United States motivate firm exit and shrinkage in emerging countries, where the dispersion of firm productivity is larger (Hsieh and Klenow, 2009) compared to developed countries where unproductive firms exit faster (Eslava, Haltiwanger, and Pinzón, 2019).

Finally, we contribute to the literature that explains the importance of firm heterogeneity by estimating employer- and worker-specific fixed effects. This literature (Abowd, McKinney, and Zhao, 2018; Card, Cardoso, Heining, and Kline, 2018; Card, Heining, and Kline, 2013) studies the relevance of employers on determining wages and how sorting between firms explain wage variation.[6] We contribute to this literature by estimating heterogeneous effects of import competition along the distribution of firm- and worker-specific wage premiums. We find that the responses to import competition are heterogeneous across firms with different wage structures, and workers earning different wages. Ignoring this heterogeneity can have negative policy implications because of potential erroneous conclusions about who is really affected by import competition.

The rest of the paper is organized as follows: Section 2 presents some conceptual considerations relating the heterogeneous effects of increased import competition and its relationship with the AKM model. Section 3 describes the background as well as the data we use. Section 4 details the empirical strategy that identifies the casual effect of import competition from the United States on workers' and firms' outcomes. Section 5 presents the results. Section 6 provides some robustness checks. Section 7 concludes.

2. Conceptual Framework

Melitz (2003) shows how trade induces high-productivity firms to export, and, simultaneously, forces low-productivity firms to exit the market. We analyze a setting in which tariffs were reduced in one country (Colombia) and not in the other (United States), leading to an increase in import competition but not in exports. Applying the predictions of Melitz (2003) to our setting, we expect import competition to heterogeneously affect low-and high-productivity firms and low- and high-skilled workers. We present a basic framework here (for a more detailed version, see Appendix A).

[6]Some recent papers have highlighted the importance of firm-wage premiums on economic phenomena like the effects of job displacement (Lachowska, Mas, and Woodbury, 2018) and the gender pay gap (Card, Cardoso, and Kline, 2016)

2.1. The Heterogeneous Effects of Increased Import Competition

Consider a continuum of J firms indexed by j that combine labor (L) and capital goods (X) to produce output Y. Labor can be either skilled (L_S) or unskilled (L_U), whereas capital can be foreign (X_F) or national (X_N). Each firm is indexed by a level of productivity φ_j that is randomly drawn from a distribution G. The production function takes the form of:

$$Y_j = \varphi_j f\left(L(L_S, L_U), X(X_F, X_N)\right),$$

where $f(\cdot)$ is a production function with usual properties. $\pi_j(\varphi) = \varphi_j P_j(\tau) Y_j - c_j(\tau)$ stands for the firms' profits, where $c_j(\tau)$ is a cost function of firm j, $P_j(\tau)$ is the price of goods, and τ is an ad valorem tariff rate charged to foreign products. Firms have market power and act as monosopnies in a monopolistic competition framework.

Denote $\varphi^* = \inf\{\varphi : \pi(\varphi) \geq 0\}$ as the threshold that determines firm exit. Any firm with $\varphi < \varphi^*$ will exit the market, and any firm with $\varphi \geq \varphi^*$ will stay. Formally, we can express this as:

$$\varphi^* = \frac{c_j(\tau)}{P_j(\tau) Y_j}.$$

The threshold φ^* depends on the tariffs charged to foreign products in two ways: 1) a decrease in τ decreases φ^* by decreasing the cost of inputs; 2) a decrease in τ increases φ^* by reducing the demand for local goods and, consequently, decreasing the price $P_j(\tau)$. This framework suggests that a decrease in Colombian tariffs will induce low-productivity firms to exit the market if the decrease in demand for local goods is larger than the decrease in costs. It is then expected that import competition affects the likelihood of exiting of low- and high-productivity firms differently.

In addition, the effects of decreasing τ on employment are also heterogeneous between skilled and unskilled workers. In this setting, workers can lose employment in two ways.

First, if import competition induces the exit of low-productivity firms, then we will expect that workers in those firms switch to unemployment, move to other firms, or leave the labor force. If firms' productivity is correlated with workers' skills, then the effect of import competition on employment should be heterogeneous by low- and high-skilled workers. Second, skilled and unskilled employment can be also affected heterogeneously if there is a differential substitution between each type of labor and imported goods. Consider the cost function as follows:

$$c_j(\tau) = W_{Uj}L_{Uj}(\tau) + W_{Sj}L_{Sj}(\tau) + X_N Q_N(\tau) + X_F Q_F(\tau),$$

where W_{ij} is the wage obtained by individual $i \in \{S,U\}$ and Q_N and Q_F are prices of national and foreign goods, respectively. A decrease in tariffs will increase the demand for foreign goods, and potentially decrease the demand for skilled and/or unskilled labor. The magnitudes of $L'_S(\tau)$ and $L'_U(\tau)$ depend on the degree of substitution of workers for foreign goods. For instance, we expect to see a larger effect on unskilled employment if unskilled workers have a higher degree of substitution with products from the United States.

2.2. Firms and Worker-Specific Wage Premiums

Given this setting, a fundamental task is to account for the heterogeneous effects of import competition across firms' levels of productivity and workers' skills. Both measures are difficult to empirically quantify, but, following Card, Cardoso, Heining, and Kline (2018), we suggest a framework that derives close proxies of these measures and can be computed using matched employer-employee data. Firms have market power and workers have heterogeneous preferences over firms. As we show in Appendix A, the equilibrium wages for skilled and unskilled workers can be expressed as:

$$\ln W_{ij} = \ln \lambda + \underbrace{\ln(\varphi_j f_L(L_j, X_j))}_{FWP} + \underbrace{\ln(L'(L_i))}_{WWP} - \ln(M_{ij}(\gamma_{ij})), \tag{1}$$

where M_{ij} is a wage markdown caused by the firms' monopsonic power, and γ_{ij} is the wage elasticity of labor supply of worker i to firm j.

Equation (1) has two important components that proxy for firms' productivity and workers' skills. First, the firm-specific wage premium (FWP) is a common measure across all individuals working in firm j and proxies that firms' productivity. It is composed of the firm's level of productivity and the marginal product of labor in that firm. In other words, it is composed of the firms' productivity and a measure of rent sharing from the firm to its workers. Second, the worker-specific wage premium (WWP) captures the common component among all workers of skill type i across firms, and accounts for the productivity of individuals with a given level of skills. It can be therefore considered as a proxy for the worker's level of skill in production. These measures can be estimated using the AKM model on matched employer-employee data (Section 4 provides greater detail), and correspond to proxies of firms' productivity and workers' skills that help account for heterogeneous effects of import competition.

3. Data and Background

3.1. Background

The Free Trade Agreement:- Trade between the United States and Colombia grew remarkably after the beginning of the 1990s, when both countries took measures to increase trade.[7] In 1991 the United States, under the Andean Trade Preference Act (ATPA), eliminated tariffs on a large number of Colombian products.[8] At the same time, Colombia liberalized markets by decreasing the tariffs charged to the United States to around 15 percent.[9]

Later, in 2006, both countries started negotiations on the implementation of a free trade agreement, that was approved in 2007 by the Colombian government. Four years later, in

[7] Appendix Figure B.1 presents the evolution of trade between both countries by industries. Colombian exports to the United States are mostly composed of mining products, whereas imports are composed primarily of manufactured goods. Imports from the United States are mainly manufacturing goods, while exports correspond primarily to mining and secondly to manufacturing.

[8] ATPA was established to promote Colombia's export industries, as well as to help the fight against drug production. It was continuously renewed after 2002, when it was called the Andean Trade Promotion and Drug Eradication Act (ATPDEA).

[9] A more detailed discussion about Colombian liberalization can be found in Eslava, Haltiwanger, Kugler, and Kugler (2004).

2011, the U.S. senate approved it, and was legally implemented in May 2012. However, two years before the implementation date, the Colombian government, under Decree 4114 of 2010 (implemented on November 5th, 2010), unilaterally implemented the tariff cuts originally stipulated in the free trade agreement aiming to boost employment, reduce costs, and increase production. Therefore, Colombia effectively adopted the tariff reductions two years before it was officially implemented by the United States.

The free trade agreement renewed the existing tariff exemptions that had been granted to Colombian products under the ATPA. In return, Colombia reduced tariffs on incoming products from the United States. Tariffs were eliminated for most manufacturing, services, and mining products. Some other goods, most of them agricultural products, remained protected for additional years (in most cases for five years, but for some products such as rice, the tariffs were set to continue for an additional 20 years), allowing local producers to adapt progressively to the incoming competition.[10]

Figure 1 presents the evolution of the tariffs charged by Colombia to the United States (Panel 1a), and the evolution of tariffs charged by the United States to Colombia (Panel 1b). Panel 1a shows that tariffs on mining goods decreased with the free trade agreement, whereas tariffs for manufacturing and service goods decreased after 2010. Such decrease is explained by Colombian decree 4111 of 2010. A big portion of agriculture goods, on the contrary, remained protected for some additional years. Panel 1b show that tariff cuts for Colombian products entering the United States were much lower, and basically renewed the already low tariff rates imposed years before. Such cuts, nonetheless, were implemented with the agreement in 2012.

Imports from the United States increased strongly between 2010 and 2014 among industries that reduced tariffs, passing from 9 to 16 billion dollars.[11] In figure 2 we present the dollar value

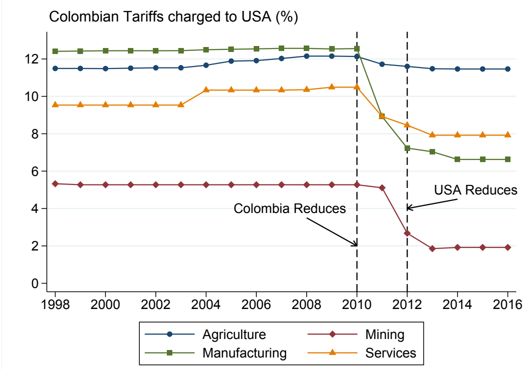
[10] The main protected products were rice, chicken, milk, cheese, butter, corn, meats, motorcycles (between 1500 and 3000 cc.) paper, ink, iron and steel products, glass, and plastics. The agreement additionally regulated competition, customs, environmental rights, intellectual property, and investment procedures.

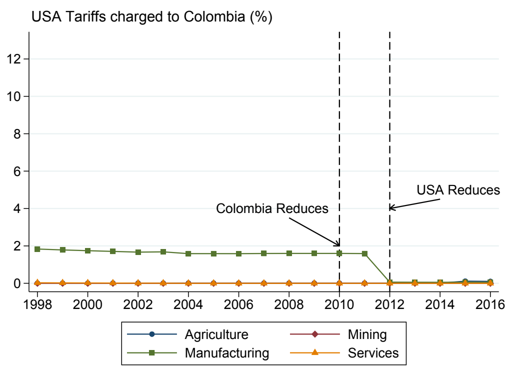
[11] Appendix Table C.13 presents a list of the goods most frequently imported from the United States to Colombia, and those that are seldom imported from the United States to Colombia, before and after the free trade agreement.

Figure 1: Tariffs Charged by Country

(a) Colombia

(b) United States

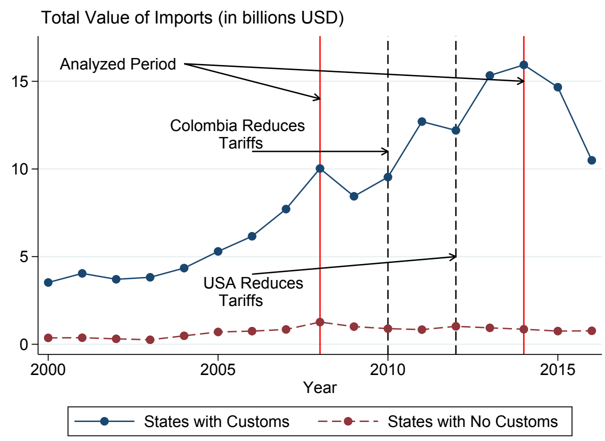




Notes: These graphs present the average tariffs charged by Colombia and the United States by two-digit industry codes. These industries correspond to agriculture, manufactures, mining, and services. The left panel presents the historical tariffs that Colombia charged on products from the United States. The right panel plots the historical tariffs charged by the United States on incoming imports from Colombia.

of imports by industries that did and did not reduce tariffs. The solid line depicts a continuous increase in imports among the industries that experienced tariffs cuts, exclusively. After 2014, however, the value of imports decreased presumably because of a 30% appreciation of the U.S. dollar with respect to the Colombian peso or a strong decrease in international oil prices.[12]

Figure 2: Imports by Industries With and Without Tariff Cuts



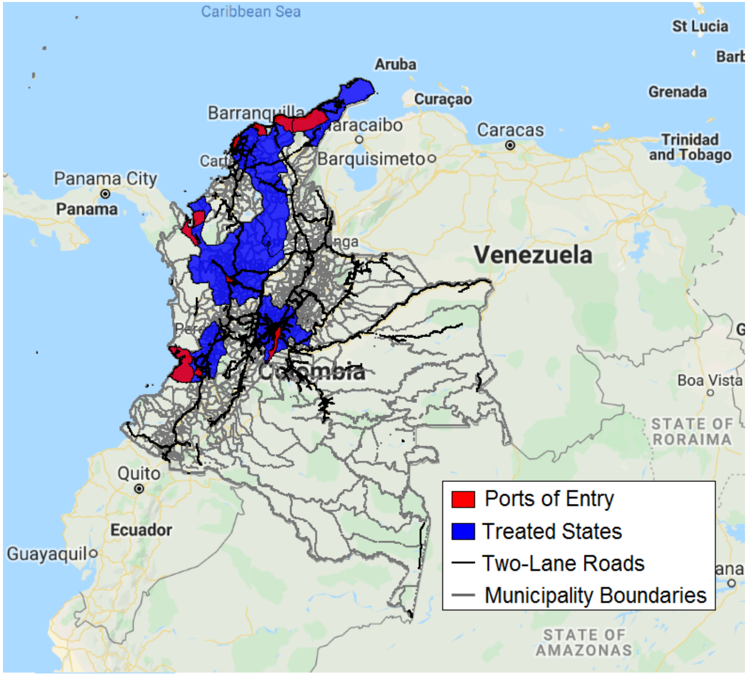
Notes: This graph plots the value of imports in billions USD, by industries were tariffs were and were not reduced. The solid connected line depicts the value of imports among industries that experienced tariff cuts. The dashed connected line presents the value of imports in industries were tariffs did not change. The dashed vertical lines depict the period 2008 to 2014, which is the period we analyze herein. The solid vertical lines plot the years in which Colombia and the United States decreased tariffs.

[12] Appendix Figure B.2 shows the evolution of the exchange rate and oil prices for the analyzed period. The decrease in oil prices affected the dollar value of exports, whereas the peso devaluation (of around 30 percent) increased the price of importing goods from the United States.

Regional Trade in Colombia:- Connectivity and trade among Colombian regions are very limited because train and river transportation is practically nonexistent, and road infrastructure is very scarce (Duranton, 2015). The Colombian government historically neglected road construction due to geographic limitations and civil conflict in many parts of the country (Bushnell, 1993). As a result, incoming products from the United States affect mainly states with customs ports, and do not reach isolated areas. In Figure 3 we present a map of the different customs ports that receive incoming goods from the United States, and the states around these ports. The map also shows the main roads built as of 2010. All of the roads shown are two-lane highways (i.e., one lane going in each direction). Red areas highlight municipalities with customs ports, and blue areas highlight the surrounding states. The three red areas within Colombian mainland correspond to Bogotá, Medellín, and Cali, which are the three biggest Colombian cities with customs in international airports. Around the coastline the red areas depict the maritime customs of Buenaventura, Barranquilla, Santa Marta, Cartagena, and Riohacha.

Incoming products from the United States stay primarily in states with customs ports. In figure 4 we present the value (in millions of U.S. dollars) of imported goods by states with and without customs ports. Around 80 percent of imports from the United States stay in the state where the customs port is located, and 90 percent stay within states that have customs ports. The 10 percent difference stems from goods that move across states that both have customs ports. The majority of the incoming goods stay in the coasts, or reach the heartland by plane. A total of eight states (out of 33) are mainly affected by import competition, while imports in the remaining states are limited. Local producers outside states with customs ports rarely buy products from the United States. In general, they produce products locally and use local inputs. Import competition from the United States thus affects specific regions rather than the entirety of the country.

Figure 3: Regional Trade



Notes: This map depicts the Colombian territory with all the municipality boundaries. The areas depicted in red correspond to municipalities with custom ports for products imported from the United States. They correspond to: Barranquilla, Bogotá, Buenaventura, Cali, Cartagena, Medellín, Riohacha, and Santa Marta. In blue we depict the states where such municipalities are located. These states correspond to: Atlántico, Bolívar, Cauca, Cundinamarca, La Guajira, Magdalena, and Valle del Cauca.

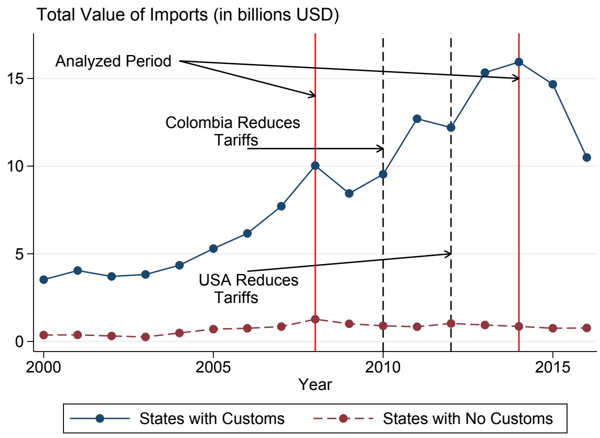
3.2. Data

We use a rich and unique Colombian data set from three different sources. First, we use yearly matched employer-employee earnings records from 2008 to 2014.[13] This is a confidential, administrative data set that includes all formal-sector workers who contribute to health or pension in any given month. The data include firm identifiers, four-digit industry codes, and the municipality where the payment occurred. A primary feature of the data is that we are able to follow every worker and firm. A limitation, however, is that the data set contains only formal-sector workers, who correspond to around 60 percent of Colombian workers.[14]

[13]The data include the years 2015 and 2016, but we excluded the use of data from these years because of the strong devaluation (depicted in Appendix Figure B.2a).

[14]Even though informality is a big issue in Latin America, Appendix Figure B.3 shows that informality by sector in Colombia did not increase during the period we analyze. In fact, during the relevant time frame, we observe a slight decrease in informal employment in the informal sector. This provides evidence that our results are not mainly driven by people moving to informal work. Even if the results were driven by workers shifting from formal to informal employment, we would still consider formal employment to be a first-best option compared to either informal employment or unemployment.

Figure 4: Imports in States With and Without Customs Ports



Notes: This graph plots the value of imports in billions USD, by states with and without customs ports. The solid connected line depicts the value of imports among states with customs ports. The dashed connected line presents the value of imports in states with no customs ports. The dashed vertical lines depict the period 2008 to 2014, which is the period we analyze herein. The solid vertical lines plot the years in which Colombia and the United States decreased tariffs.

We complement these data using headcounts of workers per state and industry from the 2005 census.[15]

Second, we use highly detailed administrative records on Colombian imports and exports from 2008 to 2014. These data, recorded at the 10-digit level, are broken up by state where the good was bought (in the case of imports) or sold (in the case of exports).[16] These data constitute administrative information from the customs authorities that is sent to the Colombian central bank. We complement this information with data records on every single imported and exported product by each firm in 2008.

Finally, we use tariff information from the United Nation's Trade Analysis Information System, the World Trade Organization, and the U.S. International Trade Commission. We use multiple tariff data due to differences in the level of industry code aggregation, and because individually no single source covers our entire period of study.[17]

[15]The 2005 census provided the number of workers for every state and industry. Such information is available at: `http://systema59.dane.gov.co/cgibin/RpWebEngine.exe/PortalAction?BASE=CG2005BASICO`.
[16]Colombia has 33 different states that are very heterogeneous.
[17]These different data sources work with different industry codes. Therefore, we homogenize and merge them using four-digit industry codes.

We merge all the data sets using four-digit ISIC codes (845 industries) and state identifiers (33 states), and create three different estimating samples. First, we collapse the data at the industry-state-year level and create a yearly panel of industries by states (N = 142,212).[18] The agreement could have motivated the creation or destruction of industries in some states, so we replace by zeros those industries-states-years that reported having at least one worker between 2008 and 2014. So, for instance, if Bogotá reported production of shoes in 2008 exclusively, then we replace further years with zeros, and vice versa. This sample is static and does not change in time, so there are not issues of potential selection bias.

Second, we create a panel of incumbent (before the free trade agreement) workers in 2010. Individual-level samples change over time, raising concerns about non-random selectivity if particular types of workers leave or enter the sample non-randomly. Therefore, following Autor, Dorn, Hanson, and Song (2014), we restrict the sample to workers observed before the tariff reduction, and track them up to four years after. We limit the sample to workers between 25 and 64 years old working in 2010 (N = 6,615,624). Third, we create a panel of incumbent firms (N = 165,724), and again track them up to four years after the tariff reduction. This sample also suffers from potential selection bias, so it is also restricted to those observed in 2010. Following Card et al. (2013), we keep firms with more than five employees so that the AKM can be estimated. Appendix Table C.1 presents descriptive statistics across all samples.[19]

4. Empirical Strategy

Our empirical analysis aims to find the causal effect of imports competition from the United States on Colombian labor markets. The direct correlation between import competition and employment estimated by OLS is unlikely to reflect causal effects due to endogeneity concerns. Reverse causality (e.g., industries with more employment may be more subject to trade effects)

[18] We drop industry by state cells that do not report any person employed from 2008 to 2014. So from a perfectly balanced panel of 195,195, we keep 142,212 observations.

[19] We also use a fully balanced panel with a total of N = 195,195 observations (33 states, seven years, and 845 industries), and the results remained unchanged.

and potential unobserved confounders (e.g., unobserved productivity in certain industries or states may correlate positively with trade and labor market outcomes) can upwardly bias the coefficients. For this reason, we implement the strategy detailed herein.

4.1. Measuring Import Competition

We first introduce a measure for import competition as following:

$$\log(\text{IC})_{sjt} = \log\left(1 + \frac{\text{USD Value of Imports}_{sjt}}{L_{sj}^{2005}}\right). \tag{2}$$

This measure accounts for the per capita import competition from the United States faced by every industry j in state s, and year t in Colombia. We add a one in the logarithm to include all those sectors and regions that have imports equal to zero. It is important to include the zeros since some industries and regions may have not imported before the free trade agreement took effect, and, as a result of the reduction in tariffs, they may have started importing goods. We normalize by the number of workers in 2005 using data from the Colombian 2005 census at the state and industry levels.[20]

The purpose of this measure is to account for the degree of import competition from the United States across industries and states. We normalize the measure by the size of the workforce since smaller industries or states are more subject to competition. This measure varies by state, industry, and year, and it captures the degree of competition faced before and after the free trade agreement.

Similarly, we define the following measure to evaluate whether the free trade agreement affects exports:

$$\log(\text{EW})_{sjt} = \log\left(1 + \frac{\text{USD Value of Exports}_{sjt}}{L_{sj}^{2005}}\right).$$

[20] We divide by workers in 2005 since the free trade agreement may have affected the number of workers in later years.

This measure replaces the value of exports, and accounts for the degree of exports per worker in each industry, state, and year.

4.2. Industry and State Shocks

To address the endogeneity concerns we introduce some shocks that use the exogenous decrease in tariffs and state disparities in access to imports. Consider, first, the following imports and exports penetration shocks:

$$
\begin{aligned}
IMP^{dd}_{jt} &= 1(\text{COL Reduction})_j \times \text{Post}_t \\
EXP^{dd}_{jt} &= 1(\text{USA Reduction})_j \times \text{Post}_t,
\end{aligned}
\tag{3}
$$

where $1(\text{COL Reduction})_j$ and $1(\text{USA Reduction})_j$ are categorical variables that take the value of one if industry j experienced a tariff reduction in Colombia and in the United States, respectively.[21] Post_t is a dummy indicator that takes the value of one after 2010, and zero otherwise. We denote these shocks using the superscript "dd" to indicate that the shocks correspond to a double difference.

The shocks in (3) do not take into account regional variation. However, as shown in Section 3.1, Colombia has large regional variation in trade flows, with eight states serving as the destination for almost 90 percent of the imported goods from the United States. To account for this, we define the following alternative and more reliable trade shocks:

$$
\begin{aligned}
IMP^{ddd}_{sjt} &= IMP^{dd}_{jt} \times 1(\text{Customs in State})_s \\
EXP^{ddd}_{sjt} &= EXP^{dd}_{jt} \times 1(\text{Customs in State})_s,
\end{aligned}
$$

where $1(\text{Customs in State})_s$ is a categorical variable that takes the value of one if state s has a customs port that receives imported goods from the United States. We use the superscript "ddd" to denote that these shocks come from a triple difference.

[21] We define a reduction in tariffs by comparing tariffs in 2014 with tariffs in 2010. A tariff reduction implies that tariffs in 2014 are smaller than tariffs in 2010.

These measures rely on temporal, industry, and regional variation. We expect that, after the implementation of the agreement, industries with lower tariffs and regions with access to import competition from the United States are more affected than protected industries in isolated regions. It is expected, therefore, that imported goods have a greater effect on manufacturing goods in states with customs ports, such as Bogotá, than non-tradable goods in isolated states, such as the Amazon.

4.3. Triple-Difference Model (First Stage)

Consider now the following differences-in-differences model:

$$Y_{sjt} = \alpha_1 IMP^{dd}_{jt} + \alpha_2 EXP^{dd}_{jt} + \mu_s + \mu_j + \mu_t + \varepsilon_{sjt}, \tag{4}$$

where Y_{sjt} corresponds to an outcome in state s, industry j and year t. Such outcomes include the measure of import competition from the United States and the measure of export per worker. This model includes state (μ_s), industry (μ_j), and year (μ_t) fixed effects to account for within variation.

Equation 4 pools the effect of the decrease in tariffs across states with and without customs ports. However, as suggested in Section 3.1, import competition from the United States affects exclusively those states with customs ports. For this reason, we estimate the following model that accounts for these differences:

$$Y_{sjt} = \alpha_1 IMP^{ddd}_{sjt} + \alpha_2 EXP^{ddd}_{sjt} + \mu_{sj} + \mu_{st} + \mu_{jt} + \varepsilon_{sjt}. \tag{5}$$

This model includes state-by-industry (μ_{sj}), state-by-year (μ_{st}), and industry-by-year (μ_{jt}) fixed effects and is identified using within industry-by-state variation. The fixed effects account for potential confounding effects and control for potential pre-existing differences. As treated units, the model uses industries that experienced a tariff reduction, and that are located in states with customs ports; as control units, the model uses industries that did not receive tariff reductions, or that are located in states that do not have customs ports. The model treats industries-by-states as separate units and therefore isolates the effect of the tariff reduction by states with and without customs ports.

4.4. The Effects of Import Competition (Second Stage)

The results of the triple-difference model quantify the effect of the free trade agreement on import competition. We take advantage of these results and estimate a second stage that uses variation induced by the free trade agreement to identify the effects of import competition on worker and firm outcomes. The richness of the data allows to estimate aggregated (i.e., at the industry-state-year level) and individual level (i.e., at the worker and firm level) models.

Aggregated Model:- We collapse the data at the state-industry-year level, and use the variation in import competition to identify aggregated effects by industries and states. These estimations do not suffer from sample selection since the units of observation remain constant. Using equation 5 as a first stage, we can find the effect of import competition from the United States on aggregated measures by estimating:

$$Y_{sjt} = \gamma_1^{ddd} \log(\widehat{\text{IC}})_{sjt} + \gamma_2^{ddd} \log(\text{EW})_{sjt} + \mu_{sj} + \mu_{ts} + \mu_{jt} + e_{sjt}, \tag{6}$$

where Y_{sjt} correspond to an aggregated outcome (employment, number of firms, and average firm size), $\log(\widehat{\text{IC}})_{sjt}$ stands for the predicted import competition, and $\log(\text{EW})_{sjt}$ is the measure of exports per worker.[22] We also include state-by-industry (μ_{sj}), year-by-state (μ_{ts}), and year-by-industry (μ_{tj}) fixed effects. Excluding such fixed effects will bias the coefficients because the instrument may be no longer exogenous. The parameter of interest is γ_1^{ddd}. Standard errors are clustered at the industry-by-state level.

Individual Level Model:- We additionally estimate regressions at the worker and firm level. To deal with selection issues, we restrict the sample to incumbent observations observed before

[22] In the first stages we drop the term EXP_{sjt}^{ddd} because it adds noise to the estimations. We also control for the value of exports on the second stage, but excluding it does not affect any of the results.

the implementation of the free trade agreement (i.e., in 2010). Our individual level model takes the form:

$$Y_{isj,t} = \delta_1 \log(\widehat{\text{IC}})_{sj,t} + \delta_2 \log(\text{EW})_{sj,\tau} + \delta_3 X_i + \mu_s + \mu_j + u_{ijs,t}, \tag{7}$$

where $Y_{isj,t}$ corresponds to an outcome, that varies for workers or firms i, state s, and industry j. We measure the outcome year-by-year, up to four years after the tariff reduction, and estimate separate regressions for each year. The measure on import competition from the United States, $\log(\text{IC})_{sj,t}$, corresponds to that in equation (2) but included separately for each year. The term $\log(\text{EW})_{sj,t}$ corresponds to the measure exports per worker.[23] Note that this model includes state (μ_s) and industry (μ_j) fixed effects to control for pre-existing differences, and resemble a differences-in-differences specification with repeated cross sections. We additionally control for a set of baseline characteristics X_i.[24] Standard errors are again clustered at the state–industry level, and the parameter of interest is δ_1.

This specification is of course subject to reverse causality or omitted variable bias, similar to the aggregated level estimations. To deal with this we instrument using the interaction of the dummy that takes the value of one for industries that decreased tariffs and a dummy for states that have customs ports. Formally, this instrument is defined as:

$$\text{IMP}_{sj} = 1(\text{CoI Reduction})_j \times 1(\text{Customs in State})_s.$$

4.5. Firm and Worker Wage Premiums

Individual level estimations are useful to estimate heterogeneous effects across workers and firms. As we showed in Section 2, the effects of import competition are expected to be heterogeneous across firms' levels of productivity and workers' skills. Even though in our data

[23] Again these results are not sensitive to excluding this control.

[24] For workers we include age, age-squared, gender, earnings averaged from 2008 to 2010, worker wage premiums averaged from 2008 to 2010, and number of days worked averaged from 2008-2010. For firms we include wages, firm wage premiums, and the number of days worked. Each of these measures is averaged across all workers within the firm, and then averaged from 2008 to 2010.

we are not able to directly measure firm productivity and worker skills, we are still able to find proxies by extracting information from wages. In particular, we follow Abowd, Kramarz, and Margolis (1999) and Card, Heining, and Kline (2013) and estimate the following high-dimensional firm and worker fixed-effect model:

$$\ln W_{ijt} = \alpha_i + \psi_{J(i,j)} + X'_{ijt}\beta + \varepsilon_{ijt}, \tag{8}$$

where W_{imt} corresponds to income of individual i, in firm j, in period of time t. Equation (8) is the sample counterpart of equation (1). The components α_i and $\psi_{J(i,j)}$ correspond to the worker- and firm-specific wage premiums, respectively.[25]

The firm wage premium is the component of the wage that is common to all the workers of the firms. Even though it is not an exact measure of productivity, for the purposes of this paper, it can nevertheless serve as a good proxy for productivity. As shown in Section 2, and following Card, Cardoso, Heining, and Kline (2018), the firm wage premium can be a function of the firm's productivity. Furthermore, it has been shown empirically that firm productivity and firm wage premiums are highly correlated (Alvarez, Benguria, Engbom, and Moser, 2018; Card, Cardoso, and Kline, 2016).[26]

The individual wage premium, on the other hand, measures the workers' compensation irrespective of the firm where he/she works. If wages are equivalent to the marginal product of labor, then the worker wage premium is a measure of worker productivity that is highly correlated with the level of skills. As in the case of the firm wage premiums, we can interpret the worker wage premium as a proxy for skills, but, if we do not accept such an interpretation, then the worker wage premiums still rank workers according to earnings irrespective of the employer. Such ranking reflects discrepancies among workers that should be reflected in heterogeneous effects of import competition.

[25]We additionally control for year fixed effects.

[26]In any case, even if this interpretation of productivity were not accepted, the firm wage premiums still rank firms between lower- and higher-paying firms, and the effects of imports among them are expected to be different.

We classify incumbent firms and workers based on their wage premiums in the period 2008-2010. To do a more reasonable comparison, and to be in line with our estimation strategy, we classify the samples by quartiles within industries and states.[27] We then follow this set of incumbents after the tariff reduction, to identify the effect of the policy on firms and workers of different ex ante ranks.

We estimate heterogeneous effects in three main ways. First, we break down the sample of firms into quartiles of the distribution of firm-specific wage premiums. Such partition distinguishes between low- and high-fixed effect firms, which proxy low- and high-productivity firms. Second, we break down the sample of workers into quartiles of the distribution of firm-specific wage premiums. This allows us to see what happens to workers who were originally employed in low- and high-productivity firms. Lastly, we divide the sample of workers by quartiles of the distribution of worker-specific wage premiums. With this we are able to distinguish among low- and high-fixed effect workers, which proxy for low- and high- skilled workers.

4.6. Macroeconomic Confounders

Variation in oil prices and the exchange rate (Colombian pesos per dollar) can cause spurious correlations that should be avoided. As we show in Appendix Figure B.2, oil prices and exchange rates fluctuate strongly, especially after 2015. Therefore, we exclude the years 2015 and 2016 from our analysis. As a consequence, our results are valid in the short term only, and we are unable to say much about longer-term effects of import competition. Figure B.2b shows, additionally, a strong decrease in the price of oil in 2009. This variation certainly affects the trade between Colombia and the United States, so we drop the mining sector from our analysis. In Section 6 we show that including 2015 and 2016, or including the mining sector, does not alter our main findings, even though those results can be biased due to confounded measures.

[27] To do this, we run a regression of the worker and firm wage premiums on state and industry fixed effects, and take the residuals. We examine the results by quartiles of the distribution of these residuals.

5. Results

5.1. Effect of the Free Trade Agreement on Import Competition (First Stage)

We begin by presenting the results of the free trade agreement on import competition and exports per worker. Columns (1) to (3) in panel A) of Table 1 present the results of estimating the differences-in-differences model in equation (4).[28] The results suggest that imports increased among the sectors that reduce tariffs, and that the result is robust to alternative fixed effects used. In columns (4) and (5), we present the results separately between states without and with customs ports, respectively, and find that the increase in imports is entirely driven by a strong effect among states with customs ports. In states without customs ports we do not see any effects on imports, presumably because road connectivity hindered the access of these products. We do not observe any effect regarding exports.

These results motivate the estimation the triple-difference model. The results are displayed in columns (6) to (8) of Table 1. We observe a strong increase in imports from the United States of around 15 to 18 percent among industries that reduced the tariffs in states with customs ports. The results are robust to the alternative structure of fixed effects. As expected, imports from the United States increase remarkably among non-protected industries in states with customs ports. We again do not observe any effects in exports among industries in which the United States reduced its tariffs.

In general, Table 1 suggests a strong impact of the free trade agreement on import competition. No effect on exports was expected because tariffs in the United States remained low under the agreement. In fact, the F-stats for exports are very low, and the export shocks are not even significant. Thus, in the rest of the specifications we focus only on imports, and we use exports as a control to account for potential gains from the free trade agreement.[29]

[28] We control for the tariff reductions in the United States, but do not display the point estimates.

[29] When we use alternative specifications with and without exports as controls, the results do not change.

Table 1: Effect of the Free-Trade Agreement on Imports and Exports

	Differences-in-Differences			Het. Effects by States		Triple-Differences		
				No Customs	Customs			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A) Log(Import Competition)								
1(COL reduction)**Post*	2.434***	0.077***	0.077***	0.027	0.175***			
	(0.100)	(0.023)	(0.023)	(0.029)	(0.037)			
1(COL reduction)**Post**1(Customs)						0.172***	0.175***	0.150***
						(0.037)	(0.037)	(0.045)
Ind. F	587.714	11.577	11.574			22.035	22.857	10.878
B) Log(Exports per Worker)								
1(USA reduction)**Post*	0.054	-0.060	-0.060	-0.040	-0.096			
	(0.175)	(0.047)	(0.047)	(0.043)	(0.110)			
1(USA reduction)**Post**1(Customs)						-0.095	-0.096	-0.101
						(0.109)	(0.109)	(0.121)
Ind. F	.097	1.591	1.591			.76	.776	.698
Observations	142,212	142,212	142,212	100,051	42,161	142,212	142,212	142,212
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	No	No
Industry FE		Yes	Yes	Yes	Yes	No	No	No
State FE			Yes	Yes	Yes	No	No	No
Industry*State FE						Yes	Yes	Yes
State*Year FE							Yes	Yes
Industry*Year FE								Yes

Note: This table presents the estimation of equation 5 on imports and exports. Panel A uses the import competition measure, defined as equation 2, as dependent variable, and control for the reduction in U.S tariffs. Panel B uses as dependent variable log exports per worker defined as equation 2, but changing the value of imports for the value of exports, and controls for the reduction in Colombian tariffs. Columns (1) to (5) present the results of a difference-in-difference model. Columns (6) to (8) presents the results of a triple-difference model as in equation 5. $1(\text{COL Reduction})$ and $1(\text{USA Reduction})$ are categorical variables that take the value of one if Colombia and the USA reduced tariffs in a given industry, respectively. $1(\text{Customs})$ is a categorical variable that takes the value of one if the observation is within a state with customs port. *Post* is a categorical variable that takes the value of one for observations after 2010. *** p<0.01, ** p<0.05, * p<0.1

5.2. The Effects of Import Competition from the United States (Second Stage)

5.2.1 Aggregated-Level Results

Table 2 presents the results of the estimation of the second stage results detailed in equation (6). We present the reduced form, OLS, and IV estimates. Columns (1) to (3) suggest that import competition from the United States decreases employment with an elasticity of employment to import competition of around -0.64. Recall that the increase in import competition estimated in table 1 is of around 15 to 18 percent, so this point estimate implies a reduction in employment of around 9.6 to 11.5 percent. [30] This magnitude is similar to the United States' elasticity of employment to imports from China found in Autor, Dorn, and Hanson (2013) (around -0.6), and resembles many other results estimating the effect of import competition on employment around the world.

The decrease in employment can be driven by an extensive margin (firms exit) or an intensive margin (firms downsize). Thus, we analyze the effect of import competition from the United States on the number of firms and the average firm size. Columns (4) to (6) show a strong and robust negative effect on the number of firms, equivalent to an overall decrease of 8.4 to 10 percent.[31] Columns (7) and (9), on the contrary, show a less precise and smaller, although still negative, effect on the average firm size.[32] Even though the point estimate is not significant, alternative specifications (shown in Section 6) yield significant and meaningful results on this outcome, so we cannot rule out that import competition does not affect firm size. This estimate implies an overall reduction in firm size of 1.6 to 1.9 percent.

Such results suggest that import competition from the United States decreases employment among affected industries and states in Colombia. The decrease in employment is mediated by

[30] Even though we reject the null only at the 10 percent level, we provide in Section 6 additional evidence that this effect is robust to many other specifications in which it is more precisely estimated. We do this for simplicity in the presentation of the paper.

[31] This result is very robust to alternative specifications, as suggested in appendix table 4.

[32] We measure firm size by counting the number of workers registered in each firm by each year.

Table 2: Imports from the United States and the Decline in Employment

	log (Employment)			log (Number of Firms)			log (Firm Size)		
	RF	OLS	IV	RF	OLS	IV	RF	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1(COL reduction)**Post**1(Customs)	-0.080*			-0.064***			-0.023		
	(0.041)			(0.016)			(0.037)		
log(Import Competition)		-0.007	-0.640*		-0.003	-0.559***		-0.006	-0.105
		(0.006)	(0.331)		(0.002)	(0.193)		(0.005)	(0.243)
Observations	142,212	142,212	142,212	142,212	142,212	142,212	142,212	142,212	142,212
F-first stage			11.352			11.352			11.352
Industry*State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State*Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry*Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: This table presents the estimation of equation 6. Columns (1)-(3) use log of employment as outcome. Columns (4)-(6) use the log number of firms as outcome. Columns (7)-(9) use the log of the average firm size as outcome. Columns (1), (4), and (7) present reduced form estimates. Columns (2), (5), and (8) presents OLS estimations. Columns (3), (6), and (9) presents two-stage least squares results. All specifications control for industry–state, state–year, and industry–year fixed effects. Standard errors clustered at the industry*state level. *** p<0.01, ** p<0.05, * p<0.1

the extensive and the intensive margin, even though the weight of the extensive margin is larger implying a bigger importance for firm exit rather than for firms shrinking.

5.2.2 Individual-Level Results by Wage Premiums of Firms and Workers

Our main interest is to distinguish the effect between low- and high-productivity firms and low- and high-skilled workers. So, as detailed in Section 4.5, we estimate heterogeneous effects across the within industry-state distributions of firm and worker wage premiums.[33] As a result, we have three sets of results: 1) effects on firms by firm wage premiums; 2) effects on workers by firm wage premiums; and 3) effects on workers by worker wage premiums. The first two show heterogeneous effects by types of firms, whereas the third shows effects that emerge according to types of workers.

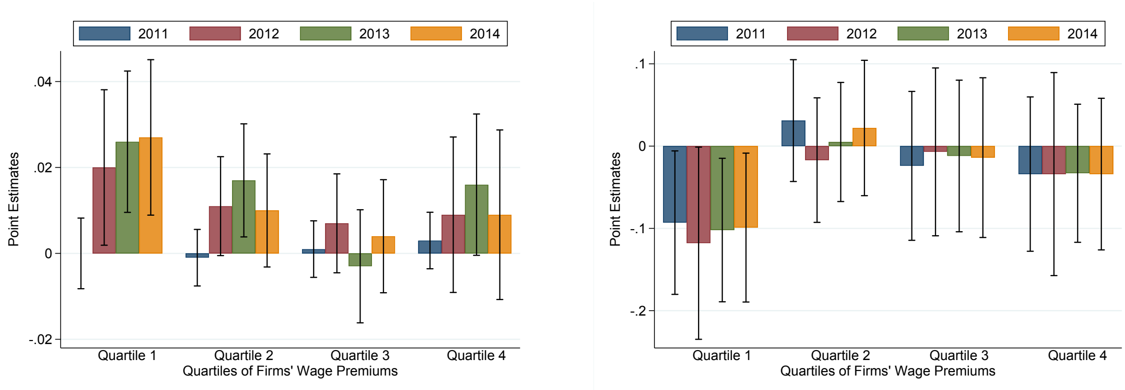
Effects on Firms by Firm-Specific Wage Premiums: In Figure 5 we present the estimation of equation 7 on two outcomes at the firm level: Panel 5a uses an indicator variable for whether the

[33]The results of the first-stage estimation are presented in Appendix Table C.2. We show a very robust first stage with a positive increase in imports.

firm exits or not; Panel 5b uses the log of firm size. We estimate heterogeneous effects using the quartiles of the distribution of firm-specific wage premiums, and track the firms yearly. Quartile 1 corresponds to those firms in the first quartile of the within industry and state distribution of firm wage premiums.

Figure 5: Effects on Firms' Outcomes by Quartiles of Firm-Specific Wage Premiums

(a) 1(Firm Exit) (b) Firm Size



Notes: These graphs present estimates of the parameter δ_1 in equation 7 at the firm level by quartiles of the distribution of firm-specific wage premiums. Panel 5a uses an indicator that takes the value of one if the firm is not observed in year τ as outcome. Appendix table C.3 presents the underlying regressions. Panel 5b use the log of firm size as dependent variable, and appendix table C.4 presents the regression results. All quartiles are defined in the distribution of firm-specific wage premiums within industry and state. Panel A presents estimates of a linear probability model. 90% confidence intervals displayed.

We observe in Panel 5a that a 10 percent increase in import competition from the United States increases the probability of exiting among firms in the first quartile by around 0.003 percentage points. We also see a positive effect among firms in the second quartile, although the magnitude (0.002 percentage points) and the precision are smaller. Firms in the fourth quartile also show positive point estimates, but these are even less precise and smaller. These results suggest that import competition motivates an exodus of firms, especially low-productivity firms. We test for this by grouping below and above the median, and we find that firms below the median are significantly more likely to exit compared to firms above the median.

We also test for effects in firm size among the firms that do not exit. We find that firm size decreases among firms in the first quartile, as shown in Panel 5b. As opposed to the effects of Chinese import competition in the United States (Bloom, Handley, Kurman, and Luck, 2019), we do not observe that more productive firms increase in size. Such result implies that missing production generated by firms exiting and shrinking is not appropriated by high-productivity local firms. Instead consumers seem to substitute their previous consumption of locally produced goods with imported goods from the United States.

In general, these results suggest two effects. First, low-productivity firms are more likely to be driven out of the market, inducing a decrease in the supply of locally produced goods. Second, low-productivity firms are likely to shrink, whereas high-productivity firms do not grow. This provides some evidence that local consumers (either individual consumers or firms) decrease consumption, or stop buying locally produced goods and begin buying imported substitutes or other goods from the United States. If this were not the case, then we should observe increases in the size of high-productivity firms induced by the decrease in the supply of locally produced goods. This contrasts with the effects of Chinese competition in the United States, where import competition affects mainly high-paying and bigger firms.

Firm dispersion in productivity is very large in developing countries. Such distribution, especially in Latin America, is usually bimodal, with a predominance of very low- and very high- productive firms Busso, Madrigal, and Pagés (2013); Eslava, Haltiwanger, and Pinzón (2019). The results herein suggest that an increase in import competition from the United States induces the exit of firms, especially among low-productivity firms, and that remaining low-productivity firms decrease in size.

Effects on Workers by Firm Wage Premiums: Results this far leave open the question regarding what happens with the workers who were originally working in firms with different levels of productivity, especially those who lose their job because the firm exit or shrink. To answer this we estimate equation 7 on the sample of incumbent workers, and estimate heterogeneous effects across the firms where these workers were initially employed. Quartile 1 refers to workers who were initially working in a firm in the first quartile of the distribution of firm-specific wage premiums. Figure 6 presents the results using as outcome a dummy for whether the worker works (panel 6a), a dummy for whether working in an industry that did not reduce tariffs (panel 6b), an indicator variable for whether the worker works in a state without customs ports (panel 6c), and the worker's log daily wage (panel 6d). We again follow the same format as in Figure 5 separating the results by year and quartiles.

Figure 6: Effects on Workers' Outcomes by Quartiles of Firm-Specific Wage Premiums of Initial Firms

Note: These graphs present estimates of the parameter δ_1 in equation 7 by quartiles of the distribution of firm-specific wage premiums of incumbent firms. Quartile 1 corresponds to workers working in a firm in the first quartile of the within state-industry distribution of firm-specific wage premiums. Panel 6a uses an indicator that takes the value of one if the workers is observed working in year τ as outcome. Appendix table C.5 presents the underlying regressions. Panel 6b uses an indicator variable for whether the worker is an industry that did not reduce tariffs as dependent variable, and appendix table C.7 presents the regression results. Panel 6c uses in indicator variable for whether the worker works in a state without a customs port. Appendix Table C.8 presents the point estimates. Panel 6d uses the log of workers' daily wage, and appendix table C.6 presents the point estimates. Panels A, B, and C present estimates of a linear probability model. 90% confidence intervals displayed.

The results in Panel 6a present a small and positive effect on the probability of working among workers in the first quartile. Surprisingly, we do not observe that workers in low-productivity firms transition into unemployment (or informality), but instead they are more likely to remain employed than workers in unaffected industries or states. This can occur if workers from low-productivity firms in affected industries or states are reallocated into low-productivity firms in unaffected industries and/or states.

We find direct evidence of this by presenting, in panels 6b and 6c, the effect of import competition on a dummy for working in an industry that did not reduce tariffs and a dummy for working in a state with no customs ports, respectively. We see that workers in the first and second quartiles are more likely to move to industries that did not reduce tariffs, whereas there is a generalized movement across all quartiles to states without customs ports. The point estimates in panels 6b, nonetheless, are much larger in magnitude, implying a bigger reallocation across industries than across states. Such reallocation exists more prominently among workers in low-productivity firms.

This reallocation of workers to unaffected industries and states does not explain entirely the positive point estimates in panel 6a. In fact, workers can reallocate and that does not necessarily increase the probability of being employed. A possibility is that workers in unaffected industries or states are displaced, decreasing therefore their probability of being employed. This result is equivalent to a situation of job displacement in times of recession as shown in Haltiwanger et al. (2017).

Theoretically, reallocation of workers mitigates wage losses after a labor demand shock. We observe in panel 6d that wages are not affected for workers in the top three quartiles, but workers in the first quartile experience a wage decrease of around -0.05%. Two main reasons can explain this result: 1) workers who switch jobs accept lower-paid offers; 2) workers who stay experience wage losses. Unfortunately, we cannot rule out either of these explanations. However, the evidence in panels 6a, 6b, and 6c shed some light about workers in low-productivity firm relocating and displacing other workers in low-productivity firms by accepting lower paid offers.

In general, two results can be derived here. First, workers in low-productivity firms move into unaffected industries and states, and they can potentially displace former workers by accepting lower-paid job offers. Second, workers in all the other quartiles shift to unaffected industries and/or states and mitigate wage loses. Those in the second quartile are more likely to move into other industries, whereas workers in high-productivity firms move geographically, across states.

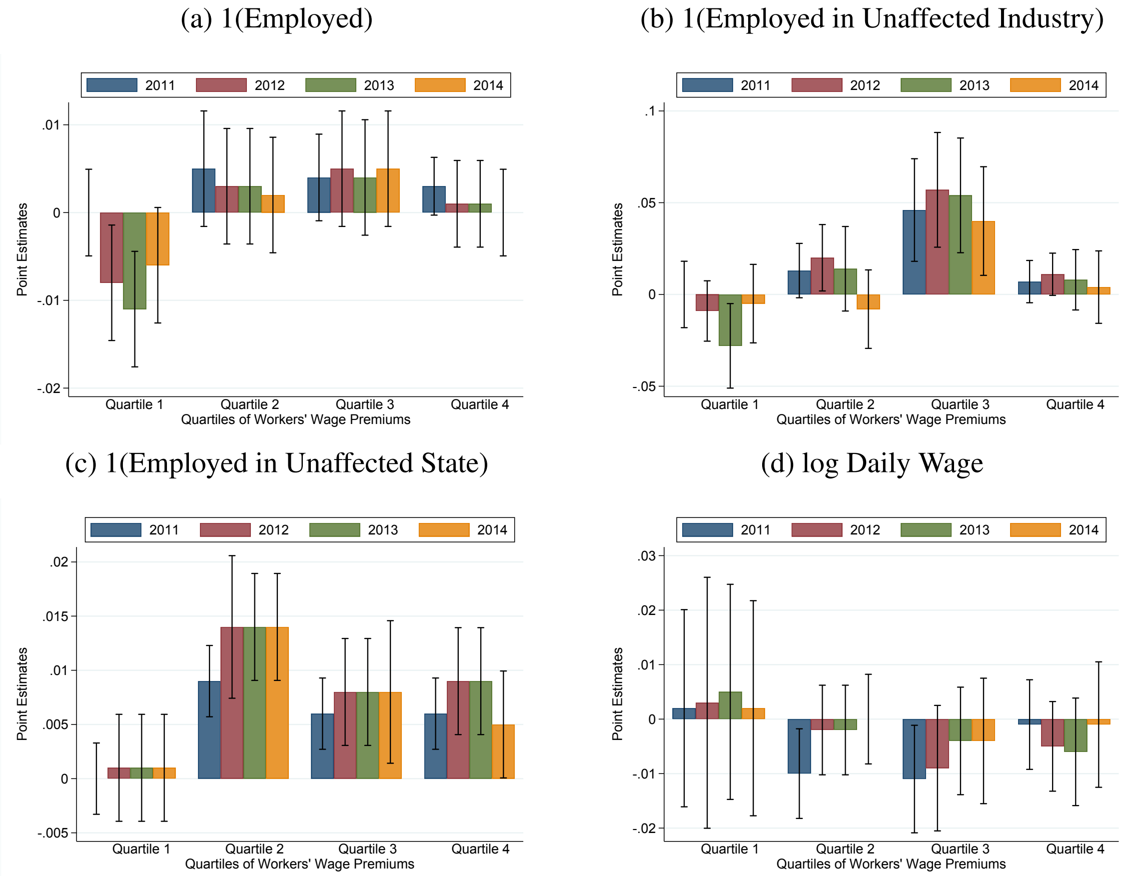
Effects on Workers by Worker Wage Premiums: The effects of import competition from the United States can differ depending on the levels of skills of the workers. Thus, we analyze what happens to workers with different levels of worker-specific wage premiums, which can proxy for skills. We analyze the same outcomes included in Figure 6 but now separate the results by quartiles of the distribution of worker-specific wage premiums. These results are presented in Figure 7 that follows the same format as Figure 6.

The results in panel 7a show a precise and negative effect on the probability of being (formally) employed among workers in the first quartile of the workers wage premium distribution. The workers in this quartile do not shift into unaffected industries (panel 7b) or into unaffected states (panel 7c), and we do not see any effect in wages among the ones who remained employed (panel 7d). Such results imply that the losses in employment are mainly driven by low-skilled workers who transition to informality, unemployment, or leave the labor force. The results in employment in Table 2 are thus mainly driven by low-skilled workers.

These results contrast with those among workers in other quartiles. We do not observe any effect on the likelihood of working, but we do observe positive point estimates on the probability of shifting into industries that did not reduce tariffs (for workers in the third quartile) and into states without custom ports (for all quartiles except the first). We do not see any effects on wages, suggesting that reallocation could have mitigated potential wage losses.

In general, we observe four main sets of results. First, the free trade agreement between Colombia and the United States decreases the amount of import competition but leaves exports relatively unaffected. Second, import competition reduces employment by decreasing the

Figure 7: Effect on Worker Outcomes by Worker-Specific Wage Premiums



Notes: These graphs present estimates of the parameter δ_1 in equation 7 by quartiles of the distribution of worker-specific wage premiums. Panel 7a uses an indicator that takes the value of one if the workers is observed working in year τ as outcome. Appendix Table C.9 presents the underlying regressions. Panel 7b uses an indicator variable for whether the worker is an industry that did not reduce tariffs as dependent variable, and Appendix Table C.11 presents the regression results. Panel 7c uses in indicator variable for whether the worker works in a state without custom ports. Appendix Table C.12 presents the point estimates. Panel 7d uses the log of workers' daily wage, and Appendix Table C.10 presents the point estimates. All quartiles are defined in the distribution of worker-specific wage premiums within industry and state. Panels A, B, and C present estimates of a linear probability model. 90% confidence intervals displayed.

number of firms, and the average size of remaining ones. Such effects are mainly driven by low-skilled workers who are more likely to lose their (formal) jobs. Third, low-productivity firms are more likely to exit the market and shrink in size. We interpret this as evidence of firm selection due to import competition. Fourth, import competition from the United States induces worker movement from affected industries (i.e., those in which tariffs on related goods fell) and states (i.e., those with customs ports) to unaffected industries (i.e., those in which related tariffs did not fall) and states (i.e., those without customs ports). Such reallocation of labor mitigates or increases wage loses, depending on the case, and can potentially induce job displacement of workers who were originally employed in unaffected industries or states.

6. Robustness Checks

6.1. Pre-trends

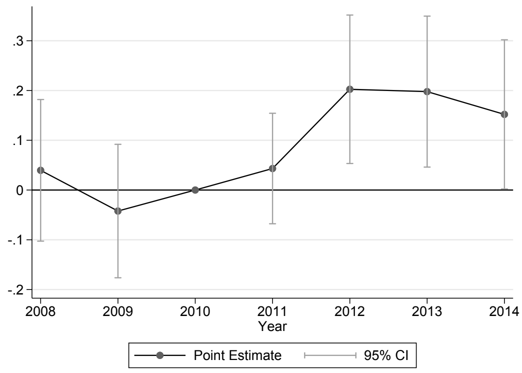
The biggest threat to identification comes by potential pre-trends between our treated and non-treated units. We test for this estimating event study models that identify potential pre-trends between the treated and control groups. Figure 8a plots the coefficients of an event study model, and normalize with respect to 2010, which is when Colombian tariffs were reduced. Panel 8a uses the measures of import competition from the United States as outcome, and resembles the first stage of the model. Panels 8b, 8c, and 8d use log employment, log number of firms, and log average firm size as dependent variables, respectively. These results resemble the reduced form estimates of Table 2. All the models are estimated in the sample aggregated at the industry-state-year level.

We do not observe any pre-trends prior to 2010, suggesting that our main results may not be driven by differentiated trends among industries that experienced tariff reductions nor states with and without customs ports. We do observe an increase in imports after 2011 among industries where tariffs were reduced and states with custom ports, as the first stage suggested. We also see a decrease in employment, number of firms, and the average firm size after 2010. The effect fades on time, except for the number of firms where we do not see any process of mean reversion.

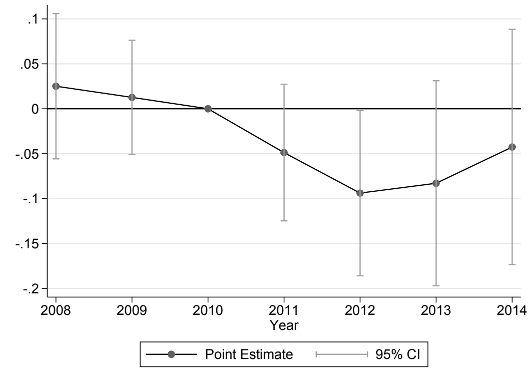
These results give strong evidence that our estimations are not driven by differential pre-trends, and suggest that we are not violating the parallel trends assumption that is necessary for the proper identification of the double and triple-difference model. Instead, it gives evidence of the exogeneity of our instrument and the validity of the exclusion restriction.

Figure 8: Event Studies to Check Existence of Pre-Trends

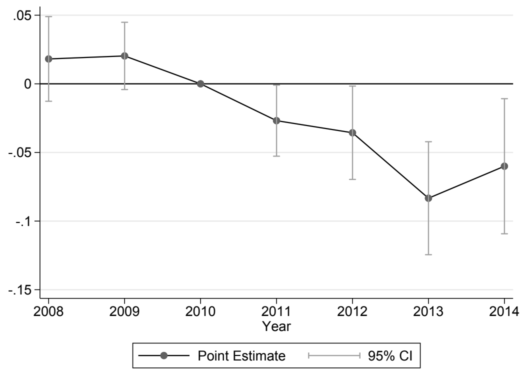
(a) Import Competition



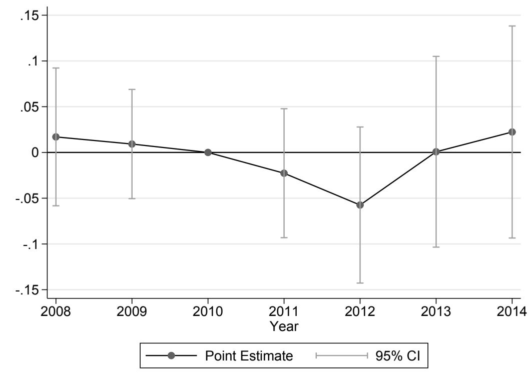
(b) Employment



(c) Number of Firms



(d) Average Firm Size



Notes: These graph presents the point estimates of an event study model using equation 5. Panel 8a uses import competition as dependent variable, panel 8b uses log Employment, panel 8c use log of the number of firms, and panel 8d uses log of average firm size. We interact IMP^{ddd}_{sjt} and EXP^{ddd}_{sjt} with yearly dummies, and exclude 2010. We present the coefficients on the interactions of IMP^{ddd}_{sjt} and the yearly dummies. Standard errors are clustered at the state*industry level. 95% confidence intervals are shown.

6.2. Differences-in-Differences

Our results are additionally robust to just using a differences-in-differences strategy. In particular, we use the tariff reduction of the free trade agreement before and after 2010 to design a differences-in-differences estimator, and ignore differences among states with and without customs ports. For such we use an import shock as in equation 3 and first identify the effect of that shock on the measure of import competition. This estimation is the first stage of the model, and the results are presented in columns (1) to (3) of table 1. Using this as first stage, we instrument the measure of import competition and estimate the following model:

$$Y_{sjt} = \gamma_1^{dd} \log(\widehat{\text{IC}})_{sjt} + \gamma_2^{dd} \log(\text{EW})_{sjt} + \mu_j + \mu_s + \mu_t + e_{sjt}, \tag{9}$$

where we control by the measure of exports, and include industry (μ_j), state (μ_s), and year (μ_t) fixed effects. Standard errors are clustered at the industry–state level. The results are presented in table 3. We present reduced forms, OLS, and IV results. Columns (1) to (3) use log employment as outcome, columns (4) to (6) use the log number of firms, and columns (7) to (9) use the log of average firm size.

Table 3: Imports from the U.S. and Decline on Employment: *D-i-D* Model

	log (Employment)			log (Number of Firms)			log (Firm Size)		
	RF	OLS	IV	RF	OLS	IV	RF	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1(COL reduction)**Post*	-0.268***			-0.135***			-0.130***		
	(0.022)			(0.009)			(0.018)		
log(Import Competition)		0.044***	-2.020***		0.011***	-0.952***		0.031***	-1.065***
		(0.008)	(0.379)		(0.004)	(0.175)		(0.006)	(0.218)
Observations	142,212	142,212	142,212	142,212	142,212	142,212	142,212	142,212	142,212
F-first stage			33.315			33.315			33.315
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: This table presents the estimation of equation 9. Columns (1)-(3) use log of employment as outcome. Columns (4)-(6) use the log number of firms as outcome. Columns (7)-(9) use the log of the average firm size as outcome. Columns (1), (4), and (7) present reduced form estimates. Columns (2), (5), and (8) presents OLS estimations. Columns (3), (6), and (9) presents two-stage least squares results. All specifications control for industry, state, and year fixed effects. Standard errors clustered at the industry*state level. *** p<0.01, ** p<0.05, * p<0.1

We observe again negative and very precise results in all three estimations. These results suggest again that the decrease in employment is mediated by firms exiting and shrinking. The magnitudes are bigger than the triple-difference model, but they mix results in states who experienced import competition with states that did not. The triple difference accounts for this issue and gives more reliable estimates.

6.3. Moving Fixed Effect Structure

All the estimates so far include a very conservative structure of fixed effects. Our strategy relies on within industry and state variation as the proper exogenous source of variation that identifies the model. However, there are alternative combinations of fixed effects that use different source of time variation to estimate the model. Our results are not altered when considering alternative less-demanding combinations. We present in Table 4 alternative models that change the structure of the fixed effects, and therefore the identifying variation.

Columns (1) to (3) show that the result in the difference-in-difference model remains unchanged when different fixed effects are included. The precision of the estimates is the same, although the magnitudes change. In columns (5) to (7) we do the same using the triple-difference model. All specifications include state-by-industry fixed effects since our instrument is valid exclusively using within state and industry variation. We see that the sign does not change when including year-by-state not year-by-industry fixed effects. However, we do observe a decrease in magnitude and precision when industry-by-year fixed effects are included. This estimate is our preferred specification since it shows more conservative estimates.

6.4. Input Prices

An increase in imported products from the United States increases competition for local firms, but also decreases the cost of some inputs. Firms may be harmed if there is an increase in import competition, but they may also benefit if there is a decrease in the cost of inputs Goldberg, Khandelwal, Pavcnik, and Topalova (2010). The effects of import competition on the number of firms, for instance, may be mediated by the direct effect of competition or by a decrease in the cost of inputs. To account for the effect on input prices and isolate the effect of import competition, we compute a measure for the cost of inputs and include it as a control.

To construct this measure, we use detailed data on all the goods imported by every firm in

2008. These data includes information on the firms' industry and state. Using this, we compute the following measure of input prices at the state (s), industry (j), and year (t) level:

$$IP_{sjt} = \frac{\sum_k \left[\text{Imports}_{ksjt} \times \left(T^{2008}_{ksj} \times \log(\text{Import Intensity})^{2008}_{sj}\right)\right]}{K_{sj}},$$

where k indexes each input and K_{sj} is the total number of inputs used per industry by state. Imports_{ksjt} correspond to the imported value of input k by industry j, state s, and year t. We multiply this value times some weights that measure the relevance of input k and the intensity in imports of industry j by state s. T^{2008}_{ksj} is a weight equivalent to the percentage imported of good k with respect to the total imported goods in industry j, state s, in 2008. Formally, the weights are equivalent to:

$$T^{2008}_{ksj} = \frac{\text{Imports}^{2008}_{ksj}}{\sum_k \text{Imports}^{2008}_{ksj}}.$$

Import intensity is a measure of how much the output sector j in state s imported in 2008. We expect that industries that import more are more affected by input prices. Therefore, we multiply the weights for a measure of import intensity. We normalize such measure by the number of employees in 2005 and take logs. Formally such measure is equivalent to:

$$\log(\text{Import Intensity})^{2008}_{sj} = \log\left(\frac{\sum_k \text{Imports}^{2008}_{ksj}}{L^{2005}_{sj}}\right).$$ [34]

We then average across the k inputs to construct a weighted average of the prices of imported inputs for each industry, state, and year.

We include this measure as a control, and present the results in columns (4), for the differences-in-differences model, and columns (8), for the triple-difference model, of Table 4. For both cases we observe that the measure of input costs do not have much of an effect on the point estimate of the coefficient associated with the measure of import competition. Therefore, we are able to conclude that the effect of import competition from the United States is neither mediated nor affected by a reduction in input prices. Similar results are found in Autor, Dorn, and Hanson (2013) when analyzing the employment effects of Chinese import competition among labor markets in the United States.

6.5. Mining and additional Years

Finally, we present the results of our main strategy, including the mining sector and the years 2015 and 2016. Recall that we dropped the mining sector because of potential confounders due to the high volatility in the price of oil. A decrease in the price of oil can affect the mining industry, which is one of the biggest industrial sectors in Colombia. Therefore, imports from this industry could be correlated with fluctuations in oil prices, rather than with the free trade agreement; this could confound the estimates. Furthermore, recall that data from 2015 and 2016 were also dropped because of a steep devaluation that affected Colombia in those two years. A peso devaluation (or a dollar appreciation) changes the prices of imports and, thus, could confound the timing of the free trade agreement's potential effects. Both forces could potentially bias our estimations, so we chose not to include them in our main strategy.

However, our main results do not change much when these additional observations are included. In Table 5 we again present the results of the difference-in-difference and triple difference models, including the reduced form, OLS, IV, and input cost-controlled specifications. The results are very close to our main estimates, but they may be somewhat biased due to the variability in the price of oil in 2009 and 2010.

The same happens when we include data from 2015 and 2016. We present these results in Table 6, in which we follow the same structure but include these two additional years. Again the main results do not change much, but these results do show larger point estimates that can be confounded by exchange rate fluctuations that primarily affect our measure of imports. We can evidence this by observing the decrease in the F-stat of the first stage compared to the estimations without 2015 and 2016. Nonetheless, all the estimates maintain the signs, and precision does not change dramatically.

In general, our results are robust to alternative samples, controls, and specifications. The signs, magnitudes, and precision are not affected. We also show strong evidence about the non-existence of pre-trends, that validate our identifying assumptions.

Table 4: Robustness of the Effects of Import Competition from the U.S.

	Differences-in-Differences				Triple-Differences			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A) log *Employment*								
log(IC)	-0.697***	-1.874***	-2.020***	-2.057***	-2.176***	-2.258***	-0.640*	-0.639*
	(0.057)	(0.374)	(0.379)	(0.383)	(0.472)	(0.484)	(0.331)	(0.331)
B) log *Number of Firms*								
log(IC)	-0.390***	-0.875***	-0.952***	-0.972***	-1.044***	-1.227***	-0.559***	-0.559***
	(0.029)	(0.173)	(0.175)	(0.177)	(0.217)	(0.249)	(0.193)	(0.193)
C) log *Average Firm Size*								
log(IC)	-0.270***	-1.000***	-1.065***	-1.079***	-1.229***	-1.029***	-0.105	-0.105
	(0.029)	(0.215)	(0.218)	(0.220)	(0.296)	(0.265)	(0.243)	(0.243)
Observations	142,212	142,212	142,212	142,212	142,212	142,212	142,212	142,212
F-first stage	377.439	33.349	33.315	33.418	26.318	27.098	11.352	11.338
Year FE	Yes	Yes	Yes	Yes	Yes	No	No	No
Industry FE		Yes	Yes	Yes	No	No	No	No
State FE			Yes	Yes	No	No	No	No
Industry*State FE					Yes	Yes	Yes	Yes
State*Year FE						Yes	Yes	Yes
Industry*Year FE							Yes	Yes
Inputs Cost Reduction				Yes				Yes

Note: This table presents IV estimations using the log of employment as outcome in panel A), the log of number of firms in panel B), and the log of average firm size in panel C). Log(IC) stands for log of import competition. Columns (1)-(4) present the estimates of equation 9, but vary on the fixed effects included. Column (1) includes year fixed effects, column (2) adds industry fixed effects, and column (3) adds state fixed effects. Column (4) includes the measure of inputs costs. Columns (5)-(8) present the results of the estimation of equation 6. Column (5) includes year and state by industry fixed effects. Column (6) includes state by industry and state by year fixed effects. Column (7) adds state by industry fixed effects. Column (8) includes the measure of inputs costs. All specifications additionally control for the log of exports per worker. Standard errors clustered at the industry*state level. *** p<0.01, ** p<0.05, * p<0.1.

Table 5: Effects of Trade of Import Competition Including the Mining Sector

	Reduced Form		OLS		IV		Inputs Cost	
	D-D	*D-D-D*	*D-D*	*D-D-D*	*D-D*	*D-D-D*	*D-D*	*D-D-D*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A) log *Employment*								
1(COL reduction)**Post*	-0.275***							
	(0.021)							
1(COL reduction)**Post**1(Customs)		-0.095**						
		(0.040)						
log(Import Competition)			0.035***	-0.010*	-2.718***	-0.816**	-2.706***	-0.816**
			(0.009)	(0.006)	(0.636)	(0.393)	(0.616)	(0.393)
B) log *Number of Firms*								
1(COL reduction)**Post*	-0.134***							
	(0.009)							
1(COL reduction)**Post**1(Customs)		-0.060***						
		(0.015)						
log(Import Competition)			0.009**	-0.003	-1.252***	-0.585***	-1.245***	-0.585***
			(0.004)	(0.002)	(0.289)	(0.216)	(0.279)	(0.216)
C) log *Average Firm Size*								
1(COL reduction)**Post*	-0.144***							
	(0.018)							
1(COL reduction)**Post**1(Customs)		-0.044						
		(0.035)						
log(Import Competition)			0.024***	-0.008*	-1.503***	-0.269	-1.497***	-0.269
			(0.006)	(0.005)	(0.368)	(0.275)	(0.359)	(0.275)
Observations	149,611	149,611	149,611	149,611	149,611	149,611	149,611	149,611
F-first stage					20.59	9.782	21.593	
Year FE	Yes	No	Yes	No	Yes	No	Yes	No
Industry FE	Yes		Yes		Yes		Yes	
State FE	Yes		Yes		Yes		Yes	
Industry*State FE		Yes		Yes		Yes		Yes
State*Year FE		Yes		Yes		Yes		Yes
Industry*Year FE		Yes		Yes		Yes		Yes
Input Import Cost							Yes	Yes

Note: This table presents estimations using the log of employment as outcome in panel A), the log of number of firms in panel B), and the log of average firm size in panel C). All specifications include the mining sector. Column (1) and column (2) present the estimates of equations 4 and 5, respectively. The coefficients on EMP_{sjt}^{dd} and EMP_{sjt}^{ddd} are not shown. Column (3) presents the estimation of the OLS version of equation 9, and column (4) of equation 6. Columns (5) and (6) present the second stage estimates of equations 9 and 6, respectively. Columns (7) and (8) additionally control for input costs. Standard errors clustered at the industry*state level. *** p<0.01, ** p<0.05, * p<0.1

Table 6: Effects of Trade of Import Competition Including 2015-2016

	Reduced Form		OLS		IV		Inputs Cost	
	D-D	*D-D-D*	*D-D*	*D-D-D*	*D-D*	*D-D-D*	*D-D*	*D-D-D*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A) log *Employment*								
1(COL reduction)**Post*	-0.353***							
	(0.025)							
1(COL reduction)**Post**1(Customs)		-0.107**						
		(0.046)						
log(Import Competition)			0.044***	-0.003	-3.731***	-1.165*	-3.341***	-1.136*
			(0.008)	(0.006)	(0.914)	(0.679)	(0.746)	(0.660)
B) log *Number of Firms*								
1(COL reduction)**Post*	-0.178***							
	(0.011)							
1(COL reduction)**Post**1(Customs)		-0.083***						
		(0.018)						
log(Import Competition)			0.010***	-0.002	-1.779***	-1.023**	-1.574***	-0.977**
			(0.003)	(0.002)	(0.433)	(0.478)	(0.348)	(0.453)
C) log *Average Firm Size*								
1(COL reduction)**Post*	-0.173***							
	(0.020)							
1(COL reduction)**Post**1(Customs)		-0.026						
		(0.040)						
log(Import Competition)			0.033***	-0.002	-1.963***	-0.100	-1.786***	-0.131
			(0.006)	(0.005)	(0.498)	(0.393)	(0.416)	(0.389)
Observations	182,844	182,844	182,844	182,844	182,844	182,844	182,844	182,844
F-first stage					17.768	5.203	21.582	5.353
Year FE	Yes	No	Yes	No	Yes	No	Yes	No
Industry FE	Yes		Yes		Yes		Yes	
State FE	Yes		Yes		Yes		Yes	
Industry*State FE		Yes		Yes		Yes		Yes
State*Year FE		Yes		Yes		Yes		Yes
Industry*Year FE		Yes		Yes		Yes		Yes
Input Import Cost							Yes	Yes

Note: This table presents estimations using the log of employment as outcome in panel A), the log of number of firms in panel B), and the log of average firm size in panel C). All specifications include 2015-2016. Column (1) and column (2) present the estimates of equations 4 and 5, respectively. The coefficients on EMP^{dd}_{sjt} and EMP^{ddd}_{sjt} are not shown. Column (3) presents the estimation of the OLS version of equation 9, and column (4) of equation 6. Columns (5) and (6) present the second stage estimates of equations 9 and 6, respectively. Columns (7) and (8) additionally control for input costs. Standard errors clustered at the industry*state level. *** p<0.01, ** p<0.05, * p<0.1

7. Conclusion

In this paper we explore how import competition from the United States affects firms and employment in Colombia. We additionally take advantage of a high-dimensional workers and firms fixed model (i.e., the AKM model) to find proxies for firms' productivity and workers' skills, and estimate heterogeneous effects of import competition among them. To the best of our knowledge we are the first to study the effects of import competition from a developed country on a developing country, to analyze the empirical effects of free-trade agreements in general, and to estimate the heterogeneous effects of import competition across the distribution of firm- and worker-specific wage premiums.

We take advantage of the implementation of a free trade agreement signed between Colombia and the United States, and regional variation in access to trade, to estimate the effect of increased import competition from the United States on Colombian firms and local labor markets. The free trade agreement led to increased competition from goods coming from the United States, but left exports unaffected because already low tariffs on Colombia goods exported to the United States remained intact. Furthermore, competition from U.S. goods increased exclusively in specific Colombian regions: those states with access to customs ports. Colombia's lack of infrastructure (trains and roads) hinders wider distribution of the imported products. This unique setting enables us to identify the effect of import competition from the United States on Colombian firms and formal-sector workers.

We use administrative matched employer-employee that allow us to track job spells for formal workers up to four years after the tariff reduction. These data also allow us to estimate high-dimensional firm- and worker-fixed effect models, and estimate the heterogeneous effects among low- and high-fixed effect firms and workers. These fixed effects account for firm and worker wage premiums, which can be interpreted as measures of productivity and skills, respectively. Though the data set excludes informal workers, these data offer a nearly ideal way to identify the effects of import competition on firm exit and employment.

Our results suggest that a 10 percent increase in import competition from the United States decreases employment on 6.4 percent in Colombia. The decrease in employment is mainly driven by low-productivity firms that exit or shrink. High-productivity firms do not grow, suggesting that local consumers substitute locally produced goods for imported products from the United States. We also observe that workers shift mainly from affected to unaffected industries and regions. We do not observe effects on wages suggesting that reallocation mitigates such effects, except for the case of workers originally working in low-productivity firms who presumably reallocate and displace former workers in unaffected industries and regions by accepting lower paid jobs. Low-skilled workers seem to be the most affected since they are more likely to lose their (formal) job.

This paper provides evidence of the positive and the potentially negative effects of import competition from high-wage countries for developing countries. Spurring the exit of low-productivity firms can boost employment and development, as many have suggested. However, this process exacts a price in terms of employment among lower-skilled workers. The question regarding how long these effects last remains unanswered and should motivate future research on the topic. Negative effects on employment may be mitigated in a longer run, potentially boosting the benefits.

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A. Mathematical Appendix

A.1. Workers

Consider a continuum of skilled (S) and unskilled (U) workers indexed by i endowed with a unit of time, and a continuum of firms indexed by j. Workers choose between consumption and leisure, and have preferences over the firms as in Card, Cardoso, Heining, and Kline (2018). In this model, workers have heterogeneous preferences for firms who offer differentiated work environments. The utility function for each skill group takes the form of:

$$U(C_{ij}, L_{ij}) = \frac{C_{ij}^{1-\frac{1}{\nu}}}{1-\frac{1}{\nu}} - \frac{L_{ij}^{1+\frac{1}{\gamma_{i,j}}}}{1+\frac{1}{\gamma_{i,j}}},$$

where C_{ij} corresponds to aggregate consumption and L_{ij} to hours worked. Note that preferences depend on the individual, $i \in \{S, U\}$, and the firm, j, where the individual works. We define the wage elasticity of labor supply, γ_{ij}, as specific to every skill group i who works in a firm j. Individuals have preferences over firms such that the wage elasticity of supply is firm specific.

Aggregate consumption is a composite of national (N) and foreign (F) goods:

$$C_i = \left[(C_N^i)^\rho + (C_F^i)^\rho\right]^{\frac{1}{\rho}},$$

where $0 < \rho < 1$.[35] To determine the consumption of both types of goods, agents solve:

$$\min_{C_N^i, C_F^i} P_N C_N^i + P_F C_F^i \text{ s.t. } \left[(C_N^i)^\rho + (C_F^i)^\rho\right]^{\frac{1}{\rho}} = C_i,$$

where $P_F = P_F^0(1+\tau)$ and τ is an ad-valorem tariff charged to foreign products. The solution to the worker's problem yields consumption levels of national and foreign goods for skilled and unskilled workers of the form:

$$C_k^i = \frac{P_k^{-\sigma}}{P^{1-\sigma}} C_i \text{ for } i \in \{S, U\}, \text{ and } k \in \{N, F\},$$

where $P = \left[P_N^{1-\sigma} + [P_F^0(1+\tau)]^{1-\sigma}\right]^{\frac{1}{1-\sigma}}$ is the CES price index. National and foreign goods are substitutes because $\rho < 1$.[36]

The allocation of the worker's unit of time between consumption and leisure determines labor supply. Formally, agents choose:

$$\max_{C_{ij}, L_{ij}} \frac{C_{ij}^{1-\frac{1}{\nu}}}{1-\frac{1}{\nu}} - \frac{L_{ij}^{1+\frac{1}{\gamma_{ij}}}}{1+\frac{1}{\gamma_{ij}}} \text{ s.t. } PC \leq W_{ij} L_{ij},$$

[35]This implies that the elasticity of substitution, $\sigma = \frac{1}{1-\rho}$, is positive and bigger than one. If $\rho > 1$ then $\sigma < 0$. If $\rho < 0$ then $\sigma \in \{0, 1\}$.

[36]The price elasticity of consumption of national goods with respect to the price of foreign goods (or the the tariff τ) is positive. This implies that a price decrease of foreign goods (or a decrease in tariffs) decreases the demand of national goods.

where the amount of leisure corresponds to $N_{ij} = 1 - L_{ij}$, and it varies by skill group and firm. Labor supply is thus firm- and worker- specific:

$$\frac{W_{ij}}{P} = C_i^{\frac{1}{\nu}} L_{ij}^{\frac{1}{\gamma_{ij}}},$$

where γ_{ij} corresponds to the wage elasticity and ν to the price elasticity of demand.

A.2. Firms

Consider a continuum of J national firms. Each firm $j \in J$ produces output combining labor and capital goods. Labor can be skilled, L_S, or unskilled, L_U, whereas capital goods can be national, X_N, or foreign, X_F. The production function is formally given by:

$$Y_j(L_j, X_j) = \varphi_j f\left(L_j(L_{Sj}, L_{Uj}), X_j(X_{Nj}, X_{Fj})\right)$$

where φ_j is the productivity associated to firm j, and $f(\cdot)$ is the production function of firm j that combines labor and capital goods to produce output.[37]

We assume a monopsonic setup in which firms have market power when hiring workers, but are price takers in the capital and output markets. Thus, firms offer a wage bundle $\{W_{Sj}, W_{Uj}\}$ that determines labor demand, and choose an optimal amount of national and foreign capital goods subject to the labor supply schedules of workers:

$$\min_{W_{Uj}, W_{Sj}, X_{Nj}, X_{Fj}} W_{Uj}L_{Uj} + W_{Sj}L_{Sj} + X_{Nj}Q_{Nj} + X_{Fj}Q_{Fj}(1+\tau) \text{ s.t. } Y_j(L_j, X_j) \geq Y$$

$$L_{ij} = \left[W_{ij}\left(PC_i^{\frac{1}{\nu}}\right)^{-1}\right]^{\gamma_{ij}},$$

where τ corresponds to the ad-valorem tariff charged to foreign goods.

A.2.1 Firm- and Individual- Wage Premiums

The wage setting condition for each skill group gives the following expression:

$$W_{ij}\left(\frac{1+\gamma_{L_{ij}}}{\gamma_{L_{ij}}}\right) = \lambda \varphi_j f_L(L_j, X_j) L'(L_i),$$

where $f_L(L_j, X_j)$ is the marginal product of labor which is specific for each firm, $L'(L_i)$ is the marginal product of skill type i, and λ is the lagrange multiplier that is constant across all workers. Note that we substitute $L'_j(L_{ij}) = L'(L_i)$ because the marginal product of skill type i is the same across all firms.

[37] Fieler, Eslava, and Xu (2018) present a solution for this model assuming different functional forms of the production function. Their main results use a nested CES production function.

Reordering terms and taking logarithms yields:

$$\ln W_{ij} = \ln\lambda + \underbrace{\ln(\varphi_j f_L(L_j,X_j))}_{FWP} + \underbrace{\ln(L'(L_i))}_{WWP} - \ln(M_{ij}(\gamma_{Sj}))$$

where $M_{ij}(\gamma_{ij}) = \frac{1+\gamma_{ij}}{\gamma_{ij}}$ is a markdown that decreases wages from the competitive equilibrium because of the firm's market power. Thus, wages can be decomposed into four separate components: 1) A value, $\ln\lambda$, common to all workers; 2) A component common to all workers in firm j ($\ln(\varphi_j f_L(L_j,X_j))$, which we call the "firm-specific wage premium" (FWP); 3) an individual component determined by the marginal productivity of skill type i ($\ln(L'_j(L_{ij}))$, , which we call the worker-specific wage premium (WWP); and 4) a component that quantifies the match between the worker and the firm ($\ln(m_{ij}(\gamma_{ij}))$ that is equivalent to the wage markdown and is a function of the wage elasticity of supply of workers to firm j.

Note that the FWP depends on the firm's inherent productivity and on the marginal product of labor in that specific firm. Thus, following Card, Cardoso, Heining, and Kline (2018) we consider the FWP as a close proxy for the firm's productivity level.[38] The WWP, on the contrary, is the marginal product worker type i and is irrespective of the firm. Therefore, workers' wage is highly mediated by the firm where they work and their own productivity, which is a measure of skill.

In addition, note that the equilibrium wages are affected by tariff changes in two ways: 1) substituting with foreign capital goods; and 2) inducing firms to close (or enter) and worker reallocation. Workers can receive wage increases or decreases by moving to more or less productive firms, respectively. If skilled workers (or any particular group) are more likely to reallocate into more productive firms then we can expect wage inequality to rise.

A.2.2 Firms' Productivity Level

Melitz (2003) suggested that international trade induces less productive firms to exit the markets and more productive firms to enter. In the setting of this paper, we observe similar patterns by analyzing the minimum productivity level required to make a firm profitable.

Assume that firms have a level of productivity, $\varphi_j \sim G$, that is known before entering the market. A firm will only decide to enter if their own productivity level ,φ_j, is not below a threshold level φ_j^* defined by:

$$\varphi_j^*(\tau) \equiv \frac{W_{Uj}L_{Uj} + W_{Sj}L_{Sj} + X_N Q_N + X_F Q_F(1+\tau)}{P_N(\tau) f(L_j,X_j)} \tag{A.1}$$

If a firm's productivity level is not below φ_j^* then the firm will enter the market. It can also be the case that a firm that is already in the market decides to exit if φ_j^* increases above its own productivity φ_j.

A change in tariffs affects the threshold in two ways. First, it decreases the price of foreign goods used as inputs in production. This implies a reduction in the input costs of firms

[38] Card, Cardoso, Heining, and Kline (2018) present a discussion on how firm's productivity relates to the FWP and wages.

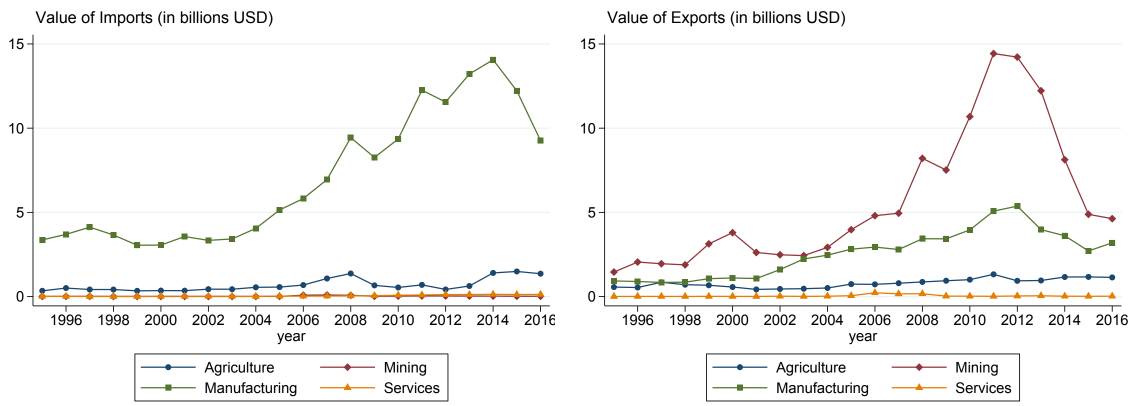
which will enable less productive firms to enter the market by decreasing φ_j^*. This reduction decreases the numerator of (A.1). Second, the reduction in the price of foreign goods also affects the demand for local products. In fact, the price elasticity of consumption of local goods ($C_N = C_N^U + C_N^S$) with respect to foreign goods' prices is positive. Therefore, a decrease in tariffs reduces the demand of national goods and therefore the price P_N. Formally $P_N'(\tau) > 0$, which implies that a reduction in tariffs reduces P_N, increases φ_j^*, and induces less productive firms to exit the market.

The change in the threshold with respect to a change in tariffs, $\frac{\partial \varphi_j^*(\tau)}{\partial \tau}$, depends on how these two forces interact. Formally, a change in tariffs motivates less productive firms to exit the market (i.e. $\frac{\partial \varphi_j^*(\tau)}{\partial \tau} < 0$) if $P_N < (1+\tau)P_N'(\tau)$. In words, firm exit depends on the degree in which national prices adjust to changes in tariffs, on the magnitude of the tariffs, and on the magnitude of the national prices. Therefore, under certain conditions an increase in imports penetration can motivate less productive firms to exit the market. Workers who are able sort to more productive firms/industries will have wage increases, while workers who are less mobile will experience wage losses and potentially unemployment.

B. Appendix Figures

Appendix Figure B.1: Colombian Imports and Exports by Industry

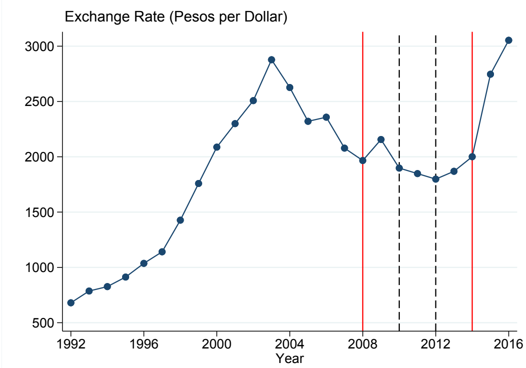
(a) Imports (b) Exports



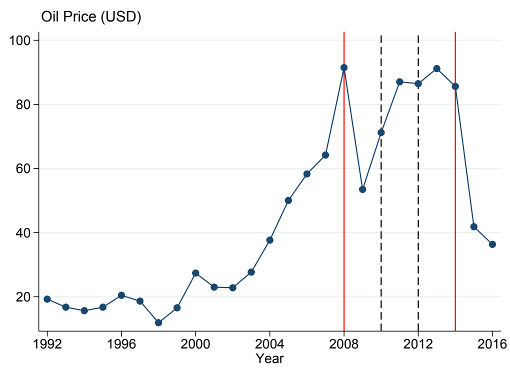
Notes: These graphs present the value of imports and exports in USD millions by two-digit industry codes. These industries correspond to agriculture, manufacturing, mining, and services. The left panel presents imports, whereas the right presents exports.

Appendix Figure B.2: Macroeconomic Environment

(a) Exchange Rates

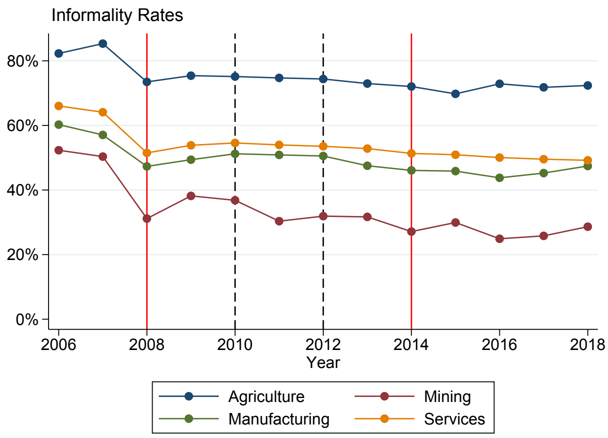


(b) Oil Prices



Notes: These graphs describe the macroeconomic environment around the implementation of the free-trade agreement. Panel B.2a presents the evolution of the exchange rate of U.S. dollars to Colombian pesos. Panel B.2b presents the evolution of the price of oil (in dollars). The vertical solid lines depict the period analyzed in this paper. The vertical dashed lines correspond to the year when Colombia (2010) and the United States (2012) reduced tariffs.

Appendix Figure B.3: Colombian Informality Rates



Notes: These graph presents the evolution of the informality rate in Colombia defined as persons who do not contribute to pension nor health. The vertical solid lines depict the period analyzed in this paper. The vertical dashed lines correspond to the year when Colombia (2010) and the United States (2012) reduced tariffs.

C. Appendix Tables

Appendix Table C.1: Descriptive Statistics Across Samples

	Count (1)	Mean (2)	S.D. (3)	Min. (4)	Max. (5)
A) Workers					
1(Male)	5,870,178	0.61	0.49	0.00	1.00
Age	5,870,178	41.52	9.36	26.00	63.00
1(Works at Endline)	5,870,178	0.77	0.42	0.00	1.00
1(Same 2-digit Ind. at Endline)	4,504,017	0.24	0.43	0.00	1.00
1(Same firm at Endline)	4,504,017	0.26	0.44	0.00	1.00
1(Same State)	4,504,017	0.60	0.49	0.00	1.00
log(Wage)	5,499,549	15.69	1.17	0.25	22.11
log(Daily Wage)	5,482,481	10.57	0.69	0.00	18.84
1(State that Trades)	5,870,178	0.74	0.44	0.00	1.00
1(Col Reduction)	5,870,178	0.06	0.23	0.00	1.00
1(USA Reduction)	5,870,178	0.01	0.11	0.00	1.00
1(Col Reduction)*1(State that Trades)	5,870,178	0.05	0.21	0.00	1.00
log(Output Import Competition)	5,870,178	0.59	2.45	0.00	19.66
B) Firms					
1(Open at Endline)	165,724	0.76	0.43	0.00	1.00
log(Days Worked)	165,724	7.40	1.87	0.22	15.20
log(Daily Wage)	165,693	10.48	0.55	0.04	15.92
Firm Wage Premium	152,793	-0.04	0.27	-10.75	6.96
1(State that Trades)	165,724	0.66	0.47	0.00	1.00
1(Col Reduction)	165,724	0.08	0.26	0.00	1.00
1(USA Reduction)	165,724	0.02	0.12	0.00	1.00
1(Col Reduction)*1(State that Trades)	165,724	0.05	0.23	0.00	1.00
log(Exports per Worker)	165,724	0.39	1.81	0.00	16.24
log(Output Import Competition)	165,724	0.53	2.31	0.00	19.66
C) Industry-State with at least one employee		.			
Employment	142,212	516.82	3,927.06	0.00	298,019.00
Wage with zeros (USD)	142,212	303.19	266.62	0.00	13,244.75
Number of Firms	142,212	20.90	264.90	0.00	34,465.00
Firm Size	142,212	23.46	114.31	0.00	16,671.00
Imports Per Worker (in millions)	142,212	0.03	2.36	0.00	384.50
Exports Per Worker (in millions)	142,212	0.01	1.09	0.00	179.68
1(COL reduction)	142,212	0.12	0.32	0.00	1.00
1(USA reduction)	142,212	0.02	0.14	0.00	1.00
1(States Trades with US)	142,212	0.30	0.46	0.00	1.00
1(COL reduction)**Post**1(Customs)	142,212	0.02	0.15	0.00	1.00
1(USA reduction)**Post**1(Customs)	142,212	0.00	0.06	0.00	1.00

Note: This table presents descriptive statistics of the three samples used. Panel A) describes the sample of incumbent workers observed in 2010 and tracked until 2014. Panel B) describe the sample of incumbent firms observed in 2010 and tracked until 2014. Panel C) describes the sample of industries-states-years from 2008 to 2014. Values of this sample were replaced to zero if that observation was missing for that year but we observed it in any other year. 1() stands for a dummy variable that takes the value of one if the condition inside parentheses is met.

Appendix Table C.2: First Stage at the Worker and Firm Level

	(1)	(2)	(3)	(4)	(5)
A) Worker Level					
1(COL reduction)1(Trade)	1.284**	1.277**	1.297**	1.725***	1.731***
	(0.589)	(0.589)	(0.589)	(0.367)	(0.361)
Log(Exports per Worker)	1.047***	1.047***	1.047***	0.676***	0.671***
	(0.073)	(0.073)	(0.073)	(0.042)	(0.042)
Observations	6,615,624	6,615,624	6,615,624	6,615,624	6,615,624
F-stat	4.751	4.696	4.696	22.038	22.985
B) Firm Level					
1(COL reduction)1(Trade)	4.065***	4.066***	4.157***	2.728***	2.734***
	(0.352)	(0.352)	(0.357)	(0.259)	(0.254)
Log(Exports per Worker)	0.615***	0.616***	0.611***	0.196***	0.191***
	(0.088)	(0.088)	(0.087)	(0.043)	(0.043)
Observations	165,724	165,724	165,724	165,724	165,724
F-stat	133.367	133.321	135.282	110.66	116.189
Demographics		Yes	Yes	Yes	Yes
Industry FE				Yes	Yes
State FE			Yes		Yes

Note: This table presents the first stage of equation 7. *** p<0.01, ** p<0.05, * p<0.1

Appendix Table C.3: Effects of Import Competition on Indicator for whether firm open by Quartiles of Firms-Specific Wage Premiums

	Quartile 1	Quartile 2	Quartile 3	Quartile 4
	(1)	(2)	(3)	(4)
A) 2011				
log(IC)	0.000	0.001	-0.001	-0.003
	(0.005)	(0.004)	(0.004)	(0.004)
B) 2012				
log(IC)	-0.020*	-0.011	-0.007	-0.009
	(0.011)	(0.007)	(0.007)	(0.011)
C) 2013				
log(IC)	-0.026***	-0.017**	0.003	-0.016*
	(0.010)	(0.008)	(0.008)	(0.010)
D) 2014				
log(IC)	-0.027**	-0.010	-0.004	-0.009
	(0.011)	(0.008)	(0.008)	(0.012)
Observations	38,958	39,003	38,953	38,956
Demographics	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
log(Exports)	Yes	Yes	Yes	Yes

Note: This table presents the estimation of Equation 7 on indicator for whether firm open separately by quartiles of the firms-specific wage premiums and year. Panel A) presents results for 2011, panel B) for 2012, panel C) for 2013, and panel D) for 2014. Column (1) plots estimates among quartile 1, column (2) for quartile 2, column (3) for quartile 3, and column (4) for quartile 4. All specifications control for age, age-squared, gender, wages in 2010, and exports per workers. State and industry fixed effects included. Standard errors clustered at the industry–state level. *** p<0.01, ** p<0.05, * p<0.1

Appendix Table C.4: Effects of Import Competition on firm size by Quartiles of Firms-Specific Wage Premiums

	Quartile 1 (1)	Quartile 2 (2)	Quartile 3 (3)	Quartile 4 (4)
A) 2011				
log(IC)	-0.093*	0.031	-0.024	-0.034
	(0.053)	(0.045)	(0.055)	(0.057)
B) 2012				
log(IC)	-0.118*	-0.017	-0.007	-0.034
	(0.071)	(0.046)	(0.062)	(0.075)
C) 2013				
log(IC)	-0.102*	0.005	-0.012	-0.033
	(0.053)	(0.044)	(0.056)	(0.051)
D) 2014				
log(IC)	-0.099*	0.022	-0.014	-0.034
	(0.055)	(0.050)	(0.059)	(0.056)
Observations	37,505	37,512	37,858	38,013
Demographics	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
log(Exports)	Yes	Yes	Yes	Yes

Note: This table presents the estimation of Equation 7 on firm size separately by quartiles of the firms-specific wage premiums and year. Panel A) presents results for 2011, panel B) for 2012, panel C) for 2013, and panel D) for 2014. Column (1) plots estimates among quartile 1, column (2) for quartile 2, column (3) for quartile 3, and column (4) for quartile 4. All specifications control for age, age-squared, gender, wages in 2010, and exports per workers. State and industry fixed effects included. Standard errors clustered at the industry–state level. *** p<0.01, ** p<0.05, * p<0.1

Appendix Table C.5: Effects of Import Competition on Indicator for whether the individual works by Quartiles of Firms-Specific Wage Premiums

	Quartile 1 (1)	Quartile 2 (2)	Quartile 3 (3)	Quartile 4 (4)
A) 2011				
log(IC)	0.009*	0.001	0.004	0.004
	(0.005)	(0.004)	(0.003)	(0.005)
B) 2012				
log(IC)	0.011	0.002	-0.000	-0.003
	(0.007)	(0.005)	(0.003)	(0.005)
C) 2013				
log(IC)	0.007	-0.002	0.000	-0.003
	(0.005)	(0.005)	(0.004)	(0.005)
D) 2014				
log(IC)	0.004	-0.001	-0.000	-0.001
	(0.004)	(0.005)	(0.004)	(0.005)
Observations	1,411,549	1,412,053	1,411,162	1,411,607
Demographics	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
log(Exports)	Yes	Yes	Yes	Yes

Note: This table presents the estimation of Equation 7 on indicator for whether the individual works separately by quartiles of the workers-specific wage premiums and year. Panel A) presents results for 2011, panel B) for 2012, panel C) for 2013, and panel D) for 2014. Column (1) plots estimates among quartile 1, column (2) for quartile 2, column (3) for quartile 3, and column (4) for quartile 4. All specifications control for age, age-squared, gender, wages in 2010, and exports per workers. State and industry fixed effects included. Standard errors clustered at the industry–state level. *** p<0.01, ** p<0.05, * p<0.1

Appendix Table C.6: Effects of Import Competition on Worker log Daily Wage by Quartiles of Firms-Specific Wage Premiums

	Quartile 1 (1)	Quartile 2 (2)	Quartile 3 (3)	Quartile 4 (4)
A) 2011				
log(IC)	-0.032*	-0.002	-0.004	-0.004
	(0.017)	(0.008)	(0.005)	(0.008)
B) 2012				
log(IC)	-0.056**	0.016**	0.000	0.000
	(0.023)	(0.008)	(0.006)	(0.011)
C) 2013				
log(IC)	-0.045***	0.009	0.002	-0.001
	(0.017)	(0.007)	(0.005)	(0.008)
D) 2014				
log(IC)	-0.028**	0.013*	-0.000	0.003
	(0.013)	(0.008)	(0.006)	(0.008)
Observations	1,202,821	1,237,696	1,240,444	1,266,747
Demographics	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
log(Exports)	Yes	Yes	Yes	Yes

Note: This table presents the estimation of Equation 7 on worker log daily wage separately by quartiles of the workers-specific wage premiums and year. Panel A) presents results for 2011, panel B) for 2012, panel C) for 2013, and panel D) for 2014. Column (1) plots estimates among quartile 1, column (2) for quartile 2, column (3) for quartile 3, and column (4) for quartile 4. All specifications control for age, age-squared, gender, wages in 2010, and exports per workers. State and industry fixed effects included. Standard errors clustered at the industry–state level. *** p<0.01, ** p<0.05, * p<0.1

Appendix Table C.7: Effects of Import Competition on Indicator for whether working in unaffected industry by Quartiles of Firms-Specific Wage Premiums

	Quartile 1 (1)	Quartile 2 (2)	Quartile 3 (3)	Quartile 4 (4)
A) 2011				
log(IC)	0.033**	0.018	0.012	0.017
	(0.016)	(0.015)	(0.011)	(0.012)
B) 2012				
log(IC)	0.038*	0.035*	0.006	0.007
	(0.021)	(0.018)	(0.009)	(0.013)
C) 2013				
log(IC)	0.016	0.033*	0.016	-0.007
	(0.014)	(0.019)	(0.015)	(0.012)
D) 2014				
log(IC)	0.016	0.028	-0.012	-0.004
	(0.014)	(0.021)	(0.016)	(0.014)
Observations	1,164,541	1,193,932	1,203,767	1,234,526
Demographics	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
log(Exports)	Yes	Yes	Yes	Yes

Note: This table presents the estimation of Equation 7 on indicator for whether working in unaffected industry separately by quartiles of the workers-specific wage premiums and year. Panel A) presents results for 2011, panel B) for 2012, panel C) for 2013, and panel D) for 2014. Column (1) plots estimates among quartile 1, column (2) for quartile 2, column (3) for quartile 3, and column (4) for quartile 4. All specifications control for age, age-squared, gender, wages in 2010, and exports per workers. State and industry fixed effects included. Standard errors clustered at the industry–state level. *** p<0.01, ** p<0.05, * p<0.1

Appendix Table C.8: Effects of Import Competition on Indicator for whether working in unaffected state by Quartiles of Firms-Specific Wage Premiums

	Quartile 1	Quartile 2	Quartile 3	Quartile 4
	(1)	(2)	(3)	(4)
A) 2011				
log(IC)	0.005*	0.003	0.006***	0.005
	(0.003)	(0.002)	(0.002)	(0.004)
B) 2012				
log(IC)	0.008	0.005*	0.009***	0.010**
	(0.005)	(0.003)	(0.002)	(0.005)
C) 2013				
log(IC)	0.006	0.005*	0.010***	0.008**
	(0.004)	(0.003)	(0.003)	(0.003)
D) 2014				
log(IC)	0.007*	0.004	0.010***	0.005
	(0.004)	(0.003)	(0.003)	(0.004)
Observations	1,209,538	1,240,741	1,245,414	1,273,099
Demographics	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
log(Exports)	Yes	Yes	Yes	Yes

Note: This table presents the estimation of Equation 7 on indicator for whether working in unaffected state separately by quartiles of the workers-specific wage premiums and year. Panel A) presents results for 2011, panel B) for 2012, panel C) for 2013, and panel D) for 2014. Column (1) plots estimates among quartile 1, column (2) for quartile 2, column (3) for quartile 3, and column (4) for quartile 4. All specifications control for age, age-squared, gender, wages in 2010, and exports per workers. State and industry fixed effects included. Standard errors clustered at the industry–state level. *** p<0.01, ** p<0.05, * p<0.1

Appendix Table C.9: Effects of Import Competition on Indicator for whether the individual works by Quartiles of Workers-Specific Wage Premiums

	Quartile 1 (1)	Quartile 2 (2)	Quartile 3 (3)	Quartile 4 (4)
A) 2011				
log(IC)	-0.000	0.005	0.004	0.003
	(0.003)	(0.004)	(0.003)	(0.002)
B) 2012				
log(IC)	-0.008**	0.003	0.005	0.001
	(0.004)	(0.004)	(0.004)	(0.003)
C) 2013				
log(IC)	-0.011**	0.003	0.004	0.001
	(0.004)	(0.004)	(0.004)	(0.003)
D) 2014				
log(IC)	-0.006	0.002	0.005	0.000
	(0.004)	(0.004)	(0.004)	(0.003)
Observations	1,411,610	1,411,950	1,411,189	1,411,620
Demographics	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
log(Exports)	Yes	Yes	Yes	Yes

Note: This table presents the estimation of Equation 7 on indicator for whether the individual works separately by quartiles of the workers-specific wage premiums and year. Panel A) presents results for 2011, panel B) for 2012, panel C) for 2013, and panel D) for 2014. Column (1) plots estimates among quartile 1, column (2) for quartile 2, column (3) for quartile 3, and column (4) for quartile 4. All specifications control for age, age-squared, gender, wages in 2010, and exports per workers. State and industry fixed effects included. Standard errors clustered at the industry–state level. *** p<0.01, ** p<0.05, * p<0.1

Appendix Table C.10: Effects of Import Competition on Worker log Daily Wage by Quartiles of Workers-Specific Wage Premiums

	Quartile 1	Quartile 2	Quartile 3	Quartile 4
	(1)	(2)	(3)	(4)
A) 2011				
log(IC)	0.002	-0.010*	-0.011*	-0.001
	(0.011)	(0.005)	(0.006)	(0.005)
B) 2012				
log(IC)	0.003	-0.002	-0.009	-0.005
	(0.014)	(0.005)	(0.007)	(0.005)
C) 2013				
log(IC)	0.005	-0.002	-0.004	-0.006
	(0.012)	(0.005)	(0.006)	(0.006)
D) 2014				
log(IC)	0.002	0.000	-0.004	-0.001
	(0.012)	(0.005)	(0.007)	(0.007)
Observations	1,231,395	1,205,653	1,203,824	1,306,830
Demographics	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
log(Exports)	Yes	Yes	Yes	Yes

Note: This table presents the estimation of Equation 7 on worker log daily wage separately by quartiles of the workers-specific wage premiums and year. Panel A) presents results for 2011, panel B) for 2012, panel C) for 2013, and panel D) for 2014. Column (1) plots estimates among quartile 1, column (2) for quartile 2, column (3) for quartile 3, and column (4) for quartile 4. All specifications control for age, age-squared, gender, wages in 2010, and exports per workers. State and industry fixed effects included. Standard errors clustered at the industry–state level. *** p<0.01, ** p<0.05, * p<0.1

Appendix Table C.11: Effects of Import Competition on Indicator for whether working in unaffected industry by Quartiles of Workers-Specific Wage Premiums

	Quartile 1	Quartile 2	Quartile 3	Quartile 4
	(1)	(2)	(3)	(4)
A) 2011				
log(IC)	-0.000	0.013	0.046***	0.007
	(0.011)	(0.009)	(0.017)	(0.007)
B) 2012				
log(IC)	-0.009	0.020*	0.057***	0.011
	(0.010)	(0.011)	(0.019)	(0.007)
C) 2013				
log(IC)	-0.028*	0.014	0.054***	0.008
	(0.014)	(0.014)	(0.019)	(0.010)
D) 2014				
log(IC)	-0.005	-0.008	0.040**	0.004
	(0.013)	(0.013)	(0.018)	(0.012)
Observations	1,199,398	1,159,688	1,158,841	1,278,832
Demographics	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
log(Exports)	Yes	Yes	Yes	Yes

Note: This table presents the estimation of Equation 7 on indicator for whether working in unaffected industry separately by quartiles of the workers-specific wage premiums and year. Panel A) presents results for 2011, panel B) for 2012, panel C) for 2013, and panel D) for 2014. Column (1) plots estimates among quartile 1, column (2) for quartile 2, column (3) for quartile 3, and column (4) for quartile 4. All specifications control for age, age-squared, gender, wages in 2010, and exports per workers. State and industry fixed effects included. Standard errors clustered at the industry–state level. *** p<0.01, ** p<0.05, * p<0.1

Appendix Table C.12: Effects of Import Competition on Indicator for whether working in unaffected state by Quartiles of Workers-Specific Wage Premiums

	Quartile 1	Quartile 2	Quartile 3	Quartile 4
	(1)	(2)	(3)	(4)
A) 2011				
log(IC)	-0.000	0.009***	0.006**	0.006***
	(0.002)	(0.002)	(0.002)	(0.002)
B) 2012				
log(IC)	0.001	0.014***	0.008***	0.009***
	(0.003)	(0.004)	(0.003)	(0.003)
C) 2013				
log(IC)	0.001	0.014***	0.008***	0.009***
	(0.003)	(0.003)	(0.003)	(0.003)
D) 2014				
log(IC)	0.001	0.014***	0.008**	0.005*
	(0.003)	(0.003)	(0.004)	(0.003)
Observations	1,235,568	1,209,926	1,209,570	1,313,721
Demographics	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
log(Exports)	Yes	Yes	Yes	Yes

Note: This table presents the estimation of Equation 7 on indicator for whether working in unaffected state separately by quartiles of the workers-specific wage premiums and year. Panel A) presents results for 2011, panel B) for 2012, panel C) for 2013, and panel D) for 2014. Column (1) plots estimates among quartile 1, column (2) for quartile 2, column (3) for quartile 3, and column (4) for quartile 4. All specifications control for age, age-squared, gender, wages in 2010, and exports per workers. State and industry fixed effects included. Standard errors clustered at the industry–state level. *** p<0.01, ** p<0.05, * p<0.1

Appendix Table C.13: Most and Less Imported Products

Before free-trade agreement (2008-2010)		After free-trade agreement (2011-2014)	
Product	Value of Imports (USD)	Product	Value of Imports (USD)
More Imported Products			
Manufacture of refined petroleum products	3,454,817,062	Manufacture of refined petroleum products	18,043,048,647
Manufacture of basic chemicals, except fertilizers and nitrogen compounds	2,986,627,388	Manufacture of basic chemicals, except fertilizers and nitrogen compounds	4,618,210,761
Manufacture of aircraft and spacecraft	2,671,057,996	Manufacture of aircraft and spacecraft	3,904,964,753
Growing of cereals and other crops n.e.c.	2,434,170,631	Growing of cereals and other crops n.e.c.	2,918,795,023
Manufacture of machinery for mining, quarrying and construction	1,674,661,590	Manufacture of plastics in primary forms and of synthetic rubber	2,424,816,198
Manufacture of plastics in primary forms and of synthetic rubber	1,319,655,422	Manufacture of motor vehicles	2,011,364,592
Manufacture of pumps, compressors, taps and valves	1,046,711,803	Manufacture of machinery for mining, quarrying and construction	1,984,965,474
Manufacture of motor vehicles	1,045,354,478	Manufacture of other chemical products n.e.c.	1,657,742,734
Manufacture of other chemical products n.e.c.	901,847,834	Manufacture of pharmaceuticals, medicinal chemicals and botanical products	1,604,872,773
Less Imported Products			
Manufacture of pharmaceuticals, medicinal chemicals and botanical products	864,893,890	Manufacture of pumps, compressors, taps and valves	1,578,531,260
Dramatic arts, music and other arts activities	485,316	Motion picture and video production and distribution	810,482
Manufacture of structural non-refractory clay and ceramic products	351,996	Manufacture of television and radio transmitters	748,602
Cutting, shaping and finishing of stone	197,031	Cutting, shaping and finishing of stone	567,766
Photographic activities	191,111	Fishing, operation of fish hatcheries and fish farms	521,867
Manufacture of tobacco products	134,139	Manufacture of gas; distribution of gaseous fuels through mains	485,745
Manufacture of coke oven products	54,830	Manufacture of wooden containers	110,183
Manufacture of wooden containers	36,301	Photographic activities	79,673
Hairdressing and other beauty treatment	33,667	Manufacture of coke oven products	57,461
Dressing and dyeing of fur; manufacture of articles of fur	24,040	Architectural and engineering activities and related technical consultancy	38,926
Manufacture of gas; distribution of gaseous fuels through mains	10,515	Dressing and dyeing of fur; manufacture of articles of fur	29,811
Architectural and engineering activities and related technical consultancy	9,797	Hairdressing and other beauty treatment	4,214

Note: This table describes the most and less imported products in Colombia from the United States, before and after the free-trade agreement. The values are presented in USD.