Immigration and Firm-level Upgrading as Exports Boosters in Developing Countries*

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Abstract

We examine firm-level upgrading in Colombian manufacturing firms following a high-skilled labor supply shock triggered by the Venezuelan exodus. Using a unique and confidential dataset from 2013 to 2019 and a shift-share instrumental variables approach, we find that the increased supply of skilled workers primarily drove high-skill hiring, particularly in R&D-related tasks. This skill-upgrading process boosted investments in R&D activities and increased demand for higher-quality intermediate inputs. Improved access to both high-skilled labor and higher-quality intermediate inputs led to better production and organizational processes, the adoption of more skill- and R&D intensive products, and an increased likelihood of obtaining quality certifications. Collectively, these changes were crucial for firms to expand their exports. This effect was driven by a rise in differentiated product exports, allowing firms to enter new and more sophisticated markets, particularly in high- and upper-middle-income countries. We develop a multi-country model of trade to rationalize our findings. In the model each good features two quality dimensions that map R&D intensity in production into higher product quality and exports to richer destinations. We thus interpret the exodus as a labor supply shock that lowers R&D labor costs and induces firm-level upgrading through quality improvements.

JEL Classification: D22, D24, F22, F14, F16, J61, L16, O14, O31.
Keywords: Firm-level Upgrading, Trade, Development, Migration.

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1 Introduction

Productivity varies starkly across countries. Since 2010, developing economies have achieved labor productivity levels that are less than one-fifth of those observed in advanced economies. In particular, low-income countries have demonstrated productivity levels as low as 2% of those of their high-income counterparts (Hall and Jones, 1999; Bloom and Van Reenen, 2007; Bloom et al., 2010; Kindberg-Hanlon and Okou, 2020). Closing this gap is essential for economic development, and firm-level upgrading plays a critical role. By accumulating knowledge, improving quality, adopting technology, and innovating products, firms can enhance their productivity levels, accelerate growth, access higher-income and higher-standards markets, and drive structural transformation (Hausmann et al., 2007; Atkin et al., 2017). However, such upgrading hinges on the availability of skilled labor, as advanced production methods and products are inherently skill-intensive (Goldin and Katz, 1998; Verhoogen, 2023).

Massive migration events provide an opportunity to bridge this gap by supplying firms with the high-quality skills and expertise needed for upgrading (Beerli et al., 2021; Bahar et al., 2022). High-skilled migrant inflows enrich labor markets, enabling firms to match with better workers. This, in turn, facilitates investment in innovative production processes and technology adoption. These changes not only boost productivity but also enhance firm product portfolios, allowing them to compete in higher-income export markets—a critical step for developing countries pursuing structural transformation (Hausmann et al., 2007). Despite its relevance, empirical evidence on how high-skilled labor, and particularly migration, drives firm-level upgrading and promotes improved export performance in developing countries remains scarce. This is true particularly regarding the extent of these upgrades and the internal mechanisms within firms that enable them.

In this paper, we explore the impact of the Venezuelan exodus on firm-level upgrading and trade dynamics within Colombian manufacturing firms. Since 2013, Venezuela has faced a severe political, social, and macroeconomic crisis, resulting in the third-largest global displacement of citizens, totaling around 6.1 million. Simultaneously, Colombia emerged as the third most significant destination for displaced immigrants, providing refuge to about 2.9 million Venezuelan migrants (UNHCR, 2024). A unique aspect of this migration wave is that displaced Venezuelans, on average, have similar skills to the local Colombian workforce (Lebow, 2024). In the manufacturing sector, however, Venezuelan migration led to a relatively larger supply shock of high-skilled labor. Our estimates indicate that the share of high-skilled Venezuelans in this sector increased by over 5 percentage points (p.p.), while the shares of medium- and low-skilled workers rose by 3.6 and 2.6 p.p., respectively.

We estimate the impact of this labor supply shock on the Colombian manufacturing sector by leveraging variation in migrant settlements across Colombian local labor markets from 2013 to 2019 and tracking their evolution over time. Acknowledging the non-random distribution of refugees, we employ a shift-share instrumental variable approach based on the distance to Venezuelan states for each local labor market. This instrument is designed to account for the forced nature of the influx, as Venezuelan migrants were notably concentrated in places near the Colombian side of the border with Venezuela.[1]

[1] This instrumental variable is a well-established tool and has been previously utilized in various studies examining episodes of forced migration (see, for instance, Del Carpio and Wagner, 2015; Morales, 2018; Caruso et al., 2019).

We perform our analysis using a novel, rich, representative, and confidential dataset. This dataset merges customs data, the Annual Manufacturing Survey (EAM, by its acronym in Spanish), and the Technological Development and Innovation Survey (EDIT, by its acronym in Spanish), all of them provided by Colombia's National Statistical Office (DANE). Hence, it enables a detailed analysis of firm-level upgrading measures, the skill composition of the workforce (both overall and in R&D-related tasks), as well as wages, firms' product mix, and the composition of their intermediate inputs. It also provides key variables related to firms' export performance, such as total value, product variety, and destination markets. We further match these datasets at the local labor market level with the Colombian Household Survey (GEIH, for its acronym in Spanish). This survey provides data on migration status, allowing us to calculate the share of Venezuelan migrants relative to the local labor force and assess its impact on firm performance.

The economic literature has proposed several approaches to measure firm-level upgrading, including residual-based measures of total factor productivity (TFP) and measures derived from demand information combined with data on output prices and market shares (Hallak and Schott, 2011; Khandelwal et al., 2013). However, according to Verhoogen (2023), directly observable measures of firm-level upgrading—such as technology adoption (including management practices) or quality certifications—provide a more informative alternative. These measures offer more credible evidence on the scope of upgrading and its implications for firms' performance and productivity, while avoiding strong assumptions about the functional forms of demand and production or about the relationship between quality and markups in observed prices (examples of papers using these measures are Verhoogen, 2008; Crozet et al., 2012; Atkin et al., 2017; Macchiavello and Morjaria, 2021).

In this paper, we use direct measures of upgrading by exploiting detailed information on firms' technological development decisions, including the adoption of new production processes, organizational practices, and marketing techniques. These dimensions are rarely observed in developing-country settings. We also use highly granular information on firms' output and intermediate inputs to characterize the types of products offered in the market, assess whether firms shift toward more skill- or R&D-intensive products, and examine whether firms shift the composition of their intermediate inputs toward higher-quality inputs in the production process following the migration shock. Finally, in line with Verhoogen (2008) and Kugler and Verhoogen (2012), we use quality certifications, such as ISO 9001 for quality management systems and ISO 14040 for environmental management and life-cycle assessment, as indicators of both production process and product upgrading. Together, these measures allow us to assess changes in product quality as well as firms' organizational and managerial practices.

Our primary findings show that the increased availability of skilled workers following the exodus induced firm-level upgrading in the Colombian manufacturing sector. We first document a skill-upgrading effect: firms increased their hiring of high-skilled workers, who are likely to enhance performance through improved production, business, and managerial practices. Importantly, firms expanded high-skilled hiring in R&D-related tasks, bringing knowledge crucial for technology adoption and process and product improvements. We estimate that a one p.p. increase in the migrant share relative to the local labor force raised the number of high-skilled R&D workers (with more than secondary education) by 3.1%. In addition, we find positive effects on intermediate input quality and R&D investment—defined as expenditures aimed at introducing new or significantly improved goods, services, or processes—consistent with a technological upgrading mechanism driven by complementarities between skilled R&D labor, higher-quality inputs, and innovation investment.

Furthermore, we find that firms upgraded not only their input mix but also their production processes and organizational methods. A one percentage point increase in the share of Venezuelan migrants relative to the local labor force raised the probability of process innovation by 1.9 percentage points and the adoption of new organizational methods by 0.6 percentage points. We interpret these changes as efforts to optimize the use of higher-quality inputs. Such advancements, often referred to as *recipes* in the literature, are expected to improve firm performance, operational efficiency, and product quality by better coordinating activities within firms (Boehm and Oberfield, 2020; Verhoogen, 2023).

This comprehensive upgrading, encompassing both input quality and refinements in production and organizational processes, translated into improvements in firms' product choices and quality outcomes. A one percentage point increase in the local migrant share increased the probability of changing the firm's main product by 1.3 percentage points, with changes disproportionately directed toward more skill- and R&D-intensive products (by 0.9 and 0.7 percentage points, respectively). In addition, the same increase in migrant exposure raised the likelihood of attaining a quality certification by 1.1 percentage points. These certifications are essential for firms competing in high-standard markets, which require strict compliance with quality requirements in both production processes and final goods (Kugler and Verhoogen, 2012; Hallak and Sivadasan, 2013).

Subsequently, we go one step further and study how these firm-level upgrading effects impacted the export performance of Colombian manufacturing firms. Our estimates reveal five main results. First, the Venezuelan exodus boosted exports, increasing both the probability that firms engage in international trade (the extensive margin) and the value of exports (the intensive margin). Second, this trade-creation effect was largely driven by exports to high- and upper-middle-income destinations. Third, beyond increasing export participation and volumes, the exodus also contributed to greater diversification of exported product varieties. Fourth, the effects operated in part through firms' entry into new markets, particularly high- and upper-middle-income destinations. Finally, the trade-creation effect was primarily driven by differentiated goods (Rauch, 1999), indicating that firms entered global markets with more complex products rather than homogeneous ones.

Why these firms thrive? What's the connection between firm level upgrading and trading to higher income countries? How can this make a country grow? We develop a theory where labor is crucial for higher quality production, which is more valued in richer countries following Fieler and Eaton (2025). Thus, we interpret the Venezuelan exodus as a large labor supply shock, firm-level upgrading as quality increases stemming from workers in the R&D division and higher income countries as demanding higher quality.

We propose a static model that rationalizes the central role of labor we observe in the data. It features nonhomothetic preferences over two dimensions of quality and monopolistic competition over the production of goods that carry these quality features. The technology for producing quality is skill intensive and in charge of the R&D division of the firm, however complementarities in the production function make it necessary to have workers from all skill levels to manufacture the goods that feature increased quality. Thus, the labor supply shock generates the incentives for firms to produce higher quality. In turn, higher quality helps firm overcome international entry costs, fostering exports, and, richer countries pay more for higher quality goods. One of the two dimensions of quality helps us pin down the effect of labor on quality upgrading. The other dimension of quality helps us pin down the fact that higher income countries demand higher quality.

Literature review. Our research contributes to three main strands of economic literature. First, we build on studies of firm-level upgrading, which examine the capacity of firms to enhance productivity and narrow the gap with the global technological frontier—a crucial determinant of economic development (Verhoogen, 2023). This body of work highlights the importance of hiring workers with specific skills as a key driver of this upgrading process (Lewis, 2011; Hornbeck and Naidu, 2014). By expanding the skill set available to firms, high-skilled workers can lead improvements in production and organizational processes, enabling firms to secure quality certifications and implement more complex and advanced practices.

However, as Verhoogen (2023) notes, much of the existing literature falls short in measuring firm-level upgrading and identifying the mechanisms behind it. We address this gap by leveraging rich firm-level data to capture upgrading through the interaction between higher-quality inputs, advanced production and organizational techniques, and higher-quality outputs. In particular, we show how increased skill availability led firms to expand high-skilled hiring in R&D, which in turn fostered the adoption of improved production and organizational practices. These changes enhanced firms' ability to upgrade their products and attain quality certifications—an objective measure of both output and process quality. The novelty of our paper lies in identifying migration in developing countries as a key driver of firm-level upgrading and a central mechanism through which firms can narrow productivity gaps relative to their counterparts in developed economies.

Secondly, our paper adds to the literature on migration-induced trade creation. Traditional research has focused on the positive effect of migration on trade via network channels, where migrants reduce the costs of doing business in export markets (Gould, 1994; Head and Ries, 1998; Peri and Requena-Silvente, 2010; Hiller, 2013). However, more recent studies have explored the impacts of migration on the skills and knowledge within host economies, demonstrating how these factors can enhance firm performance and positively influence export dynamics (Bahar and Rapoport, 2018; Orefice et al., 2021; Bahar et al., 2022; Ariu, 2022).

This paper advances this second line of inquiry. We show that a migration-induced increase in skilled labor not only facilitated skill- and technological-upgrading within firms, boosting their export potential, but also drove a comprehensive firm-level upgrading process. This process went beyond improving input quality because it involved implementing more advanced techniques for combining these inputs, ultimately resulting in higher-quality products, better aligned with the demands of high-income markets. In summary, our work is the first to directly analyze and quantify the firm upgrading mechanisms taking place within firms that link improvements in labor inputs, investment in R&D, enhancements in terms of production and organizational techniques, and exports to higher-standards destinations.

Furtheremore, firm-level upgrading is often linked to export growth, especially in high-income markets (Verhoogen, 2008; Bastos and Silva, 2010; Martin, 2012; Artopoulos et al., 2013; Brambilla and Porto, 2016; Macis and Schivardi, 2016; Görg et al., 2017). Products exported to these markets are typically differentiated and of higher relative quality.[2] Most studies in this literature suggest

[2] Using firm-level trade transaction data, Bastos and Silva (2010), Manova and Zhang (2012), Martin (2012), and Görg et al. (2017) find a positive correlation between export prices and GDP per capita of the destination (in Portugal, China, France, and Hungary, respectively). This supports the hypothesis in Verhoogen (2008) that firms offer higher-quality varieties to consumers willing to pay for premium quality.

that firm-level upgrading is driven by trade with high-income destinations and markets with high-quality standards (Verhoogen, 2008; Brambilla et al., 2012; Brambilla and Porto, 2016). However, for the first time, we demonstrate that this causal relationship can also work in the opposite direction. Specifically, the increased availability of skilled labor in the economy due to a migration shock led firms to demand more skilled workers and invest in R&D, thereby improving production processes, organizational practices, and output quality. This upgrading boosted exports in the Colombian manufacturing sector, enabling firms to access high-standard markets, including those in high-income countries, with more differentiated goods.

Thirdly, our study contributes to the literature on migration and structural transformation, with a focus on its role in promoting economic development (Imbs and Wacziarg, 2003; Hausmann et al., 2007; Hidalgo et al., 2007). In cases like the one analyzed in this paper, migration significantly increases the supply of skills and human capital in the host economy. By enhancing the skill composition of the workforce, migration can shift the product mix offered to the market, increasing complexity and facilitating entry into higher-standards markets. This shift can ultimately benefit the economic performance of the host countries (Hummels and Klenow, 2005; Hausmann et al., 2007; Hallak and Schott, 2011; Koren and Tenreyro, 2013).

To our knowledge, the most closely related studies to ours are those by Bahar et al. (2022) and Imbert et al. (2022). Bahar et al. (2022) examines the impact of Yugoslavian returnees on export performance and firm productivity in their country of origin. Our analysis differs in several key ways. First, while they consider a process of knowledge diffusion through migrants returning from a developed country to their home countries, we focus on the effect of expanding the skill set available to firms in the host economy. Second, we study a migration episode between two developing countries with similar cultural, social, and economic contexts, as well as comparable educational levels. This highlights the relevance of skill-upgrading not only when immigrants bring specific skills or knowledge absent in the host economy but also when there is merely an increase in the availability of skills overall.

Third, we extend their analysis by examining not only firms' total exports but also export destinations, product diversification, and product complexity. This allows us to link firm-level upgrading induced by Venezuelan migration to improved export performance, particularly toward high-income markets with stricter quality standards. Finally, while Bahar et al. (2022) rely on TFP and labor productivity as proxies for upgrading, we focus on directly observable measures—such as technology adoption, the implementation of new methods, the production of higher-quality goods, and quality certifications—which provide a more direct assessment of firm-level upgrading (Verhoogen, 2023).

In contrast, Imbert et al. (2022) finds that low-skilled rural-urban migration in China resulted in a downgrading effect for manufacturing firms, shifting production to labor-intensive techniques, lowering productivity, and changing the output mix toward low-skill products and reduced patenting. Our paper goes beyond these findings by focusing on skilled migration and its effects on firm-level upgrading at a granular level. Unlike Imbert et al. (2022), we estimate the labor composition of firms by skill level, particularly in R&D-related tasks, which we argue is the main driver of firm upgrading in the Colombian manufacturing sector following Venezuelan migration. We also link this firm upgrading to their export performance, a crucial determinant of structural transformation and macroeconomic growth in developing countries.

The remainder of the paper is organized as follows. Section 2 describes the Venezuelan exodus in Colombia. Section 3 presents the data used to perform our analysis. Then, Section 4 shows some descriptive statistics of Venezuelan migration, manufacturing firms, and exports. Section 5 provides a theoretical framework to interpret the results found in the paper. Section 6 presents the empirical strategy proposed in this paper to estimate the causal effect of the Venezuelan exodus on firms' outcomes. Section 7, shows our estimates on the impact of the Venezuelan exodus on firm-level upgrading in the Colombian manufacturing sector. Section 8 analyzes how the firm-level upgrading caused by the migration labor supply shock had a trade-creation effect on firms. In Section 9, we show additional results in terms of firms' wages, but also using local labor market level information to reassure the results presented in the paper. In Section 10 we conduct robustness checks and address potential threats and concerns regarding the internal validity of our identification strategy. Finally, Section 11 concludes.

2 The Venezuelan exodus in Colombia

Venezuela has faced an unprecedented economic crisis over the past decade, driven by a decline in government revenues, unsustainable public debt, and macroeconomic imbalances. The onset of this economic chaos dates back to 2013 when Nicolás Maduro took office as the president of Venezuela. The country faced formidable challenges in sustaining public spending and economic activity, primarily due to a sharp drop in international oil prices, a significant contributor to fiscal and external revenues (Caruso et al., 2019; Rozo and Vargas, 2021; UNHCR, 2024).

The economic turmoil, coupled with unsustainable public debt and macroeconomic imbalances, triggered a staggering 62.2% decline in GDP from 2013 to 2019, as estimated by ECLAC (2019). This downturn exacerbated existing challenges, including food shortages, insecurity, and numerous human rights violations, fostering an atmosphere of chaos, uncertainty, and social unrest (United Nations, 2019). The dire circumstances forced an exodus of 6.1 million Venezuelans, seeking a new beginning predominantly in Latin America. Geographic proximity made Colombia the primary destination, receiving over 2.9 million immigrants between 2016 and 2023 (UNHCR, 2024).

Despite the substantial efforts exerted by the Colombian government to integrate Venezuelan migrants into the national economy, the challenges faced by Venezuelans still persist in both the labor market and daily life (Bahar et al., 2021). Starting in 2017, the Colombian government implemented various waves of work permits to facilitate the participation of Venezuelan migrants in the formal labor sector and enable access to essential public services like education and health. Nevertheless, Venezuelans continue to face challenging labor conditions marked by high levels of informality, low wages, and limited job opportunities within the market (Delgado-Prieto, 2023). In the upcoming sections, we will explore the distinctive characteristics of Venezuelan migrants in comparison to Colombian individuals. This examination aims to shed light on the scope and circumstances of immigrants' integration into the Colombian economy.

3 Data

We use data from various sources and perform our analysis at the firm level. The units are treated at the local labor market level, which groups municipalities (Colombian administrative units), focusing on the period from 2013 to 2019.[3]

3.1 Data on Venezuelan Migrants

Data on immigrant stocks at the municipality level come from the Colombian household survey carried out by the National Statistical Office (DANE): the *Gran Encuesta Integrada de Hogares* (GEIH, for its acronym in Spanish).[4] We consider all individuals who were born in Venezuela as Venezuelan migrants. As we analyze the effects on firm performance, we only take into account working-age individuals (18-64 years old). We use GEIH's weights to calculate representative shares of Venezuelan immigrants at the local labor market level. To further characterize Venezuelan migration in Colombia, we complement this information with data from the *Encuesta de Pulso de la Migración*, also collected by DANE. This survey covers individuals aged 15 or older living in households interviewed in the GEIH between January and June 2021 that include at least one member born in Venezuela.

3.2 Firms and Exports Data

For our empirical analysis, we use a unique and confidential panel dataset of firms in the manufacturing sector which merges information from three different sources. First, we use the Colombian Annual Manufacturing Survey (EAM, for its acronym in Spanish), a representative panel of manufacturing firms in the country with 10 or more employees, or firms with fewer employees but with revenues above a certain threshold annually updated.[5] The EAM provides information on employment, wage bill, sales, sector identifiers, and unique identifiers for both the firm and the constituent plants that make up the firm. Additionally, we have 7-digit product-level data on both firms' outputs and inputs, with information on whether each input is sourced domestically or from international markets. We keep a balanced panel of firms for the period analyzed. Our sample consists of 3,017 manufacturing firms in 79 local labor markets.

The second source of information in our database is the Technological Development and Innovation Survey (EDIT, for its acronym in Spanish), which collects data on innovation, technology, and the quality of productive processes for the same universe of manufacturing firms covered by the EAM. This survey allows us to examine the skill composition of each firm's labor force, distinguishing between workers who perform R&D tasks and those who do not, as well as firms' investments in R&D

[3] Municipalities in Colombia are similar to counties in the US. Colombia has 1,123 municipalities. In our sample, we are working with 106 municipalities for which there is information on manufacturing firms grouped in 79 local labor markets that represent about 65% of the Colombian population. For the case of the municipalities belonging to the Metropolitan Area of the main cities Bogotá, Barranquilla, Medellin, and Cali, we grouped them as part of the main city in our data (which we define as local labor market), according to the official definition of DANE. The Metropolitan Area of Bogotá is comprised of Soacha, Mosquera, Funza, Madrid, Chía, Cajicá, Cota, La Calera, Tenjo, Tubio, Sibaté, Zipaquirá, and Facatativá. The Metropolitan Area of Barranquilla is comprised of Puerto Colombia, Soledad, Malambo, and Galapa. The Metropolitan Area of Medellín is comprised of Barbosa, Bello, Copacabana, La Estrella, Girardota, Itagüi, Envigado, Caldas, and Sabaneta. Finally, the Metropolitan Area of Cali is comprised of Palmira, Yumbo, Jamundí, and Candelaria.

[4] The household survey consists of monthly repeated cross-sections that characterize both individual sociodemographics and labor outcomes. Although the migration module of DANE's household survey has been available since 2012, the question about immigrants' country of origin was included in April 2013.

[5] For example, DANE set US$ 164 million (approximately) in annual revenue as the inclusion threshold in 2016.

activities. Additionally, it includes questions on the implementation of new or significantly improved production, organizational, and marketing processes, as well as the improvement or creation of new products. It also captures whether firms obtained quality certifications such as ISO 9000 and ISO 14000, along with subjective measures of the impact of these technological adoptions and the barriers firms face in implementing them.[6] By leveraging EDIT, we can merge each firm in the EAM with its corresponding observations in EDIT. Since EDIT data is only available at the firm level rather than the plant level, for multi-plant firms, we retain the plant with the largest number of employees over the analysis period.[7]

Finally, to estimate firm exporting performance we use data on their export values and destinations. We rely on detailed Colombian customs data also published by DANE. This data records the total value of Colombian exports by firm, year, destination country, and 10-digit NANDINA (Common Tariff Nomenclature of the Andean Community) product classification from 2013 to 2019. Using this data, we merge our yearly panel of firms from the EAM and EDIT databases with their corresponding export values (in FOB US dollars), as well as the number of different products exported and different destinations firms traded with each year. We ignore exports to Venezuela in our sample (so our results are not driven by network effects of the immigrants with their home country), and exports to Free Trade Zones.

4 Descriptive Statistics

4.1 Venezuelan refugees in Colombia

As can be seen in Panel (a) of Figure 1, the number of Venezuelans living in Colombia increased continuously over the 2013-2019 period. Notably, the influx of Venezuelan immigrants into Colombia intensified starting in 2016. This surge can be attributed to the reopening of the border between the two countries following a year-long closure due to a political crisis between the governments of Colombia and Venezuela (Peñaloza-Pacheco, 2022).

As presented in Panel (b) Figure 1, the distribution of the massive influx of Venezuelan refugees has been heterogeneous across Colombian departments.[8] Although the proportion of working-age Venezuelans in comparison to the local labor force has risen in nearly all Colombian departments, this relative surge in labor supply has been particularly pronounced in the bordering departments

[6] The questions regarding the implementation of new or significantly improved techniques or goods, the attainment of quality certifications, and the subjective measures of the impact of these technological adoptions, including barriers faced during implementation, are asked retrospectively every two years. For example, firms are asked if they implemented a new production process during the 2013-2014 period. Consequently, for these two years, by construction the variable will have the same value. In our sample, we consider only the observations from one year for each of the corresponding periods. Results that include all years are quite similar and can be provided upon request.

[7] We exclude from our sample firms that meet any of the following criteria: (i) those with zero sales and (ii) those reporting fewer than 10 employees. Also, to avoid the influence of outliers, we follow Kugler and Verhoogen (2012) and exclude firms whose capital, employment, intermediate inputs, energy consumption, or wage bill differ by more than a factor of 5 from the median value across the entire period of analysis.

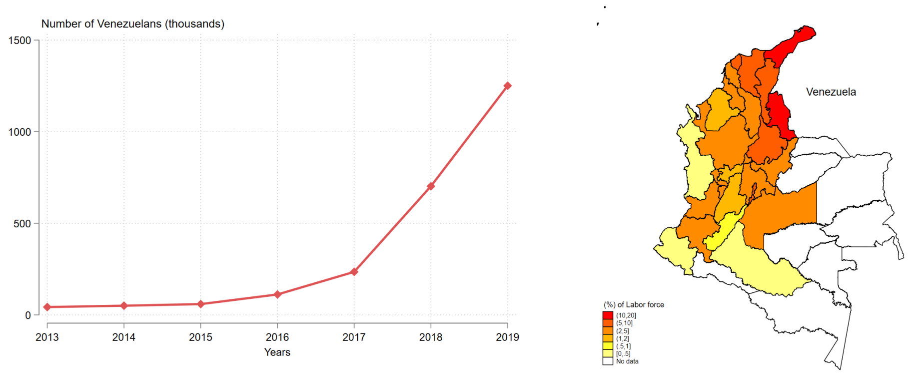
[8] The departments in Colombia are equivalent to the States in the U.S. and consist of grouped municipalities. Figure 1 illustrates the migration by department instead of municipality, providing a clearer visualization of the geographical distribution of Venezuelan migration in Colombia.

situated near Venezuela (e.g., La Guajira and Norte de Santander). Based on our calculations, border departments experienced a substantial increase of approximately 10-15 percentage points (p.p.) in the share of the Venezuelan labor force relative to the local labor force.

Figure 1: Inflow of Venezuelans in Colombia

(a) Number of Venezuelans over time

(b) Share (%) Labor Force 2019



Notes: We define Venezuelan immigrants as individuals born in Venezuela. In Panel (b) the number of immigrants was normalized by the working-age population of each department in 2012. Departments with no data in the figure primarily consist of regions in the Amazon characterized by low population density and small cities where data is unavailable. According to the latest available census in Colombia (2018), the population in these departments accounts for less than 3% of the total population in Colombia. Survey weights are applied to calculate the shares by department.
Source. Own elaboration based on GEIH data from DANE.

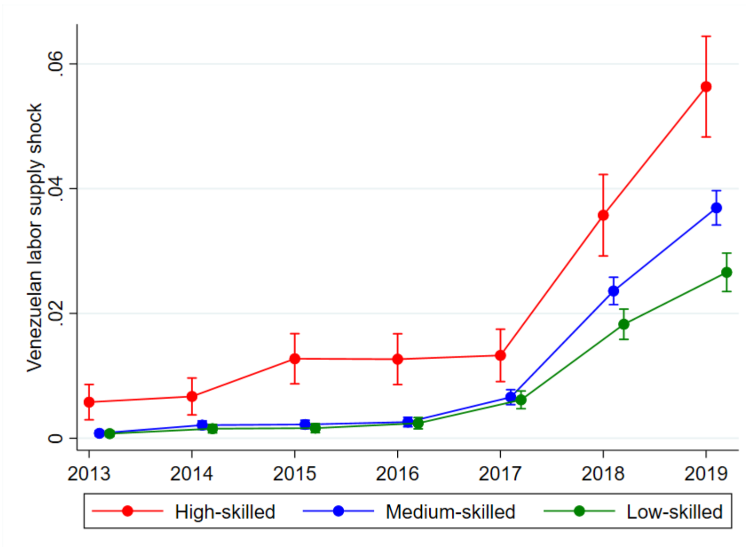
Table A.1 in Appendix A presents descriptive statistics of individual socio-demographic and labor market variables, drawing comparisons between Venezuelan migrants and native populations. Among the working-age population, Venezuelans are notably younger than Colombians. Turning to labor market characteristics, Table A.1 further highlights that working-age Venezuelans have a higher likelihood of unemployment, work more hours per week, earn lower average wages, and have a reduced likelihood of securing formal employment. These descriptives underscore a well-documented aspect discussed in recent economic literature: the challenges faced by Venezuelan refugees in attaining satisfactory living conditions and their struggles in integrating into the formal labor market under the same conditions as native workers, despite the various measures implemented by the Colombian Government to facilitate the integration of Venezuelan immigrants into Colombia's formal labor market (Bahar et al., 2021; Lebow, 2024).[9]

Remarkably, according to Table A.1, Venezuelan immigrants exhibit higher qualifications in terms of years of education. Figure 2 delves into this fact particularly in the manufacturing sector by illustrating the proportion of Venezuelan workers employed in that sector, broken down by education levels, in comparison to their Colombian counterparts of the same educational attainment. In 2019, the highest proportion belonged to high-skilled workers, followed by medium-skilled ones. The data shows that, relative to the pre-exodus share, the increase in the share of Venezuelans compared to Colombians was 5.1 and 3.6 p.p. for high- and medium-skilled workers respectively, and 2.6 p.p. for

[9] For instance, the Colombian Government implemented the "Special Permit of Permanence" which was a renewable two-year visa that granted the legal right to work and access to basic public services to undocumented Venezuelan migrants in Colombia.

low-skilled workers. This suggests that the majority of the impact of the labor supply shock in the manufacturing sector was concentrated among individuals with higher educational levels.[10]

Figure 2: Share of Venezuelans working in the Colombian manufacturing sector by skills, 2013-2019



Notes. Each line shows the share of Venezuelan workers in the manufacturing sector within each education group, relative to the total number of Colombian workers in the same group. Low-skilled refers to those with primary education, medium-skilled to those with secondary education, and high-skilled to those with post-secondary education. Source. Own elaboration based on GEIH data from DANE.

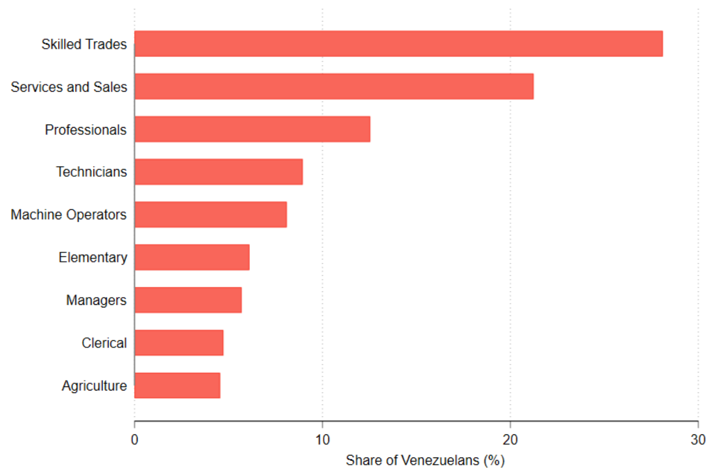
Finally, Figure 3 shows the proportion of Venezuelans working in the Colombian manufacturing sector by their self-reported main occupation held in Venezuela prior to migrating. Consistent with the mechanism proposed in this paper, the concentration of workers in skilled trades, professional, and technical occupations suggests that migrants employed in manufacturing brought occupation-specific knowledge and skills well suited to the tasks performed in their new jobs. For instance, some of the most common prior occupations among Venezuelan migrants include food processing and garment workers, metalworkers and mechanics, construction trades workers, machine operators, and mid-level technicians and professionals in finance and administration. This pattern points to a production-oriented integration of Venezuelan workers into Colombian manufacturing firms and highlights a potential channel through which migration may have facilitated improvements in production processes and technological adoption.

Based on this analysis, we propose the Venezuelan migration as a skilled labor supply shock in the Colombian manufacturing sector. It is plausible to consider that Venezuelan workers may play a

[10] A potential concern is whether Venezuelan and Colombian workers differ in education quality. Prior work shows that the two countries' education systems are highly comparable: in the 2009 PISA assessments, Colombia and Venezuela performed similarly across reading, math, and science, with Venezuela slightly outperforming Colombia (Lebow, 2024). Consistent with this, Venezuelan and Colombian immigrants in the U.S. earn similar education wage premia at both secondary and post-secondary levels, suggesting comparable education quality. Further evidence comes from Colombia's Ministry of Education, which approved 88% of Venezuelan post-secondary degree validation requests between 2015 and 2019. Taken together, these findings indicate that education quality in Colombia and Venezuela is highly similar.

crucial role in the manufacturing labor market, offering the skilled labor that this sector requires. As a result of this shock, Colombian firms would be enabled to undergo a firm-level upgrading process that enhances their ability to trade in international markets.

Figure 3: Share of Venezuelan Workers in Colombian Manufacturing, by Previous Occupation in Venezuela



Notes. The figure shows the distribution of Venezuelan workers employed in the Colombian manufacturing sector in 2021, by their main occupation in Venezuela prior to migrating to Colombia. Source: Own elaboration based on EPM data from DANE.

4.2 Characteristics of Manufacturing Firms and their Exports

Table A.2 reports summary statistics from our balanced panel of firms, distinguishing between exporters (firms that exported at least once between 2013 and 2019) and non-exporters, as well as between high- and low-productivity firms.[11] On average, firms in our sample employ about 150 workers, while exporting firms are substantially larger, with an average workforce of 230 employees.[12]

Exporting and high-productivity firms systematically differ from their counterparts along several dimensions. First, they employ a more skilled workforce: high-skilled workers account for 37% of total employment among exporters, compared to 25% among non-exporters, with a similar pattern observed when comparing high- and low-productivity firms. Second, these firms rely more heavily on R&D labor. Exporters and high-productivity firms employ significantly more high-skilled workers in R&D activities, consistent with the role of skilled labor in the adoption of new technologies and production processes (Brambilla et al., 2012).

In addition, exporters and high-productivity firms pay higher average wages, are larger in terms

[11] High- (low-) productivity firms are defined as those whose average output per worker in 2013, relative to the corresponding 3-digit industry, lies above (below) the median.

[12] In departments most affected by Venezuelan migration, manufacturing activity remained concentrated in a stable set of industries throughout the period. Atlántico and Cesar were dominated by food processing and chemicals; La Guajira by beverage manufacturing; Magdalena by food, machinery, and chemicals; and Norte de Santander by non-metallic minerals, food processing, and leather industries. Overall, migration was more intense in relatively labor-intensive and diversified manufacturing regions, with little evidence of sectoral reallocation.

of sales, invest more in technological development as a share of sales, and are more likely to hold quality certifications and to have adopted new production techniques or methods. These patterns are consistent with the higher quality and technological standards required to compete in international markets and are similarly observed when comparing high- and low-productivity firms.

Table A.3 in Appendix A shows the export values (in millions of US dollars) of manufacturing products from Colombian firms in our sample for each year between 2013 and 2019. The exports are categorized by the income level of the destinations following the World Bank classification. As can be seen, the majority of Colombian exports are directed toward high- and upper-middle-income destinations, which represented 47% and 50% of total exported value, respectively in 2013. An evident trend emerges from the data: after a peak in 2013, total exports experienced a decline until 2016.[13] However, exports rebounded in 2017 and by 2019 had returned to levels close to those of 2013.

Furthermore, in Table A.4 of Appendix A, we present descriptive statistics regarding the proportion of firms that engaged in exports to different destination country groups in 2019, employing the same classification introduced in Table A.3. We also report the total export value in millions of US dollars for these establishments in 2019, along with the number of products they exported.

According to our data, it appears that, on average, approximately 39% of the manufacturing firms in our sample were involved in exporting their products. Furthermore, roughly 28% of these firms exported to at least one high-income country, 32% exported to an upper-middle-income country and, finally, 14% to a lower-middle/low-income country, according to the World Bank classification.

In Panels B and C of Table A.4, we can observe that there exists a substantial dispersion in both export values and the number of products exported by the firms in our dataset. Conditioning on firms that exported in 2019, firms exported an average of 10 products. However, the top 5% of firms exported approximately 39 different products, as indicated by the product codes they reported. Surprisingly, the diversification of these exports seems to be less pronounced for products traded with high-income countries when compared to those exported to upper-middle-income countries.

5 Theoretical Framework

We build on Fieler and Eaton (2025) and abstracting away from intermediates and building in richer labor mechanisms that will determine higher efficiency and quality at the firm level that, in turn, will make higher quality firms select into higher income destinations by overcoming greater entry barriers.

Demand. There is a continuum of varieties, indexed by $\omega \in \Omega$ enjoyed by individual consumers in consumption, varieties aggregate according to:

$$Y = \left[\int_{\omega \in \Omega} u(\omega)^{\beta} d\omega \right]^{1/\beta} \tag{1}$$

Where the variety-specific benefit is

[13] The decline in manufacturing exports post-2014 can be attributed to general equilibrium effects resulting from the decrease in international commodity prices, primarily oil, and a slowdown in economic activity within the European Union (MinCIT, 2019).

$$u(\omega) = \left[q(\omega)^{\rho} + \Big(y(\omega) Q(\omega) \Big)^{\rho} \right]^{1/\rho} \tag{2}$$

Here $y(\omega)$ represents the physical amount of variety ω, $Q(\omega)$ its substitutable quality, and $q(\omega)$ its complementary quality. Note how $Q(\omega)$ perfectly substitutes for physical quantity so that "effective quantity" is the product $y(\omega)Q(\omega)$. In contrast, quality $q(\omega)$ complements effective quantity with the elasticity of substitution between the two governed by the parameter $\rho < 0$. The parameter $\beta \in (0, 1)$ governs the elasticity of substitution between varieties.

Each variety displays the two quality dimensions of quality. For clothing style and texture may enter into complementary quality q whereas durability and warmth may enter into substitutable quality Q.

Production. Each firm has monopoly rights over a single differentiated variety ω and chooses its price, complementary and substitute quantity and, for each skill ς, the amount of labor used in production and R&D divisions.

We consider a single firm, then we dorp ω.

Production function.

$$\begin{aligned}
y &= zq^{-\gamma} L_x^{1-\alpha} L_y^{\alpha} \\
Q &= z^{\eta} L_x^{\nu} \\
L_x &= \ell_{x,h}^{\xi} \ell_{x,m}^{1-\xi} \\
L_y &= \ell_{y,h}^{\kappa} \ell_{y,m}^{\iota} \ell_{y,u}^{1-\kappa-\iota}
\end{aligned}$$

Profit maximization problem.

$$\max_{y,p,q,\ell_{y,\varsigma}\ell_{x,\varsigma}} py - w_h \ell_{y,h} - w_m \ell_{y,m} - w_u \ell_{y,u} - w_h \ell_{x,h} - w_m \ell_{x,m} \tag{3}$$

$$\text{s.t.} \quad py = \lambda^{-1} Y^{1-\beta} u^{\beta-\rho} (Qy)^{\rho} \tag{4}$$

$$y = zq^{-\gamma} L_x^{1-\alpha} L_y^{\alpha} \tag{5}$$

$$Q = z^{\eta} L_x^{\nu} \tag{6}$$

$$L_x = \ell_{x,h}^{\xi} \ell_{x,m}^{1-\xi} \tag{7}$$

$$L_y = \ell_{y,h}^{\kappa} \ell_{y,m}^{\iota} \ell_{y,u}^{1-\kappa-\iota} \tag{8}$$

Where the term z_ω is the overall efficiency of the firm ω (exogenous); the parameter $\alpha \in (0, 1)$ governs the elasticity with which more production labor raises output.

5.1 Closed economy model solution.

The Producer's Problem. Each firm has a monopoly over its variety ω and takes as given the prices and qualities of other varieties. We first consider the producer's choice of price p, quantity y, and complementary quality q given its unit cost and substitutable quality Q. We then turn to the producer's cost minimization problem determining its unit cost and Q. We consider a single firm so drop the ω argument for now.

Price, output, and complementary quality. Let c denote the production cost per unit of output when $q = 1$, for given Q and ℓ_ς. The firm chooses p, q, and y to maximize gross profit:

$$\max_{p,q,y} \quad y(p - cq^\gamma)$$
$$\text{Subject to} \quad py = \mu^{-1} Y^{1-\beta} u^{\beta-\rho} y^\rho$$

The solution is:

$$p = \psi c q^\gamma \tag{9}$$

With markup:

$$\psi = \frac{1+\gamma}{\beta}$$

Acquiring Y units of the aggregate requires spending:

$$X(Y) = \Gamma_3 Y^{1+\gamma} V^{-1} \tag{10}$$
$$V = \left[\int_{\omega \in \Omega} v(\omega)^{\frac{1}{\psi-1}} d\omega \right]^{\psi-1} \tag{11}$$
$$v(\omega) = \frac{Q(\omega)}{c(\omega)}$$

Here $v(\omega)$ is the inverse of the quality-adjusted cost of variety ω and V is the inverse price index. Because a buyer demands higher complementary quality with more physical quantity, spending X increases with the aggregate Y with elasticity $1 + \gamma$.

Given X and V, the revenue of firm ω is:

$$x(\omega) = \left(\frac{v(\omega)}{V} \right)^{\frac{1}{\psi-1}} X \tag{12}$$

A firm selling to a buyer with budget x provides complementary quality:

$$q(\omega) = \left(\frac{\Gamma_1^{1/\rho}}{\psi}\right)^{\frac{1}{1+\gamma}} \left(\frac{v(\omega)}{V}\right)^{\frac{1}{1+\gamma-\beta}} (xV)^{\frac{1}{1+\gamma}} \tag{13}$$

Complementary quality increases with the firm's share in the budget, as reflected in $v(\omega)/V$ and with the buyer's real spending, xV.

Cost minimization and substitutable quality. Since a firm's gross profit is a constant share $(1 - 1/\psi)$ of revenue, maximizing profit is equivalent to maximizing inverse quality-adjusted cost of variety ω $v(\omega) = Q(\omega)/c(\omega)$. A firm with our given technologies, facing wages for each type of labor w_ς, chooses production labor $\ell_{y,\varsigma}$, R&D labor $\ell_{x,\varsigma}$, and substitutable quality Q to solve.

$$v^{-1} = \min_{\ell_{y,\varsigma}, \ell_{x,\varsigma}, Q} w_h \ell_{y,h} + w_m \ell_{y,m} + w_u \ell_{y,u} + w_h \ell_{x,h} + w_m \ell_{x,h} \tag{14}$$

$$\begin{aligned} \text{subject to} \quad & Qy \geq 1 \\ & y = z L_x^{1-\alpha} L_y^{\alpha} \\ & Q = z^{\eta} L_x^{\nu} \\ & L_x = \ell_{x,h}^{\xi} \ell_{x,m}^{1-\xi} \\ & L_y = \ell_{y,h}^{\kappa} \ell_{y,m}^{\iota} \ell_{y,u}^{1-\kappa-\iota} \end{aligned}$$

Using our definition of $c(\omega)$ being the production cost per unit of output when $q = 1$ for given Q, L_x, and L_y. Solving (14) gives inverse quality-adjusted cost:

$$v(z, w) = \frac{z^{\frac{1+\eta}{1+\nu}}}{\tilde{c}} \tag{15}$$

Where

$$\tilde{c} = \tilde{\alpha}^{-\tilde{\alpha}} (1 - \tilde{\alpha})^{-(1-\tilde{\alpha})} W_y^{\tilde{\alpha}} W_x^{1-\tilde{\alpha}}$$

indexes labor input costs and

$$\tilde{\alpha} = \frac{\alpha}{1 + \nu}$$

is the production labor share. That is, the ratio of R&D labor costs to production labor costs is

$$\frac{L_x}{L_y} = \frac{W_y}{W_x} \frac{1 - \tilde{\alpha}}{\tilde{\alpha}}$$

where,

$$
W_x = \frac{w_h^{\xi} w_m^{1-\xi}}{\xi^{\xi}(1-\xi)^{1-\xi}}
$$

$$
W_y = \frac{w_h^{\kappa} w_m^{\iota} w_u^{1-\kappa-\iota}}{\kappa^{\kappa}\iota^{\iota}(1-\kappa-\iota)^{1-\kappa-\iota}}
$$

index R&D and production wages, respectively. The implied substitutable quality is

$$
Q = z^{\frac{\eta-\nu}{1+\nu}} \left(\frac{W_x}{W_y} \frac{\tilde{\alpha}}{1-\tilde{\alpha}} \right)^{-\tilde{\alpha}\nu} \tag{16}
$$

A high-skill–biased supply shock that lowers W_x relative to W_y raises Q^*. Also, if $\eta > \nu$, Q^* increases with firm efficiency z.

5.2 Open Economy

There are N countries indexed by n when they are destinations and by i when they are sources. We focus on one particular source country, Colombia, which we denote by h (home). We assume Colombia is a small country. Equilibrium outcomes in the source country i are are its wages $w_{i,\varsigma}$, inverse price index V_i and total spending X_i. Country i has an exogenous endowment $L_i = L_{u,i} + L_{m,i} + L_{h,i}$ of workers and a measure of potential producers with efficiency at least z given by a Pareto measure $T_i z^{-\theta}$. The iceberg cots of moving goods to n from i is d_{ni}.

Consider a potential producer in country h with efficiency z selling to buyers in country n. The inverse of this firm's quality-adjusted cost in the destination is:

$$
v_{nh}(z) = \frac{z^{\frac{1+\eta}{1+\nu}}}{d_{nh}\tilde{c}_h} \tag{17}
$$

Where $\tilde{c}_h = \tilde{\alpha}^{-\tilde{\alpha}}(1-\tilde{\alpha})^{-(1-\tilde{\alpha})} W_{y,h}^{\tilde{\alpha}} W_{x,h}^{1-\tilde{\alpha}}$.

Entry and Selection. All firms are equally productive in entry. To sell in country n a firm from country h incurs a fixed cost f_n. From revenue (12), the zero-profit condition establishes a cutoff:

$$
\underline{v}_n = \Gamma_4 \left(\frac{f_n}{X_n} \right)^{\psi-1} V_n \tag{18}
$$

Such that only producers with $v_{nh}(z) > \underline{v}_n$ enter the market n. From (17), the measure of firms in country h that sell in country n is:

$$
T_h \left(d_{nh}\tilde{c}_h \underline{v}_n \right)^{-\tilde{\theta}}
$$

Where $\tilde{\theta} = \frac{\theta}{1+\eta}(1+\nu)$

Among firms from h selling in n, the fraction with $v_{nh}(z) \geq v \geq \underline{v}_n$ is:

$$\left(\frac{v}{\underline{v}_n}\right)^{-\tilde{\theta}} \tag{19}$$

Since this distribution is the same regardless of source i, the share of country h's sales in country n's spending is

$$\pi_{nh} = \frac{T_h(d_{nh}\tilde{c}_h)^{-\tilde{\theta}}}{\Phi_n} \tag{20}$$

Where

$$\Phi_n = \sum_{i=1}^{N} T_i(d_{ni}\tilde{c}_i)^{-\tilde{\theta}}$$

Assume $\psi - 1 > 1/\tilde{\theta}$. Then integrating the price index (11) over the measures of sellers from different sources in n, using the cutoff (18) and the fraction of exporting firms from i selling in n (19), yields:

$$V_n = \Gamma_5 \left(\frac{X_n}{f_n}\right)^{\psi - 1 - \frac{1}{\tilde{\theta}}} \Phi^{1/\tilde{\theta}} \tag{21}$$

Specification of Fixed Costs. Fixed costs use labor inputs in the destination country in the same Cobb–Douglas combination as production.[14] The fixed cost of entering market n is a Melitz-style per-destination, per-product fixed export cost that depends on destination input prices and market size:

$$f_n = \delta_0 \tilde{c}_n L_n^{1+\delta_1} \tag{22}$$

Where $\tilde{c}_n = \tilde{\alpha}^{-\tilde{\alpha}}(1-\tilde{\alpha})^{-(1-\tilde{\alpha})} W_{y,n}^{\tilde{\alpha}} W_{x,n}^{1-\tilde{\alpha}}$, δ_0 reflects the overall cost of market entry and δ_1 how it varies with population ($L_n = L_{u,n} + L_{m,n} + L_{h,n}$ is the exogenous labor endowment).

5.2.1 The Bilateral Price Equation

Consider a seller from h with efficiency z in market n selling to a buyer with budget x. Its substitutable quality $Q_h(z)$ is given by (16), with $w = w_h$ and $V = V_h$. It does not depend on importer features. From (9), setting $c = Q_h(z)/v_{nh}(z)$, the firm's price is

[14] There is an "entry services" sector in destination n that produces services S_n from production and R&D labor via a CRS Cobb–Douglas: $S_n = (L_{y,n,F})^{\tilde{\alpha}}(L_{x,n,F})^{1-\tilde{\alpha}}$. To serve n, each exporter must buy ϕ_n units of this service. We parametrize $\phi_n = \delta_0 L_n^{1+\delta_1}$. Then, the fixed cost in value terms is: $f_n = \tilde{c}_n \phi_n$.

$$p_{nh}(z,x) = \psi \frac{Q_h(z)}{v_{nh}(z)} \Big[q_{nh}\left(v_{nh}(z), x\right) \Big]^{\gamma} \tag{23}$$

showing how the price rises with substitutable quality $Q_h(z)$ and with complementary quality $q_{nh}\left(v_{nh}(z), x\right)$, and falls with the inverse of quality-adjusted cost $v_{nh}(z)$. Complementary quality $q_{nh}\left(v_{nh}(z), x\right)$ is defined as in (13) with $V = V_n$ and $v(\omega) = v_{nh}(z)$.

To account for selection, we introduce firm ω's relative efficiency in market n as

$$\epsilon_{nh}(\omega) = v_{nh}(z(\omega))/\underline{v}_n \tag{24}$$

whose distribution, from (19), is Pareto with lower bound 1 and shape parameter $\tilde{\theta}$. So, it does not depend on source or destination characteristics.

Substituting quality measures in (13) and (16) into (23), and replacing z with ϵ using (17) and (18), we relate the bilateral price to exporter and importer characteristics:

$$p_{nh}(\epsilon, x) = \Gamma_6 \left(d_{nh} W_{h,y}^{\tilde{\alpha}} W_{h,x}^{1-\tilde{\alpha}}\right)^{\tilde{\eta}} \left(\frac{W_{h,x}}{W_{h,y}}\right)^{-\nu\tilde{\alpha}} \left[\left(\frac{f_n}{X_n}\right)^{\psi-1} V_n\right]^{\tilde{\eta}-1} \left(\frac{f_n}{X_n}\right)^{\tilde{\gamma}\psi}$$
$$(xV_n)^{\tilde{\gamma}} \epsilon_{nh}^{\tilde{\eta}-1+\tilde{\gamma}\frac{\psi}{\psi-1}} \tag{25}$$

Where: $\tilde{\eta} = \frac{\eta-\nu}{1+\eta}$ and $\tilde{\gamma} = \frac{\gamma}{1+\gamma}$

When $\eta = \nu = 0$ both quality margins shut down: neither substitutable quality[15] Q nor complementary quality[16] q respond to firm characteristics. In this limiting case, our pricing equation collapses to:

$$p_{nh}(\epsilon) \propto \left[\left(\frac{f_n}{X_n}\right)^{\psi-1} V_n\right]^{-1} \epsilon_{nh}^{-1}$$

Which is the standard Melitz selection structure, with the term in brackets capturing destination-specific selection[17] and ϵ^{-1} the inverse productivity.

Allowing $\eta - \nu > 0$, more efficient firms have higher substitutable quality Q, so have a higher price relative to the standard melitz model. For this reason, a higher iceberg cost or labor cost raises

[15] From our cost minimization result it is easy to see that the substitutable quality component disappears when $\eta = \nu = 0$: $Q = z^{\frac{\eta-\nu}{1+\nu}} \left(\frac{W_x}{W_y} \frac{\tilde{\alpha}}{1-\tilde{\alpha}}\right)^{-\tilde{\alpha}\nu}$.

[16] As $\gamma \to 0$, $\tilde{\gamma} \to 0$. Hence, the components that stem from q all go to 1: $\left(\frac{f_n}{X_n}\right)^{\tilde{\gamma}\psi} \to 1$ and $(xV_n)^{\tilde{\gamma}} \to 1$.

[17] Note that this term is proportional to the inverse of the productivity cutoff $\underline{v}_n$. If the cutoff is high, only very efficient firms can enter that market: a higher fixed cost f_n means a higher cutoff and that only very efficient firms export there; lower total spending in destination X_n makes it also harder to enter for firms; and higher *inverse* price index V_n (cheaper goods in destination) also raises the cutoff. Tougher destinations (higher (f_n/X_n), and V_n) select a more productive subset of firms. Because price is proportional to inverse efficiency, this selection pushes prices down in those destinations, conditional on exporting.

price in the destination (as reflected in the first term in parentheses, a cost shifter): an increase in costs will show up as an increase in prices. For this same reason, the standard Melitz selection effect above (the term in squared brackets) is mitigated by the higher substitutable quality of the firms overcoming greater entry barriers.

Further allowing $\nu > 0$ makes the composition of labor across R&D and production divisions matter for Q: when R&D workers become relatively cheaper than production workers (lower W_x/W_y) firms tilt toward R&D-intensive techniques, raising substitutable quality and hence prices in destination markets.[18] In our model high-efficiency firms are high-quality firms and can charge higher prices than in a pure Melitz model.

Finally, when $\gamma > 0$ selling more per buyer is associated with greater complementary quality q and hence a higher price. In our model, sales per buyer are greater in a market with a larger entry cost, as can be seen from $\left(\frac{f_n}{X_n}\right)^{\tilde{\gamma}\psi}$,[19] and in markets where buyers are richer (xV_n is real spending per buyer).

5.2.2 Price and Quality

Prices here reflect both efficiency and quality of the firms' production. To make this connection explicit at the variety level, we combine the two dimensions of quality, complement and substitute, as they appear in equation (23), into the term:

$$\Theta\left(v_{nh}(z), x\right) = Q_h(z) q_{nh}\left(v_{nh}(z), x\right)^{\gamma}$$

Using the equations for the revenue of firm ω, (12), and firm's price, (23), we can write:

$$\log\left[\Theta_{nh}\left(v_{nh}(z), x\right)\right] = \log\left[p_{nh}(z, x)\right] + (\psi - 1)\log\left[x_{nh}(z, x)\right] + \log\left[\psi^{-1} V_n X_n^{1-\psi}\right]$$

The equation reflects how, given quality, sales vary with prices. These are all object on which we have data, so it is possible for us to aggregate to the level of bilateral trade.

5.3 Equilibrium conditions

Given exogenous productivity $\{z_\omega\}$, an equilibrium in this economy are wages for each skill level w_ς, prices of each variety $p(\omega)$, aggregate labor supply levels L_ς, choices of labor demand $l_{y,\varsigma}(\omega), l_{x,\varsigma}(\omega)$ for each firm $\omega \in \Omega$ and labor type $\varsigma = u, m, s$, output levels y_ω, complementary quality levels q_ω, and substitutable quality levels Q_ω, such that the following conditions hold. There are N countries, indexed by n when they are destinations and by i when they are sources.

[18] A high-skill-biased labor supply shock that lowers W_x relative to W_y, like the one we study in country h, raises Q and helps firms overcome the fixed cost of exporting to destinations n, i.e., makes surviving firms from that origin charge higher quality-inclusive prices, mitigating the pure selection effect. High-skill-biased labor supply growth (lower W_x/W_y) makes exporting firms both more efficient and higher-quality, so their prices do not fall as much as in a simple Melitz model, and may even rise conditional on selection.

[19] High f_n/X_n, means a higher cutoff, which means fewer exporters in that market, that reflects in higher sales per surviving firm, that lead to higher q and a higher price.

Firms optimize. For each source country i and variety $\omega \in \Omega_i$, taking as given domestic wages $\{w_{i,\varsigma}\}_{\varsigma\in\{u,m,h\}}$, destination characteristics $\{X_n, V_n, \lambda_n\}_{n=1}^N$, iceberg trade costs $\{d_{ni}\}_{n=1}^N$, and per-destination fixed export costs $\{f_n\}_{n=1}^N$, a monopolistically competitive firm chooses $\left\{p_{ni}(\omega),\, y_{ni}(\omega),\, q_{ni}(\omega)\right\}_{n=1}^N$, $Q_i(\omega)$ $\left\{\ell_{i,y,\varsigma}(\omega)\right\}_{\varsigma\in\{u,m,h\}}$, $\left\{\ell_{i,x,\varsigma}(\omega)\right\}_{\varsigma\in\{m,h\}}$ to maximize total profits from selling in all destination markets:

$$\max_{\{p_{ni},y_{ni},q_{ni}\}_n,Q_i,\{\ell_{i,y,\varsigma}\},\{\ell_{i,x,\varsigma}\}} \sum_{n=1}^N p_{ni}(\omega)\, y_{ni}(\omega) - \sum_{\varsigma\in\{u,m,h\}} w_{i,\varsigma}\, \ell_{i,y,\varsigma}(\omega)$$
$$- \sum_{\varsigma\in\{m,h\}} w_{i,\varsigma}\, \ell_{i,x,\varsigma}(\omega) - \sum_{n=1}^N 1\{y_{ni}(\omega) > 0\}\, f_n$$

subject to the production technology in the source country i,

$$\begin{aligned}
y_i(\omega) &= \sum_{n=1}^N y_{ni}(\omega),\\
y_i(\omega) &= z_i(\omega)\, q_i(\omega)^{-\gamma}\, L_{x,i}(\omega)^{\,1-\alpha}\, L_{y,i}(\omega)^{\,\alpha},\\
Q_i(\omega) &= z_i(\omega)^{\eta}\, L_{x,i}(\omega)^{\nu},\\
L_{x,i}(\omega) &= \ell_{i,x,h}(\omega)^{\xi}\, \ell_{i,x,m}(\omega)^{1-\xi},\\
L_{y,i}(\omega) &= \ell_{i,y,h}(\omega)^{\kappa}\, \ell_{i,y,m}(\omega)^{\iota}\, \ell_{i,y,u}(\omega)^{1-\kappa-\iota},
\end{aligned}$$

and the collection of destination–specific demand curves implied by preferences:

$$\left\{p_{ni}(\omega)\, y_{ni}(\omega) = \lambda_n^{-1}\, Y_n^{1-\beta}\, u_{ni}(\omega)^{\beta-\rho}\, \left[Q_i(\omega)\, y_{ni}(\omega)\right]^{\rho}\right\}_{n=1}^N,$$
$$u_{ni}(\omega) = \left[q_{ni}(\omega)^{\rho} + \left(Q_i(\omega)\, y_{ni}(\omega)\right)^{\rho}\right]^{1/\rho}.$$

Here $\{p_{ni}(\omega), y_{ni}(\omega)\}_{n=1}^N$ is the set of destination–specific price–quantity pairs for variety ω produced in i, $\{q_{ni}(\omega)\}_{n=1}^N$ is the set of destination–specific complementary qualities, while the substitutable quality $Q_i(\omega)$ is common across all destinations. Total physical output of the variety is $y_i(\omega) = \sum_{n=1}^N y_{ni}(\omega)$.

Consumers optimize. For each destination country n, a representative household that owns all firms located in n chooses the quantity $y_{ni}(\omega)$ of each variety ω from each source country $i = 1, \ldots, N$ per person in the household, taking as given destination–specific prices $p_{ni}(\omega)$ per physical unit, complementary qualities $q_{ni}(\omega)$, common substitutable qualities $Q_i(\omega)$, local wages $w_{n,\varsigma}$, and aggregate profits Π_n, to maximize the country–level aggregate demand index (defined analogously to (1)):

$$Y_n = \left[\sum_{i=1}^N \int_{\omega\in\Omega_{ni}} u_{ni}(\omega)^{\beta} d\omega\right]^{1/\beta},$$

where

$$u_{ni}(\omega) = \left[q_{ni}(\omega)^{\rho} + (Q_i(\omega)y_{ni}(\omega))^{\rho}\right]^{1/\rho}$$

is the variety–specific benefit in country n from consuming variety ω produced in i.

Let $L_n \equiv \sum_{\varsigma\in\{u,m,h\}} L_{n,\varsigma}$ denote the total number of people in country n. The household budget constraint is

$$L_n \sum_{i=1}^{N} \int_{\omega\in\Omega_{ni}} p_{ni}(\omega)y_{ni}(\omega)d\omega \leq \sum_{\varsigma\in\{u,m,h\}} w_{n,\varsigma}L_{n,\varsigma} + \Pi_n,$$

and holds with equality in equilibrium.

Upon entering the economy, Venezuelan migrants join the representative household. The non-homotheticity is at the level of the individual person, and the household aggregates preferences across all members.[20] The household supplies labor of each skill to fill firms' different types of labor demand.[21] In equilibrium these will be equal for each type, see (26). Another way of saying this is that there is a wage for each type of labor, which implies a separate market for each type.[22]

Labor markets clear. The total labor demanded in final goods divisions, R&D occupations and for fixed costs equals the total supplied labor force for each country n and skill segment $\varsigma \in \{u, m, h\}$

$$L_{n,\varsigma} = \int_{\omega\in\Omega_n} \left[l^n_{y,\varsigma}(\omega) + l^n_{x,\varsigma}(\omega)\right] d\omega + \sum_{i=1}^{N} \int_{\omega\in\Omega_i} l^{ni}_{F,\varsigma}(\omega)d\omega \tag{26}$$

Where $l_{x,u}$ is defined to be zero (the innovation tasks do not employ low skilled workers). Fixed-cost technology uses the same Cobb–Douglas shares as production, so the skill composition of $l^{ni}_{F,\varsigma}$ is proportional to the same shares as L_y and L_x.

Goods markets clear. For each source country i and each variety $\omega \in \Omega_i$, total output equals the sum of shipments to all destinations:

$$y_i(\omega) = \sum_{n=1}^{N} y_{ni}(\omega) \qquad \text{for all } i,\ \omega \in \Omega_i. \tag{27}$$

Shipments to destination n, $y_{ni}(\omega)$, are the quantities consumed in country n of variety ω and are determined by the consumer problem given prices and qualities. Since each variety is defined by

[20] If we double the number of people but each of them spends the same amount per person then they demand the same quality, but they will demand more quality at the household level because their household-level spending would be doubled. If we have 10 people that each earn \$100 and go to 20 people and they still each earn \$100 and demand the same quality, at the household level we jump from \$1000 to \$2000, thus increasing the demand for quality.

[21] Firms fill their labor requirements for each division using the household supply of each labor type.

[22] Note that, as Venezuelan migrants offer their labor force inelastically, an increase in the number of high-skilled migrants automatically translates into an increase in the number of high-skilled workers.

$(\omega, q_{ni}(\omega), Q_i(\omega))$, there is no separate market-clearing condition for quality; goods-market clearing operates on physical quantities for each differentiated product.[23]

Trade Balance. Under balanced trade, each country's total absorption equals the value of its exports. Let X_n denote total spending in country n, and let π_{ni} be the share of country n's spending on varieties produced in country i. Then exports from i to n are $\pi_{ni} X_n$, and balance trade requires.

$$X_i = \sum_{n=1}^{N} \pi_{ni} X_n \tag{28}$$

Given that households in i receive all labor income and profits, total absorption also satisfies: $X_i = \sum_{\varsigma \in \{u,m,h\}} w_{i,\varsigma} L_{i,\varsigma} + \Pi_i$. Together, these two conditions imply that income equals the value of exports in each country.

Productivity Levels are Exogenous. Firms are born with some exogenous productivity.

Equilibrium Condition in Terms of Budget. In the open economy, the economy is in equilibrium if all labor markets clear. Consider N countries indexed by n when they are destinations and by i when they are sources.

$$\sum_{\varsigma \in \{u,m,h\}} w_{i,\varsigma} L_{i,\varsigma} = \sum_{i=1}^{N} \pi_{ni} \sum_{\varsigma \in \{u,m,h\}} w_{n,\varsigma} L_{n,\varsigma} \tag{29}$$

Where π_{ni} is the share of country i's sales in country n's spending.

6 Empirical Strategy

To study the effect of Venezuelan exodus on Colombian firm outcomes, we estimate the following equation:

$$Y_{ijmrt} = \alpha + \beta S_{mrt} + \theta_i + \delta_{rt} + \omega_j t + [\Gamma_{mr} \times \gamma_t] + \epsilon_{ijmrt} \tag{30}$$

Where Y_{ijmrt} denotes the outcome variable for firm i in 4-digit CIIU industry j, local labor market m, region r, and year t. The firm-level outcomes analyzed in this paper include employment (total and by skill level, both overall and in R&D activities) and average wages; innovative behavior, measured by the probability and intensity of R&D investment, the adoption of new or improved processes, techniques, and products, the attainment of quality certifications, and the barriers faced during implementation; production and input sourcing decisions, including changes in firms' main product, whether such changes involve shifts toward skill- and/or R&D-intensive goods, and the share of imported inputs; and export behavior, including the probability of exporting, export values, the number of exported products and destinations, and exports by product type (differentiated versus homogeneous).

[23] This is equivalent to the set of $y_{ni}(\omega)$ and qualities (q_{ni}, Q_i) chosen by the firm and the consumers jointly determine a benefit profile $\{u_{ni}(\omega)\}_n$ and those quantities $y_{ni}(\omega)$ respect the resource constraint on $y_i(\omega)$.

Our main variable of interest is S_{mrt} which represents the share of Venezuelan migrants living in local labor market m, located in region r relative to the working-age population of the same local labor market-region in 2012 (before the exodus). θ_i and δ_{rt} are firm and region-year fixed effects, respectively.[24] These sets of fixed effects allow us to control for constant differences between firms over time and differential time-varying shocks across regions that affect firms in the same region equally, respectively. Finally, $\omega_j t$ is an industry-specific linear trend that controls for any monotonic trend in our outcome variables for each industry in the sample.

Furthermore, we include a set of pre-shock local labor market characteristics interacted with year fixed effects, which are captured by the term $[\Gamma_{mr} \times \gamma_t]$. The pre-determined local labor market characteristics are per capita GDP (in logs), homicide rate, the total number of cultivated hectares of coca crops (in logs), share of population in the subsidized health system, and the Gini coefficient. This set of control variables, interacted with year fixed effects, allows us to nonparametrically control for changes in our dependent variables over time that might be correlated with any shocks that differentially affect the local labor market according to their past characteristics, such as those related to the income level in the past or their exposure to violence or drug-related historical characteristics. Additionally, we also control by the total amount of exports in USD (in logs) between each firm and Venezuela in 2012 (before the exodus) interacted with year dummies, to control for any impact that the collapse of the Venezuelan economy could have had on the performance of firms.[25] Therefore, the identification in our empirical approach comes from variation between the local labor market shares of Venezuelan immigrants relative to the pre-shock local labor force over time and the local labor market average firms' outcomes. Standard errors are clustered at the local labor market level to account for potential serial correlation within local labor markets over time.

6.1 Instrumental Variable Approach

Time-varying components that we cannot account for might affect both the geographic location pattern of the Venezuelan migrants and firm behavior. Refugees, for instance, might choose to move to areas where local businesses are more prosperous, which would lead us to overestimate the effects of refugees on firms' outcomes. Thus, to account for the possibility that the allocation of Venezuelan immigrants was not random, we use an instrumental variable approach to instrument the share of Venezuelan immigrants in each Colombian local labor market.

We employ a well-known enclave instrument that has been used in several papers analyzing episodes of forced migration (see, for instance, Del Carpio and Wagner, 2015; Morales, 2018; Caruso et al., 2019). This instrument exploits the fact that given the forced nature of the migration, the location of Venezuelan migrants was spatially concentrated in local labor markets near Venezuela. Thus, the travel distance from the Venezuelan state from which the displaced are fleeing to each poten-

[24] Each region is a group of municipalities defined by DANE. The Central region comprises the municipalities in the departments of Antioquia, Caldas, Cundinamarca, Risaralda, Tolima and the city of Bogotá; the Atlántica region comprises the municipalities of Atlántico, Bolívar, Córdoba, and Magdalena; the Oriental region comprises the municipalities in the departments of Norte de Santander, Boyacá, Meta and Santander; finally, the Pacífica region comprises municipalities Cauca, Nariño and Valle del Cauca.

[25] We present all our results with the full set of pre-determined local labor market characteristics included in the vector Γ_{mr} of equation (30). However, results remain very similar if we exclude these controls. Results of those estimates are available upon request.

tial Colombian destination local labor market is a key determinant of the refugee location decisions. Formally, our instrumental variable (IV) is defined as follows:

$$IV_{mrt} = V_t \left[\frac{1}{K} \sum_{K} \frac{1}{D_{mrk}} \right] \tag{31}$$

Where V_t is the stock of Venezuelan immigrants living in Colombia in year t and provides our IV time variation. This component is orthogonal to the differences in the share of Venezuelans across Colombian local labor markets. The discrete jump in the inflow of Venezuelans between 2015 and 2019 (Figure 1) was due to events occurring in Venezuela: the macroeconomic, social, and political crisis. K is is the number of different Venezuelan states (23) and D_{mrk} is the driving-distance in kilometers between Colombian local labor market m in the region r and Venezuelan state k. This ratio provides our instrument with variability at the local labor market level. The hyperbolic functional form of the distance weights local labor markets in Colombia closer to states in Venezuela with a much higher importance than those farther away.

The intuition behind the instrument is that those Colombian local labor markets located near Venezuelan states are expected to face higher immigration than those local labor markets located far away from Venezuelan states (conditional on controls in equation 30).

The key threat to the validity of any distance-based instrument is that local labor markets closer to Venezuelan states may systematically differ from those farther away. As discussed above, we can deal with this concern by controlling for pre-shock local labor market characteristics interacted with year dummies and specific regional trends. The identifying assumption of the instrument, once local labor markets characteristics and fixed effects are included, is that the location of Venezuelan immigrants depends on the travel distance from various states of Venezuela. Moreover, we address Goldsmith-Pinkham et al. (2020)'s concerns about Bartik-type instruments in Section 10 and demonstrate the internal validity of our IV.

Table A.5 in Appendix A shows the first-stage correlation between the instrument and the share of Venezuelan immigrants, which appears to be strong, supporting the relevance condition of the instrumental variable approach proposed in this paper. The instrument is significant at the one percent level in every specification we estimated, and the F-statistic is well above the standard levels.

7 Firm-Level Upgrading Effects

7.1 Skill, R&D, and Input Quality Upgrading of Firms

To examine skill upgrading in Colombian manufacturing firms, we use data on the number of workers in each company, categorized by education level. With this data, we can divide the number of workers into three categories: those with primary education (low-skilled workers), secondary education (medium-skilled workers), and post-secondary education (high-skilled workers). The findings from this initial analysis are presented in Panel A of Table 1, which illustrates the impact on the total number of employees hired (in logs) by manufacturing firms, categorized by skill level.

Furthermore, and more importantly, we take advantage of the granularity of the EDIT data and study the impact on the skill composition of workers who are in charge of technological and innovative tasks (henceforth, R&D labor). We argue that these workers are crucial for implementing new production processes, adapting or creating better products, and upgrading overall firm performance. This improvement will be reflected in firms' ability to sell products in markets with more sophisticated demand, such as high-income countries.

To conduct this analysis, we examine the impact of the Venezuelan exodus on the total number of R&D employees by skill level (Panel B of Table 1). Additionally, we estimate the impact on the ratio of R&D employees at each skill level relative to the total number of employees in the firms (Panel C of Table 1). This latter measure captures the intensity of R&D employment within a firm.

Table 1: Effect of immigration on skill-upgrading

	High-skilled	Medium-skilled	Low-skilled
Panel A: Total No Employees			
Share of immigrants	0.010*	0.011	0.007
	(0.006)	(0.009)	(0.013)
Panel B: R&D No Employees			
Share of immigrants	0.031***	0.019***	0.004
	(0.007)	(0.007)	(0.003)
Panel C: R&D Share Employees			
Share of immigrants	0.002***	0.001**	0.001
	(0.000)	(0.001)	(0.000)
F-Statistic	65.39	65.39	65.39
Number of firms	3,017	3,017	3,017
Observations	21,119	21,119	21,119
Firm FE	Yes	Yes	Yes
Region FE $\times$ Time FE	Yes	Yes	Yes
Industry Linear Trend	Yes	Yes	Yes
Past controls $\times$ Time FE	Yes	Yes	Yes

Notes: The outcome variables are the number of employees by education level (in logs). High-skilled workers are those with any post-secondary education. Medium-skilled workers are those with secondary education. Low-skilled workers are those with less than secondary education. Industry linear trends are specified at the 4-digit CIIU level. Past controls include the following local labor market-level variables: per capita GDP (in logs), homicide rate, the total number of cultivated hectares of coca crops (in logs), share of population in the subsidized health system, and the Gini coefficient. Standard errors, clustered at the local labor market level, are reported in parentheses. Kleibergen-Paap rk Wald F-statistics are provided. Significance levels are denoted by ***, **, and * for 1%, 5%, and 10% levels, respectively. Source: Own elaboration based on data from DANE.

Several results emerge from our estimates. The influx of Venezuelan migrants into Colombia improved the skill composition of manufacturing firms by increasing high-skilled employment: a one percentage point increase in the migrant share raised high-skilled employment by about 1 percent. We find no statistically significant effects for medium- or low-skilled workers. R&D employment exhibits stronger skill-upgrading effects. A one percentage point increase in the migrant share increased the number of high- and medium-skilled R&D workers by 3.1 percent and 1.9 percent, respectively, with no significant effects for low-skilled R&D workers. As a result, firms increased the share of high- and medium-skilled R&D workers relative to total employment.

We next examine the impact of the migrant influx into Colombia on firms' R&D investment decisions and intermediate input quality. If the skill-upgrading channel is operative, firms should respond to the increased availability of skilled labor by expanding R&D investments and shifting toward higher-quality intermediate inputs, reflecting complementarities between skilled workers and other production inputs. The evidence in Table 2 supports this channel.[26]

We begin by analyzing the impact of the Venezuelan exodus on firms' R&D investments. These investments, captured by the EDIT, are explicitly identified as expenditures aimed at introducing new or significantly enhanced goods, services, and/or processes. The second column of Table 2 presents estimates for the extensive margin, where the dependent variable is a dummy indicating whether a firm undertook any R&D investments. The results show a positive and statistically significant effect, suggesting that a one p.p. increase in the share of migrants raised the probability of R&D investment by 1.2 p.p. Turning to the intensive margin, we also find a statistically significant effect, with a one p.p. increase in the share of migrants leading to a 14.2% increase in R&D investment.

Table 2: Effects of Immigration on R&D Investment and Input Quality

	R&D Investments		Share of Imported Inputs
	Extensive Margin	Intensive Margin	
Share of immigrants	0.012***	0.142**	0.002***
	(0.005)	(0.057)	(0.001)
F-Statistic	65.39	65.39	59.12
Number of firms	3,017	3,017	3,017
Observations	21,119	21,119	20,993
Firm FE	Yes	Yes	Yes
Region FE × Time FE	Yes	Yes	Yes
Industry Linear Trend	Yes	Yes	Yes
Past controls × Time FE	Yes	Yes	Yes

Notes: The outcome variable for the Extensive Margin column is a dummy indicating whether firms invested a positive amount in technological development (investments aimed at introducing novel or significantly enhanced goods, services, and/or processes). For the Intensive Margin column it is the amount invested by the firm in technological development (in logs). The outcome variable in the last column measures the share of imported intermediate inputs relative to total inputs used by the firm. Industry linear trends are specified at the 4-digit CIIU level. Past controls include the following local labor market-level variables: per capita GDP (in logs), homicide rate, the total number of cultivated hectares of coca crops (in logs), share of population in the subsidized health system, and the Gini coefficient. Standard errors, clustered at the local labor market level, are reported in parentheses. Kleibergen-Paap rk Wald F-statistics are provided. Significance levels are denoted by ***, **, and * for 1%, 5%, and 10% levels, respectively. Source: Own elaboration based on data from DANE.

Finally, we consider the quality of intermediate inputs as an additional dimension of firm-level upgrading. Exploiting the granularity of our data, we construct an outcome measuring the share of imported intermediate inputs used in firms' production processes. Firms typically source higher-quality inputs from international markets relative to domestic suppliers, so a higher import share can be interpreted as reflecting improvements in input quality (Kugler and Verhoogen, 2009; Verhoogen,

[26] The R&D decisions discussed in this paper, given the focus on a developing country like Colombia, differ from those in developed nations, such as patents. According to Verhoogen (2023), R&D in developing countries is more about catching up with the technological frontier rather than pushing it forward.

2023). Moreover, greater reliance on imported inputs is consistent with stronger complementarities between higher-quality inputs, firms' R&D investments, and the employment of higher-skilled labor. The last column of Table 2 shows a positive and statistically significant effect: a one p.p. increase in the migrant share in the local labor market raised the imported-input share by 0.2 p.p., on average.

Taken together, these results show that skill upgrading triggers a broader reorganization of firms' production choices, R&D activities, and input sourcing, with significant implications for firms' exports and product and process quality.

7.2 Technology Adoption and Quality Upgrading

In this subsection, we examine how the increase in the quality of the labor force, R&D investments, and intermediate inputs, driven by the influx of workers from the Venezuelan exodus, led to the adoption of new technologies, including innovative processes and methods. The skilled labor supply shock experienced by Colombian manufacturing firms may have expanded the stock of knowledge available within firms, thereby improving the techniques and business practices used to produce goods that meet higher quality standards.

We analyze four sets of variables to assess how the Venezuelan exodus affected firms' ability to adopt new or improved techniques and processes, and how these changes translated into quality upgrading of their output.[27] These techniques include management practices, organizational methods, and operational *recipes* that coordinate activities within firms to improve outcomes (Boehm and Oberfield, 2020; Verhoogen, 2023).

Table 3: Effect of immigration on the improvement of production methods

	Processes	Organizational	Marketing
Share of Immigrants	0.019***	0.006*	0.003
	(0.004)	(0.003)	(0.003)
F-Statistic	59.12	59.12	59.12
Number of firms	3,017	3,017	3,017
Observations	12,068	12,068	12,068
Firm FE	Yes	Yes	Yes
Region FE × Time FE	Yes	Yes	Yes
Industry Linear Trend	Yes	Yes	Yes
Past controls × Time FE	Yes	Yes	Yes

Notes: The outcome variables are binary indicators indicating whether firms introduced or significantly improved a production process/method, internal organization of the firm or marketing/product design (thoroughly defined in the text and Appendix E). Industry linear trends are specified at the 4-digit CIIU level. Past controls include the following local labor market-level variables: per capita GDP (in logs), homicide rate, the total number of cultivated hectares of coca crops (in logs), share of population in the subsidized health system, and the Gini coefficient. Standard errors, clustered at the local labor market level, are reported in parentheses. Kleibergen-Paap rk Wald F-statistics are provided. Significance levels are denoted by ***, **, and * for 1%, 5%, and 10% levels, respectively. Source: Own elaboration based on data from DANE.

Table 3 presents the first set of outcomes. The dependent variable in the second column is a binary indicator for the adoption of new or significantly improved processes, including production,

[27] For details on the phrasing of the questions used in this section, see Appendix E.

distribution, delivery, or logistics methods (labeled "Processes"). The third column reports a binary indicator for the adoption of new organizational methods related to internal functioning, knowledge management, workplace organization, or the management of external relations ("Organizational"). The final column captures the adoption of new marketing techniques, such as changes in product packaging or design aimed at expanding or maintaining market presence ("Marketing").

Our results indicate that the Venezuelan exodus had a positive effect on firms' adoption of new or significantly improved production and organizational processes. Specifically, a one p.p. increase in the migrant share relative to the local labor force increased the probability of adopting a production process innovation by 1.9 p.p. and an organizational innovation by 0.6 p.p. Taken together, these findings suggest that the expanded supply of skilled labor facilitated technology adoption within firms, as the tasks performed by newly hired high-skilled workers contributed to improvements in production processes, workplace organization, and the management of firms' external relationships.

The second set of outcomes captures quality upgrading through firms' attainment of quality certifications. We use a dummy indicating whether a firm obtained a certification for its products or production processes, reported in the second column of Table 4.[28] Such certifications are widely used in the literature as observable and credible measures of firm-level upgrading (Verhoogen, 2008; Hallak and Sivadasan, 2013; Verhoogen, 2023). Columns three and four further distinguish between product and process certifications.

The estimates indicate a significant quality-upgrading response to the Venezuelan exodus. A one p.p. increase in the migrant share raised the probability that a firm obtained a quality certification by 1.1 p.p., with the effect primarily driven by production-process certifications. In Table A.11, we further split the sample between firms that exported prior to the exodus and those that did not. The results show that the effect was entirely driven by firms that were already exporters. This evidence reinforces the interpretation that, as a result of firm-level upgrading, firms use quality certifications as a tool to access higher-income and more sophisticated export markets. Accordingly, the effects are concentrated among firms that had already incurred the fixed costs of entering international markets.

Next, we examine whether the observed quality-upgrading effects translated into changes in firms' product mix. Table 5 reports results for three outcomes. Using 7-digit product-level data from the EAM, we assess whether the migration shock affected the probability that firms changed their main product and whether such changes were directed toward more skill-intensive or R&D-intensive products.

We estimate a first-difference specification based on equation (30). The outcomes are indicators for whether a firm changed its main product—defined as the product with the largest share of total output—or switched to a more skill-intensive or more R&D-intensive main product between 2013 and 2019.[29]

[28] These certifications correspond to ISO standards, such as ISO 9001 (quality management systems) and ISO 14040 (environmental management and life-cycle assessment).

[29] The change-in-product indicator equals one if a firm changed its main product in 2016–2019 relative to the pre-exodus period. Product-level skill and R&D intensity are constructed using pre-exodus data: for each product i, we compute the median share of high-skilled workers and the median ratio of R&D expenditures to sales at the 2-digit industry level among firms for which product i is the main product. Indicators for switching toward more skill- or R&D-intensive products equal one if the intensity of the main product in 2016–2019 exceeds that in the pre-exodus period.

Table 4: Effect of Immigration on Quality Certification Attainment

	Quality Certifications	Process quality cert.	Product quality cert.
Share of Immigrants	0.011**	0.009*	0.000
	(0.005)	(0.005)	(0.003)
F-Statistic	59.12	59.12	59.12
Number of firms	3,017	3,017	3,017
Observations	12,068	12,068	12,068
Firm FE	Yes	Yes	Yes
Region FE × Time FE	Yes	Yes	Yes
Industry Linear Trend	Yes	Yes	Yes
Past controls × Time FE	Yes	Yes	Yes

Notes: The outcome variable in column 2 is a binary indicator equal to one if the firm obtained a quality certification (either a product or a process certification). The outcome variables in columns 3 and 4 are binary indicators equal to one if the firm obtained a product quality certification or a process quality certification, respectively. Industry linear trends are specified at the 4-digit CIIU level. Past controls include the following local labor market-level variables: per capita GDP (in logs), homicide rate, the total number of cultivated hectares of coca crops (in logs), share of population in the subsidized health system, and the Gini coefficient. Standard errors, clustered at the local labor market level, are reported in parentheses. Kleibergen-Paap rk Wald F-statistics are provided. Significance levels are denoted by ***, **, and * for 1%, 5%, and 10% levels, respectively. Source: Own elaboration based on data from DANE.

The results indicate that quality upgrading was accompanied by a significant reallocation of firms' product mix. Firms became more likely to change their main product, and these changes were systematically directed toward more skill- and R&D-intensive products. These patterns are consistent with the skill, R&D, and input upgrading documented above: as firms gained access to a larger pool of high-skilled workers, increased R&D investment, and shifted toward higher-quality intermediate inputs, they were more likely to introduce differentiated and technologically intensive products.[30]

Furthermore, the EDIT allows us to examine whether technology adoption translated into improvements in firms' performance outcomes. Using a fourth set of variables, we analyze whether the implementation of new or improved processes, organizational methods, marketing practices, or products helped firms achieve specific objectives, including improving product quality or variety, accessing or retaining markets, increasing productivity, and reducing costs. Table A.9 reports results based on binary indicators that equal one if firms both implemented at least one technology adoption and experienced improvements along these dimensions. The estimates indicate that firms more exposed to the Venezuelan exodus were more likely to achieve these outcomes, including higher product quality and variety, greater market retention, increased productivity, cost reductions, and entry into new markets (although the latter effect is noisily estimated with a p-value of 0.12).

We next examine whether the Venezuelan exodus affected firms' likelihood of facing obstacles to adopting new or improved products or processes. Table A.10 reports results for binary indicators capturing constraints related to internal resources, shortages of qualified workers, difficulties complying with technical regulations, and limited availability of inspection, testing, certification, and verification services. Across all dimensions, the estimated effects are negative and statistically significant,

[30] We complement these results with firms' self-reported measures of product upgrading (columns 2–5 of Table A.8). Columns 2–3 report the log number of improved or newly introduced products (intensive margin), while columns 4–5 indicate whether firms improved or introduced new products (extensive margin). Consistent with the objective measures, firms report significant product upgrading along both margins.

indicating that firms more exposed to the skilled labor supply shock were less likely to face these barriers.

Table 5: Effect of immigration on change of main products

	Δ Main Product	Towards Skill-Intensive	Towards R&D-Intensive
Share of Immigrants	0.013**	0.009***	0.007**
	(0.005)	(0.003)	(0.003)
F-Statistic	64.73	55.32	55.32
Number of firms	2,252	2,069	2,069
Region FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Past controls	Yes	Yes	Yes

Notes: The outcome variable in column 2 is a dummy equal to one if a firm changed its main product between 2016 and 2019 relative to the pre-exodus period. The main product is defined as the product with the highest sales in a given period. Product-level skill and R&D intensity are defined using the median share of high-skilled workers and R&D expenditures relative to sales, computed at the 2-digit industry level in the pre-exodus period among firms for which product *i* was the main product. Industry FE are specified at the 4-digit CIIU level. Past controls include the following local labor market-level variables: per capita GDP (in logs), homicide rate, the total number of cultivated hectares of coca crops (in logs), share of population in the subsidized health system, and the Gini coefficient. Standard errors, clustered at the local labor market level, are reported in parentheses. Kleibergen-Paap rk Wald F-statistics are provided. Significance levels are denoted by ***, **, and * for 1%, 5%, and 10% levels, respectively. Source: Own elaboration based on data from DANE.

Taken together, these results suggest that increased access to skilled labor eased key constraints to technology adoption and quality upgrading. By reducing shortages of internal resources and qualified workers, firms were better positioned to improve operations, comply with technical standards, and upgrade product quality. These findings are consistent with the increased likelihood of quality certification attainment documented in Table 4 and highlight the role of skilled labor in facilitating firm-level upgrading.

8 The Effect of Migration on Exports through Firm-Level Upgrading

In this section, we examine how the firm-level upgrading documented above translated into export outcomes. We show that the Venezuelan exodus increased firms' participation in export markets, particularly through exports of more complex and differentiated products to high-income destinations.

8.1 The Effect on the Extensive and Intensive Margin of Exports

We begin by examining the impact of the Venezuelan exodus on the likelihood that Colombian manufacturing firms engage in export activities. Panel (a) of Table 6 reports estimates from equation (30) for all firms in the sample. A one p.p. increase in the share of Venezuelan migrants raised firms' probability of exporting by 0.6 p.p.

Disaggregating by destination, the effect is largely concentrated in high-income countries. A one p.p. increase in the migrant share raised the probability of exporting to high-income destinations by 0.5 p.p. Given that the baseline probability of exporting to high-income countries in 2013 was 32%, this corresponds to a 1.6% increase relative to the pre-shock mean.

We next assess effects along the intensive margin using the log value of firms' total exports (FOB US dollars) as the outcome. To address attrition and avoid an unbalanced panel, we include non-exporting firms and assign them a value of zero. As a result, the estimated intensive-margin effect captures both changes in export values among incumbent exporters and entry into exporting by previously non-exporting firms.

Panel (b) of Table 6 shows that the Venezuelan exodus had a positive and statistically significant effect on total exports. A one p.p. increase in the migrant share raised firms' total export value by 7.1% on average. This effect was primarily driven by exports to high- and upper-middle-income destinations, which increased by 7.3% and 4.4%, respectively, while exports to low- and lower-middle-income countries show no statistically significant response.

Table 6: Effect of immigration on the probability of exporting and total exports (in logs) - Total and by income level of destinations

	Total	High	Upper-middle	Lower/Low
Panel A: Probability of exporting				
Share of Immigrants	0.006**	0.005**	0.004*	0.003
	(0.003)	(0.003)	(0.002)	(0.002)
Panel B: Total exports (in logs)				
Share of Immigrants	0.071**	0.073***	0.044*	0.026
	(0.027)	(0.027)	(0.023)	(0.021)
F-Statistic	65.39	65.39	65.39	65.39
Number of firms	3,017	3,017	3,017	3,017
Observations	21,119	21,119	21,119	21,119
Firm FE	Yes	Yes	Yes	Yes
Region FE $\times$ Time FE	Yes	Yes	Yes	Yes
Industry Linear Trend	Yes	Yes	Yes	Yes
Past controls $\times$ Time FE	Yes	Yes	Yes	Yes

Notes: The outcome variables in Panel (a) are a binary indicator that denotes whether the firm exported to each destination. The outcome variable in Panel (b) is the total amount exported in US dollars (in logs). Industry linear trends are specified at the 4-digit CIIU level. Past controls include the following local labor market-level variables: per capita GDP (in logs), homicide rate, the total number of cultivated hectares of coca crops (in logs), share of population in the subsidized health system, and the Gini coefficient. Standard errors, clustered at the local labor market level, are reported in parentheses. Kleibergen-Paap rk Wald F-statistics are provided. Significance levels are denoted by ***, **, and * for 1%, 5%, and 10% levels, respectively. Source: Own elaboration based on data from DANE.

8.2 The Effect on the Diversification of Exports and the Creation of New Markets

Another key finding consistent with a trade-creation effect of immigration is the diversification of firms' exports, measured by both the number of exported products (at the 10-digit NANDINA level) and the number of destination countries. As shown in Panel (a) of Table 7, a one p.p. increase in the share of Venezuelan immigrants increased the number of exported products by 1.1% overall, with larger effects for exports to high-income (0.8%) and upper-middle-income (0.7%) countries. Panel (b) further shows that firms expanded their export destinations: a one p.p. increase in the migrant share raised the number of destination countries by 1%, driven primarily by entry into high-income and upper-middle-income markets.

Table 7: Effect of immigration on number of products exported and destinations (in logs) - Total and by income level of destinations

	Total	High	Upper-middle	Lower/Low
Panel A: Number of products (in logs)				
Share of Immigrants	0.011**	0.008**	0.007***	0.001
	(0.004)	(0.004)	(0.002)	(0.002)
Panel B: Number of destinations (in logs)				
Share of Immigrants	0.010***	0.007***	0.005***	0.002
	(0.003)	(0.003)	(0.002)	(0.002)
F-Statistic	65.39	65.39	65.39	65.39
Number of firms	3,017	3,017	3,017	3,017
Observations	21,119	21,119	21,119	21,119
Firm FE	Yes	Yes	Yes	Yes
Region FE × Time FE	Yes	Yes	Yes	Yes
Industry Linear Trend	Yes	Yes	Yes	Yes
Past controls × Time FE	Yes	Yes	Yes	Yes

Notes: The outcome variable in Panel (a) is the number of different products exported (in logs) categorized according to the 10-digit NANDINA product classification. The outcome variable in Panel (b) is the number of different country destinations for each firm (in logs). Industry linear trends are specified at the 4-digit CIIU level. Past controls include the following local labor market-level variables: per capita GDP (in logs), homicide rate, the total number of cultivated hectares of coca crops (in logs), share of population in the subsidized health system, and the Gini coefficient. Standard errors, clustered at the local labor market level, are reported in parentheses. Kleibergen-Paap rk Wald F-statistics are provided. Significance levels are denoted by ***, **, and * for 1%, 5%, and 10% levels, respectively. Source: Own elaboration based on data from DANE.

8.3 The Effect on the Complexity and Differentiation of Exports

Our core hypothesis in this study posits that the augmented supply of skilled workers in the Colombian economy had a positive effect on firm-level upgrading that spurred advancements in the production processes and technological development of manufacturing firms. Consequently, this increased the quality and complexity of the goods they produce and export globally.

Entering global markets with differentiated products necessitates specific knowledge, business practices, and input qualities. For example, firms employing skilled workers or adopting improved production processes are expected to be better positioned to increase exports of differentiated products (Artopoulos et al., 2013; Bernini et al., 2018). Therefore, the increased availability of skilled workforce could have positively affected manufacturing firms in this direction. The findings in Table 8, which outlines the impact on the total export value and the number of different products exported, classified by product type (differentiated or homogeneous), align with these observations.

We partition our estimates into exports of differentiated and homogeneous goods, following the methodology introduced by Rauch (1999). In his seminal work, Rauch (1999) classifies internationally traded commodities into three distinct categories: traded goods in organized exchanges, reference-priced goods, and the remaining goods. Consistent with this approach, we classify reference-priced goods and traded goods in organized markets as homogeneous goods while categorizing the remaining goods as differentiated goods.[31]

Based on our estimates outlined in Table 8, it becomes evident that the previously identified positive effect on exports was primarily concentrated in differentiated goods rather than homogeneous ones. Our analysis shows that our estimates in terms of the export value of products in USD (in logs)

[31] For instance, according to Rauch (1999)'s classification the category 8510 "Footwear" is defined as differentiated product, whereas the category 4110 "Animal oils and fats" belongs to goods traded on an organized exchange, and category 0340 "Fish, fresh (live or dead), chilled or frozen" is defined as reference-priced goods.

is only statistically significant for differentiated goods and that the coefficient for this category is 1.66 times the coefficient of homogeneous goods. Similarly, when considering the number of products (in logs) as a dependent variable, our results show that the effect on differentiated goods is 2.25 times the estimated effect for homogeneous products. Our findings suggest that Colombian manufacturing firms increased their likelihood of exporting and the total value of exports worldwide due to the Venezuelan exodus. This positive effect was largely explained by the export of differentiated and more complex goods.

Table 8: Effect of immigration on exports by type of products (in logs)

	Differentiated		Homogeneous	
	Exports USD	No. Products	Exports USD	No. Products
Share of immigrants	0.048**	0.009**	0.029	0.004**
	(0.023)	(0.004)	(0.021)	(0.002)
F-Statistic	65.39	65.39	65.39	65.39
Number of firms	3,017	3,017	3,017	3,017
Observations	21,119	21,119	21,119	21,119
Firm FE	Yes	Yes	Yes	Yes
Region FE × Time FE	Yes	Yes	Yes	Yes
Industry Linear Trend	Yes	Yes	Yes	Yes
Past controls × Time FE	Yes	Yes	Yes	Yes

Notes. The outcome variable is the total amount exported in US dollars (in logs) by a firm each year for each type of product. Products were defined as differentiated or homogeneous following Rauch (1999)'s definition. Goods defined as reference-priced goods or goods traded in organized markets were considered as homogeneous. The remaining goods were classified as differentiated goods. Industry linear trends are specified at the 4-digit CIIU level. Past controls include the following local labor market-level variables: per capita GDP (in logs), homicide rate, the total number of cultivated hectares of coca crops (in logs), share of population in the subsidized health system, and the Gini coefficient. Standard errors, clustered at the local labor market level, are reported in parentheses. Kleibergen-Paap rk Wald F-statistics are provided. Significance levels are denoted by ***, **, and * for 1%, 5%, and 10% levels, respectively. Source: Own elaboration based on data from DANE.

The evidence presented in this paper strongly suggests that the arrival of Venezuelan migrants contributed to firm-level upgrading and generated a trade-creation effect in the Colombian manufacturing sector. Descriptive statistics (Section 4.1) show that Venezuelan workers are disproportionately represented among high-skilled employees in manufacturing and that many had prior experience in manufacturing-related occupations in Venezuela (Figures 2 and 3). This influx of skilled labor enabled firms to upgrade their input mix by hiring high-skilled workers for R&D tasks, increasing R&D investment, and shifting toward higher-quality intermediate inputs.

These input upgrades facilitated the adoption of improved production techniques and organizational practices, allowing firms to make more effective use of available resources. As a result, firms improved product quality and were more likely to meet international standards, as reflected in higher rates of quality certification attainment. This firm-level upgrading translated into a competitive advantage in export markets, boosting exports—particularly of differentiated products—to high- and upper-middle-income destinations. The observed destination heterogeneity is consistent with prior evidence showing that firm upgrading enables producers in developing countries to meet the more sophisticated demands of advanced markets (Verhoogen, 2008; Bastos and Silva, 2010; Brambilla et al., 2012; Brambilla and Porto, 2016).

8.4 The Effect on Exports by Firms' Productivity and Skill-Intensity

As highlighted in the theoretical section, we interpret our trade-creation findings through the lens of a Melitz-type model (Melitz, 2003), integrated with a Heckscher-Ohlin framework. In this context, more productive firms benefit the most from productivity gains associated with hiring high-skilled workers from the Venezuelan exodus.

Our theoretical framework further predicts that firms experiencing the greatest export impacts are those with a comparative advantage in the skill composition of their workforce, especially those intensive in R&D high-skilled workers, who could capitalize more on the increased supply of skilled labor.

To test these hypotheses, we estimate heterogeneous effects by comparing high- vs. low-productivity firms and high- vs. low-skill-intensity firms. Firm productivity is measured as average output per worker, while skill intensity is defined as the share of high-skilled workers in R&D divisions relative to total employees. We categorize firms as high- or low-productivity (or skill-intensity) based on whether their average productivity (or skill-intensity) in 2013—prior to the exodus— relative to their respective 3-digit industry was above or below the median. We then estimate equation (30) separately for both groups. Our results of this exercise are shown in Tables B.1-B.6 of Appendix B.

As shown in Tables B.1-B.3, the effects on exports identified earlier were primarily driven by high-productivity firms, with stronger impacts on exports to high-income destinations and differentiated goods. This observation aligns with the theoretical framework presented by Melitz (2003). The productivity improvements resulting from the skill-upgrading process in Colombia's manufacturing sector enable firms to overcome the fixed costs associated with exporting, allowing them to enter international markets. This was especially true for firms with productivity levels close to the threshold at which they are indifferent between exporting and selling solely in the domestic market.

Additionally, our estimates in Tables B.4-B.6 indicate that high-skill intensive firms—those significantly intensive in hiring high-skilled workers in R&D divisions—benefited the most from the increased availability of skilled workers in the economy. This finding aligns with the predictions of the Heckscher-Ohlin model, which posits that an increase in the abundance of a specific input—such as a high-skilled labor force—will particularly benefit firms that are more intensive in the utilization of that input. In our context, firms that rely heavily on high-skilled workers for R&D decisions are likely to experience greater advantages. This model suggests that such firms can leverage the increased availability of high-skilled labor to enhance their technological investments, improve productivity, and ultimately gain a competitive edge in the market.

9 Additional Results: Wages and Local Labor Market-Level Outcomes

9.1 Impact on Firm Wages

As an additional result, we studied whether or not the Venezuelan exodus negatively affected the wages paid by the firms in our sample. Table A.6 presents our estimates regarding the impact of a one p.p. increase in the share of Venezuelan immigrants relative to the pre-exodus local labor force on firm wages.

Our estimates suggest a non-statistically significant effect on the average wage paid by manufacturing firms due to the exodus. These wage estimates align with findings from the economic literature on the labor market effects of the Venezuelan exodus in Colombia. Studies such as those by Caruso et al. (2019) and Peñaloza-Pacheco (2022) indicate a negative impact on wages resulting from the Venezuelan exodus. However, this effect is primarily concentrated among informal and low-skilled workers, while for high-skilled and formal workers, the effect is not statistically distinguishable from zero.

According to DANE, although the level of informality in the Colombian labor market is above 50%, among individuals working in firms with 10 or more employees, those levels are below 10%. Given that the EAM surveys firms in the manufacturing sector with 10 or more employees, it is expected that most of the workers in our sample are formal, which explains the absence of any negative effect on wages. This finding is consistent with the existing economic literature.

This result rules out the possibility that the main effect found in this paper in terms of trade-creation is merely a cost-reduction shock. Instead, we show that the effects are mostly driven by the firm-level upgrading impact of the migration episode.

Similarly to Beerli et al. (2021), the absence of a negative impact on wages can be rationalized through potential productivity effects and increasing returns to scale resulting from the hiring of high-skilled workers following the onset of the exodus. These increasing returns to scale may be attributed to positive productivity effects stemming from knowledge spillovers or the diffusion of better ideas facilitated by the hiring of new skilled workers, particularly in the R&D divisions of firms (Hunt and Gauthier-Loiselle, 2010; Bahar et al., 2022). Our results support this idea. We find that the increase in the overall hiring of high-skilled workers, and particularly the skill-upgrading in R&D divisions, enabled firms to enhance their operations. This improvement was manifested in the enhancement of production and organizational processes as well as in a significant improvement in the quality of products offered in the market, which ultimately positively impacted the ability of firms to obtain quality certifications.

9.2 Impact on Local Labor Market-Level Outcomes

One limitation of our dataset is that we cannot distinguish between Venezuelan migrants and Colombian workers within firms. As a result, we cannot directly test whether the skill-upgrading effect observed was driven by the replacement of Colombian workers with Venezuelan migrants or whether the hiring of highly qualified Venezuelans occurred without displacing Colombian workers.

However, we can use Colombian household survey data to study the impact of migration on employment at the local labor market level, focusing on both natives and migrants in the manufacturing sector, overall and by skill level. We calculate employment rates for both Colombian and Venezuelan workers in each local labor market and estimate the impact of Venezuelan migration on these outcomes. The results are presented in Table A.7 of Appendix A. Panel A shows the effect on total employment, overall and by nationality; Panel B shows the aggregate effect on employment rates by skill level; Panels C and D disaggregate this information for Colombians and Venezuelans, respectively. Finally, Panel E estimates the impact on average hourly wages (in logs) in the manufacturing sector by skill level. All employment rate regressions are normalized by the corresponding 2013 employment rate.

Several key results emerge from this analysis. First, as shown in Panel A, there is an increase in the employment rate of Venezuelans in the manufacturing sector, which aligns with the trends shown in Figure 2. Our estimates suggest that a 1 p.p. increase in the share of Venezuelans increases their employment rate by 4.4 times relative to its 2013 value. Moreover, we find no evidence that Venezuelan employment growth in the manufacturing sector negatively affected the employment opportunities of Colombian workers.

In terms of skills, Panels C and D show that while the employment rate for high-skilled Venezuelans increased nearly nine-fold with a 1 p.p. increase in the migrant share, the increase was six-fold for medium-skilled and three-fold for low-skilled workers. This supports the argument that the Venezuelan migration, particularly in the manufacturing sector, represented a high-skilled supply shock, with the participation of highly qualified Venezuelans growing more than proportionally compared to medium- and low-skilled workers. For Colombians, we do not observe any significant negative impact on employment across skill levels.

Lastly, when examining hourly wages by skill level in Panel E, we find no statistically significant effects. These results, consistent with the firm-level findings in Table A.6, provide strong evidence that the trade-creation effect observed in this paper was driven by firm-level upgrading of manufacturing firms. This enhanced their productivity, product quality, and overall performance, rather than being solely a cost shock from the influx of Venezuelan migrants.

10 Robustness checks and threats to the identification strategy

In this section, we conduct robustness checks on our empirical approach and address potential internal validity issues associated with our identification strategy. Firstly, we examine aspects of the implemented instrumental variable approach and perform additional analyses to bolster our confidence in the exogeneity of our instrumental variable. Finally, we explore a potential challenge to our identification strategy, considering changes that occurred during the analysis period that might have influenced the export performance of Colombian firms.

10.1 Parallel-trends test for IV internal validity

The study by Goldsmith-Pinkham et al. (2020) decomposes the Bartik-type 2SLS estimator into its "shift" part and "share" part. This decomposition reveals that the estimator can be understood as a weighted sum of individually just-identified instruments, each represented by a local share. In settings like ours, where the approach relies on differential exposure to a common shock, the identification hinges on the exogeneity of these shares.[32] In more concrete terms, in scenarios like the one examined in this paper, characterized by a pre-shock period, the empirical strategy is akin to a difference-in-differences setting. Consequently, assessing whether the shares of differential exposure to the common shock lead to variations in our outcomes is crucial for establishing credibility in our strategy.

[32] Although, according to Goldsmith-Pinkham et al. (2020), the consistency of the estimator depends on the shares, Borusyak et al. (2018) emphasize that under some assumptions, the consistency of the estimator might also come from the shocks.

Our IV serves as a shift-share instrument, where the "share" part is constructed through the average inverse of each pairwise distance between Colombian local labor markets and Venezuelan states. These distance shares capture the varying exposure to the national Venezuelan exodus that began in 2016.

However, it is crucial to address the possibility that the effects identified due to the massive forced immigration of Venezuelans could be partially driven by pre-existing trends at the local labor market level before their arrival. Therefore, we need to investigate potential endogenous pre-exodus mechanisms that are correlated with both distances and our main outcome variables to establish that the exposure to the national arrival of displaced persons has identifying power. Following the suggestion of Goldsmith-Pinkham et al. (2020), we conduct tests for parallel trends to alleviate concerns that our results are influenced by pre-existing differential trends in our outcomes across local labor markets with varying distances to Venezuela's states and, consequently, different exposure to the arrival of displaced citizens from that country.

To test for parallel trends, we generate plots illustrating the reduced-form coefficients of the average distance shares on our outcomes of interest for three years preceding the opening of the Colombia-Venezuela border.[33] Subsequently, we conduct regressions of our outcomes for each year against the average of the distance shares $\left(\text{i.e., } \frac{1}{K}\sum_{K}\frac{1}{D_{mrk}}\right)$ interacted with year fixed effects, following the specification outlined in equation (30).[34]

Figures D.7-D.10 in Appendix C depict the results, revealing no statistically significant parallel trends in our outcome variables before the opening of borders between Colombia and Venezuela explained by the "share" component of our instrumental variable. The findings support our identification assumption that pre-exodus shares do not predict outcomes through mechanisms other than the post-2016 immigration shock.

Finally, it is crucial to briefly address the exogeneity of the common shock affecting all our treated units (local labor markets), denoted as V_t in equation 31, representing the stock of Venezuelan immigrants living in Colombia in each year t. We argue that this component is orthogonal to the differences in the share of Venezuelans across Colombian local labor markets. The discrete surge in the inflow of Venezuelans between 2016 and 2019 (Figure 1) was primarily driven by push factors, i.e. events occurring in Venezuela, such as the macroeconomic, social, and political crisis. This influx was not instigated by any shock in Colombia that could be endogenous to the performance of manufacturing firms and potentially bias our estimates.

10.2 Potential Threats to the Identification Strategy: Free Trade Agreements

A potential threat to our identification strategy is the possibility that our estimated effects may not be solely attributed to the Venezuelan exodus and its positive impact on firm-level upgrading, but could also be influenced by the free trade agreements signed by the Colombian government in the 2010s

[33] It is worth noting that, following the insights from Goldsmith-Pinkham et al. (2020), the Bartik-type instruments are derived as a sum of shares weighted by Rotemberg weights. They recommend calculating these weights initially to identify the specific exposure design that receives a larger weight in the overall Bartik-2SLS estimate and, consequently, which share effects are worth testing. In our design, these weights are explicit as we are considering only one type of migrant inflow (Venezuelan migration).

[34] Due to the data structure underlying the estimates in Tables 3, **??**, A.9, and A.10, we cannot show parallel trends for these results, as there is only one pre-exodus period.

with various groups of countries. According to MinCIT (2019), between 2012 and 2016, Colombia entered into free trade agreements with the United States and Venezuela in 2012, the European Union in 2013, and, finally, with Costa Rica, the Pacific Alliance, and South Korea in 2016. These free trade agreements could have potentially contributed to the positive effects observed in the export performance and firm-level upgrading of Colombian firms, serving as a potential confounding factor for our estimates.

To address this potential issue, we introduce the total value of exports before our analysis period (in 2012) between each firm in our sample and each of these country groups individually, interacting with year dummy variables as a control variable in our estimates. This inclusion allows us to account for any influence stemming from the free trade agreements and better isolate the impact of the Venezuelan exodus on our outcomes of interest.

These interactions serve to control for potential divergent trends and time-varying shocks that may vary across firms based on their prior level of trade exposure with each of these groups of countries. The results, presented in Tables C.1-C.11 of Appendix C, demonstrate that our estimates remain robust even with the inclusion of these additional controls. This robustness provides further evidence supporting the idea that the positive effects on firm-level upgrading and the export performance of manufacturing firms, as previously identified, can be attributed to the Venezuelan exodus.

10.3 Robustness to Exposure to the Colombian Peace Process

Between 2012 and 2016, the Colombian government engaged in a peace process with the FARC, one of the country's oldest guerrilla group. Peace negotiations began in 2012; in 2014, the FARC declared a unilateral and permanent ceasefire; and in 2016, a definitive bilateral ceasefire was implemented, followed by the disarmament of the FARC and the signing of the final peace agreement. Given the timing of these events and their potential impact on local economic conditions, we assess the robustness of our results to the inclusion of a control capturing local exposure to the peace process. Specifically, following Bernal et al. (2024), who study the effects of the peace agreement on business formation in Colombia, we include a local labor market-level dummy equal to one if at least one FARC attack occurred during the 2011–2014 period, interacted with year fixed effects. This specification aims to control for any differential effects of the peace process on our outcome variables that are orthogonal to the Venezuelan exodus. Our results remain virtually unchanged.[35]

10.4 Leave-one-out estimates

Finally, we conduct leave-one-out robustness exercises for our main estimates. First, we re-estimate all baseline specifications by sequentially excluding each of the five largest local labor markets (Bogotá, Medellín, Cali, Barranquilla, and Santander) and the five largest industries in our sample, defined by the number of firms (Metals, Chemicals, Textiles, Rubber/Plastics, and Food). The results, reported in Appendix D together with the baseline estimates (shown in red), remain very similar to the baseline, indicating that our findings are not driven by any single local labor market or industry. Second, we re-estimate our main specifications excluding the two main border departments (La

[35] These results are available upon request.

Guajira and Norte de Santander). The results are again very similar to the baseline.[36]

11 Concluding remarks

Enabling firms in developing countries to catch up with the global technological frontier, boost their productivity, and help them compete in high-income markets is a priority for policymakers aiming to drive development and structural change. In this paper, we show evidence that skilled labor supply shocks induced by migration episodes can create the ideal conditions for firm-level upgrading, enhancing firm competitiveness in international markets. Thus, we propose migration as an alternative to traditional industrial policy tools.

We specifically examine how the significant influx of skilled labor into Colombia's manufacturing sector, driven by the Venezuelan exodus, impacted firm performance, the capacity to upgrade production processes, and the ability to expand into international markets. Our analysis leverages the variation in the location and timing of Venezuelan migrant settlements across Colombian local labor markets. To address potential endogeneity, we employ a shift-share instrumental variable strategy, using distances between Colombian local labor markets and Venezuelan states, which reflects the forced nature of the migration.

Our findings show that the skilled labor supply shock generated by the Venezuelan exodus led to firm-level upgrading in Colombian manufacturing firms. This shock enhanced firms' ability to hire skilled labor, particularly in R&D divisions, and increased investments in R&D, improving production methods and organizational practices. These improvements ultimately led to higher quality in products and processes, as evidenced by the increased ability of firms to obtain quality certifications. We also find that this firm-level upgrading translated into better export performance, characterized by a diversification effect. Firms exported a greater variety of products and entered new international markets, particularly in high- and upper-middle-income countries. The primary driver was an increase in the total exports of differentiated goods.

Our analysis underscores the role of skilled migration not merely as a labor supply phenomenon but as a driver of structural change through its impact on firm-level upgrading and exports. This perspective adds to the broader literature on migration and development by highlighting the interplay between high-skilled labor inflows and firm-level upgrading, contributing to debates on the economic integration of migrants and the global competitiveness of emerging economies.

[36] These results are available upon request.

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A Additional Tables and Figures

Table A.1: Characteristics of Venezuelans and Colombians, 2016-2019

	Venezuelan	Colombian	Difference	P-Value
Panel A: Socioeconomic Characteristics				
Male	0.60	0.59	0.01	0.02
Age	30.8	37.8	-7.04	0.00
Unemployed	0.16	0.11	0.05	0.00
Incomplete Secondary	0.31	0.41	-0.10	0.00
Complete Secondary	0.38	0.30	0.07	0.00
Incomplete Post-Secondary	0.16	0.15	0.01	0.51
Complete Post-Secondary	0.15	0.14	0.01	0.76
Panel B: Working Population				
Informal Worker	0.74	0.52	0.22	0.00
Formal Worker	0.11	0.37	-0.26	0.00
Hourly Wage (in 1,000 COP)	4.37	5.59	-1.23	0.00
Hours worked per week	50.5	45.8	4.68	0.00
Manufacturing	0.10	0.12	-0.01	0.00
Non-manufacturing	0.74	0.78	-0.04	0.00
Panel C: Manufacturing Firms' Workers				
Incomplete Secondary	0.17	0.19	-0.03	0.30
Complete Secondary	0.38	0.43	-0.05	0.13
Incomplete Post-Secondary	0.22	0.22	0.00	0.78
Complete Post-Secondary	0.23	0.16	0.07	0.09
Hourly Wage (in 1,000 COP)	6.90	6.80	0.10	0.87
Hours worked per week	50.8	49.0	1.81	0.03
Economic Activities				
Food, Beverages, and Tobacco	0.23	0.25	-0.02	0.52
Textiles and Leather	0.32	0.23	0.09	0.00
Wood, Paper, Printing, and Recycling	0.04	0.06	-0.02	0.05
Petroleum Refinery and Minerals	0.06	0.06	0.00	0.82
Chemicals	0.04	0.10	-0.07	0.00
Rubber/Plastic	0.08	0.07	0.01	0.44
Metal	0.11	0.08	0.02	0.03
Machinery and Equipment	0.05	0.06	-0.01	0.34
Transportation Equipment	0.03	0.03	0.00	0.72
Furniture	0.05	0.06	-0.01	0.42

Notes. P-values are for the difference between Venezuelan and Colombian averages with clustered standard errors at the departmental level. Source. Own elaboration based on GEIH data from DANE.

Table A.2: Descriptive Statistics of Colombian Manufacturing Firms - 2013-2019

		Exporting Status		Productivity	
	All firms	**Yes**	**No**	**High**	**Low**
Panel A: Firms Characteristics					
Average annual wage in USD	13,021	15,459	10,404	16,349	9,696
Annual sales in 1,000 USD	1,347	2,160	473	2,502	193
Innovation in USD in 1,000 USD	28.66	51.96	4.06	55.26	2.48
Has a quality certification	0.14	0.20	0.08	0.20	0.09
Share of imported inputs	0.05	0.09	0.02	0.08	0.02
Adopted a new technology/technique	0.23	0.29	0.16	0.29	0.16
Panel B: Worker Characteristics					
Number of workers	149.84	230.28	63.49	230.63	68.10
High-skilled workers	51.26	84.53	15.55	85.87	16.68
Medium-skilled workers	84.41	128.62	36.94	127.50	41.35
Low-skilled workers	14.17	17.13	11.00	17.27	11.08
Panel C: Workers Involved in R&D Tasks					
High-skilled	2.19	3.64	0.63	3.65	0.73
Medium-skilled	1.03	1.59	0.43	1.48	0.58
Low-skilled	0.06	0.09	0.02	0.07	0.05
Distribution of Workers Involved in R&D Tasks by Division					
General Management	0.15	0.13	0.19	0.13	0.18
Administration	0.14	0.15	0.13	0.14	0.15
Marketing and Sales	0.10	0.11	0.07	0.10	0.09
Production	0.49	0.47	0.53	0.47	0.53
Research and Development	0.08	0.11	0.03	0.11	0.03
Accounting and Finance	0.04	0.03	0.04	0.04	0.03
Observations	3,017	1,562	1,455	1,508	1,509

Notes. Each cell contains the mean of the referred variable over the years 2013-2019 either for exporters, non-exporters, high-, low-productivity firms, and all firms. Firms were considered as exporters if they exported at least once in the 2013-2019 period. High-productive firms are those whose average output per worker in 2013 was above the median for the corresponding 3-digit industry, while low-productive firms are those with average output below the median. Monetary values were calculated in US current dollars unless otherwise specified. Source: Own elaboration based on data from DANE.

Table A.3: Colombian exports by year and destination 2013-2019 (million USD)

	Total exports	High-Income	Upper-middle	Lower/Low
2013	6,449.8	3,025.7	3,237.8	185.3
2014	6,433.8	3,392.9	2,830.5	210.5
2015	6,019.1	3,299.0	2,508.0	212.1
2016	5,952.6	3,388.3	2,314.6	249.7
2017	6,113.1	3,324.0	2,499.1	290.0
2018	6,273.7	3,198.9	2,803.8	271.0
2019	6,458.7	3,301.9	2,879.0	278.8

Notes. Each cell contains the total value of Colombia's exports in millions of dollars of the firms in our sample. The first column shows the total value exported and the following columns show the total amount for each group of destination countries. Source: Own elaboration based on customs data from DANE.

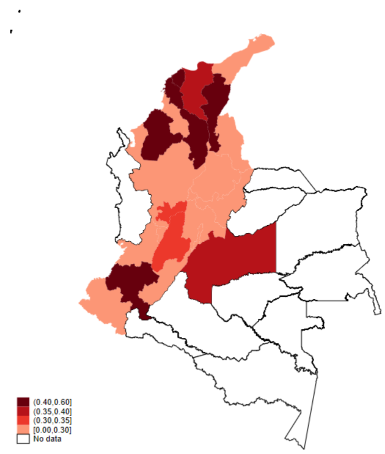
Table A.4: Exports of Colombian Firms by Destination Group: Total Exports, Exported Value Distribution, and Exported Quantity Distribution

	Total exports	High-Income	Upper-middle	Lower/Low
Panel A. Share of firms exporting in 2019				
Mean	0.39	0.28	0.32	0.14
Panel B. Exports Value of exporting firms (millions USD - 2019)				
Mean	5.55	2.84	2.47	0.24
p25	0.05	0.00	0.01	0.00
p50	0.27	0.04	0.12	0.00
p75	1.52	0.36	0.76	0.03
p95	26.9	7.12	11.3	0.87
Panel C. Number of products exported of exporting firms (2019)				
Mean	9.99	5.08	7.35	2.10
p25	2.00	0.00	1.00	0.00
p50	4.00	2.00	3.00	0.00
p75	10.0	5.00	7.00	1.00
p95	39.0	21.0	30.0	10.0

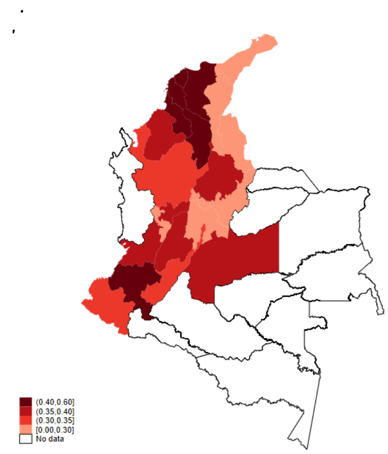
Notes. Panel A indicates the share of firms exporting in our sample and the fraction of firms exporting to at least one country of the destination groups. Panel B presents descriptive statistics for the total exported value in 2019, broken down by percentiles of the total exported value. Panel C shows the number of exported products in 2019, measured by the variety of 10-digit product codes, categorized by percentiles of product quantity. Source: Own elaboration based on customs data from DANE.

Figure A.1: Technological and Labor Skill Characteristics of Manufacturing Firms by Department, 2013–2019

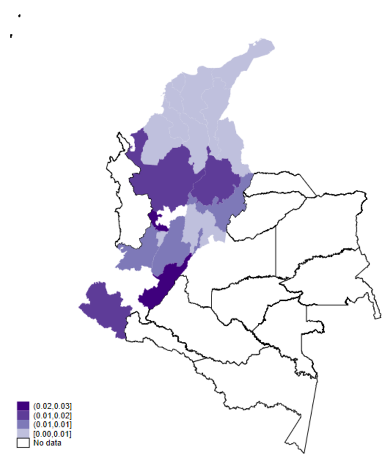
(a) High-skill, 2013



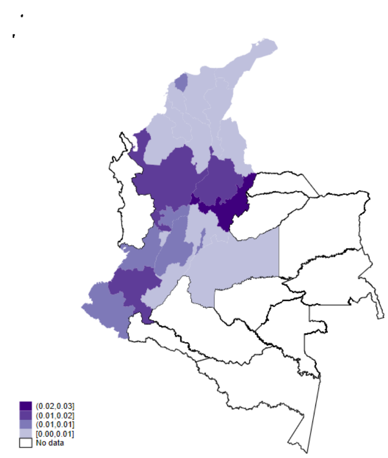
(b) High-skill, 2019



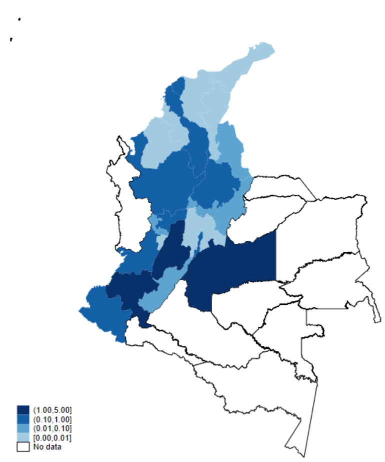
(c) R&D, 2013



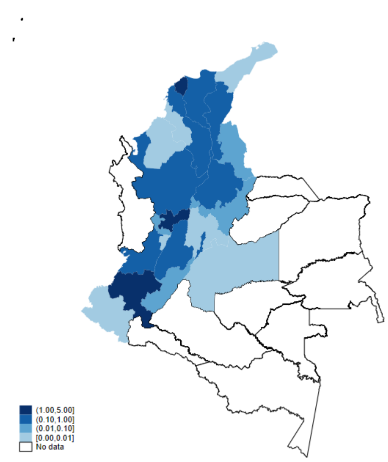
(d) R&D, 2019



(e) Innovation, 2013



(f) Innovation, 2019



Source. Own elaboration based on GEIH data from DANE.

Table A.5: First stages estimates

	(1)	(2)	(3)
Instrument	0.225***	0.234***	0.234***
	(0.038)	(0.029)	(0.029)
F-Statistic	34.44	65.39	65.59
Number of firms	3,017	3,017	3,017
Observations	21,119	21,119	21,119
Firm FE	Yes	Yes	Yes
Region FE × Time FE	Yes	Yes	Yes
Industry Linear Trend	Yes	Yes	Yes
Past controls × Time FE	No	Yes	Yes
FTA Controls × Year FE	No	No	Yes

Notes. Industry linear trends are specified at the 4-digit CIIU level. Past controls include the following local labor market-level variables: per capita GDP (in logs), homicide rate, the total number of cultivated hectares of coca crops (in logs), share of population in the subsidized health system, and the Gini coefficient. Standard errors clustered at the local labor market level in parentheses. Kleibergen-Paap rk Wald F-statistics are shown. ***, **, * denote significance at the 1, 5, and 10 percent significance level. Source: Own elaboration based on data from DANE.

Table A.6: Effect of immigration on firms' average wages

	Wages
Share of immigrants	0.003
	(0.003)
F-Statistic	65.39
Number of Firms	3,017
Observations	21,119
Firm FE	Yes
Region FE × Time FE	Yes
Industry Linear Trend	Yes
Past controls × Time FE	Yes

Notes: The outcome variable is the average wage for each firm (in logs). Industry linear trends are specified at the 4-digit CIIU level. Past controls include the following local labor market-level variables: per capita GDP (in logs), homicide rate, the total number of cultivated hectares of coca crops (in logs), share of population in the subsidized health system, and the Gini coefficient. Standard errors, clustered at the local labor market level, are reported in parentheses. Kleibergen-Paap rk Wald F-statistics are provided. Significance levels are denoted by ***, **, and * for 1%, 5%, and 10% levels, respectively. Source: Own elaboration based on data from DANE.

Table A.7: Effect of immigration on employment and wages - Local Labor Market level

	Panel A: Total Employment		
	Aggregate	Colombians	Venezuelans
Share of Immigrants	0.012 (0.034)	0.002 (0.033)	4.418*** (0.706)
	Panel B: Employment by Skill Level		
	High-Skill	Medium-Skill	Low-Skill
Share of Immigrants	-0.005 (0.082)	0.004 (0.038)	0.023 (0.032)
	Panel C: Employment of Venezuelans by Skill Level		
	High-Skill	Medium-Skill	Low-Skill
Share of Immigrants	8.762*** (2.881)	5.852*** (1.614)	3.287*** (0.589)
	Panel D: Employment of Colombians by Skill Level		
	High-Skill	Medium-Skill	Low-Skill
Share of Immigrants	-0.005 (0.082)	0.004 (0.038)	0.023 (0.032)
	Panel E: Wages by Skill Level		
	High-Skill	Medium-Skill	Low-Skill
Share of Immigrants	-0.058 (0.128)	-0.071 (0.067)	0.056 (0.048)
F-Statistic	12.54	12.54	12.54
Observations	553	553	553
Local Labor Market FE	Yes	Yes	Yes
Region FE × Year FE	Yes	Yes	Yes
Past controls × Year FE	Yes	Yes	Yes

Notes: The outcome variables for Panel A-D are the rate of employment of each group relative to the corresponding figure for 2013. The outcome variable for Panel E is the average hourly wage (in logs). Past controls include the following local labor market-level variables: per capita GDP (in logs), homicide rate, the total number of cultivated hectares of coca crops (in logs), share of population in the subsidized health system, and the Gini coefficient. Standard errors, clustered at the local labor market level, are reported in parentheses. Kleibergen-Paap rk Wald F-statistics are provided. Significance levels are denoted by ***, **, and * for 1%, 5%, and 10% levels, respectively. Source: Own elaboration based on data from DANE.

Table A.8: Effect of immigration on self-reported product mix variables

	Number of products (in logs)		Probability (dummy variable)	
	Improved	New	Improved	New
Share of Immigrants	0.007**	0.007	0.007**	0.005
	(0.003)	(0.004)	(0.003)	(0.004)
F-Statistic	59.12	59.12	59.12	59.12
Number of firms	3,017	3,017	3,017	3,017
Observations	12,068	12,068	12,068	12,068
Firm FE	Yes	Yes	Yes	Yes
Region FE × Time FE	Yes	Yes	Yes	Yes
Industry Linear Trend	Yes	Yes	Yes	Yes
Past controls × Time FE	Yes	Yes	Yes	Yes

Notes: The outcome variables in columns 2, 5, and 6 are binary indicators reflecting whether firms obtained a quality certification, significantly improved an existing product or introduced a new product. Columns 3 and 4 represent the total number (in logs) of significantly improved or new products. Industry linear trends are specified at the 4-digit CIIU level. Past controls include the following local labor market-level variables: per capita GDP (in logs), homicide rate, the total number of cultivated hectares of coca crops (in logs), share of population in the subsidized health system, and the Gini coefficient. Standard errors, clustered at the local labor market level, are reported in parentheses. Kleibergen-Paap rk Wald F-statistics are provided. Significance levels are denoted by ***, **, and * for 1%, 5%, and 10% levels, respectively. Source: Own elaboration based on data from DANE.

Table A.9: Effect of immigration on firms' performance indicators through the adoption of new/better production methods/products

	Quality	Variety	Keep Markets	New Markets	Productivity	Costs
Share of Immigrants	0.012**	0.007**	0.013***	0.007	0.008*	0.007*
	(0.005)	(0.004)	(0.005)	(0.004)	(0.004)	(0.004)
F-statistic	59.12	59.12	59.12	59.12	59.12	59.12
Number of observations	3,017	3,017	3,017	3,017	3,017	3,017
Observations	12,068	12,068	12,068	12,068	12,068	12,068
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Region FE × Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry Linear Trend	Yes	Yes	Yes	Yes	Yes	Yes
Past controls × Time FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The outcome variables are binary indicators indicating whether firms (i) introduced or significantly improved a product and/or a process (as described in the text) *and* (ii) achieved one of the goals described in the columns. Industry linear trends are specified at the 4-digit CIIU level. Past controls include the following local labor market-level variables: per capita GDP (in logs), homicide rate, the total number of cultivated hectares of coca crops (in logs), share of population in the subsidized health system, and the Gini coefficient. Standard errors, clustered at the local labor market level, are reported in parentheses. Kleibergen-Paap rk Wald F-statistics are provided. Significance levels are denoted by ***, **, and * for 1%, 5%, and 10% levels, respectively. Source: Own elaboration based on data from DANE.

Table A.10: Effect of immigration on the probability of facing obstacles to adopt new and better production methods or products

	Own resources	Skills	Regulations	Accreditation services
Share of Immigrants	-0.009**	-0.010**	-0.016***	-0.014**
	(0.004)	(0.005)	(0.005)	(0.007)
F-statistic	59.12	59.12	59.12	59.12
Number of observations	3,017	3,017	3,017	3,017
Observations	12,068	12,068	12,068	12,068
Firm FE	Yes	Yes	Yes	Yes
Region FE × Time FE	Yes	Yes	Yes	Yes
Industry Linear Trend	Yes	Yes	Yes	Yes
Past controls × Time FE	Yes	Yes	Yes	Yes

Notes: The outcome variables are binary indicators that specify whether firms encountered any of the described obstacles when attempting to introduce or significantly improve a product or method. Industry linear trends are specified at the 4-digit CIIU level. Past controls include the following local labor market-level variables: per capita GDP (in logs), homicide rate, the total number of cultivated hectares of coca crops (in logs), share of population in the subsidized health system, and the Gini coefficient. Standard errors, clustered at the local labor market level, are reported in parentheses. Kleibergen-Paap rk Wald F-statistics are provided. Significance levels are denoted by ***, **, and * for 1%, 5%, and 10% levels, respectively. Source: Own elaboration based on data from DANE.

Table A.11: Effect of immigration on objective quality measures - by exporting status

	Quality Certifications	Process quality cert.	Product quality cert.
Exporters	0.024*	0.021*	0.001
	(0.014)	(0.012)	(0.010)
F-Statistic	17.03	17.03	17.03
Observations	5,444	5,444	5,444
Non-exporters	0.009	0.006	0.002
	(0.006)	(0.006)	(0.002)
F-Statistic	73.67	73.67	73.67
Observations	6,624	6,624	6,624
Firm FE	Yes	Yes	Yes
Region FE × Time FE	Yes	Yes	Yes
Industry Linear Trend	Yes	Yes	Yes
Past controls × Time FE	Yes	Yes	Yes

Notes: The outcome variable in column 2 is a binary indicator equal to one if the firm obtained a quality certification (either a product or a process certification). The outcome variables in columns 3 and 4 are binary indicators equal to one if the firm obtained a product quality certification or a process quality certification, respectively. Industry linear trends are specified at the 4-digit CIIU level. Past controls include the following local labor market-level variables: per capita GDP (in logs), homicide rate, the total number of cultivated hectares of coca crops (in logs), share of population in the subsidized health system, and the Gini coefficient. Standard errors, clustered at the local labor market level, are reported in parentheses. Kleibergen-Paap rk Wald F-statistics are provided. Significance levels are denoted by ***, **, and * for 1%, 5%, and 10% levels, respectively. Source: Own elaboration based on data from DANE.

B Heterogeneous Effects

Table B.1: Effect of immigration by firms' productivity

	Probability of Exporting			
	Total	High	Upper-middle	Low
High Productivity	0.009*	0.011**	0.007*	0.001
	(0.005)	(0.005)	(0.004)	(0.002)
Low Productivity	0.002	0.002	0.000	0.004*
	(0.002)	(0.003)	(0.002)	(0.002)
	Exports (in logs)			
	Total	High	Upper-middle	Low
High Productivity	0.128**	0.152***	0.090*	0.010
	(0.054)	(0.055)	(0.045)	(0.024)
Low Productivity	0.022	0.022	0.002	0.043*
	(0.025)	(0.029)	(0.019)	(0.024)
Firm FE	Yes	Yes	Yes	Yes
Region FE $\times$ Time FE	Yes	Yes	Yes	Yes
Industry Linear Trend	Yes	Yes	Yes	Yes
Past controls $\times$ Time FE	Yes	Yes	Yes	Yes

Notes: The outcome variables are a binary indicator that denotes whether the firm exported to each destination (Probability of Exporting), and the total amount exported in US dollars (in logs). Industry linear trends are specified at the 4-digit CIIU level. Past controls include the following local labor market-level variables: per capita GDP (in logs), homicide rate, the total number of cultivated hectares of coca crops (in logs), share of population in the subsidized health system, and the Gini coefficient. Standard errors, clustered at the local labor market level, are reported in parentheses. Kleibergen-Paap rk Wald F-statistics are provided. Significance levels are denoted by ***, **, and * for 1%, 5%, and 10% levels, respectively. Source: Own elaboration based on data from DANE.

Table B.2: Effect of immigration on number of products and destinations by firms' productivity

	Number of Products			
	Total	High	Upper-middle	Low
High Productivity	0.021***	0.017**	0.010**	-0.003
	(0.008)	(0.007)	(0.004)	(0.002)
Low Productivity	0.006	0.005	0.004	0.005*
	(0.004)	(0.003)	(0.003)	(0.003)
	Number of Destinations			
	Total	High	Upper-middle	Low
High Productivity	0.016***	0.015***	0.008**	-0.000
	(0.005)	(0.005)	(0.004)	(0.002)
Low Productivity	0.005*	0.003	0.003	0.004**
	(0.003)	(0.003)	(0.002)	(0.002)
Firm FE	Yes	Yes	Yes	Yes
Region FE $\times$ Time FE	Yes	Yes	Yes	Yes
Industry Linear Trend	Yes	Yes	Yes	Yes
Past controls $\times$ Time FE	Yes	Yes	Yes	Yes

Notes: The outcome variables are the number of different products exported (in logs) categorized according to the 10-digit NANDINA product classification, and the number of different country destinations for each firm (in logs). Industry linear trends are specified at the 4-digit CIIU level. Past controls include the following local labor market-level variables: per capita GDP (in logs), homicide rate, the total number of cultivated hectares of coca crops (in logs), share of population in the subsidized health system, and the Gini coefficient. Standard errors, clustered at the local labor market level, are reported in parentheses. Kleibergen-Paap rk Wald F-statistics are provided. Significance levels are denoted by ***, **, and * for 1%, 5%, and 10% levels, respectively. Source: Own elaboration based on data from DANE.

Table B.3: Effect of immigration on exports by type of products and firms' productivity

	Differentiated		Homogeneous	
	Exports USD	No. Products	Exports USD	No. Products
High Productivity	0.083*	0.015**	0.078	0.011*
	(0.044)	(0.007)	(0.047)	(0.005)
Low Productivity	0.013	0.004	0.010	0.002
	(0.024)	(0.004)	(0.020)	(0.002)
Firm FE	Yes	Yes	Yes	Yes
Region FE × Time FE	Yes	Yes	Yes	Yes
Industry Linear Trend	Yes	Yes	Yes	Yes
Past controls × Time FE	Yes	Yes	Yes	Yes

Notes. The outcome variables are the total amount in US dollars and the total number of different products exported (both in logs) by a firm each year for each type of product. Products were defined as differentiated or homogeneous following Rauch (1999)'s definition. Goods defined as reference-priced goods or goods traded in organized markets were considered as homogeneous. The remaining goods were classified as differentiated goods. Industry linear trends are specified at the 4-digit CIIU level. Past controls include the following local labor market-level variables: per capita GDP (in logs), homicide rate, the total number of cultivated hectares of coca crops (in logs), share of population in the subsidized health system, and the Gini coefficient. Standard errors, clustered at the local labor market level, are reported in parentheses. Kleibergen-Paap rk Wald F-statistics are provided. Significance levels are denoted by ***, **, and * for 1%, 5%, and 10% levels, respectively. Source: Own elaboration based on data from DANE.

Table B.4: Effect of immigration by firms' skill intensity

	Probability of Exporting			
	Total	High	Upper-middle	Low
High Skill-intensity	0.012***	0.006**	0.009***	0.006**
	(0.003)	(0.003)	(0.002)	(0.003)
Low Skill-intensity	-0.001	0.004	-0.003	-0.004*
	(0.004)	(0.006)	(0.003)	(0.002)
	Exports (in logs)			
	Total	High	Upper-middle	Low
High Skill-intensity	0.146***	0.100***	0.110***	0.071**
	(0.032)	(0.030)	(0.026)	(0.031)
Low Skill-intensity	-0.019	0.044	-0.035	-0.045**
	(0.046)	(0.068)	(0.038)	(0.021)
Firm FE	Yes	Yes	Yes	Yes
Region FE $\times$ Time FE	Yes	Yes	Yes	Yes
Industry Linear Trend	Yes	Yes	Yes	Yes
Past controls $\times$ Time FE	Yes	Yes	Yes	Yes

Notes: The outcome variables are a binary indicator that denotes whether the firm exported to each destination (Probability of Exporting), and the total amount exported in US dollars (in logs). Industry linear trends are specified at the 4-digit CIIU level. Past controls include the following local labor market-level variables: per capita GDP (in logs), homicide rate, the total number of cultivated hectares of coca crops (in logs), share of population in the subsidized health system, and the Gini coefficient. Standard errors, clustered at the local labor market level, are reported in parentheses. Kleibergen-Paap rk Wald F-statistics are provided. Significance levels are denoted by ***, **, and * for 1%, 5%, and 10% levels, respectively. Source: Own elaboration based on data from DANE.

Table B.5: Effect of immigration on number of products and destinations by firms' skill intensity

	Number of Products			
	Total	High	Upper-middle	Low
High Skill-intensity	0.020***	0.016***	0.011***	0.006*
	(0.005)	(0.005)	(0.004)	(0.003)
Low Skill-intensity	0.000	-0.003	0.002	-0.006*
	(0.007)	(0.007)	(0.005)	(0.003)
	Number of Destinations			
	Total	High	Upper-middle	Low
High Skill-intensity	0.019***	0.013***	0.012***	0.006**
	(0.003)	(0.003)	(0.002)	(0.002)
Low Skill-intensity	-0.003	0.001	-0.002	-0.004
	(0.005)	(0.007)	(0.003)	(0.002)
Firm FE	Yes	Yes	Yes	Yes
Region FE × Time FE	Yes	Yes	Yes	Yes
Industry Linear Trend	Yes	Yes	Yes	Yes
Past controls × Time FE	Yes	Yes	Yes	Yes

Notes: The outcome variables are the number of different products exported (in logs) categorized according to the 10-digit NANDINA product classification, and the number of different country destinations for each firm (in logs). Industry linear trends are specified at the 4-digit CIIU level. Past controls include the following local labor market-level variables: per capita GDP (in logs), homicide rate, the total number of cultivated hectares of coca crops (in logs), share of population in the subsidized health system, and the Gini coefficient. Standard errors, clustered at the local labor market level, are reported in parentheses. Kleibergen-Paap rk Wald F-statistics are provided. Significance levels are denoted by ***, **, and * for 1%, 5%, and 10% levels, respectively. Source: Own elaboration based on data from DANE.

Table B.6: Effect of immigration on exports by type of products and firms' skill intensity

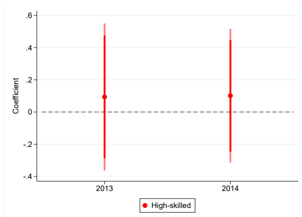
	Differentiated		Homogeneous	
	Exports USD	No. Products	Exports USD	No. Products
High Skill-intensity	0.096***	0.015***	0.065**	0.007**
	(0.028)	(0.005)	(0.026)	(0.003)
Low Skill-intensity	-0.001	0.001	-0.013	0.000
	(0.028)	(0.006)	(0.040)	(0.004)
Firm FE	Yes	Yes	Yes	Yes
Region FE $\times$ Time FE	Yes	Yes	Yes	Yes
Industry Linear Trend	Yes	Yes	Yes	Yes
Past controls $\times$ Time FE	Yes	Yes	Yes	Yes

Notes. The outcome variables are the total amount in US dollars and the total number of different products exported (both in logs) by a firm each year for each type of product. Products were defined as differentiated or homogeneous following Rauch (1999)'s definition. Goods defined as reference-priced goods or goods traded in organized markets were considered as homogeneous. The remaining goods were classified as differentiated goods. Industry linear trends are specified at the 4-digit CIIU level. Past controls include the following local labor market-level variables: per capita GDP (in logs), homicide rate, the total number of cultivated hectares of coca crops (in logs), share of population in the subsidized health system, and the Gini coefficient. Standard errors, clustered at the local labor market level, are reported in parentheses. Kleibergen-Paap rk Wald F-statistics are provided. Significance levels are denoted by ***, **, and * for 1%, 5%, and 10% levels, respectively. Source: Own elaboration based on data from DANE.

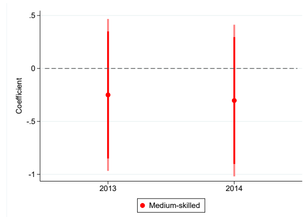
C IV Internal Validity, Identification Threats, Robustness Checks

Figure C.1: IV internal validity test (pre-trends) - Skill-upgrading and R&D investments

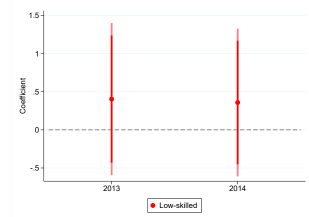
(a) High-skilled



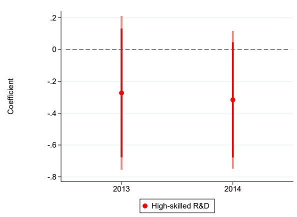
(b) Medium-skilled



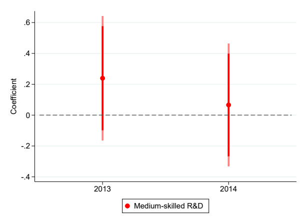
(c) Low-skilled



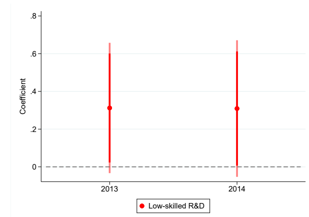
(d) High-skilled R&D



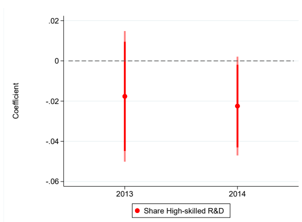
(e) Medium-skilled R&D



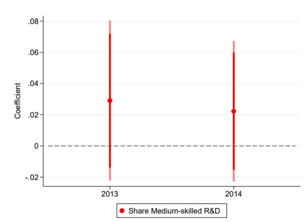
(f) Low-skilled R&D



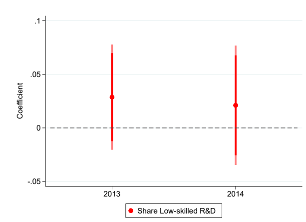
(g) Share High-skilled R&D



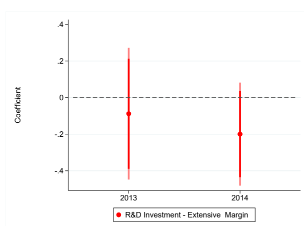
(h) Share Medium-skilled R&D



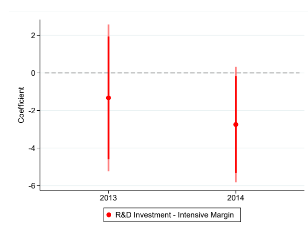
(i) Share Low-skilled R&D



(j) R&D Investment - Extensive Margin



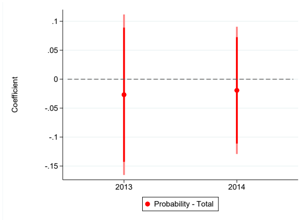
(k) R&D Investment - Intensive Margin



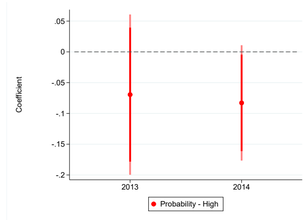
Notes. Titles above each graph show the outcome of each regression. Each dot represents the coefficient of the interaction between the average distance shares $\left(\text{i.e.}, \frac{1}{K}\sum_K \frac{1}{D_{mrk}}\right)$ and year dummies. Regressions control for Industry Linear Trends at the 4-digit CIIU level and region fixed effects interacted with year dummies. Standard errors are clustered at the local labor market level. Source: Own elaboration based on data from DANE.

Figure C.2: IV internal validity test (pre-trends) - Trade-creation effect

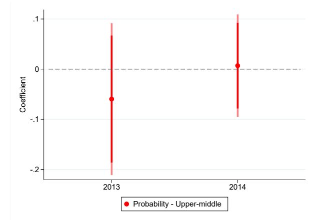
(a) Exporting dummy (all)



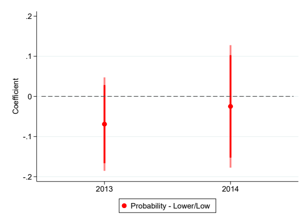
(b) Exporting dummy (High-income)



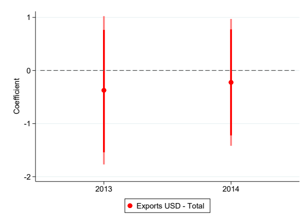
(c) Exporting dummy (Upper-middle)



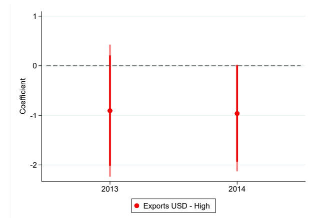
(d) Exporting dummy (Lower/Low)



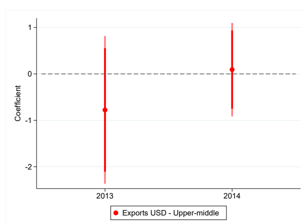
(e) Exports in USD (all)



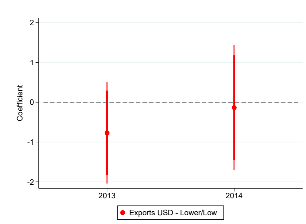
(f) Exports in USD (High-income)



(g) Exports in USD (Upper-middle)



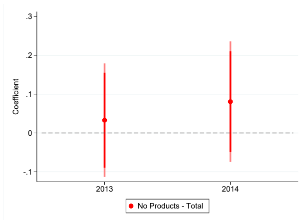
(h) Exports in USD (Lower/Low)



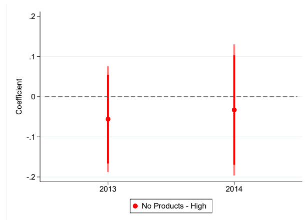
Notes. Titles above each graph show the outcome of each regression. Each dot represents the coefficient of the interaction between the average distance shares $\left(\text{i.e., } \frac{1}{K}\sum_K \frac{1}{D_{mrk}}\right)$ and year dummies. Regressions control for Industry Linear Trends at the 4-digit CIIU level and region fixed effects interacted with year dummies. Standard errors are clustered at the local labor market level. Source: Own elaboration based on data from DANE.

Figure C.3: IV internal validity test (pre-trends) - Trade-creation effect

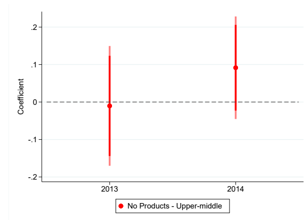
(a) Number of products (all)



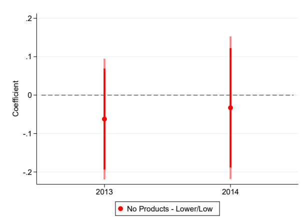
(b) Number of products (High-income)



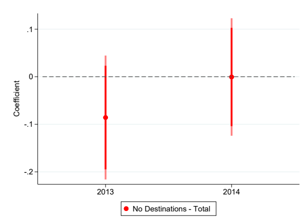
(c) Number of products (Upper-middle)



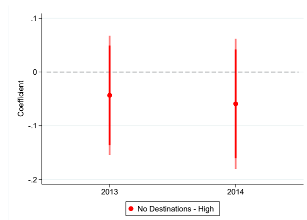
(d) Number of products (Lower/Low)



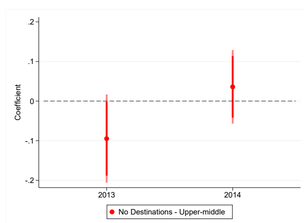
(e) Number of destinations (all)



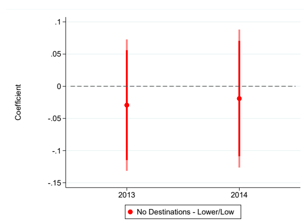
(f) Number of destinations (High-income)



(g) Number of destinations (Upper-middle)



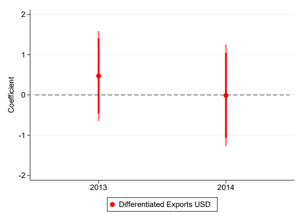
(h) Number of destinations (Lower/Low)



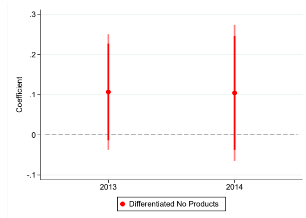
Notes. Titles above each graph show the outcome of each regression. Each dot represents the coefficient of the interaction between the average distance shares $\left(\text{i.e., } \frac{1}{K}\sum_K \frac{1}{D_{mrk}}\right)$ and year dummies. Regressions control for Industry Linear Trends at the 4-digit CIIU level and region fixed effects interacted with year dummies. Standard errors are clustered at the local labor market level. Source: Own elaboration based on data from DANE.

Figure C.4: IV internal validity test (pre-trends) - Trade-creation effect

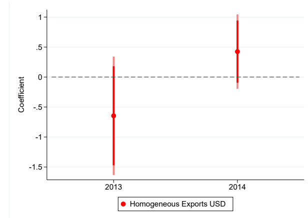
(a) Differentiated exports



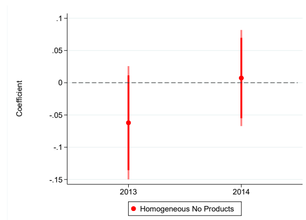
(b) Number of differentiated products



(c) Homogeneous exports



(d) Number of homogeneous products



Notes. Titles above each graph show the outcome of each regression. Each dot represents the coefficient of the interaction between the average distance shares $\left(\text{i.e., } \frac{1}{K}\sum_K \frac{1}{D_{mrk}}\right)$ and year dummies. Regressions control for Industry Linear Trends at the 4-digit CIIU level and region fixed effects interacted with year dummies. Standard errors are clustered at the local labor market level. Source: Own elaboration based on data from DANE.

Table C.1: Effect of immigration on skill-upgrading (Robustness)

	High-skilled	Medium-skilled	Low-skilled
Panel A: Total No Employees			
Share of immigrants	0.010	0.011	0.006
	(0.006)	(0.009)	(0.013)
Panel B: R&D Division No Employees			
Share of immigrants	0.031***	0.019***	0.004
	(0.007)	(0.006)	(0.003)
Panel C: R&D Division Share Employees			
Share of immigrants	0.002***	0.001**	0.001
	(0.000)	(0.001)	(0.000)
F-Statistic	65.59	65.59	65.59
Number of firms	3,017	3,017	3,017
Observations	21,119	21,119	21,119
Firm FE	Yes	Yes	Yes
Region FE $\times$ Time FE	Yes	Yes	Yes
Industry Linear Trend	Yes	Yes	Yes
Past controls $\times$ Time FE	Yes	Yes	Yes
FTA Controls $\times$ Year FE	Yes	Yes	Yes

Notes: The outcome variables are the number of employees by education level (in logs). High-skilled workers are those with any post-secondary education. Medium-skilled workers are those with secondary education. Low-skilled workers are those with less than secondary education. Industry linear trends are specified at the 4-digit CIIU level. Past controls include the following local labor market-level variables: per capita GDP (in logs), homicide rate, the total number of cultivated hectares of coca crops (in logs), share of population in the subsidized health system, and the Gini coefficient. FTA controls include the amount exported by each firm in 2012 (in logs) to South Korea, the U.S., Costa Rica, the European Union, Chile, Mexico, and Peru. Standard errors, clustered at the local labor market level, are reported in parentheses. Kleibergen-Paap rk Wald F-statistics are provided. Significance levels are denoted by ***, **, and * for 1%, 5%, and 10% levels, respectively. Source: Own elaboration based on data from DANE.

Table C.2: Effect of immigration on technological development investment - Extensive and intensive margin (Robustness)

	Extensive Margin	Intensive Margin
Share of immigrants	0.012***	0.141**
	(0.005)	(0.057)
F-Statistic	65.59	65.59
Number of firms	3,017	3,017
Observations	21,119	21,119
Firm FE	Yes	Yes
Region FE × Time FE	Yes	Yes
Industry Linear Trend	Yes	Yes
Past controls × Time FE	Yes	Yes
FTA Controls × Year FE	Yes	Yes

Notes: The outcome variables are binary indicators indicating whether firms invested a positive amount in technological development (investments aimed at introducing novel or significantly enhanced goods, services, and/or processes). Industry linear trends are specified at the 4-digit CIIU level. Past controls include the following local labor market-level variables: per capita GDP (in logs), homicide rate, the total number of cultivated hectares of coca crops (in logs), share of population in the subsidized health system, and the Gini coefficient. FTA controls include the amount exported by each firm in 2012 (in logs) to South Korea, the U.S., Costa Rica, the European Union, Chile, Mexico, and Peru. Standard errors, clustered at the local labor market level, are reported in parentheses. Kleibergen-Paap rk Wald F-statistics are provided. Significance levels are denoted by ***, **, and * for 1%, 5%, and 10% levels, respectively. Source: Own elaboration based on data from DANE.

Table C.3: Effect of immigration on the improvement of processes (Robustness)

	Production	Organizational	Marketing
Share of Immigrants	0.019***	0.006*	0.004
	(0.004)	(0.003)	(0.003)
F-Statistic	59.40	59.40	59.40
Number of firms	3,017	3,017	3,017
Observations	12,068	12,068	12,068
Firm FE	Yes	Yes	Yes
Region FE × Time FE	Yes	Yes	Yes
Industry Linear Trend	Yes	Yes	Yes
Past controls × Time FE	Yes	Yes	Yes
FTA Controls × Year FE	Yes	Yes	Yes

Notes: The outcome variables are binary indicators indicating whether firms introduced or significantly improved a product and/or a method. Industry linear trends are specified at the 4-digit CIIU level. Past controls include the following local labor market-level variables: per capita GDP (in logs), homicide rate, the total number of cultivated hectares of coca crops (in logs), share of population in the subsidized health system, and the Gini coefficient. FTA controls include the amount exported by each firm in 2012 (in logs) to South Korea, the U.S., Costa Rica, the European Union, Chile, Mexico, and Peru. Standard errors, clustered at the local labor market level, are reported in parentheses. Kleibergen-Paap rk Wald F-statistics are provided. Significance levels are denoted by ***, **, and * for 1%, 5%, and 10% levels, respectively. Source: Own elaboration based on data from DANE.

Table C.4: Effect of immigration on the adoption of new and better products (Robustness)

	Certifications	Number of products (in logs)		Probability (dummy variable)	
		Improved	New	Improved	New
Share of Immigrants	0.011**	0.007**	0.007	0.007**	0.005
	(0.005)	(0.003)	(0.004)	(0.003)	(0.004)
F-Statistic	59.40	59.40	59.40	59.40	59.40
Number of firms	3,017	3,017	3,017	3,017	3,017
Observations	12,068	12,068	12,068	12,068	12,068
Firm FE	Yes	Yes	Yes	Yes	Yes
Region FE × Time FE	Yes	Yes	Yes	Yes	Yes
Industry Linear Trend	Yes	Yes	Yes	Yes	Yes
Past controls × Time FE	Yes	Yes	Yes	Yes	Yes
FTA Controls × Year FE	Yes	Yes	Yes	Yes	Yes

Notes: The outcome variables are binary indicators indicating whether firms introduced or significantly improved a product and/or a method. Industry linear trends are specified at the 4-digit CIIU level. Past controls include the following local labor market-level variables: per capita GDP (in logs), homicide rate, the total number of cultivated hectares of coca crops (in logs), share of population in the subsidized health system, and the Gini coefficient. FTA controls include the amount exported by each firm in 2012 (in logs) to South Korea, the U.S., Costa Rica, the European Union, Chile, Mexico, and Peru. Standard errors, clustered at the local labor market level, are reported in parentheses. Kleibergen-Paap rk Wald F-statistics are provided. Significance levels are denoted by ***, **, and * for 1%, 5%, and 10% levels, respectively. Source: Own elaboration based on data from DANE.

Table C.5: Effect of immigration on the adoption of new/better processes/products and improving firms' outcomes (Robustness)

	Quality	Variety	Keep Markets	New Markets	Productivity	Costs
Share of Immigrants	0.012**	0.008**	0.013***	0.007	0.008*	0.008*
	(0.005)	(0.004)	(0.005)	(0.004)	(0.004)	(0.004)
F-statistic	59.40	59.40	59.40	59.40	59.40	59.40
Number of observations	3,017	3,017	3,017	3,017	3,017	3,017
Observations	12,068	12,068	12,068	12,068	12,068	12,068
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Region FE × Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry Linear Trend	Yes	Yes	Yes	Yes	Yes	Yes
Past controls × Time FE	Yes	Yes	Yes	Yes	Yes	Yes
FTA Controls × Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The outcome variables are binary indicators indicating whether firms introduced or significantly improved a product and/or a method. Industry linear trends are specified at the 4-digit CIIU level. Past controls include the following local labor market-level variables: per capita GDP (in logs), homicide rate, the total number of cultivated hectares of coca crops (in logs), share of population in the subsidized health system, and the Gini coefficient. FTA controls include the amount exported by each firm in 2012 (in logs) to South Korea, the U.S., Costa Rica, the European Union, Chile, Mexico, and Peru. Standard errors, clustered at the local labor market level, are reported in parentheses. Kleibergen-Paap rk Wald F-statistics are provided. Significance levels are denoted by ***, **, and * for 1%, 5%, and 10% levels, respectively. Source: Own elaboration based on data from DANE.

Table C.6: Effect of immigration on the probability of facing obstacles to adopt new and better products or processes (Robustness)

	Own resources	Skills	Regulations	Qualified services
Share of Immigrants	-0.008**	-0.010**	-0.016***	-0.014**
	(0.004)	(0.005)	(0.005)	(0.007)
F-statistic	59.40	59.40	59.40	59.40
Number of observations	3,017	3,017	3,017	3,017
Observations	12,068	12,068	12,068	12,068
Firm FE	Yes	Yes	Yes	Yes
Region FE × Time FE	Yes	Yes	Yes	Yes
Industry Linear Trend	Yes	Yes	Yes	Yes
Past controls × Time FE	Yes	Yes	Yes	Yes
FTA Controls × Year FE	Yes	Yes	Yes	Yes

Notes: The outcome variables are binary indicators indicating whether firms introduced or significantly improved a product and/or a method. Industry linear trends are specified at the 4-digit CIIU level. Past controls include the following local labor market-level variables: per capita GDP (in logs), homicide rate, the total number of cultivated hectares of coca crops (in logs), share of population in the subsidized health system, and the Gini coefficient. FTA controls include the amount exported by each firm in 2012 (in logs) to South Korea, the U.S., Costa Rica, the European Union, Chile, Mexico, and Peru. Standard errors, clustered at the local labor market level, are reported in parentheses. Kleibergen-Paap rk Wald F-statistics are provided. Significance levels are denoted by ***, **, and * for 1%, 5%, and 10% levels, respectively. Source: Own elaboration based on data from DANE.

Table C.7: Effect of immigration on the probability of exporting - Total and by income level of destinations (Robustness)

	Total	High	Upper-middle	Lower/Low
Share of Immigrants	0.006**	0.005**	0.004*	0.002
	(0.003)	(0.003)	(0.002)	(0.002)
F-statistic	65.59	65.59	65.59	65.59
Number of firms	3,017	3,017	3,017	3,017
Observations	21,119	21,119	21,119	21,119
Firm FE	Yes	Yes	Yes	Yes
Region FE × Time FE	Yes	Yes	Yes	Yes
Industry Linear Trend	Yes	Yes	Yes	Yes
Past controls × Time FE	Yes	Yes	Yes	Yes
FTA Controls × Year FE	Yes	Yes	Yes	Yes

Notes: The outcome variable is a binary indicator that denotes whether the firm exported to each destination. Industry linear trends are specified at the 4-digit CIIU level. Past controls include the following local labor market-level variables: per capita GDP (in logs), homicide rate, the total number of cultivated hectares of coca crops (in logs), share of population in the subsidized health system, and the Gini coefficient. FTA controls include the amount exported by each firm in 2012 (in logs) to South Korea, the U.S., Costa Rica, the European Union, Chile, Mexico, and Peru. Standard errors, clustered at the local labor market level, are reported in parentheses. Kleibergen-Paap rk Wald F-statistics are provided. Significance levels are denoted by ***, **, and * for 1%, 5%, and 10% levels, respectively. Source: Own elaboration based on data from DANE.

Table C.8: Effect of immigration on exports - Total and by income level of destinations (Robustness)

	Total	High	Upper-middle	Lower/Low
Share of Immigrants	0.071**	0.070**	0.043*	0.024
	(0.029)	(0.027)	(0.023)	(0.020)
F-statistic	65.59	65.59	65.59	65.59
Number of firms	3,017	3,017	3,017	3,017
Observations	21,119	21,119	21,119	21,119
Firm FE	Yes	Yes	Yes	Yes
Region FE $\times$ Time FE	Yes	Yes	Yes	Yes
Industry Linear Trend	Yes	Yes	Yes	Yes
Past controls $\times$ Time FE	Yes	Yes	Yes	Yes
FTA Controls $\times$ Year FE	Yes	Yes	Yes	Yes

Notes: The outcome variable is the total amount exported in US dollars (in logs). Industry linear trends are specified at the 4-digit CIIU level. Past controls include the following local labor market-level variables: per capita GDP (in logs), homicide rate, the total number of cultivated hectares of coca crops (in logs), share of population in the subsidized health system, and the Gini coefficient. FTA controls include the amount exported by each firm in 2012 (in logs) to South Korea, the U.S., Costa Rica, the European Union, Chile, Mexico, and Peru. Standard errors, clustered at the local labor market level, are reported in parentheses. Kleibergen-Paap rk Wald F-statistics are provided. Significance levels are denoted by ***, **, and * for 1%, 5%, and 10% levels, respectively. Source: Own elaboration based on data from DANE.

Table C.9: Effect of immigration on number of products exported - Total and by income level of destinations (Robustness)

	Total	High	Upper-middle	Lower/Low
Share of Immigrants	0.011**	0.008*	0.007**	0.001
	(0.005)	(0.004)	(0.003)	(0.002)
F-statistic	65.59	65.59	65.59	65.59
Number of firms	3,017	3,017	3,017	3,017
Observations	21,119	21,119	21,119	21,119
Firm FE	Yes	Yes	Yes	Yes
Region FE $\times$ Time FE	Yes	Yes	Yes	Yes
Industry Linear Trend	Yes	Yes	Yes	Yes
Past controls $\times$ Time FE	Yes	Yes	Yes	Yes
FTA Controls $\times$ Year FE	Yes	Yes	Yes	Yes

Notes: The outcome variable is the number of different products exported (in logs) categorized according to the 10-digit NANDINA product classification. Industry linear trends are specified at the 4-digit CIIU level. Past controls include the following local labor market-level variables: per capita GDP (in logs), homicide rate, the total number of cultivated hectares of coca crops (in logs), share of population in the subsidized health system, and the Gini coefficient. FTA controls include the amount exported by each firm in 2012 (in logs) to South Korea, the U.S., Costa Rica, the European Union, Chile, Mexico, and Peru. Standard errors, clustered at the local labor market level, are reported in parentheses. Kleibergen-Paap rk Wald F-statistics are provided. Significance levels are denoted by ***, **, and * for 1%, 5%, and 10% levels, respectively. Source: Own elaboration based on data from DANE.

Table C.10: Effect of immigration on number of destinations - Total and by income level of destinations (Robustness)

	Total	High	Upper-middle	Lower/Low
Share of Immigrants	0.009***	0.007***	0.005**	0.002
	(0.003)	(0.003)	(0.002)	(0.001)
F-statistic	65.59	65.59	65.59	65.59
Number of firms	3,017	3,017	3,017	3,017
Observations	21,119	21,119	21,119	21,119
Firm FE	Yes	Yes	Yes	Yes
Region FE × Time FE	Yes	Yes	Yes	Yes
Industry Linear Trend	Yes	Yes	Yes	Yes
Past controls × Time FE	Yes	Yes	Yes	Yes
FTA Controls × Year FE	Yes	Yes	Yes	Yes

Notes: The outcome variable is the number of different country destinations for each firm (in logs). Industry linear trends are specified at the 4-digit CIIU level. Past controls include the following local labor market-level variables: per capita GDP (in logs), homicide rate, the total number of cultivated hectares of coca crops (in logs), share of population in the subsidized health system, and the Gini coefficient. FTA controls include the amount exported by each firm in 2012 (in logs) to South Korea, the U.S., Costa Rica, the European Union, Chile, Mexico, and Peru. Standard errors, clustered at the local labor market level, are reported in parentheses. Kleibergen-Paap rk Wald F-statistics are provided. Significance levels are denoted by ***, **, and * for 1%, 5%, and 10% levels, respectively. Source: Own elaboration based on data from DANE.

Table C.11: Effect of immigration on exports by type of products - Total and by income level of destinations (Robustness)

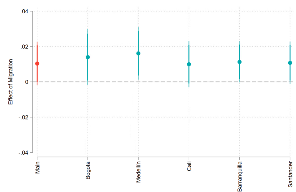
	Differentiated		Homogeneous	
	Exports USD	No. Products	Exports USD	No. Products
Share of immigrants	0.049*	0.009*	0.026	0.004*
	(0.025)	(0.005)	(0.021)	(0.002)
F-Statistic	65.59	65.59	65.59	65.59
Number of firms	3,017	3,017	3,017	3,017
Observations	21,119	21,119	21,119	21,119
Firm FE	Yes	Yes	Yes	Yes
Region FE × Time FE	Yes	Yes	Yes	Yes
Industry Linear Trend	Yes	Yes	Yes	Yes
Past controls × Time FE	Yes	Yes	Yes	Yes
FTA Controls × Year FE	Yes	Yes	Yes	Yes

Notes. The outcome variable is the total amount exported in US dollars (in logs) by a firm each year for each type of product. Products were defined as differentiated or homogeneous following Rauch (1999)'s definition. Goods defined as reference-priced goods or goods traded in organized markets were considered as homogeneous. Industry linear trends are specified at the 4-digit CIIU level. Past controls include the following local labor market-level variables: per capita GDP (in logs), homicide rate, the total number of cultivated hectares of coca crops (in logs), share of population in the subsidized health system, and the Gini coefficient. FTA controls include the amount exported by each firm in 2012 (in logs) to South Korea, the U.S., Costa Rica, the European Union, Chile, Mexico, and Peru. Standard errors, clustered at the local labor market level, are reported in parentheses. Kleibergen-Paap rk Wald F-statistics are provided. Significance levels are denoted by ***, **, and * for 1%, 5%, and 10% levels, respectively. Source: Own elaboration based on data from DANE.

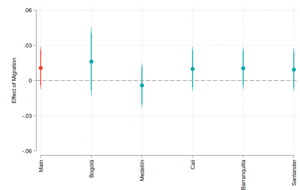
D Robustness Checks - Leave-one-out Estimations

Figure D.1: Robustness checks - leave-one-out estimates (local labor markets) - Skill-upgrading and R&D investments

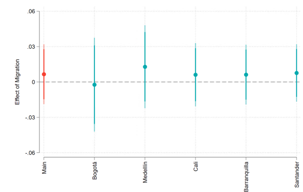
(a) High-skilled



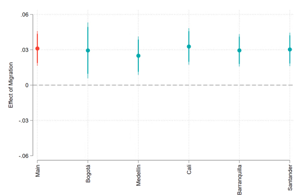
(b) Medium-skilled



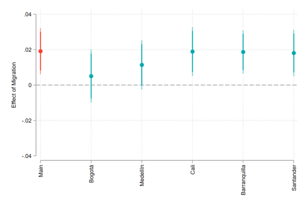
(c) Low-skilled



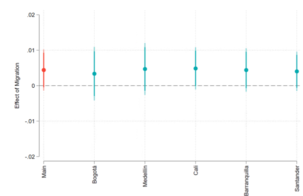
(d) High-skilled R&D



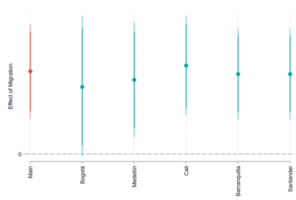
(e) Medium-skilled R&D



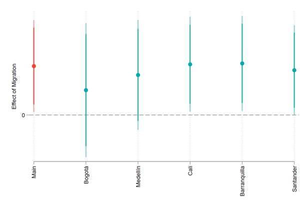
(f) Low-skilled R&D



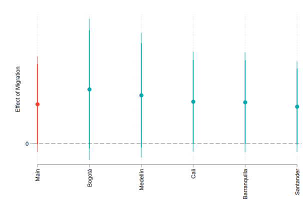
(g) Share High-skilled R&D



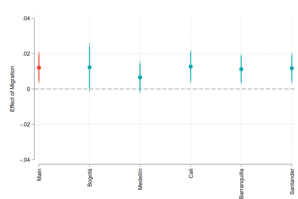
(h) Share Medium-skilled R&D



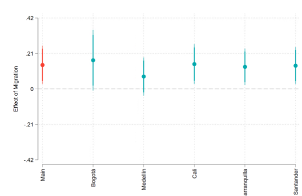
(i) Share Low-skilled R&D



(j) R&D Investment - Extensive Margin



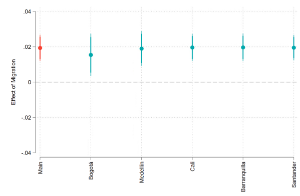
(k) R&D Investment - Intensive Margin



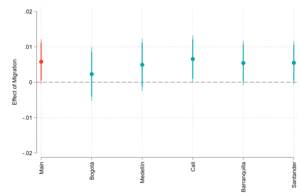
Notes. Titles above each graph show the outcome of each regression. Each blue dot represents the coefficient from estimating equation (30), excluding the corresponding local labor market indicated on the x-axis. The red dot represents the baseline estimate presented in the paper. Regressions control for industry linear trends at the 4-digit CIIU level, region fixed effects interacted with year dummies, and past controls interacted with year dummies. Past controls include the following local labor market–level variables: log per capita GDP, homicide rate, log cultivated hectares of coca crops, share of the population enrolled in the subsidized health system, and the Gini coefficient. Standard errors are clustered at the local labor market level. Source: Own elaboration based on data from DANE.

Figure D.2: Robustness checks - leave-one-out estimates (local labor markets) - Technology Adoption and Quality Upgrading

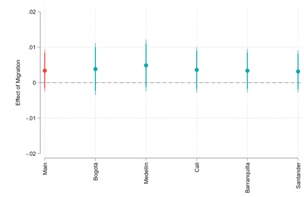
(a) Production



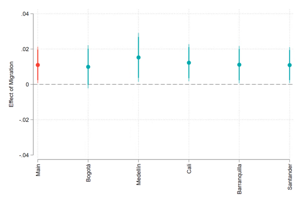
(b) Organizational



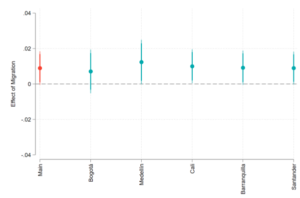
(c) Marketing



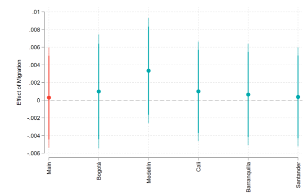
(d) Quality Certifications



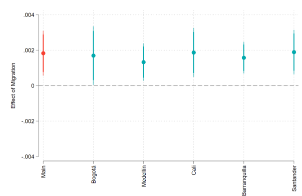
(e) Process quality cert.



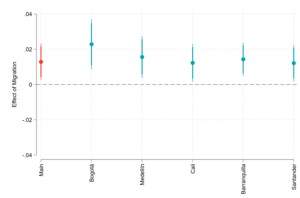
(f) Product quality cert.



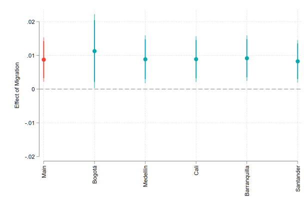
(g) Share of Imported Inputs



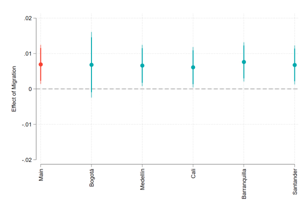
(h) Δ Main Product



(i) Towards Skill-Intensive



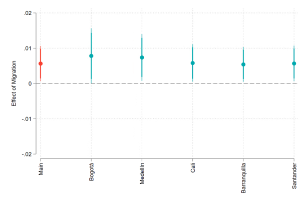
(j) Towards R&D-Intensive



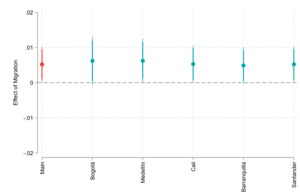
Notes. Titles above each graph show the outcome of each regression. Each blue dot represents the coefficient from estimating equation (30), excluding the corresponding local labor market indicated on the x-axis. The red dot represents the baseline estimate presented in the paper. Regressions control for industry linear trends at the 4-digit CIIU level, region fixed effects interacted with year dummies, and past controls interacted with year dummies. Past controls include the following local labor market–level variables: log per capita GDP, homicide rate, log cultivated hectares of coca crops, share of the population enrolled in the subsidized health system, and the Gini coefficient. Standard errors are clustered at the local labor market level. Source: Own elaboration based on data from DANE.

Figure D.3: checks - leave-one-out estimates (local labor markets) - Trade-creation effect

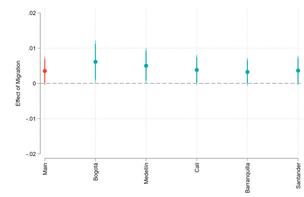
(a) Exporting dummy (all)



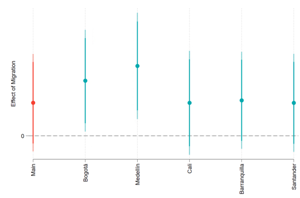
(b) Exporting dummy (High-income)



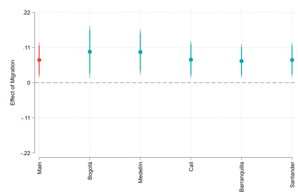
(c) Exporting dummy (Upper-middle)



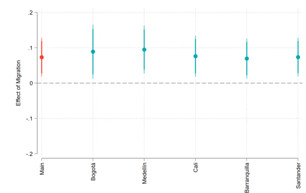
(d) Exporting dummy (Lower/Low)



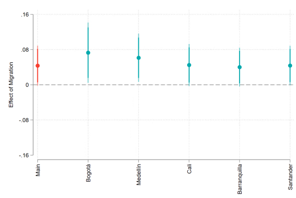
(e) Exports in USD (all)



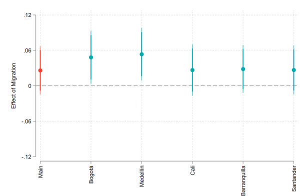
(f) Exports in USD (High-income)



(g) Exports in USD (Upper-middle)



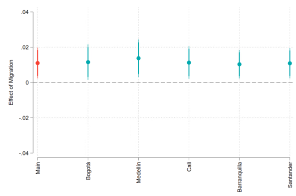
(h) Exports in USD (Lower/Low)



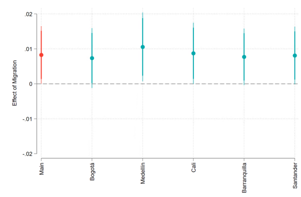
Notes. Titles above each graph show the outcome of each regression. Each blue dot represents the coefficient from estimating equation (30), excluding the corresponding local labor market indicated on the x-axis. The red dot represents the baseline estimate presented in the paper. Regressions control for industry linear trends at the 4-digit CIIU level, region fixed effects interacted with year dummies, and past controls interacted with year dummies. Past controls include the following local labor market–level variables: log per capita GDP, homicide rate, log cultivated hectares of coca crops, share of the population enrolled in the subsidized health system, and the Gini coefficient. Standard errors are clustered at the local labor market level. Source: Own elaboration based on data from DANE.

Figure D.4: Robustness checks - leave-one-out estimates (local labor markets) - Trade-creation effect

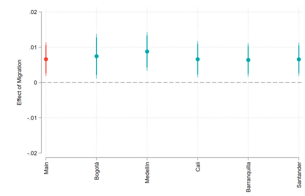
(a) Number of products (all)



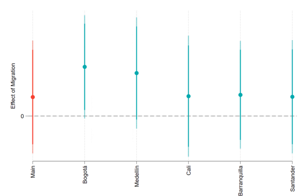
(b) Number of products (High-income)



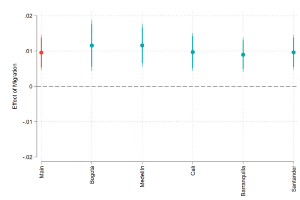
(c) Number of products (Upper-middle)



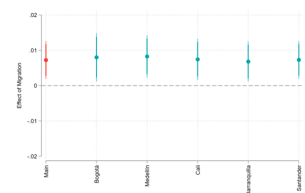
(d) Number of products (Lower/Low)



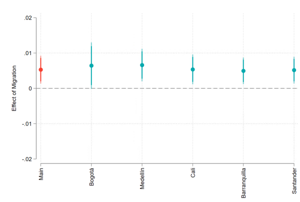
(e) Number of destinations (all)



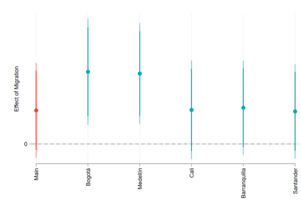
(f) Number of destinations (High-income)



(g) Number of destinations (Upper-middle)



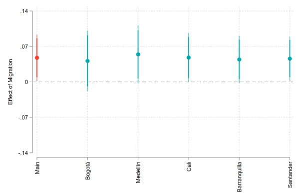
(h) Number of destinations (Lower/Low)



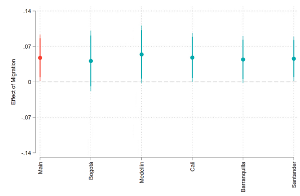
Notes. Titles above each graph show the outcome of each regression. Each blue dot represents the coefficient from estimating equation (30), excluding the corresponding local labor market indicated on the x-axis. The red dot represents the baseline estimate presented in the paper. Regressions control for industry linear trends at the 4-digit CIIU level, region fixed effects interacted with year dummies, and past controls interacted with year dummies. Past controls include the following local labor market–level variables: log per capita GDP, homicide rate, log cultivated hectares of coca crops, share of the population enrolled in the subsidized health system, and the Gini coefficient. Standard errors are clustered at the local labor market level. Source: Own elaboration based on data from DANE.

Figure D.5: Robustness checks - leave-one-out estimates (local labor markets) - Trade-creation effect

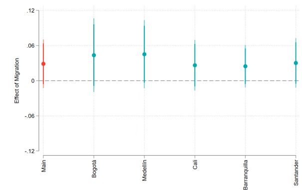
(a) Differentiated exports



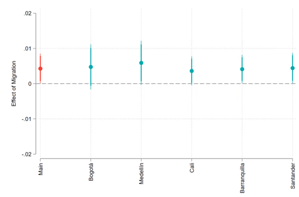
(b) Number of differentiated products



(c) Homogeneous exports



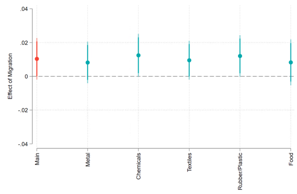
(d) Number of homogeneous products



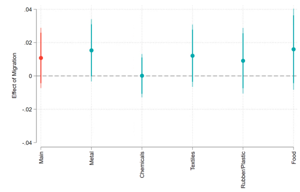
Notes. Titles above each graph show the outcome of each regression. Each blue dot represents the coefficient from estimating equation (30), excluding the corresponding local labor market indicated on the x-axis. The red dot represents the baseline estimate presented in the paper. Regressions control for industry linear trends at the 4-digit CIIU level, region fixed effects interacted with year dummies, and past controls interacted with year dummies. Past controls include the following local labor market–level variables: log per capita GDP, homicide rate, log cultivated hectares of coca crops, share of the population enrolled in the subsidized health system, and the Gini coefficient. Standard errors are clustered at the local labor market level. Source: Own elaboration based on data from DANE.

Figure D.6: Robustness checks - leave-one-out estimates (main industries) - Skill-upgrading and R&D investments

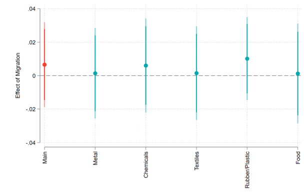
(a) High-skilled



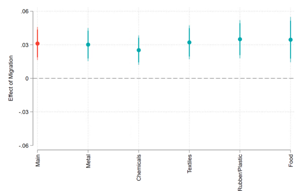
(b) Medium-skilled



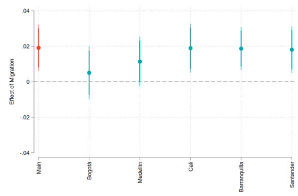
(c) Low-skilled



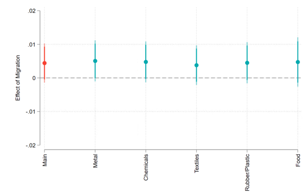
(d) High-skilled R&D



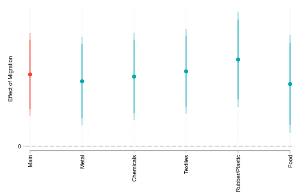
(e) Medium-skilled R&D



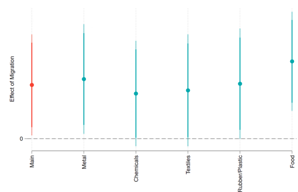
(f) Low-skilled R&D



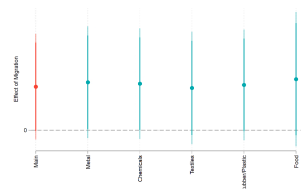
(g) Share High-skilled R&D



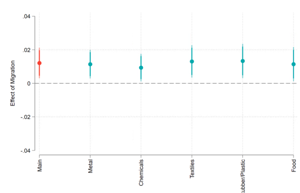
(h) Share Medium-skilled R&D



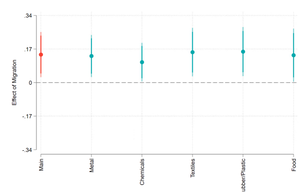
(i) Share Low-skilled R&D



(j) R&D Investment - Extensive Margin



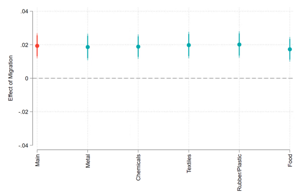
(k) R&D Investment - Intensive Margin



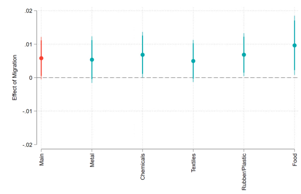
Notes. Titles above each graph show the outcome of each regression. Each blue dot represents the coefficient from estimating equation (30), excluding the corresponding 2-digit CIIU industry indicated on the x-axis. The red dot represents the baseline estimate presented in the paper. Regressions control for industry linear trends at the 4-digit CIIU level, region fixed effects interacted with year dummies, and past controls interacted with year dummies. Past controls include the following local labor market–level variables: log per capita GDP, homicide rate, log cultivated hectares of coca crops, share of the population enrolled in the subsidized health system, and the Gini coefficient. Standard errors are clustered at the local labor market level. Source: Own elaboration based on data from DANE.

Figure D.7: Robustness checks - leave-one-out estimates (main industries) - Technology Adoption and Quality Upgrading

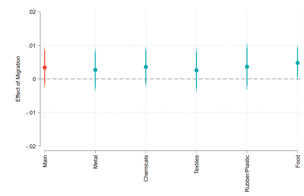
(a) Production



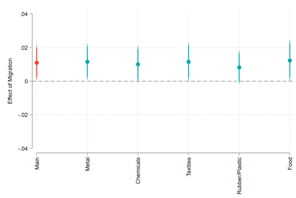
(b) Organizational



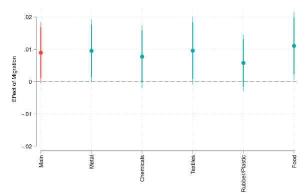
(c) Marketing



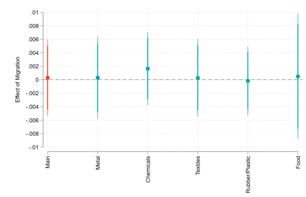
(d) Quality Certifications



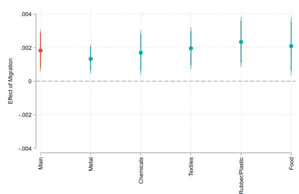
(e) Process quality cert.



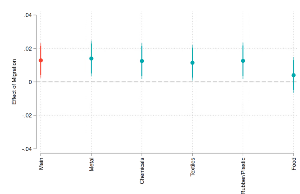
(f) Product quality cert.



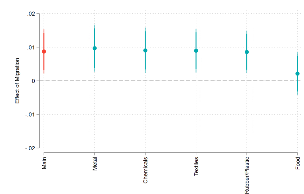
(g) Share of Imported Inputs



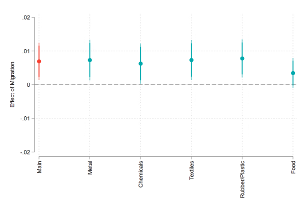
(h) Δ Main Product



(i) Towards Skill-Intensive



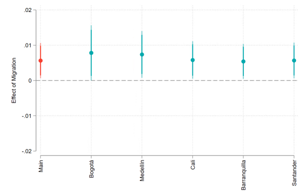
(j) Towards R&D-Intensive



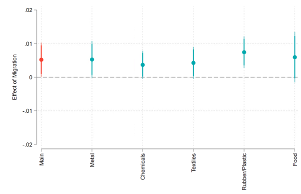
Notes. Titles above each graph show the outcome of each regression. Each blue dot represents the coefficient from estimating equation (30), excluding the corresponding local labor market indicated on the x-axis. The red dot represents the baseline estimate presented in the paper. Regressions control for industry linear trends at the 4-digit CIIU level, region fixed effects interacted with year dummies, and past controls interacted with year dummies. Past controls include the following local labor market–level variables: log per capita GDP, homicide rate, log cultivated hectares of coca crops, share of the population enrolled in the subsidized health system, and the Gini coefficient. Standard errors are clustered at the local labor market level. Source: Own elaboration based on data from DANE.

Figure D.8: checks - leave-one-out estimates (main industries) - Trade-creation effect

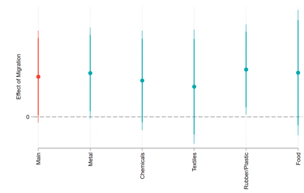
(a) Exporting dummy (all)



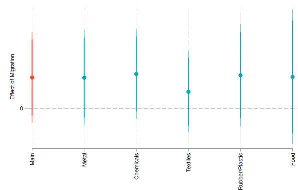
(b) Exporting dummy (High-income)



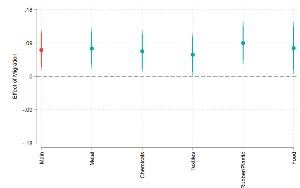
(c) Exporting dummy (Upper-middle)



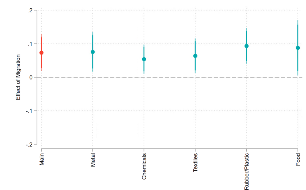
(d) Exporting dummy (Lower/Low)



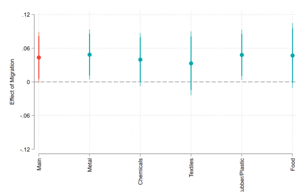
(e) Exports in USD (all)



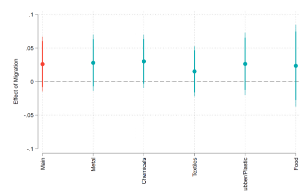
(f) Exports in USD (High-income)



(g) Exports in USD (Upper-middle)



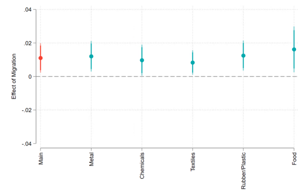
(h) Exports in USD (Lower/Low)



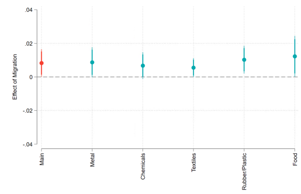
Notes. Titles above each graph show the outcome of each regression. Each blue dot represents the coefficient from estimating equation (30), excluding the corresponding 2-digit CIIU industry indicated on the x-axis. The red dot represents the baseline estimate presented in the paper. Regressions control for industry linear trends at the 4-digit CIIU level, region fixed effects interacted with year dummies, and past controls interacted with year dummies. Past controls include the following local labor market–level variables: log per capita GDP, homicide rate, log cultivated hectares of coca crops, share of the population enrolled in the subsidized health system, and the Gini coefficient. Standard errors are clustered at the local labor market level. Source: Own elaboration based on data from DANE.

Figure D.9: Robustness checks - leave-one-out estimates (main industries) - Trade-creation effect

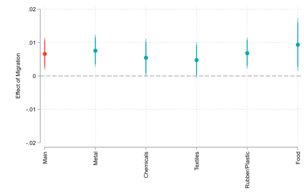
(a) Number of products (all)



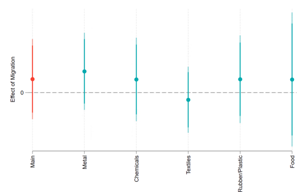
(b) Number of products (High-income)



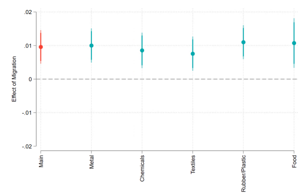
(c) Number of products (Upper-middle)



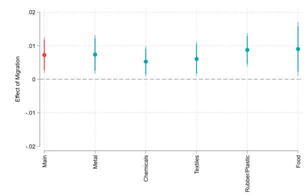
(d) Number of products (Lower/Low)



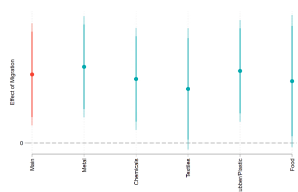
(e) Number of destinations (all)



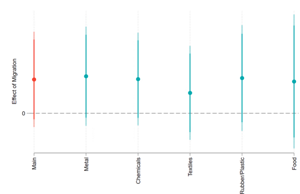
(f) Number of destinations (High-income)



(g) Number of destinations (Upper-middle)



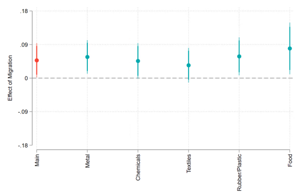
(h) Number of destinations (Lower/Low)



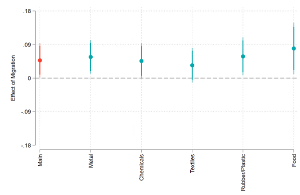
Notes. Titles above each graph show the outcome of each regression. Each blue dot represents the coefficient from estimating equation (30), excluding the corresponding 2-digit CIIU industry indicated on the x-axis. The red dot represents the baseline estimate presented in the paper. Regressions control for industry linear trends at the 4-digit CIIU level, region fixed effects interacted with year dummies, and past controls interacted with year dummies. Past controls include the following local labor market–level variables: log per capita GDP, homicide rate, log cultivated hectares of coca crops, share of the population enrolled in the subsidized health system, and the Gini coefficient. Standard errors are clustered at the local labor market level. Source: Own elaboration based on data from DANE.

Figure D.10: Robustness checks - leave-one-out estimates (main industries) - Trade-creation effect

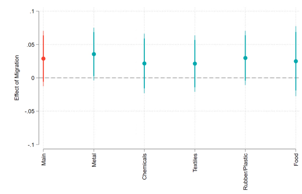
(a) Differentiated exports



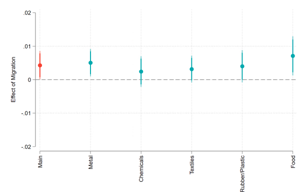
(b) Number of differentiated products



(c) Homogeneous exports



(d) Number of homogeneous products



Notes. Titles above each graph show the outcome of each regression. Each blue dot represents the coefficient from estimating equation (30), excluding the corresponding 2-digit CIIU industry indicated on the x-axis. The red dot represents the baseline estimate presented in the paper. Regressions control for industry linear trends at the 4-digit CIIU level, region fixed effects interacted with year dummies, and past controls interacted with year dummies. Past controls include the following local labor market–level variables: log per capita GDP, homicide rate, log cultivated hectares of coca crops, share of the population enrolled in the subsidized health system, and the Gini coefficient. Standard errors are clustered at the local labor market level. Source: Own elaboration based on data from DANE.

E Variables Details: Technology Adoption and Quality Upgrading Outcomes

Variables related to the improvement of processes - Table 3:

Please indicate whether your company introduced any of the following innovations during the period XXXX-YYYY. If your answer is affirmative, specify the number.

Processes: Introduction of new or significantly improved processes, production methods, distribution methods, delivery methods, or logistics systems in the company (Dummy variable).

Organizational: Introduction of new organizational methods implemented in the internal functioning of the company, in the knowledge management system, in the organization of the workplace, or in the management of the company's external relations (including suppliers, partners, and other stakeholders) (Dummy variable).

Marketing: Introduction of new marketing techniques in your company (channels for promotion and sales, or significant changes in product packaging or design) aimed at expanding or maintaining your market. (Excludes changes affecting product functionalities, as this would correspond to a significantly improved good or service) (Dummy variable).

Variables related to the improvement or introduction of products - Table ??:

Please indicate whether your company introduced any of the following innovations during the period XXXX-YYYY. If your answer is affirmative, specify the number.

Certifications: During the period XXXX–YYYY, did your company obtain process/product quality certifications? If your answer is affirmative, please specify how many. (Dummy variable if the firm answered 'yes' to any type of quality certification).

New Product: A product whose fundamental characteristics (technical specifications, components and materials, embedded software, or intended uses) are new compared to previous products produced by the company. (Dummy variable and Number of Products in logs)

Improved Product: A product whose performance has been significantly improved or refined. This may occur through the use of better-performing components or materials or by changes in one of the technical subsystems that make up a complex product. (Dummy variable and Number of Products in logs)

Variables related to firms' outcomes affected by the adoption of new/better processes/products - Table A.9:

Please indicate the degree of importance of the impact that the introduction of new or significantly improved goods or services, and/or the implementation of new or significantly improved processes, organizational methods, or new marketing techniques had on the following aspects of your company during the period XXXX - YYYY:

Quality: Improvement in the quality of goods or services.

Variety: Expansion of the range of goods or services.

Keep Markets: Maintenance of your company's geographic market share.

New Markets: Entry into a new geographic market.

Productivity: Increase in productivity.

Costs: Reduction in labor costs.

Variables related to the probability of facing obstacles to adopt new and better products or processes - Table A.10:

Please indicate the degree of importance of the following obstacles to the introduction of new or significantly improved goods or services, and/or the implementation of new or significantly improved processes, organizational methods, or new marketing techniques in your company during the period XXXX-YYYY:

Own Resources: Lack of own resources.

Skills: Lack of qualified personnel.

Regulations: Difficulty in complying with regulations and technical standards.

Qualified Services: Low availability of inspection, testing, calibration, certification, and verification services.