

Global Value Chain Participation and Upgrading: Opportunities and Challenges for Colombia¹

Key message:

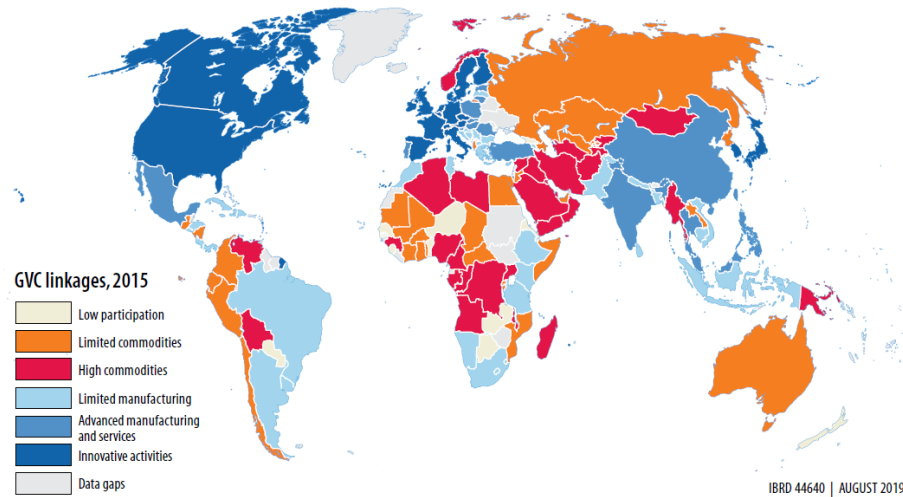
This note identifies key opportunities for and challenges to economic upgrading through global value chain (GVC) participation in Colombia and policy options to seize these opportunities. Reflecting the country's comparative advantage, Colombia's sectoral specialization in commodities explains the country's pattern of low backward and high forward participation in GVCs. Recent developments suggest a strong increase in backward GVC participation driven by the manufacturing sector which is confirmed by sector- and firm-level analysis. However, backward GVC participation has not significantly contributed to domestic value added gains in Colombia. This note identifies four policy priorities that can help Colombia foster economic upgrading through backward GVC participation: (i) improving connectivity and trade facilitation; (ii) fostering competition and the quality of institutions; (iii) increasing productivity and skills; and (iv) addressing existing bottlenecks in trade and investment policies.

1. Motivation

Colombia has been unable to substantially integrate into limited manufacturing global value chains (GVCs) over the past decades, although there are signs of recent improvements. A GVC taxonomy classifies countries according to their GVC participation, sectoral specialization and innovation into four basic groups – commodities (high and limited), limited manufacturing, advanced manufacturing and services, and innovative activities (World Bank 2019). Colombia falls into the group of countries that specialize in commodity GVCs (Figure 1). What characteristics of Colombia's GVC participation have prevented the country from upgrading towards limited manufacturing GVC activities? And what are policy options to overcome these challenges, seize new opportunities and foster economic upgrading through GVC participation in Colombia? This analysis draws on a combination of macro- and micro-level datasets to provide answers to these questions (see Appendix 2 for the scope of the analysis and definitions of GVC participation).

¹ This note has been authored by Deborah Winker, Guillermo Arenas and Alvaro Espitia, as background note for the activity Colombia Trade Engagement (P174297). This paper is part of a larger project "Mision Internacionalizacion" of Colombia involving the Ministry of Commerce, Industry and Tourism; the National Planning Department; and the Office of the Vice-President in Colombia and the World Bank. The project team is co-led by Donato De Rosa (Lead Economist, ELCDR), Paolo Dudine (Senior Country Economist, ELCMU), Nadia Rocha (Senior Economist, ETIRI) and Mariana Vijil (Senior Economist, ELCFN). The authors thank Hiau Looi Kee for sharing data on non-tariff measures, and peer reviewers Woori Lee and Nadia Rocha, the Ministry of Commerce, the National Planning Department and other members of the project team for helpful comments. The findings of this paper are those of the authors and do not necessarily represent the views of the World Bank or its member countries.

Figure 1: Colombia is specialized in commodity GVCs



Source: GVC taxonomy for 2015. See World Bank (2019, p. 21). See Appendix 1 for a description.

2. Key opportunities and challenges

2.1 Colombia's backward participation in GVCs is low, but increased strongly in manufacturing

Colombia's concentration in commodity exports explains the country's pattern of high forward and low backward participation in GVCs. Colombia specializes mainly in mining; commodity-intensive manufacturing sectors such as chemicals, metals, coke and food; and business services, in particular wholesale and retail trade and storage and transportation (Appendix 3). Reflecting the country's comparative advantage, this sectoral specialization in commodities explains the country's pattern of low backward and high forward participation in GVCs² which is typical of commodity exporters. The abundance of natural resources in a country is linked to high forward GVC participation because commodities are used in a variety of downstream production processes that typically cross several borders. The business services sector has been dynamic with the share in the total domestic value added in gross exports increasing from around 10 to almost 15 percent over the period 2011-2015, while that of manufacturing only increased by 1 percentage point to 29 percent.

Colombia's total forward GVC participation is driven by high contributions of coke and chemicals, while other manufacturing sectors contribute substantially less than its comparator countries, reflecting the country's sectoral specialization. While Colombia's forward GVC participation is high, as is typical of countries specialized in commodity exports, it is still lower than in most of its comparator countries³. The share of Colombia's domestic value added that is embodied in third countries' exports as percent of Colombia's total exports was 22 percent in 2015, substantially lower than in Chile and Peru, but higher than in South Africa. A closer look at the sectoral contribution to forward participation reveals that coke

² Backward GVC participation is the portion of imported inputs used in export production. Forward GVC participation is the portion of domestic value added that is re-exported by third countries. Both can be measured in levels and as percent of gross exports.

³ Comparator countries have been selected based on their specialization in GVCs and regional proximity.

and chemicals contribute a larger portion to Colombia's forward participation, while the contribution of electronics, machinery and transport as well as metals is substantially lower (Appendix 4).

Following the trend of Colombia's comparator countries, forward GVC participation in the country declined, while the electronics, machinery and transport goods sectors withstood this general trend.

Colombia's decline in total forward participation from 27 to 22 percent of gross exports was driven by a lower contribution of mining, coke and metals.⁴ Interestingly, while the contribution of the electronics, machinery and transport sectors declined in the comparator countries between 2011 and 2015, Colombia's share remained constant at around 4.5 percent. These three sectors made up one fifth of Colombia's total forward participation and have exceeded the contribution of coke, the largest manufacturing sector. Despite this expansion, Colombia still lags behind the average contribution of these three sectors in Argentina, Brazil, Chile, Colombia, Costa Rica and Peru exceeding 7 percent which are more strongly integrated in these value chains (Appendix 4).

While Colombia's GVC backward participation is still relatively low, it has increased strongly over the past years, especially in manufacturing, enabling the country to import high-quality inputs and knowledge.

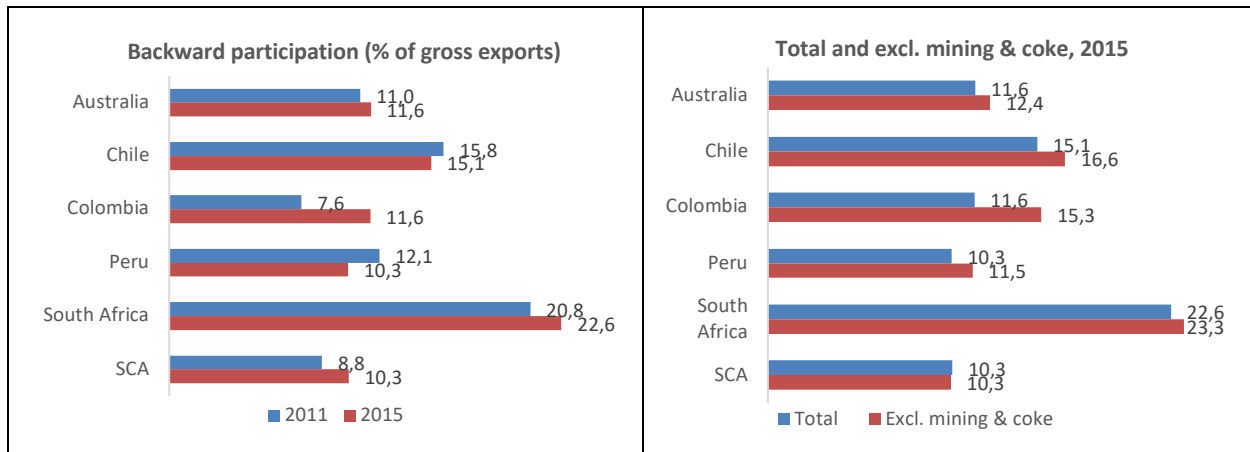
Between 2011 and 2015, Colombia's total backward GVC participation⁵ expanded by a remarkable 4 percentage points to 11.6 percent in 2015, while that of its comparators declined or grew by a lesser extent (Figure 2, left panel).⁶ Backward participation in manufacturing expanded by over 6 percentage points to 22.3 percent, driven by chemicals, textiles, electronics, and mining. Despite this expansion, backward GVC participation in several sectors still lags behind comparator countries, in particular in textiles and machinery, but also in food and chemicals. South Africa and Chile, in particular, are more highly integrated across most sectors (Appendix 5 and 6).

⁴ It is not clear if the decline is driven by falling commodity prices. The sectoral contribution of coke first increased between 2011 and 2013 before it fell again (Appendix 4).

⁵ Including agricultural, manufacturing, and services sectors.

⁶ Vietnam's backward GVC participation over the same period expanded by 2.7 percentage points, although starting at much higher levels (from 41.8 to 44.5 percent).

Figure 2: Backward participation in Colombia grew strongly



Source: OECD TiVA 2018 release. Backward GVC participation = imported inputs in exports (% of exports). SCA = South and Central America which consists of Argentina, Brazil, Chile, Colombia, Costa Rica and Peru.

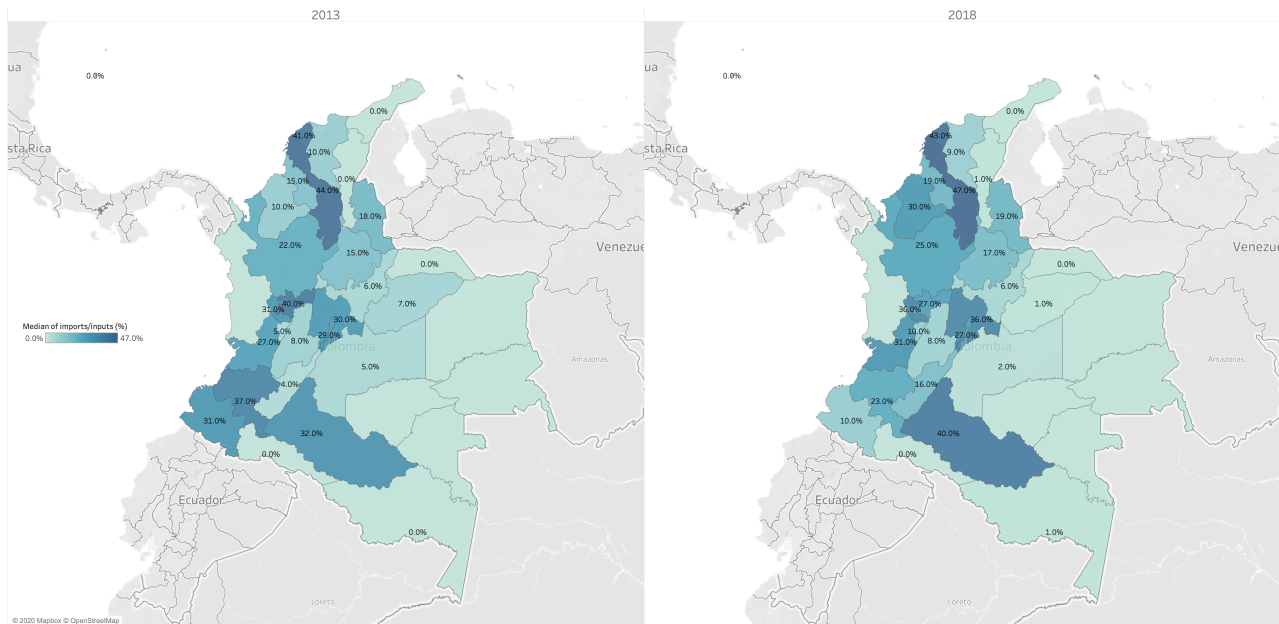
2.2 GVC participating firms matter strongly for Colombia’s trade

Within Colombia, the percentage of GVC participating firms in non-coke manufacturing and the median share of imported inputs in total inputs increased in most regions. The percentage of GVC firms⁷ in all firms in the manufacturing survey increased in almost all regions between 2013 and 2018 (Appendix 7). GVC firms represent 22 percent of non-coke manufacturing firms in Bogotá, D.C. and Valle del Cauca, over 26 percent in Antioquia and 35 percent in Cundinamarca – the four regions with the highest number of firms. The share of GVC firms in non-coke manufacturing output in these four regions ranges from 67 to 71 percent in 2018. The median share of imported inputs in a GVC firm’s total inputs in these regions is 25 to 27 percent in Antioquia and Bogotá, D.C., respectively, and exceeds 30 percent in Valle del Cauca and Cundinamarca, reflecting an increase in all regions with the exception of Bogotá, D.C. (Figure 3).

GVC firms in Colombia dominate exports, especially in manufacturing, which can be linked to their higher productivity and size relative to non-GVC firms. Although GVC firms represent less than 20 percent of exporters, they account for 80 percent of non-oil exports in Colombia. GVC firms represent a higher share of exports in key manufacturing sectors like plastics (98 percent), chemicals (98 percent), and pharmaceutical (89 percent) than in agricultural sectors like fruits (71 percent), coffee (66 percent) and flowers (63 percent). The higher contribution of GVC firms to exports can be attributed to their higher labor productivity. While GVC manufacturing firms (excluding coke) were 26 percent more productive than non-GVC manufacturing firms in 2013, their productivity premium reached 38 percent by 2018 (results available upon request). The larger firm size of GVC-participating firms, which has been well documented across countries, may have also played a role.

⁷ GVC firms import at least 10 percent of their inputs and export at least 10 percent of their output (Appendix 2 and 15).

Figure 3: Regions' median share of imported inputs in total inputs across GVC firms increased in Colombia



Source: Customs data and Encuesta Annual Manufacturera 2013 and 2018. Note: The maps show the median share of imported inputs as percent of total inputs across GVC-participating manufacturing firms (excluding manufacture of coke and refined petroleum products) by region in Colombia. See Appendix 7 for more details.

2.3 Colombia's backward GVC participation has not significantly contributed to domestic value added

While increases in GVC participation and domestic value added are positively correlated, Colombia exhibited lower growth rates. Figure 4 suggests a positive link between growth in both backward and forward GVC participation (in levels) and increases in domestic value added⁸ over the period 2005-15, based on a sample of 59 countries and 23 manufacturing and business services sectors. However, Colombia's value added only increased by 3.2 percent, while its backward participation grew by 5.5 and its forward participation by 7.2 percent. To assess the relationship between GVC participation and domestic value added, we follow the model by Stolzenberg, Taglioni and Winkler (2019), as described in Appendix 8. The analysis suggests that backward and forward GVC participation are positively linked to value added in the full country sample (green bars in Figure 5).

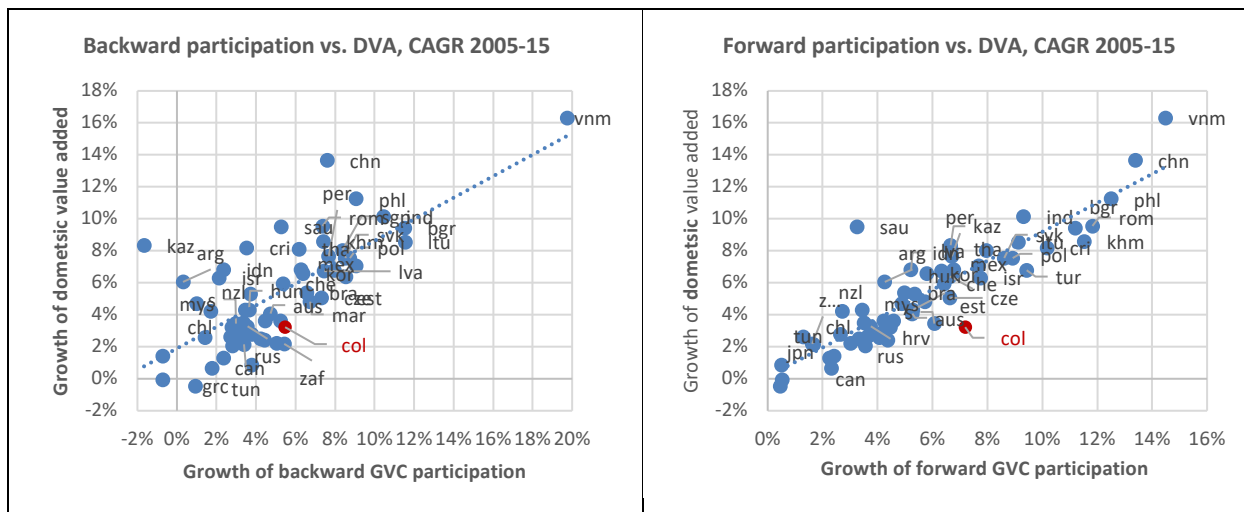
More GVC participation is linked to higher domestic value added gains, especially for countries specializing in more advanced and innovative GVCs. Figure 5 also reports the results by GVC taxonomy group and for Colombia separately to detect whether the relationship varies across country types. The analysis suggests that backward and forward GVC participation are positively linked to value added and that the gains are highest for countries specializing in more advanced manufacturing and services or innovative GVCs categories (Figure 5, blue bars).⁹ The finding that backward participation is less strongly

⁸ We choose the domestic value added as our measure of economic upgrading as it combines the gains for firms (gross profits) and workers alike (total compensation) and thus reflects economic upgrading via better skills, capital, and processes.

⁹ Countries specialized in commodity GVCs in 2015 include (see Appendix 1): Australia, Chile, Colombia, Kazakhstan, Norway, New Zealand, Peru, Russia and Saudi Arabia. Countries specialized in limited manufacturing GVCs in 2015 include: Argentina, Bulgaria, Brazil, Cambodia, Costa Rica, Cyprus, Greece, Croatia, Indonesia, Latvia, Morocco, South Africa, Tunisia, and Vietnam. Countries

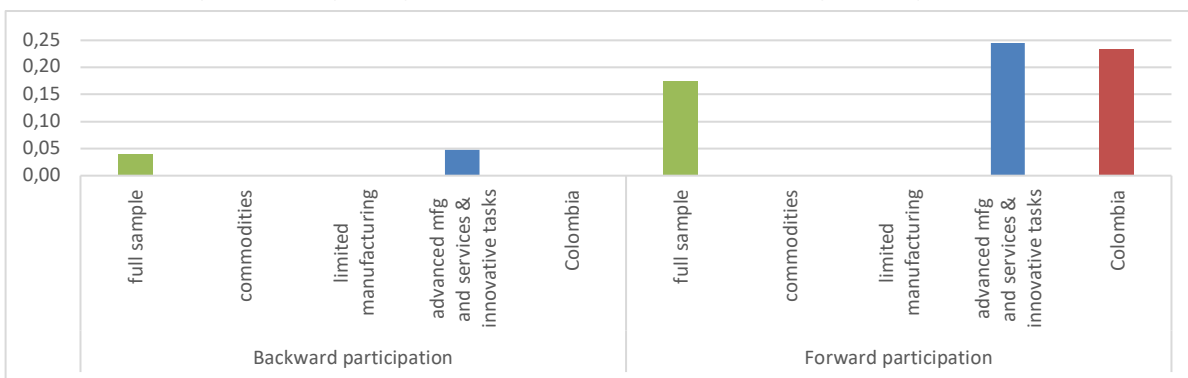
linked to domestic value added than forward participation is surprising, but could be related to the sample which excludes low-income countries for which imported inputs would offer larger potential growth gains.

Figure 4: Colombia's growth in GVC participation and domestic value added lags behind other countries



Data: OECD TiVA 2018 release. Note: Excludes mining and non-tradable services sectors (see Appendix 8). DVA = domestic value added. CAGR = Compound annual growth rate.

Figure 5: GVC participation and domestic value added are positively correlated



Data: OECD TiVA 2018 release. Note: The charts report elasticities of country-sector panel regressions over the period 2005-15 linking GVC participation measures to domestic value added as dependent variable, controlling for employment and domestic final demand (in logs). See Appendix 8 for the model and Appendix 9 for econometric results. Robust standard errors are corrected for clustering by country-sector. Only estimates that are significant at the 10% level or higher are reported. Regressions control for country-sector, country-year and sector-year fixed effects. The full sample covers 59 high- and middle-income countries.

Colombia has captured the gains from forward participation, but not from backward participation.

Interestingly, unlike other countries specializing in commodity GVCs, Colombia has captured the value added gains from forward GVC participation (Figure 5, red bar). This has likely been driven by the contribution of mining and related sectors (coke, metals), but also electrical, machinery and transport

specialized in advanced manufacturing and services GVCs in 2015 include: China, Estonia, Hong Kong, Hungary, India, Lithuania, Mexico, Malaysia, Philippines, Poland, Portugal, Romania, Slovakia, Slovenia, Thailand and Turkey. Countries specialized in innovative GVCs in 2015 include: Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Ireland, Israel, Italy, Japan, Korea, Netherlands, Singapore, Sweden, Spain, Switzerland, UK, and US.

which generally create larger domestic profits and labor value added (Appendix 10). Higher backward participation in metals, electrical, machinery and transport is also robustly associated with increases in value added in the full country sample (Appendix 11). However, Colombia's backward GVC participation has not significantly contributed to domestic value added.

3. Policy options

GVC firms' larger dependence on imported inputs, international shipments and skilled workers require a concerted effort to address main bottlenecks in several policy areas simultaneously. Colombian firms engaged in GVCs are involved in complex interactions with a variety of domestic and foreign suppliers. Their number of international shipments is five times higher than that for non-GVC exporters, requiring seamless logistics and customs procedures. Since GVC firms rely more strongly on imported inputs, 30 percent more intensively than non-GVC exporters, this also makes them more vulnerable to high tariffs which can significantly increase their production costs. GVC firms also depend more strongly on skilled workers, hiring as many as 30 percent more workers on technical roles, requiring a better educated pool of potential workers. Due to the complexity and dynamism of GVCs, increasing GVC participation and upgrading is unlikely to be achieved solely through addressing issues in one policy area alone.

The case of Vietnam illustrates that a combination of fundamental and policy factors jointly contributed to the country's success in the electronics GVC. Vietnam has become the second-largest smartphone exporter in the world within only a decade. The country's large supply of low-cost labor and its geographical proximity to regional suppliers of electronics parts and components helped foreign investors gain access to high-quality inputs from abroad. But endowments and geography need not determine a country's destiny. Vietnam's trade liberalization and participation in trade agreements, its favorable investment climate as well as improved connectivity to import and export in a timely manner also contributed to its success (World Bank 2019).

Backward GVC participation is a necessary condition for firms and countries to integrate and upgrade in value chains. Higher backward GVC participation helps firms and countries absorb valuable foreign technology and know-how and import inputs that they process and export. It also entails opportunities for countries to promote structural transformation.¹⁰ Since Colombia's backward GVC participation has not materialized in domestic value added gains, this section identifies major policy constraints that may have prevented upgrading through GVC participation.

In particular, (i) improving connectivity and trade facilitation; (ii) fostering competition and the quality of institutions; (iii) increasing productivity and skills; and (iv) addressing existing bottlenecks in trade and investment policy could help Colombia increase domestic value added through backward GVC participation¹¹ and also increase GVC participation directly. Improved trade and investment policies, connectivity and trade facilitation, competition and the quality of institutions as well as productivity and skills promote domestic value added gains through backward participation in our country sample (Figure 6, left panel).¹² This section discusses these broad areas in more detail and assesses Colombia's

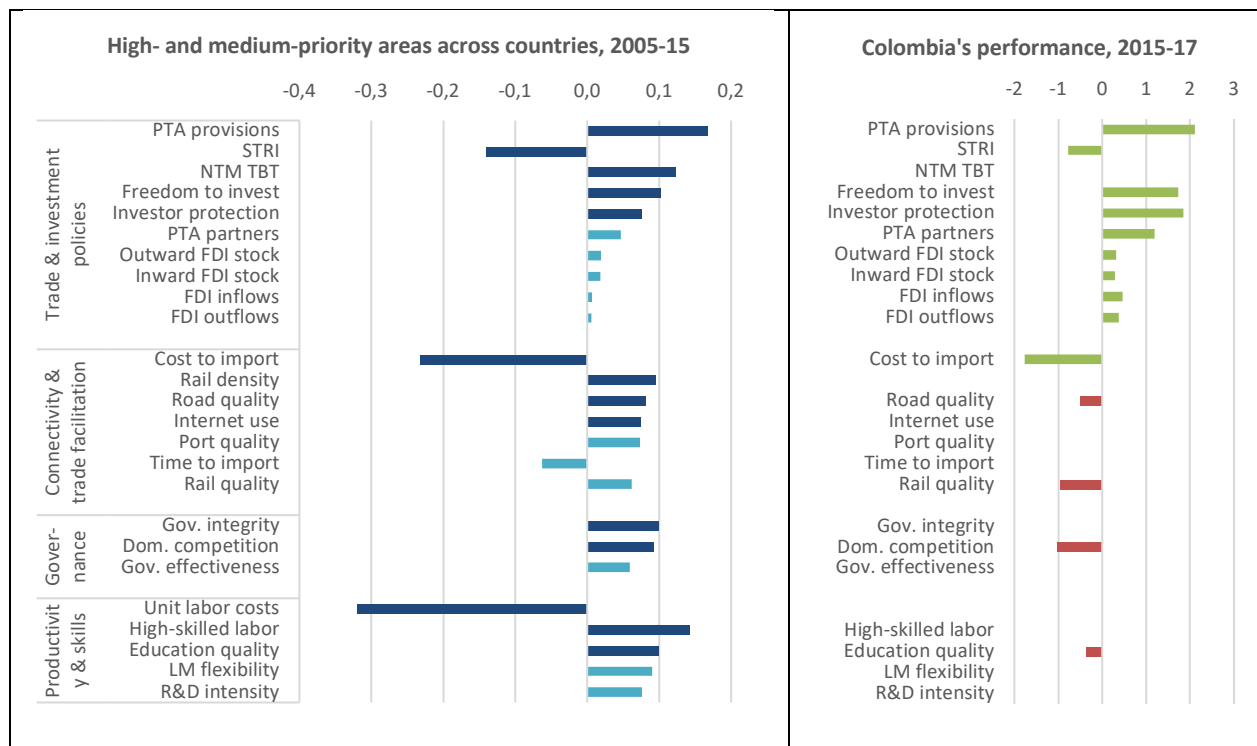
¹⁰ Taglioni and Winkler (2016).

¹¹ We extend the previous econometric analysis and include an interaction term between a set of national policies and our measure of GVC participation (see econometric model in Appendix 12 and data description in Appendix 13).

¹² We extend the previous econometric analysis and include an interaction term between a set of national policies and our measure of GVC participation (see econometric model in Appendix 12 and data description in Appendix 13).

performance in high- and medium-priority indicators to detect possible bottlenecks for GVC upgrading. While Colombia over-performs in trade and investment indicators, other policy areas show several bottlenecks (Figure 6, right panel). We complement the cross-country analysis with a subnational analysis that identifies the role of determinants for GVC participation across regions in Colombia.

Figure 6: Policy priorities for upgrading through backward GVC participation vs. Colombia's performance in these areas, standardized coefficients



Source: Own computations. Note: Dark-blue bars = high priority, bright-blue bars = medium priority. Insignificant indicators are considered low priority. Green bars = over-performance of Colombia, red bars = under-performance of Colombia in high-priority policy areas. Regressions cover 59 high- and middle-income countries (see Appendix 12 for details). The left graph shows standardized (beta) coefficients of the interaction terms between GVC participation and policy variables of cross-country-sector regressions, following equation (2) of Appendix 12. Robust standard errors are corrected for clustering by country-sector. Regressions control for country-sector, country-year and sector-year fixed effects and cover 23 sectors over the period 2005-15. The right graph shows standardized (beta) coefficients of the Colombia dummy variable of the cross-country following equation (3) of Appendix 12 over the period 2015-17. The model uses different indicators as the dependent variable, controlling GDP per capita, population (both in logs) and Colombia's taxonomy group. Robust standard errors. Only estimates that are significant at the 10% level or higher are reported.

3.1 Improving connectivity and trade facilitation¹³

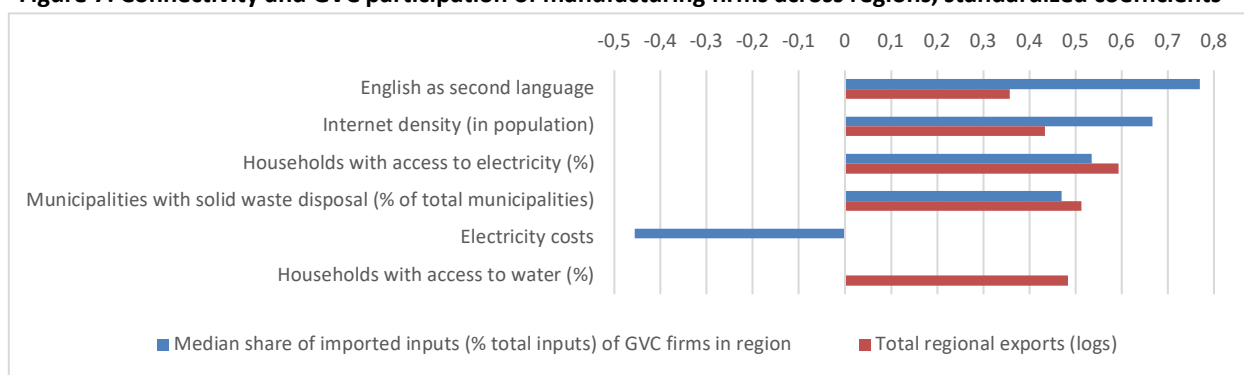
To foster GVC upgrading, promoting connectivity and improving the quality of infrastructure are important policy priorities. Promoting connectivity and improving the quality of infrastructure touches on several dimensions: securing the flow and lowering the costs of inputs and outputs, increasing speed, and reducing uncertainty. Several studies confirmed the importance of connectivity for GVC

¹³ A more detailed analysis on Colombia's connectivity and trade facilitation can be found in the accompanying note "Benchmarking of logistics and trade facilitation in Colombia".

participation.¹⁴ Our cross-country analysis finds a particularly strong role of costs to import, rail density, road quality and internet density (Figure 6, left panel). Better connectivity and infrastructure can not only facilitate GVC participation, but also have a positive impact on supplier linkages within Colombia.

A better infrastructure and connectivity also matter directly for a region’s GVC participation in Colombia. Our cross-regional regressions confirm that English as second language and density of fixed broadband internet subscriptions in a region over the period 2013-15 are strongly linked to a region’s median share of imported inputs in total inputs across non-coke manufacturing firms in 2016-18 (Figure 7, blue bars). While these characteristics also matter for a region’s total exports (including coke), they matter relatively less (red bars). Households’ access to electricity, electricity costs and solid waste disposal also matter for the extent of GVC participation, while access to water only matters for overall exports.

Figure 7: Connectivity and GVC participation of manufacturing firms across regions, standardized coefficients



Note: The bars show standardized (beta) coefficients of regressions across regions (departments) in Colombia, following equation (1) of Appendix 14. The model uses the median share of imported inputs in total inputs of non-coke GVC firms (2016-18 average) as dependent variable and individual determinants at the regional level (2013-15 average) as independent variable, controlling for GDP per capita (in logs). For comparison, the model also uses total regional exports of all firms as dependent variable. Only estimates that are significant at the 10% level or higher are reported. Regional averages for 2018 are reported in Appendix 16.

Subpar transport infrastructure and high transportation costs magnify the geographical disadvantage of many GVC firms. Many GVC firms are located far from the most important international ports (see Figure 3), placing an extra burden on GVC firms that rely on a large number of export and import shipments per year. Despite its importance for the functioning of trade, Colombia shows a significantly lower quality of transport infrastructure than its comparator countries, even after controlling for a country’s income per capita, population size and specialization in commodity GVCs (Figure 6, right panel). Road transport costs are also high by international standards due to the lack of competition in the domestic transport sector which is characterized by high barriers to entry. More investment in new and improved roads would reduce the travel times from where export production takes place to the main international ports. Similarly, introducing competition in the transport sector by reducing barriers to entry could reduce the costs of moving goods from and to the border.

In addition, high costs and time to trade at the border put Colombia’s GVC firms in an unfavorable position. Colombia shows significantly lower costs to import¹⁵ with regard to documentary compliance¹⁶

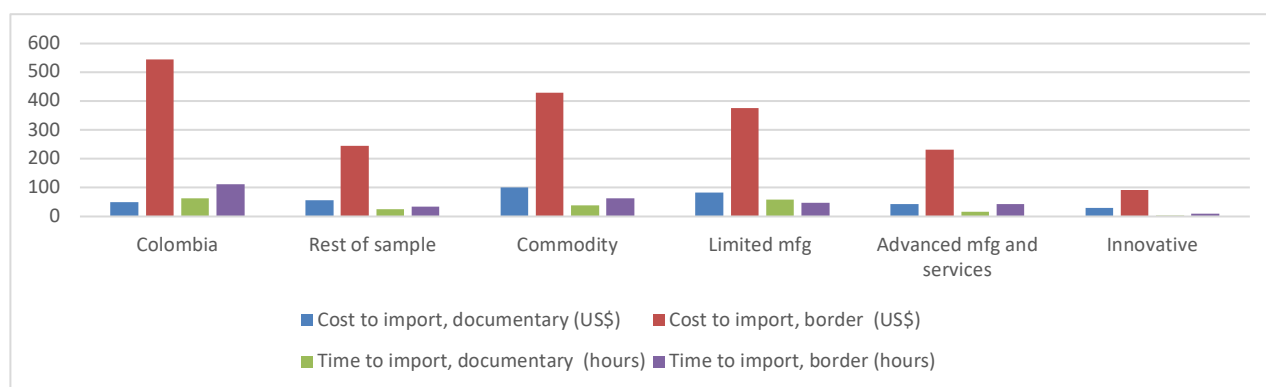
¹⁴ Hummels et al. (2007), Christ and Ferrantino (2011), Arvis et al. (2010) and Fernandes et al. (2020).

¹⁵ While the focus is accessing imported inputs, high costs and time to export can also prevent GVC participation.

¹⁶ Documentary compliance captures the time and cost associated with compliance with the documentary requirements of all government agencies of the origin economy, the destination economy and any transit economies.

relative to the full country sample (Figure 6, right panel), but lags behind other countries with regard to the cost and time of border compliance¹⁷ as well as time of documentary compliance (Figure 8). Imports of a standardized shipment¹⁸ to Colombia cost \$545 at the border, \$300 more than in the other countries of the sample, and over \$160 more than for countries specialized in limited manufacturing GVCs. A standardized shipment that is imported to Colombia spends particularly long times at the border (112 hours on average) which is more than twice as long as the time spent at the border in countries operating in limited manufacturing GVCs (47 hours). Documentary compliance also takes longer than in other countries, but the relative underperformance is not that striking.

Figure 8: Time and cost to import, 2015-17 average, Colombia and country groups



Source: Doing Business Indicators.

Increased digitization of border procedures and expansion of simplified border procedure regimes can reduce the cost and time for border compliance. Expansion of the Authorized Economic Operator (AEO) and advanced declarations program would go a long way towards reducing the time spent on border clearance for relatively large firms. However, these regimes might be too complex for smaller firms for which digitalization of border procedures might provide an easier solution.

3.2 Fostering competition and the quality of institutions¹⁹

Domestic competition and the quality of institutions matter for GVC upgrading and participation. Weak institutions – including corruption, red tape, intellectual property rights and contract enforcement – are linked to local firm preference, network-driven business practices and inefficient markets, which, possibly, constrain firms from fully exploiting their competitive advantages. The quality of institutions matters strongly for upgrading along the GVC taxonomies and is also positively linked to backward GVC participation (World Bank 2019). Research on spillovers from foreign direct investment (FDI), for example, suggests that the strength of intellectual property rights in a host country may help attract high-quality FDI initially and, therefore, create the potential for FDI spillovers (Javorcik 2004; Gorodnichenko, Svejnar

¹⁷ Border compliance captures the time and cost associated with compliance with the economy’s customs regulations and with regulations relating to other inspections that are mandatory in order for the shipment to cross the economy’s border, as well as the time and cost for handling that takes place at its port or border.

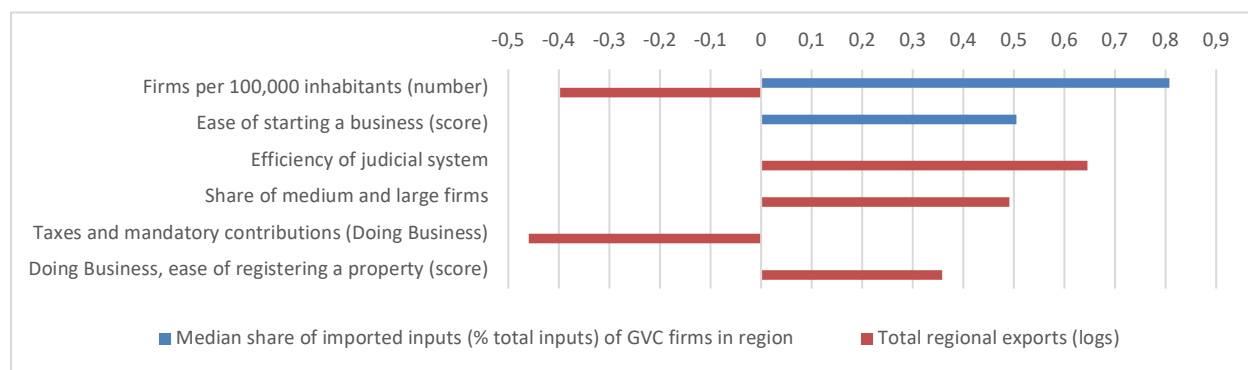
¹⁸ <https://www.doingbusiness.org/en/methodology/trading-across-borders>

¹⁹ A more detailed analysis on Colombia’s quality of institutions and competition policies can be found in the accompanying notes on “Colombia’s institutional arrangements and governance to support Colombia’s internationalization” and “Market power and internationalization: an empirical assessment for Colombia”.

and Terrell 2007). Our cross-country analysis shows that more government integrity and competition are positively associated with domestic value added gains from backward GVC participation (Figure 6, left panel).

Higher business density and institutional quality are also linked to higher extent of GVC participation across Colombia’s regions. The cross-regional regressions suggest that a higher number of firms in 2013-15 shows a strongly positive link with a region’s extent of GVC participation in 2016-18, but is negatively associated with a region’s overall exports (Figure 9). The latter finding may be linked to regions with a high percentage of mining and high exports and low business density. The ease of starting a business also matters for the extent of GVC participation in a region, while the efficiency of the judicial system, taxes and mandatory contributions, and the ease of registering a business only matter for overall exports.

Figure 9: Institutions and GVC participation of manufacturing firms across regions, standardized coefficients



Note: The bars show standardized (beta) coefficients of regressions across regions (departments) in Colombia, following equation (1) of Appendix 14. The model uses the median share of imported inputs in total inputs of non-coke GVC firms (2016-18 average) as dependent variable and individual determinants at the regional level (2013-15 average) as independent variable, controlling for GDP per capita (in logs). For comparison, the model also uses total regional exports of all firms as dependent variable. Only estimates that are significant at the 10% level or higher are reported. Regional averages for 2018 are reported in Appendix 16.

Colombia’s performance in the areas of competition and government seems to be trailing its comparator countries in particular in domestic competition policies. The domestic competition index (WEF) is concerned with market concentration, anti-monopolistic policies, investment incentives, and tax policy, ranging from 1-7 (best). Colombia’s domestic competition index significantly trails the rest of the country sample (Figure 6, right panel). Its domestic competition index is lower than that in all other GVC taxonomy groups, including those specialized in limited manufacturing GVCs (Figure 10, left panel). While Colombia also underperforms the rest of the country sample with regard to intellectual property protection, its score is on par with countries participating in limited manufacturing GVCs. There also seems to be room to improve the country’s government effectiveness and particularly integrity (Appendix 14).

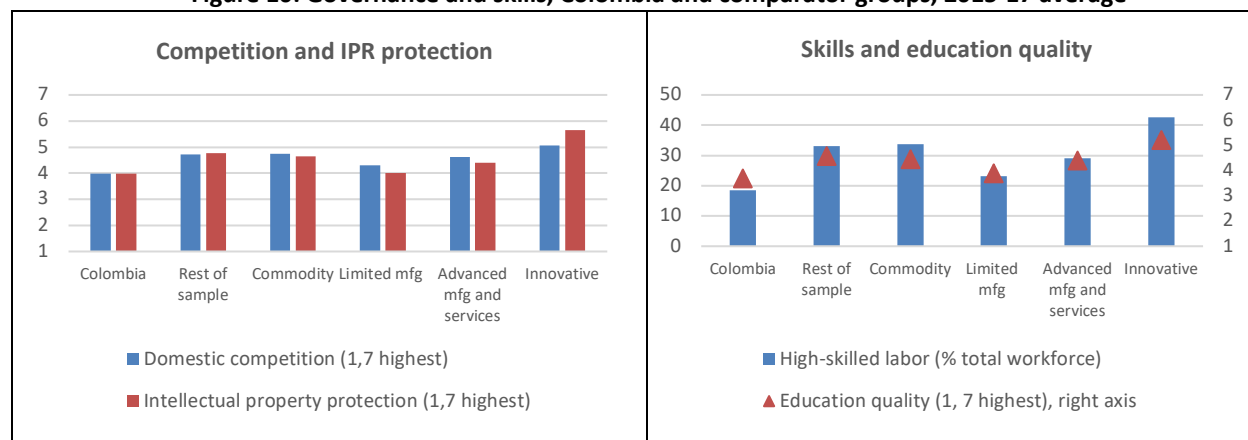
3.3 Increasing productivity and skills

Labor skills and productivity matter for upgrading through GVC participation. Endowments with low skilled workers may be a way for countries to enter GVCs due to low wages²⁰. But costs encompass a wide range of drivers and the goal should be higher labor productivity and higher wages, allowing the country

²⁰ Fernandes et al. (2020).

to remain cost competitive despite rising living standards.²¹ Several studies confirm the positive role of skills on spillovers from FDI²² and GVC participation²³. The movement of workers across firms is facilitated by a higher labor market flexibility, and thus is also positively linked to larger economic gains from GVC participation. Higher absolute and relative labor market flexibility than in the foreign investor’s home country has shown to have a positive effect on the chances of securing initial foreign investment²⁴. Our cross-country analysis finds that lower unit labor costs strongly magnify the positive link between backward GVC participation and domestic value added, suggesting an important role of labor productivity. A higher share of high-skilled labor and a better quality of education are also relevant (Figure 6, left panel).

Figure 10: Governance and skills, Colombia and comparator groups, 2015-17 average



Data: ILO and WEF. See Appendix 13 for a data description.

Several characteristics related to skills and innovation also matter positively for the extent of GVC participation across regions (Figure 11). Both a region’s higher product complexity and higher number of patent applications in the population in 2013-15 matter strongly for the median share of imported inputs in total inputs for non-coke manufacturing firms in 2016-18, reflecting the importance of innovation. Interestingly, both are irrelevant for a region’s overall exports. The quality and supply of skills are also important for a region’s extent of GVC participation, in particular students’ higher average test results in standardized tests and the percentage of postgraduates, as well as more enrollment in higher-quality accredited, technical and higher education institutions. Interestingly, enrollment in high-technology and higher-quality institutions does not matter for overall exports, implying that GVC firms operate in sectors with higher technology intensities. By contrast, a lower share of formal labor in the workforce and a higher gap between the male and female labor force participation are positively correlated with overall exports only, indicating the country’s specialization in export industries (mining, coke, metals) that rely more strongly on informal and male workers. The latter finding differs from other countries where exporting and GVC status has been related to increased female labor shares.²⁵

²¹ Taglioni and Winkler (2016).

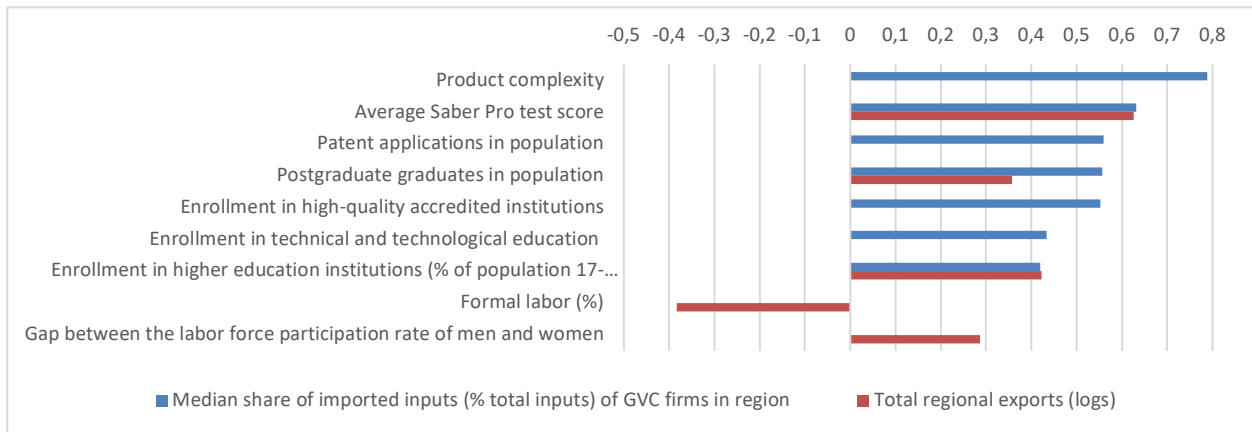
²² Tytell and Yudaeva (2007), Meyer and Sinani (2009).

²³ Stolzenberg et al. (2019)

²⁴ Javorcik and Spatareanu (2005).

²⁵ Rocha and Winkler (2019).

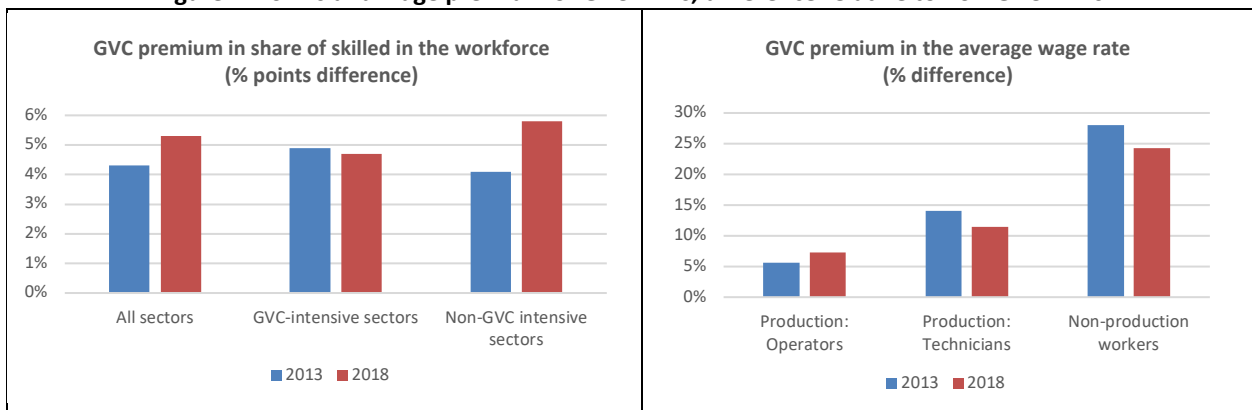
Figure 11: Labor, skills, innovation and GVC participation of firms across regions, standardized coefficients



Note: The bars show standardized (beta) coefficients of regressions across regions (departments) in Colombia, following equation (1) of Appendix 14. The model uses the median share of imported inputs in total inputs of non-coke GVC firms (2016-18 average) as dependent variable and individual determinants at the regional level (2013-15 average) as independent variable, controlling for GDP per capita (in logs). For comparison, the model also uses total regional exports of all firms as dependent variable. Only estimates that are significant at the 10% level or higher are reported. Regional averages for 2018 are reported in Appendix 16.

GVC firms employ a higher share of skilled workers and also pay a larger wage premium to skilled labor, underlining the importance of adequate skills supply and productivity. Cross-sectional regressions for 2018 suggest that the share of skilled workers in GVC-participating non-coke manufacturing firms in Colombia is on average 5 percentage points larger relative to non-GVC firms, controlling for firm size, sector and region fixed effects. The share has slightly increased since 2013 and is more pronounced in non-GVC intensive sectors (Figure 12, left panel). GVC firms also pay a wage premium across all worker categories, although the premium is highest for non-production workers (directors and administrative workers) and technicians (right panel). The skills and wage premium of GVC firms underlines the importance of adequate skills supply and productivity to successfully integrate and upgrade in GVCs.

Figure 12: Skills and wage premium of GVC firms, difference relative to non-GVC firms



Note: The table shows coefficients of separate regressions across firms for 2013 and 2018. The left panel shows the coefficient of a GVC dummy variable that is regressed on the firm's average share of skilled workers (directors and administrative workers), controlling for employment (in logs), sector and region fixed effects. GVC-intensive sectors include electronics, machinery, auto and textiles. The right panel regressions show the coefficient of a GVC dummy variable that is regressed on the firm's average wage rate (in logs) by worker category, controlling for employment and total factor productivity (in logs), sector and region fixed effects. Only estimates that are significant at the 10% level or higher are reported.

However, Colombia is lagging behind other countries with regard to the supply of high-skilled labor and education quality. Over the period 2015-17, only 18 percent of Colombia’s workforce was categorized as high-skilled compared to 23 percent in countries specialized in limited manufacturing GVCs and a third of the workforce in the rest of the country sample (Figure 10, right panel). While Colombia’s relative supply of high-skilled workers does not differ significantly from other countries in the cross-country regressions, its quality of education remains significantly lower. Colombia, however, does not differ from other countries in terms of labor market flexibility (Figure 6, right panel). The results thus suggest that strengthening the relative supply of high-skilled labor in particular and the quality of education are the main priorities. Box 1 discusses several policy options on how skills can be developed and used to more fully benefit from GVC participation.

While innovation seems to matter for GVC upgrading, it becomes more relevant once countries are in advanced GVC stages. While Colombia only spent 0.3% of its GDP on research and development (R&D), compared to 0.7% for countries in the limited manufacturing GVCs group (Appendix 14), Colombia’s spending on R&D does not differ significantly from other countries (Figure 6, right panel).

Box 1: Skills development to benefit from global value chain participation

Investing in worker skills ensures that participation in global value chains (GVCs) increases productivity. Higher-skilled workers are better able absorb knowledge spillovers deriving from the use of new technologies or work processes and more sophisticated goods and services inputs. In order to seize these benefits, countries need to invest in education and training, align skill-based policies with industry requirements, make better use of skills, and remove barriers to further skills development.

First, education and training systems need to equip all learners with a strong skill mix from early childhood through adult learning. This requires maintaining a strong focus on cognitive skills, while developing innovative teaching strategies, flexibility in the curriculum choice and well-designed entrepreneurship education.

Second, countries should align their skills supply with industries’ skills requirements through high-quality vocational and professional education and training. This includes a strong work-based learning component and specific policies to foster closer collaboration between the private sector, higher-education institutions and research institutions. The Penang Skills Development Centre in Malaysia, an industry-led training center, has played an important role in supporting Malaysia’s upgrading in the electronics and engineering GVCs. Similarly, Turkey’s upgrading into the branded segment of the apparel GVC was supported by both government and private sector initiatives, including workforce training, consulting and design services, and incentives for investment in research and development and technology.

Third, policies also need to ensure to use existing skills more effectively to benefit the whole economy. While improved skills increase firms’ and workers’ absorptive capacity to benefit from GVC participation, making the best use of their skills can help maximize productivity gains. This requires to design labor market policies in a way that allow workers to move easily into better-matching jobs, while providing flexibility to firms and security to workers. Countries can develop effective management practices, design employment protection legislation, and regulate non-compete clauses in ways that enable expertise and knowledge to be shared across the whole economy more effectively.

Finally, countries need to remove barriers to further skills development, especially for adults with weaker skill sets. Governments, employers, unions, and education and training providers should work together to develop flexible on-the-job training opportunities, improve access to formal education for adults, and make it easier for workers to combine work and training. Greater recognition of skills acquired informally would help workers gain further qualifications and adapt their careers to changing needs.

Source: Authors’ elaboration based on OECD (2017) and World Bank (2019).

3.4 Addressing existing bottlenecks in trade and investment policies²⁶

Trade and investment policies matter for upgrading through GVC participation. Studies have confirmed the positive role of low tariffs for GVC participation and FDI spillovers because firms are less constrained by a country's market size²⁷, are able import low-cost and high-quality inputs, because domestic firms are more exposed to international competitive pressures²⁸, or tend to adopt the newest technologies.²⁹ Our cross-country analysis finds that favorable trade and investment policies strongly magnify the positive link between backward GVC participation and domestic value added (Figure 6, left panel). Previous tariff liberalization episodes in Colombia show the importance of reduced tariffs for productivity³⁰ and quality upgrading³¹. The positive effects of tariff liberalization are likely to be higher for GVC firms in Colombia because of their more intensive use of imported inputs (up to 30 percent) compared to non-GVC exporters.³²

High tariffs and non-tariff measures (NTMs) on inputs and capital goods increase exporters' production costs and make them less competitive. Although average tariffs declined from 12.4 percent in 2000 to 6.4 percent in 2019, they are still higher than in most comparator countries. Tariffs for many key inputs used for exports are more than three times higher than the average tariff rate and are especially high for agricultural products like sugar, vegetable oil, and wheat that are inputs to export industries like processed foods, beverages (Figure 13, left panel). Higher than average tariffs are also imposed on inputs for manufacturing exports like textiles, plastics, and chemicals. NTMs are prevalent in most industries and entail significant costs increases for firms that provide inputs to key exports (right panel Figure 13). The ad-valorem equivalent of NTMs is in many cases higher than tariffs applied on the same products and affect both agricultural and manufacturing sectors. Technical barriers to trade and quantitative restrictions have the highest burden in key input sectors. By restricting competition in domestic sectors, NTMs decrease the incentive for domestic suppliers to increase productivity and result in higher input costs for exporters.

Reducing import tariffs on key inputs and capital goods can help exporters become more cost-competitive. Lowering tariffs on an MFN basis could help reduce effective costs spent on imported inputs for GVC firms. To achieve maximum impact for exporters and minimize changes in the tariffs structure, a targeted tariff reduction could focus on key inputs used by exporting firms in priority export sectors and identify tariffs above a pre-defined threshold. Lower tariffs will also provide incentives for domestic firms in highly protected sectors to increase efficiency.

Increasing FDI in manufacturing and lifting restrictions on foreign participation in services sectors could help increase exports. FDI firms are central players in GVCs as they represent close to two thirds of non-oil GVC exports. However, Colombia's inward FDI stock in its GDP (60 percent) lags behind countries

²⁶ A more detailed analysis on Colombia's trade policies and investment policies can be found in the accompanying notes "Trade policy options for Colombia" and "Foreign direct investment and investment promotion in Colombia".

²⁷ Crespo and Fontoura (2007), Fernandes et al. (2020).

²⁸ Havranek and Irsova (2011).

²⁹ Meyer and Sinani (2009).

³⁰ Eslava et al. (2013) find that a fall in tariffs from 60 to 20 percent is associated with a within-plant increase in productivity of about 3 log points.

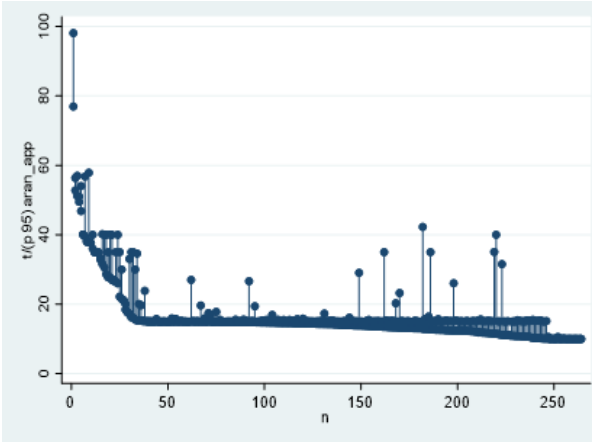
³¹ Fieler et al. (2018) also show that direct effects of trade liberalization on a minority of plants percolate through the domestic market, leading to large and widespread improvements in firm quality by providing incentives to non-exporting firms to upgrade.

³² Javorcik and Spatareanu (2005).

operating in limited manufacturing GVCs (120 percent), while FDI inflows into the manufacturing sector declined in recent years (Appendix 14). Moreover, some restrictions on foreign participation in export enabling sectors like transport and logistics might prevent competition and hurt efficiency in those sectors. Attracting FDI in manufacturing and upstream sectors should be a key priority since export quality upgrading can be facilitated by inflows of foreign investment in the upstream (input-supplying) industries.³³

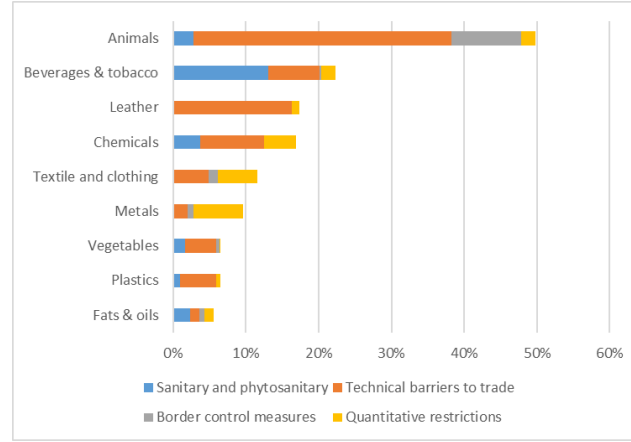
Figure 13: High tariffs and NTMs increase the costs of importing key inputs for exporters

Average and maximum tariffs for key imported inputs



Source: World Bank staff using DANE data

Ad-valorem equivalent of NTMs on key input sectors



Source: World Bank staff using data from Cadot et. al (2018)

³³ Bajgar and Javorcik (2020).

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Appendices

Appendix 1: Taxonomy of GVC participation

Countries participate in GVCs in different ways, but there are regularities in the type of GVC integration and how countries upgrade. In 146 countries over the period 1990–2015, the following four types of GVC participation are particularly notable: (1) commodities; (2) limited manufacturing; (3) advanced manufacturing and services; and (4) innovative activities.

Data and measures

Countries are classified based on (1) the goods and services exported, (2) the extent of GVC participation, and (3) measures of innovation. A country's sectoral specialization of exports is based on the domestic value added in gross exports of primary goods, manufacturing, and business services. A country's extent of GVC participation is measured as backward integration of the manufacturing sector as a share of the country's total exports. Higher backward integration in manufacturing is an important characteristic of countries entering or specialized in noncommodity GVCs.

Two measures are used to capture a country's innovative activities:

(1) intellectual property (IP) receipts as a percentage of GDP and (2) research and development (R&D) intensity, defined as its expenditure of public and private R&D as a percentage of GDP.

Definitions of GVC taxonomy groups

The rules take into account country size because smaller countries naturally rely on trade to a relatively greater extent. The following taxonomy groups are defined *sequentially*:

Commodities

Manufacturing share of total domestic value added in exports is less than 60 percent, *and*

- *Small countries*: Backward manufacturing is less than 20 percent.
- *Medium-size countries*: Backward manufacturing is less than 10 percent.
- *Large countries*: Backward manufacturing is less than 7.5 percent.

These criteria ensure that manufacturing is a small share of exports and that backward linkages in manufacturing are limited.

This group is further subdivided as follows:

- *Low participation*: Primary goods' share of total domestic value added in exports is less than 20 percent.
- *Limited commodities*: Primary goods' share of total domestic value added in exports is equal to or greater than 20 percent but less than 40 percent.
- *High commodities*: Primary goods' share of total domestic value added in exports is equal to or greater than 40 percent.

These criteria define countries according to their export dependence on manufacturing.

Innovative activities (based on remaining countries)

- *Small countries:* IP receipts as a percentage of GDP are equal to or greater than 0.15 percent, and R&D intensity is equal to or greater than 1.5 percent.
- *Medium-size and large countries:* IP receipts as a percentage of GDP are equal to or greater than 0.1 percent and R&D intensity is equal to or greater than 1 percent.

These criteria split groups into those that spend a relatively large share of GDP on research and receive a large share of GDP from IP.

Advanced manufacturing and services (based on remaining countries)

Share of manufacturing and business services^a in total domestic value added in exports is equal to or greater than 80 percent, and

- *Small countries:* Backward manufacturing is equal to or greater than 30 percent.
- *Medium-size countries:* Backward manufacturing is equal to or greater than 20 percent.
- *Large countries:* Backward manufacturing is equal to or greater than 15 percent.

Limited manufacturing (rest of sample)

Upgrading trajectories

Based on these definitions, the following countries transitioned from commodities into limited manufacturing GVCs over the period 1990–2015: Argentina, Armenia, Bosnia and Herzegovina, Cambodia, Costa Rica, Cyprus, El Salvador, Ethiopia, Indonesia, Kenya, Nepal, Serbia, South Africa, and Tanzania.

The following countries moved into advanced manufacturing and services from limited manufacturing GVCs: China, the Czech Republic, Estonia, India, Lithuania, the Philippines, Poland, Portugal, Romania, Thailand, and Turkey.

The Czech Republic moved further up into the innovative activities group in 2012 and remained in this group over the period covered. Other countries moved into innovative GVC activities: Austria, Canada, Finland, Ireland, Israel, Italy, the Republic of Korea, Singapore, and Spain.

Two countries, Jordan and Lesotho, downgraded from limited manufacturing to commodities. Meanwhile, some countries upgraded and then downgraded. Swaziland (now Eswatini) moved from limited manufacturing to advanced manufacturing and services and then back to limited manufacturing. Five other countries switched from commodities to limited manufacturing and then back to commodities: Botswana, Jamaica, the Democratic People's Republic of Korea, Nicaragua, and Senegal.

All other countries remained in the same group over the period covered.

a. Business services include maintenance and repair; wholesale trade; retail trade; transport; post and telecommunications; and financial intermediation and business activities. Business services, not total services, were used to detect advanced countries with a developed services sector.

Source: World Bank (2019, p. 22-23).

Appendix 2: Scope of the analysis

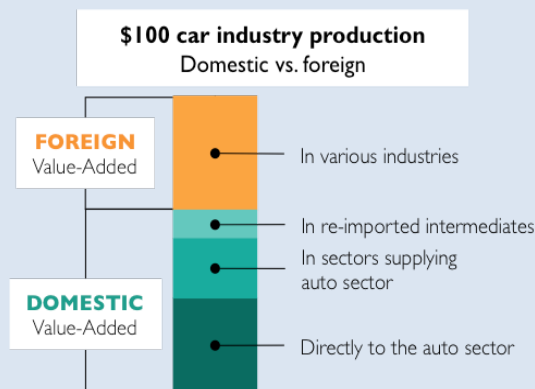
Datasets and classifications

The GVC taxonomy that has been introduced in the WDR2020 (World Bank 2019) differentiates between four types of GVC participation (commodities, limited manufacturing, advanced manufacturing and services, and innovative activities) and allows to identify a country's type of participation and common characteristics across taxonomy groups. The use of gross trade data allows to identify the main import and export data at a detailed product level. However, gross trade data do not reveal the domestic and foreign value added portions of trade. The development of value-added trade data represents a fundamental step forward in understanding GVC trade, in particular the GVC segment a country specializes into. These are based on international input-output data which, like national input-output data, allow to assess inter-sectoral linkages, but additionally include the source and destination countries and sectors of value added trade. Such datasets can help compare Colombia's GVC participation to that of selected comparator countries. In addition, firms are the main actors in GVCs, so drawing on insights from firm-level data (customs-level data and manufacturing survey) regarding firms' sourcing and selling patterns and linking them to sub-national characteristics from national sources can give additional insights on where subnational regions stand within the country.

Measures of GVC participation

Backward GVC participation is mainly captured by the imported inputs embodied in a country's or sector's exports. This is the orange portion in graph B2 below. *Forward GVC participation* is captured by the domestic value added embodied in foreign country exports. Both can be measured as percentage of a country's or sector's total gross exports. *Backward linkages to domestic upstream sectors* captures the indirect contribution of domestic upstream sectors supplying a sector, as depicted in a medium-green in graph B2 (they are not to be confused with backward GVC participation). In combination with the direct domestic value added contribution of a sector (dark green) and re-imported intermediates, they make up the *domestic value added in gross exports* (all green portions of graph B2).

Figure B2: Decomposition of gross exports in the automotive sector



Modified from Taglioni and Winkler (2016). Adapted from Baldwin and Lopez-Gonzalez (2013).

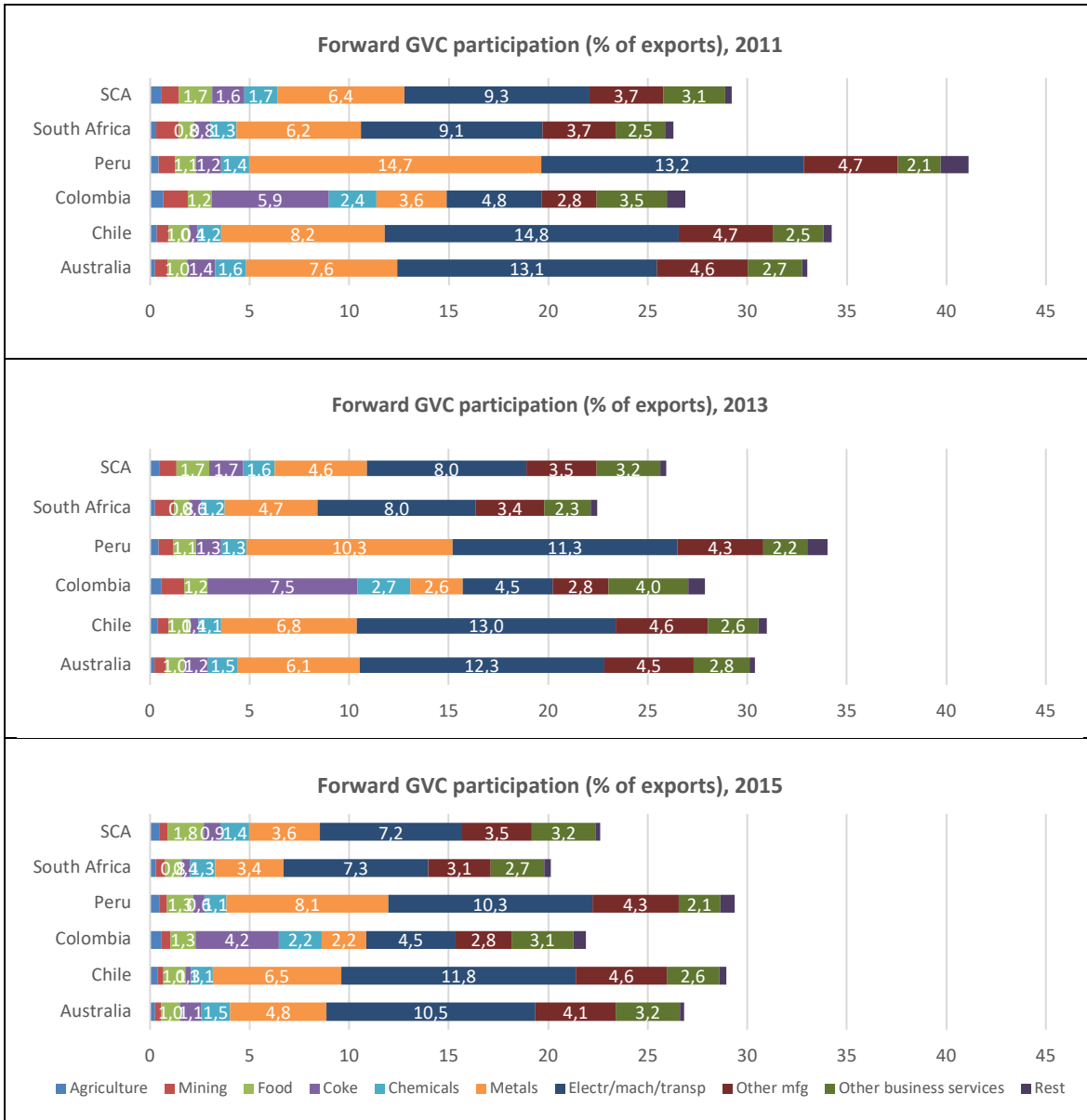
At the firm-level, this study relies on the share of imported inputs in total inputs sourced by firms in Colombia to assess their extent of *imported input share*. In combination with a firm's share of exports in total sales (*export share*), one can determine those firms that both import inputs and export as GVC participants. The definition of GVC participating firms in this study includes firms that import at least 10 percent of their inputs and simultaneously export at least 10 percent of their output. We exclude firms in the coke sector from the firm sample to get a better sense of the distribution of non-oil firms across regions in Colombia as well as the relative importance of regional determinants.

Appendix 3: Domestic value added in gross exports, Colombia, 2011 vs. 2015

IND	Industry	2011	%	2015	%	Selection
DTOTAL	TOTAL	55,057	100.0%	37,773	100.0%	
D01T03	Agriculture, forestry and fishing	2,107	3.8%	2,172	5.8%	
D05T09	Mining and quarrying	31,478	57.2%	18,654	49.4%	
D05T06	Mining and extraction of energy producing products	31,393	57.0%	18,591	49.2%	x
D07T08	Mining and quarrying of non-energy producing products	61	0.1%	63	0.2%	
D09	Mining support service activities	24	0.0%	0	0.0%	
D10T33	Manufacturing	15,435	28.0%	10,978	29.1%	x
D10T12	Food products, beverages and tobacco	1,973	3.6%	1,685	4.5%	x
D13T15	Textiles, wearing apparel, leather and related products	967	1.8%	792	2.1%	x
D16	Wood and products of wood and cork	44	0.1%	34	0.1%	
D17T18	Paper products and printing	522	0.9%	389	1.0%	
D19	Coke and refined petroleum products	4,527	8.2%	1,310	3.5%	
D20T21	Chemicals and pharmaceutical products	2,062	3.7%	2,356	6.2%	x
D22	Rubber and plastic products	522	0.9%	411	1.1%	
D23	Other non-metallic mineral products	522	0.9%	407	1.1%	
D24	Basic metals	2,864	5.2%	1,803	4.8%	x
D25	Fabricated metal products	227	0.4%	274	0.7%	
D26	Computer, electronic and optical products	39	0.1%	20	0.1%	
D27	Electrical equipment	445	0.8%	505	1.3%	x
D28	Machinery and equipment, nec	398	0.7%	418	1.1%	x
D29	Motor vehicles, trailers and semi-trailers	16	0.0%	251	0.7%	
D30	Other transport equipment	32	0.1%	44	0.1%	
D31T33	Other manufacturing; repair and installation of machinery and equipment	274	0.5%	279	0.7%	
D35T39	Electricity, gas, water supply, sewerage, waste and remediation services	135	0.2%	55	0.1%	
D41T43	Construction	-	0.0%	19	0.1%	
D45T82	Total business sector services	5,637	10.2%	5,595	14.8%	x
D45T47	Wholesale and retail trade; repair of motor vehicles	2,789	5.1%	2,502	6.6%	x
D49T53	Transportation and storage	1,176	2.1%	1,203	3.2%	x
D55T56	Accommodation and food services	826	1.5%	1,014	2.7%	
D58T60	Publishing, audiovisual and broadcasting activities	148	0.3%	113	0.3%	
D61	Telecommunications	181	0.3%	169	0.4%	
D62T63	IT and other information services	27	0.0%	61	0.2%	
D64T66	Financial and insurance activities	67	0.1%	73	0.2%	
D68	Real estate activities	126	0.2%	150	0.4%	
D69T82	Other business sector services	297	0.5%	312	0.8%	
D84T98	Public admin, education and health; social and personal services	265	0.5%	299	0.8%	

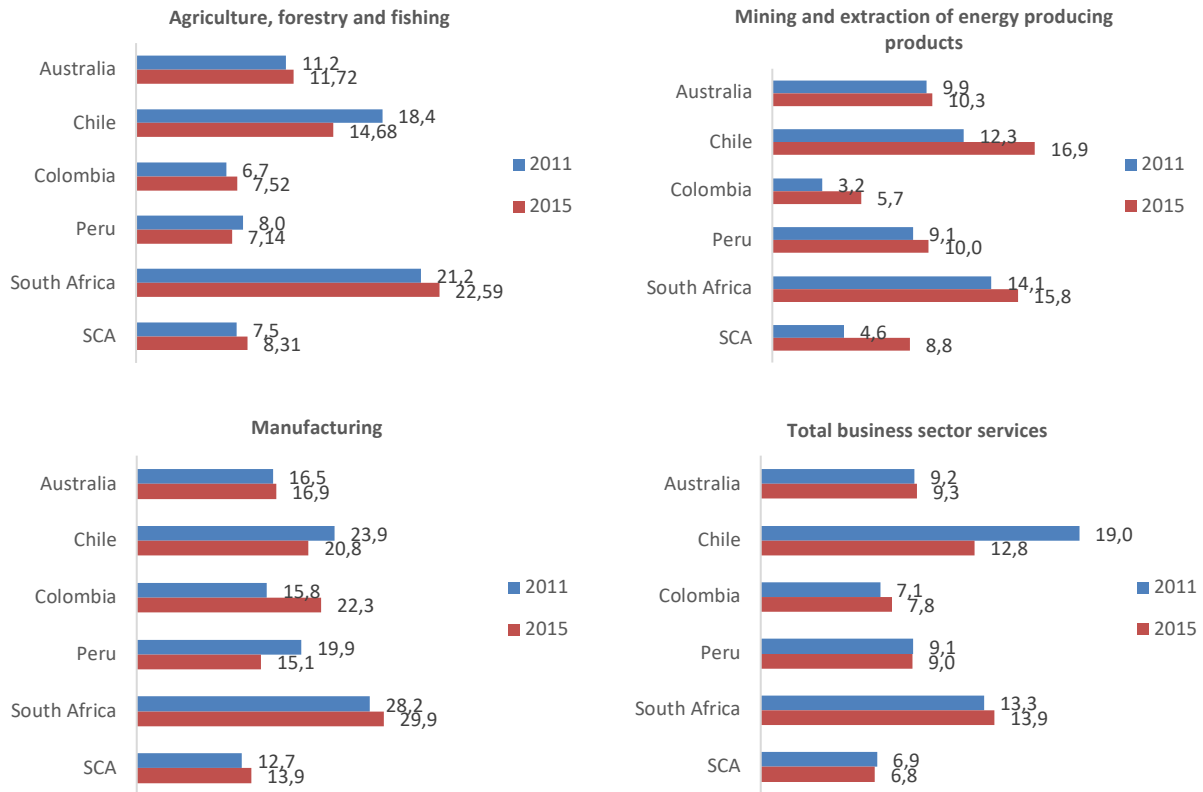
Source: OECD TiVA 2018 release. Note: Selection indicates sectors that are analyzed in more detail in this note.

Appendix 4: Coke and chemicals contribute relatively more to forward GVC participation in Colombia, while other manufacturing sectors contribute substantially less than comparator countries



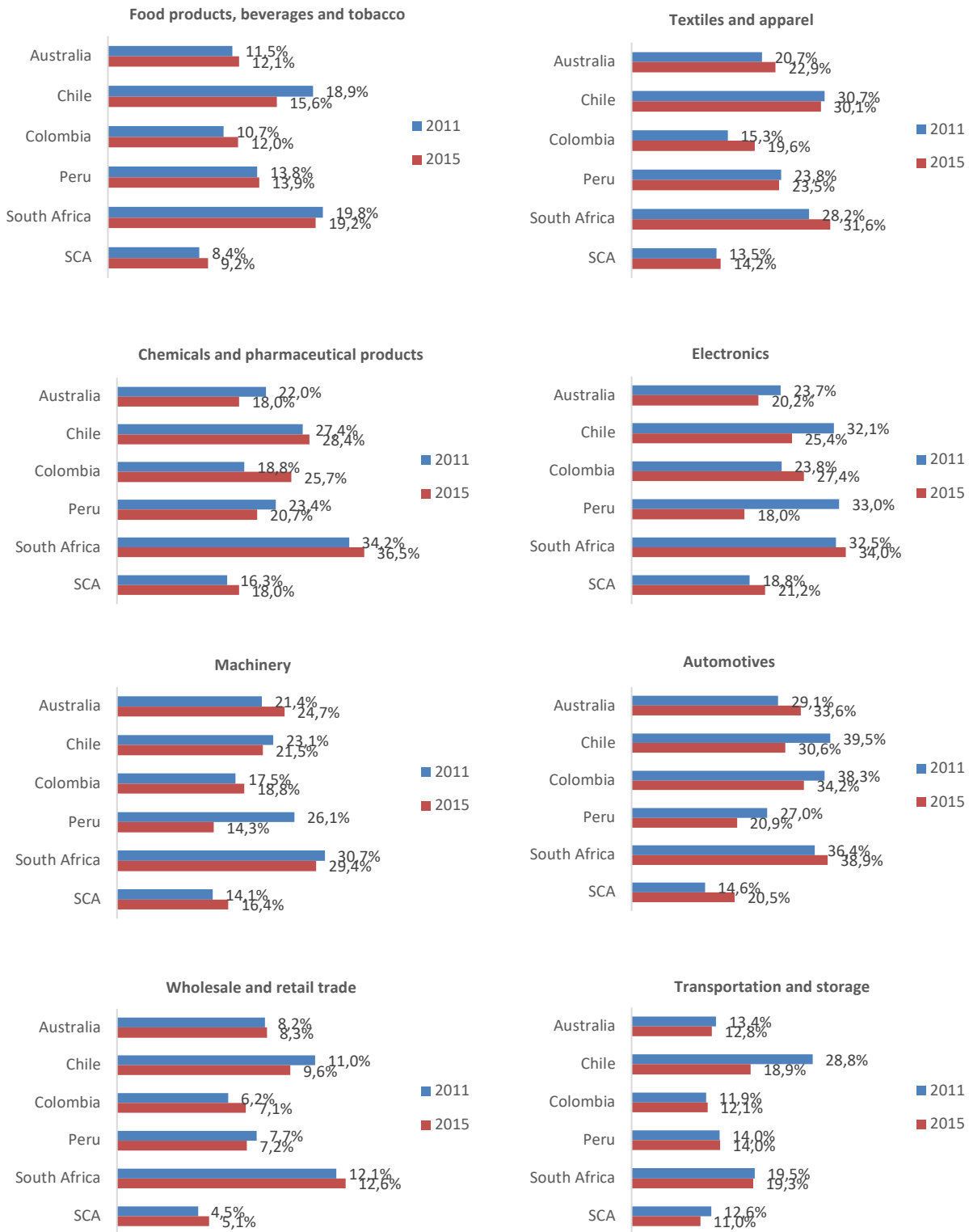
Source: OECD TiVA 2018 release. Forward GVC participation = Domestic value added embodied in third country exports (% of total exports). SCA = South and Central America which consists of Argentina, Brazil, Chile, Colombia, Costa Rica and Peru.

Appendix 5: Colombia's manufacturing exports have driven the increase in backward participation



Source: OECD TiVA 2018 release. Backward GVC participation = imported inputs in exports (% of exports). SCA = South and Central America which consists of Argentina, Brazil, Chile, Colombia, Costa Rica and Peru.

Appendix 6: Backward participation in Colombia grew strongly in chemicals, textiles and electronics



Source: OECD TiVA 2018 release. Backward GVC participation = imported inputs in exports (% of exports). SCA = South and Central America which consists of Argentina, Brazil, Chile, Colombia, Costa Rica and Peru.

Appendix 7: Summary statistics of non-coke manufacturing GVC firms by region, 2018 vs. 2013

Region name	Region code	2018				2013			
		Total firms (number)	GVC firms (number)	Share of GVC firms	Median share of imported inputs (% of total inputs)	Total firms (number)	GVC firms (number)	Share of GVC firms	Median share of imported inputs (% of total inputs)
Antioquia	5	1,624	432	26.6%	25.0%	1,886	423	22.4%	22.0%
Atlántico	8	284	86	30.3%	43.0%	345	101	29.3%	41.0%
Bogotá, D.C.	11	2,550	559	21.9%	27.0%	3,282	670	20.4%	29.0%
Bolívar	13	98	35	35.7%	47.0%	113	34	30.1%	44.0%
Boyacá	15	63	4	6.3%	6.0%	69	2	2.9%	6.0%
Caldas	17	121	32	26.4%	27.0%	144	26	18.1%	40.0%
Caquetá	18	4	1	25.0%	40.0%	4	1	25.0%	32.0%
Cauca	19	77	23	29.9%	23.0%	83	22	26.5%	37.0%
Cesar	20	26	0	0.0%	1.0%	31	2	6.5%	0.0%
Córdoba	23	21	3	14.3%	30.0%	21	3	14.3%	10.0%
Cundinamarca	25	548	191	34.9%	36.0%	525	178	33.9%	30.0%
Chocó	27								
Huila	41	44	0	0.0%	16.0%	49	4	8.2%	4.0%
La Guajira	44	3	0	0.0%	0.0%	4	0	0.0%	0.0%
Magdalena	47	45	4	8.9%	9.0%	49	4	8.2%	10.0%
Meta	50	42	3	7.1%	2.0%	50	2	4.0%	5.0%
Nariño	52	35	0	0.0%	10.0%	43	0	0.0%	31.0%
Norte de Santander	54	106	7	6.6%	19.0%	116	9	7.8%	18.0%
Quindío	63	44	8	18.2%	10.0%	50	8	16.0%	5.0%
Risaralda	66	152	36	23.7%	36.0%	179	29	16.2%	31.0%
Santander	68	303	36	11.9%	17.0%	358	39	10.9%	15.0%
Sucre	70	16	1	6.3%	19.0%	15	2	13.3%	15.0%
Tolima	73	79	6	7.6%	8.0%	93	2	2.2%	8.0%
Valle del Cauca	76	895	197	22.0%	31.0%	1092	235	21.5%	27.0%
Arauca	81	1	0	0.0%	0.0%	1	0	0.0%	0.0%
Casanare	85	13	0	0.0%	1.0%	8	0	0.0%	7.0%
Putumayo	86	2	0	0.0%	0.0%	2	0	0.0%	0.0%
San Andrés y Providencia	88	3	0	0.0%	0.0%	3	0	0.0%	0.0%
Amazonas	91	2	0	0.0%	1.0%	2	0	0.0%	0.0%
Guainía	94								
Guaviare	95								
Vaupés	97								
Vichada	99								

Source: Customs data and Encuesta Annual Manufacturera 2013 and 2018.

Appendix 8: Econometric model on GVC upgrading

To capture the relationship between GVC participation and economic upgrading, we follow the model by Stolzenberg, Taglioni and Winkler (2019) and estimate a standard fixed effects model for country c in sector s at time t :

$$dva_{cst} = \alpha + \beta_1 gvc_{cst} + \beta_2 emp_{cst} + \beta_3 dfd_{cst} + \alpha_{cs} + \alpha_{st} + \alpha_{ct} + \epsilon_{cst} \quad (1)$$

Our measure of economic upgrading is the domestic value added (dva) which combines the gains for firms (gross profits) and workers alike (total compensation). It reflects economic upgrading via better skills, capital, and processes, and therefore represents a comprehensive upgrading metric. The key variable of interest is GVC participation, gvc . The first GVC measure is the amount of foreign value added embodied in exports (fva), also referred to as backward GVC participation, while the second indicator is the amount of domestic value added used in the export production of partner countries (dvx), also referred to as forward GVC participation.³⁴ We also use gross exports (exp) as alternative trade measure to detect whether the relationship with domestic value added differs from that with GVC participation.

The model additionally controls for the number of employees (emp).³⁵ Finally, we include the amount of foreign value added embodied in domestic final demand (dfd) to separate a potential positive GVC effect from a simple positive effect of trade openness. This covers both imports of final goods and intermediate goods assembled and consumed domestically. While an overlap with GVC trade could downward bias in our estimates, not controlling for openness would prevent us from separating the effects of GVC trade and final goods trade. All country-sector variables are measured in natural logarithms. Finally, we employ a set of country-sector ($\alpha_{c,s}$), country-year ($\alpha_{c,t}$), and sector-year ($\alpha_{s,t}$) fixed effects to account for potentially omitted variables.

For the country-sector variables we rely on the OECD Trade in Value Added (TiVA) and Trade in Employment (TiE) databases which cover 64 countries and 36 industries at aggregated ISIC Rev. 4 levels for the period 2005-2015. We drop mining, coke, and non-tradable services from the sample.³⁶ We also exclude five countries that are not part of the GVC taxonomy to allow for additional tests, namely Brunei Darussalam, Iceland, Luxembourg, Malta and Taiwan. This leaves the model with 59 countries and 23 sectors.

³⁴ There is a structural relationship between domestic value added (va) and forward GVC participation (dvx) that might bias the results. However, it should not affect the qualitative results obtained with the policy interaction terms as shown below in equation (2).

³⁵ While comparable capital stock data at the detailed sector level for our set of countries are unavailable, the inclusion of country-sector fixed effects can partially control for differences in capital stock assuming sectoral capital stock changes very slowly in a country. In additional robustness checks, Stolzenberg, Taglioni and Winkler (2019) used WIOD data instead of TiVA to include measures of capital stock and confirmed that general results hold.

³⁶ Mining and supporting services (D05T06, D07T08, D09), coke and refined petroleum (D19), utilities (D35T39), construction (D41T43), accommodation and food (D55T56), real estate (D68), public services (D84), education (D85), health and social work (D86T88), arts, entertainment and recreation (D90T96) and private households with employed persons (D97T98).

Appendix 9: GVC participation and domestic value added, 2005-2015

Trade variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Backward GVC					Forward GVC				
Sample	full	comm	limited	adv&innov	Colombia	full	comm	limited	adv&innov	Colombia
<i>Ingv</i>	0.040** (0.043)	0.016 (0.606)	0.036 (0.308)	0.048** (0.028)	0.035 (0.118)	0.175*** (0.000)	-0.053 (0.429)	0.086 (0.239)	0.245*** (0.000)	0.234*** (0.003)
<i>Inemp</i>	0.380*** (0.000)	0.490*** (0.000)	0.424*** (0.000)	0.367*** (0.000)	0.550*** (0.000)	0.388*** (0.000)	0.495*** (0.000)	0.428*** (0.000)	0.376*** (0.000)	0.549*** (0.000)
<i>Indfd</i>	0.034 (0.264)	0.019 (0.792)	0.039 (0.423)	0.003 (0.942)	0.221 (0.142)	0.042 (0.136)	0.024 (0.744)	0.053 (0.229)	0.007 (0.836)	0.152 (0.241)
Constant	6.230*** (0.000)	5.798*** (0.000)	5.162*** (0.000)	6.801*** (0.000)	3.266** (0.038)	4.981*** (0.000)	6.250*** (0.000)	4.640*** (0.000)	4.973*** (0.000)	2.307 (0.113)
Observations	10,372	1,771	2,667	7,705	253	10,372	1,771	2,667	7,705	253
R-squared	0.996	0.993	0.995	0.997	0.995	0.996	0.993	0.995	0.997	0.996
Country-sector FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Country-year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Sector-year FE	YES	YES	YES	YES	NO	YES	YES	YES	YES	NO

p* < 0.1, p** < 0.05, p*** < 0.01 (robust standard errors corrected for clustering by country-sector in parentheses). All regressions control for country-sector, country-year and sector-year fixed effects.

Appendix 10: Forward GVC participation and domestic value added, 2005-2015, by sector

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Food	Text/app	Chemicals	Basic metals	Electrical	Machinery	Transport
<i>Indvx</i>	0.231** (0.032)	0.543*** (0.001)	0.452*** (0.002)	0.719*** (0.000)	0.743*** (0.000)	0.497*** (0.000)	0.565*** (0.000)
<i>Inemp</i>	0.590*** (0.000)	0.523*** (0.000)	0.538** (0.035)	0.521** (0.020)	0.440*** (0.000)	0.190 (0.208)	0.561*** (0.000)
<i>Indfd</i>	0.470*** (0.000)	0.338*** (0.000)	0.261*** (0.010)	0.159 (0.225)	0.171** (0.034)	0.280*** (0.002)	0.216** (0.012)
Constant	0.472 (0.685)	-1.558 (0.108)	0.180 (0.900)	-1.812 (0.208)	-1.599 (0.119)	0.550 (0.543)	-1.235 (0.234)
Observations	528	528	528	527	528	528	528
R-squared	0.996	0.995	0.994	0.988	0.993	0.996	0.994
Country FE	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES

p* < 0.1, p** < 0.05, p*** < 0.01 (robust standard errors corrected for clustering by country in parentheses). All regressions control for country and sector fixed effects.

Appendix 11: Backward GVC participation and domestic value added, 2005-2015, by sector

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	Food	Text/app	Chemicals	Basic metals	Electrical	Machinery	Transport
Infva	-0.075 (0.156)	-0.004 (0.968)	0.108 (0.263)	0.355** (0.038)	0.179** (0.042)	0.218*** (0.005)	0.096* (0.072)
<i>lnemp</i>	0.457*** (0.002)	0.515*** (0.001)	0.510** (0.039)	0.448** (0.040)	0.410*** (0.004)	0.120 (0.396)	0.644*** (0.000)
<i>lndfd</i>	0.602*** (0.000)	0.546*** (0.000)	0.393*** (0.000)	0.307** (0.014)	0.311*** (0.001)	0.362*** (0.000)	0.290*** (0.001)
Constant	2.686*** (0.002)	1.375* (0.098)	2.531* (0.054)	1.233 (0.320)	2.634*** (0.006)	3.189*** (0.000)	2.498*** (0.000)
Observations	528	528	528	527	528	528	528
R-squared	0.996	0.994	0.994	0.988	0.991	0.995	0.994
Country FE	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES

p* <0.1 , p** <0.05 , p*** <0.01 (robust standard errors corrected for clustering by country in parentheses). All regressions control for country and sector fixed effects.

Appendix 12: Econometric model on GVC upgrading and the role of national policies

As we are primarily interested in the contribution of country-specific policy variables to economic upgrading through GVC participation, we include an interaction term between a set of national characteristics and backward GVC participation to equation (1) in Appendix 7:

$$dva_{cst} = \alpha + \beta_1 gvc_{cst} + \beta_2 emp_{cst} + \beta_3 dfd_{cst} + \gamma gvc_{cst} * z_{ct} + \alpha_{cs} + \alpha_{st} + \alpha_{ct} + \varepsilon_{cst} \quad (1)$$

As measures for the national characteristics, z_{ct} , we employ variables capturing a set of national policies. Note that the model does not control for national characteristics separately, but rather includes country-time fixed effects (α_{ct}) to capture time-varying national characteristics more broadly. Besides manufacturing sectors, the policy analysis also covers tradable services, leading to a total of 23 sectors.

It is important to emphasize that this empirical setting does not generate causal estimates on the role of domestic policies for economic upgrading through GVC participation, but rather provides evidence to guide future more directed work. A main advantage of this study is its comprehensive nature covering an extensive part of policy space to detect which policies should be analyzed more closely and which policies might be of second order.

In a next step, we assess how Colombia's national characteristics perform compared to other countries in the sample.

$$z_c = \alpha + \beta_1 col_c + \beta_2 lngdp_c + \beta_3 lnpop_c + \beta_4 commodity_c + \varepsilon_c \quad (3)$$

The regression is performed at the country-year level using averages for the period 2015-17. We employ variables capturing a set of national policies z_c that matter of GVC upgrading.

col is a country dummy taking the value of 1 if the country is Colombia, and 0 if not. The regression also controls for GDP per capita and population in natural logarithms as well as for membership in the commodity GVCs group (*commodity*). Standardized beta coefficients were estimated to be able to compare effect sizes across different dependent variables. The standardized coefficient to the Colombia dummy is divided by the standard deviation of the Colombia dummy to obtain a beta that can be interpreted as mean difference between Colombia and the rest of the country sample, in units of standard deviations of the dependent variables.

Appendix 13: Data

Trade policy is measured by a country's weighted manufacturing *import tariff* from the WDI. We also include the Services Trade Restrictiveness Index (*STRI*) from the World Bank, which takes the value from 0 to 100 (closed). Finally, we add two measures from the World Bank's preferential trade agreements database, namely the number of *PTA partners* and the average *number of provisions*, both in natural logarithms. Non-tariff measures (*NTMs*) from the World Bank (Kee and measure the share of imports that is affected by either technical barriers to trade (*TBT*) or sanitary and phyto-sanitary standards (*SPS*)).

Investment policy is measured by *FDI inflows* and outflows from the WDI and the *inward and outward FDI stock* from UNCTAD, both as percentage of GDP. We also include an index of *investment freedom* by the Heritage foundation which serves as a proxy for investment promotion. Heritage scores ranges from 0 to 100 = highest freedom, and investment freedom measures the ability of individuals and firms to move their resources in and out of specific activities both internally and across the country's borders. This variable is mainly based on official government publications of each country on capital flows and foreign investment. Finally, we include an index of investor protection from the Doing Business indicators for the period 2006 to 2014 which measures the strength of minority investor protection (*investor protection*) and ranges from 0 to 10 (highest).

Infrastructure has three main dimensions: rail, roads, and ports. We measure *rail length per person* which is measured as kilometers of rail lines per person in natural logarithms, based on WDI data. We also rely on the World Economic Forum's (WEF) assessment of *rail, road* and *port quality* for the Global Competitiveness Report. The report is based on business executives' perceptions of their country's infrastructure quality from 2006. WEF scores range from 1 to 7, with 7 being the optimal value.

Connectivity looks at procedures and controls governing the movement of goods and services across and within national borders, as well as a country's ICT infrastructure. It is accounted for by Internet users per 100 inhabitants (*internet use*). We also include measures for the expected time of exporting (*time to export*) and importing (*time to import*), as well as the expected cost of exporting (*cost to export*) and importing (*cost to import*) from the Doing Business database. Time is the time to export or import a standardized cargo of goods by sea transport, while costs to export or import are calculated in US dollars per container deflated (in natural logarithms).

Competition and government are assessed using four indicators. The *domestic competition* index (WEF, from 2006 on) is concerned with market concentration, anti-monopolistic policies, investment incentives, and tax policy, ranging from 1-7 (best). The intellectual protection index (WEF, 1, 7 best) assess the extent of protection of intellectual property in a country. We also include a measure of government effectiveness from the World Governance Indicators, ranging from -2.5 to 2.5 (highest). The last measure is a measure of government integrity from the Heritage Foundation, ranging from 0 to 100 (highest). The index captures information on public trust in politicians, irregular payments and bribes, transparency of government policymaking, absence of corruptions, perceptions of corruptions and governmental and civil service transparency, based on external resources.

Skills and labor includes an index of unit labor costs (2010=100), i.e. labor cost per unit of real value added (in US dollars), from the Conference Board which proxies for a country's cost competitiveness. We also include direct measures of skills, namely the share of high-skilled workers (*high-skilled labor*) in the total workforce from the ILO. High-skilled workers include managers, professionals, technicians and associate professionals. As qualitative measure, we use an index of *education quality* and *labor market flexibility* provided by the WEF (from 2006) on the basis of their Executive Opinion Survey ranging from 1 to 7 (best). The latter accounts for a country's labor market policy.

Innovation is measured by *R&D intensity*, i.e. public and private expenditure on research and development as percent of GDP from the WDI. Finally, we add two measures related to payments on intellectual property (*IP payments*) and receipts from intellectual property (*IP receipts*) from the WDI which are based on balance of payments statistics and measured as percent of GDP.

Appendix 14: Policy measures, 2015-17 averages

	Colombia	Rest of sample	Commodity	Limited mfg	Advanced mfg and services	Innovative
Trade policy and NTMs						
Import tariff, mfg (%)	5.6	2.6	2.7	4.2	2.6	1.7
STRI (0,100 strictest)	15.3	24.1	18.6	27.2	31.2	19.3
PTA partners (number)	43.3	61.6	30.6	54.2	63.3	78.6
PTA provisions (number)	348.0	210.7	231.5	187.5	199.6	233.2
NTM SPS (% imports)	30.0%	17.0%	17.0%	24.0%	15.0%	16.0%
NTM TBT (% imports)	57.0%	75.0%	60.0%	74.0%	74.0%	82.0%
Investment policy						
FDI inflows (% of GDP)	4.5	5.5	2.8	5.6	6.0	6.3
Inward FDI stock (% of GDP)	55%	83%	52%	119%	71%	79%
FDI outflows (% of GDP)	1.4	4.1	1.5	3.4	3.6	6.2
Outward FDI stock (% of GDP)	17%	64%	23%	81%	45%	84%
Investment freedom (0,100 highest)	80.0	69.2	64.4	56.2	67.0	82.8
Investor protection (1,10 highest)	8.0	6.3	6.7	5.8	6.3	6.7
Infrastructure						
Rail quality (1,7 highest)	1.4	4.0	3.2	2.9	3.8	5.1
Road quality (1,7 highest)	2.8	4.6	3.9	3.8	4.5	5.5
Port quality (1,7 highest)	3.7	4.7	4.4	4.1	4.5	5.3
Connectivity						
Internet use (%)	58.8	72.4	75.4	58.0	66.4	85.2
Cost to import, documentary (US\$)	50.0	57.2	100.3	82.3	43.1	30.4
Cost to import, border (US\$)	545.0	244.5	430.0	376.4	232.5	92.8
Time to import, documentary (hours)	64.0	25.1	39.5	57.8	17.5	3.5
Time to import, border (hours)	112.0	34.3	63.6	46.9	43.9	8.9
Competition and government						
Domestic competition (1,7 highest)	4.0	4.7	4.7	4.3	4.6	5.1
Intellectual property protection (1,7 highest)	4.0	4.8	4.6	4.0	4.4	5.7
Government effectiveness (-2,5,2,5 highest)	0.0	0.9	0.7	0.2	0.6	1.5
Government integrity (0,100 highest)	37.5	57.5	56.9	41.6	50.4	73.5
Skills and labor						
High-skilled labor (% total workforce)	18.6	33.2	33.8	23.1	29.0	42.6
Education quality (1,7 highest)	3.7	4.6	4.4	3.9	4.4	5.2
Labor market flexibility (1,7 highest)	4.4	4.6	4.7	4.2	4.5	4.7
Innovation						
R&D intensity (% of GDP)	0.3%	1.5%	0.9%	0.7%	1.1%	2.6%
IP payments (% of GDP)	0.2%	1.1%	0.3%	0.3%	0.4%	2.3%
IP receipts (% of GDP)	0.0%	0.5%	0.1%	0.0%	0.1%	1.1%

Appendix 15: Cross-regional econometric model within Colombia and data description

To capture the relationship between regional characteristics and GVC participation across regions in Colombia, we estimate a standard between effects model for region r at period p :

$$gvc_{rt} = \alpha + \beta_1 \text{determinant}_{rt-1} + \beta_2 \text{gdp_pc}_{rt-1} \quad (1)$$

Our measure of regional GVC participation, gvc , is the median share of imported inputs in total inputs across GVC-participating manufacturing firms (excluding manufacture of coke and refined petroleum products) over the period 2016-18. To compare results with trade in general, we also include a region's overall exports (in logs) as dependent variable in a second set of regressions. Our key variable of interest is the regional determinant, *determinant*, which is measured as the average over the period 2013-15. Since the model covers at most 29 regions, we are unable to include several determinants simultaneously, but rather correlate them with the measure GVC participation individually. The model also controls for a region's average GDP per capita (in logs) over the period 2013-15.

We combine customs-level trade data with the annual manufacturing survey data (Encuesta Annual Manufacturera) to compute the firms' share of imported inputs in total inputs and their share of exports in sales which are used to determine GVC-participating firms. One can determine those firms that both import inputs and export as GVC participants. The definition of GVC participating firms in this study includes firms that import at least 10 percent of their inputs and simultaneously export at least 10 percent of their output. The data are available up to 2018.

Our regional determinants relate to various indicators on connectivity, competition, the quality of institutions, labor and innovation. The data are obtained from the Regional Competitiveness Indicators publication (Indice Departamental de Competitividad) for the years 2013 to 2018 which also publishes the underlying measures. Regional averages for 2018 are reported in Appendix 16.

We include several measures of *connectivity* into the analysis, including the percent of fixed broadband internet subscriptions in the population, the percent of students who obtain level B1 or B + in the English test of Saber 11, the percent of households with access to electricity and water, the percent of a regions' municipalities with solid waste disposal in all municipalities, and transportation costs to customs and domestic markets (department capital cities) in logarithms.

In order to capture *competition and the quality of institutions*, we include the number of firms per 100,000 inhabitants (number), the share of medium and large firms in all firms to measure if the business environment is conducive to firm growth, efficiency of the judicial system, the number of financial branches and non-bank correspondent (per 100,000 inhabitants) as a measure of access to finance, the World Bank's ease of starting a business and of registering property (score) and taxes and mandatory contributions (Doing Business).

Regarding *skills*, we include the Average Saber Pro test score in the generic competences module as well as English as second language which is. We also include enrollment rates in higher education institutions (% of population 17-21), enrollment in technical and technological education (per 1,000 people aged 17 to 21) and enrollment in high-quality accredited institutions (% of total higher education students). We also include the number of Postgraduate graduates per 100,000 inhabitants.

As a measure of *labor*, we include the share of formal labor and the gap between the labor force participation rate of men and women to identify the role of male intensity in regions. Finally, measures of *innovation* include investment in science, technology and innovation per capita (in logarithms), the number of patent applications per million inhabitants and a measure of the complexity of production (0, 1 highest).

Appendix 16: Regional indicators on connectivity and infrastructure, competition and institutions, and labor, skills and innovation, and labor, skills and innovation, Colombia 2018

Region name	Region code	Internet density % of population	Percent of students who obtain level B1 or B+ in the English test of Saber 11	Households with water access (%)	Households with access to electricity (%)	Electricity costs	Municipalities with solid waste disposal (% of total municipalities)	Efficiency of judicial system	Ease of starting a business (score)	Ease of obtaining building permits (score)	Taxes and mandatory contributions	Number of firms (in 100,000 people)	Number of medium and large firms (% all firms)	Enrollment in higher education (% of 17-21)	Postgraduates (per 100,000 people)	Enrollment in technical and technological education (per 1,000 people aged 17 to 21)	Enrollment in high-quality accredited institutions (% of total higher education students)	Average Saber Pro test score	Formal labor	Gap between the labor force participation rate of men and women	Investment in science, technology and innovation per capita (COP)	Patent applications (per million people)	Product complexity (0, 1 highest)	Population
Antioquia	5	17%	33%	86%	99%	301.1	99%	0.6	8.6	6.7	6.5	9.3	8%	36%	180.7	20%	44%	151	48%	23%	176,913	17.5	0.85	6,691,030
Atlántico	8	13%	28%	88%	100%	303.2	100%	0.4	8.6	6.6	6.5	9.9	7%	39%	203.3	20%	25%	144	33%	20%	84,134	3.2	0.55	2,545,924
Bogotá, D.C.	11	22%	37%	99%	100%	307.0	100%	0.6	8.5	6.8	7.0	21.6	7%	80%	519.3	31%	32%	149	56%	14%	278,938	29.6	0.96	8,181,047
Bolívar	13	8%	23%	70%	96%	290.7	96%	0.5	8.5	6.3	6.6	6.2	6%	20%	99.2	16%	39%	141	25%	25%	54,428	1.4	0.49	2,171,280
Boyacá	15	8%	17%	80%	97%	309.7	100%	0.5	7.2	6.7	6.6	4.3	3%	42%	507.4	14%	53%	152	29%	20%	76,832	2.3	0.45	1,282,063
Caldas	17	12%	24%	89%	100%	299.8	100%	0.7	8.6	7.4	6.2	4.8	6%	40%	259.3	17%	71%	152	42%	29%	92,351	5.0	0.57	993,866
Caquetá	18	4%	8%	66%	77%	337.0	91%	0.6	7.4	6.6	6.1	2.2	4%	20%	74.7	3%	1%	137	19%	32%	50,413	2.0	0.25	496,241
Cauca	19	5%	14%	62%	91%	274.1	94%	0.5	7.8	6.2	6.4	2.0	6%	25%	69.1	12%	39%	145	18%	27%	56,947	1.4	0.69	1,415,933
Cesar	20	8%	10%	83%	97%	310.8	98%	0.5	8.0	6.8	6.5	3.8	4%	25%	108.6	9%	1%	139	23%	23%	67,337	0.0	0.25	1,065,673
Córdoba	23	5%	11%	52%	93%	293.7	100%	0.5	8.0	7.1	6.6	2.2	6%	21%	36.9	3%	6%	138	15%	24%	41,887	0.0	0.31	1,788,507
Cundinamarca	25	12%	21%	83%	99%	288.5	100%	0.5	8.5	6.8	7.0	6.5	8%	17%	86.1	15%	26%	153	40%	15%	113,106	7.2	0.72	2,804,238
Chocó	27	4%	3%	22%	82%	293.8	45%	0.5	8.5	6.2	6.2	1.6	3%	23%	40.6	2%	2%	118	18%	26%	47,143	0.0	0.16	515,145
Huila	41	8%	11%	79%	96%	321.5	87%	0.5	8.4	6.8	6.2	4.2	4%	23%	54.6	12%	33%	142	22%	27%	51,752	1.7	0.25	1,197,081
La Guajira	44	3%	4%	49%	75%	318.1	94%	0.4	7.5	6.6	6.4	1.4	3%	15%	7.4	6%	1%	121	17%	14%	30,673	0.0	0.22	1,040,157
Magdalena	47	7%	16%	68%	93%	289.3	98%	0.5	7.7	6.8	6.8	4.2	6%	21%	74.6	9%	53%	140	23%	24%	46,474	0.0	0.27	1,298,691
Meta	50	11%	13%	76%	89%	271.6	99%	0.5	8.3	6.0	6.2	6.1	5%	27%	70.5	8%	11%	144	30%	22%	104,962	1.0	0.24	1,016,701
Nariño	52	5%	12%	67%	98%	373.2	86%	0.6	8.1	5.9	6.4	2.0	6%	21%	66.1	4%	32%	144	15%	20%	73,026	2.2	0.24	1,809,116
Norte de Santander	54	9%	11%	83%	96%	311.0	100%	0.6	8.6	6.7	6.2	4.3	5%	41%	115.3	11%	11%	141	22%	25%	54,547	2.9	0.38	1,391,239
Quindío	63	16%	25%	97%	96%	335.3	100%	0.6	8.6	5.8	6.1	0.8	6%	33%	49.8	23%	46%	142	36%	20%	45,223	14.0	0.44	575,010
Risaralda	66	15%	26%	93%	100%	310.6	100%	0.6	8.6	7.2	6.3	6.5	7%	41%	217.0	19%	47%	147	38%	25%	72,542	13.5	0.62	967,767
Santander	68	16%	26%	83%	99%	306.1	99%	0.5	8.2	5.8	6.4	7.9	6%	39%	341.4	24%	31%	151	32%	18%	146,880	6.2	0.49	2,090,839
Sucre	70	5%	10%	73%	98%	278.3	100%	0.5	8.5	6.9	6.6	2.5	5%	25%	29.7	5%	2%	134	16%	26%	34,700	0.0	0.22	877,057
Tolima	73	10%	15%	81%	97%	319.7	90%	0.5	8.4	4.8	6.5	3.8	4%	23%	63.9	17%	2%	144	24%	19%	77,653	0.7	0.32	1,419,947
Valle del Cauca	76	15%	26%	94%	96%	299.7	95%	0.6	8.6	5.1	6.5	7.8	8%	28%	109.0	15%	43%	150	40%	18%	102,896	6.4	0.79	4,756,113
Arauca	81	4%	2%	84%	89%	206.3	63%	0.4	8.2	6.7	6.4	3.8	3%	7%	10.1	4%	1%	134	34%	18%	96,723	0.0	0.13	270,708
Casanare	85	9%	8%	72%	95%	288.5	100%	0.4	7.9	6.9	6.6	7.7	5%	20%	62.6	8%	14%	132	39%	14%	96,493	0.0	0.26	375,249
Putumayo	86	3%	3%	44%	70%	294.9	66%	0.6	7.2	6.3	6.4	2.9	3%	3%	6.5	8%	7%	128	36%	15%	42,029	0.0	0.17	358,896
San Andrés y Providencia	88	5%	27%	47%	100%		100%	0.5	7.8	5.8	6.5	11.4	8%	1%	12.9	19%	9%	120			141,316	12.9	0.31	78,413
Amazonas	91	1%	8%	42%	71%		88%	0.0	7.5	6.6	6.4	3.5	4%	4%	24.4	4%	5%		38%	11%	185,009	0.0	0.27	78,830
Guainía	94	1%	0%	21%	73%		0%	0.0	6.9	7.3	6.5	1.6	1%	4%	18.7	8%	4%		33%	21%	99,347	0.0	0.36	43,446
Guaaviare	95	1%	2%	43%	65%		98%	0.0	7.6	7.3	6.4	1.7	2%	5%	5.3	13%	0%		26%	11%	112,797	0.0	0.19	115,829
Vaupés	97	0%	0%	60%	71%		10%	0.0	7.0	6.7	6.4	0.7	3%	1%	0.0	4%	0%		49%	7%	88,298	0.0	0.20	44,928
Vichada	99	3%	4%	40%	62%		100%	0.0	7.1	7.0	6.6	1.6	3%	1%	4.0	8%	0%		37%	14%	149,166	0.0	0.26	77,276

Source: Índice Departamental de Competitividad 2018. Blue shades = high values, red shades = low values.