Policy Research Working Paper 10635

Linking Trade to Jobs, Incomes, and Activities

New Stylized Facts for Low- and Middle-Income Countries

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WORLD BANK GROUP
Macroeconomics, Trade and Investment Global Practice
December 2023

Policy Research Working Paper 10635

Abstract

Trade expansion can create more and better jobs. This paper revisits the linkages between trade and jobs, focusing on employment, labor incomes, and job activities across a large sample of countries and sectors over 1995 to 2018. Instrumental variables regressions and new input-output measures of jobs and activities in exports highlight several patterns: Exports and especially imports of intermediate inputs are associated with more jobs and higher incomes, while final imports show weaker correlations. Manufacturing has the biggest potential for job and income creation both directly and indirectly in supplying sectors. As countries move from specialization in commodities to limited manufacturing to advanced manufacturing and services global value chains, export-employment and export-income elasticities increase. Global value chain–intensive developing countries tend to have larger shares of production activities in exports compared to resource-intensive countries. As countries get richer, nonproduction activities in exports, such as support, engineering, and managerial services, become increasingly important. Finally, the paper explores the role of policy for the export job share across countries.

This paper is a product of the Macroeconomics, Trade and Investment Global Practice. It is part of a larger effort by the World Bank to provide open access to its research and make a contribution to development policy discussions around the world. Policy Research Working Papers are also posted on the Web at http://www.worldbank.org/prwp. The authors may be contacted at dwinkler2@worldbank.org.

Linking Trade to Jobs, Incomes, and Activities: New Stylized Facts for Low- and Middle-Income Countries

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Keywords: Economic development, employment, international trade, global value chains, occupations, sectors

JEL codes: F14, F63, O14

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This paper was developed for the project "Leveraging trade for more and better job opportunities in developing countries" and financed by the Umbrella Facility for Trade Trust Fund. The authors thank Elcin Koten for her research assistance and are thankful for great comments provided by Sébastien Dessus, Mona Haddad, Mary Hallward-Driemeyer, Claire Hollweg, Gladys Lopez-Acevedo, Dino Merotto, Jorge Tudela Pye, Ben Shepherd, and Gaaitzen de Vries, as well as participants of the two authors' workshops in May and November 2022. The work was carried out under the overall supervision of Sébastien Dessus and Antonio Nucifora. The findings, interpretations, and conclusions expressed in this paper are entirely those of the authors. They do not necessarily represent the views of the World Bank Group and its affiliated organizations, its Executive Directors or the governments they represent.

1. Introduction

Economists are largely in agreement that, at least at the aggregate level and over the long term, trade plays an important role in driving economic growth, job creation, and wage growth (Dutt, Mitra and Ranjan 2009; Hollweg et al. 2014; Brown et al. 2016). Recent empirical evidence, however, finds no impact of participation in global value chains (GVCs) on employment in low- and middle-income countries (LMICs) (Pahl and Timmer 2020). Empirical assessments across countries are still scarce, in large part because of the difficulty to establish causality in such models. Another strand of literature highlights the negative effects of import competition from low- and middle-income countries on workers at the local level in developed economies (e.g., Autor, Dorn, and Hanson 2013; Balsvik, Jensen, and Salvanes 2015; Hakobyan and McLaren 2016).

Recent evidence also points out that the gains are unequally distributed and losses more visible. Recent policy research concludes that (i) the gains from trade are unequally distributed across countries, sectors, regions, and workers (Engel et al. 2021), and (ii) the losses are often more concentrated and visible than the gains (Artuç et al. 2019; 2021). Studies, for instance, find that trade liberalization could lead to heightened inequality and deteriorating labor market outcomes (Goldberg and Pavcnik 2007; Nicita 2009; Topalova 2010; De Loecker et al. 2016; Dix-Carneiro and Kovak 2017; Pavcnik 2017; Erten, Leight and Tregenna 2019).[5]

Inconclusive findings can to some extent also be attributed to the different types of trade under study, with the labor market effects from import competition differing from those of GVC participation. While the former type of trade directly competes with domestic production over consumer demand, the latter emphasizes the role of imported inputs for export production. Given that over half of international trade happens within the boundaries of GVCs (World Bank 2020), it is critical to not only focus on exports and imports, but also assess the role of GVC participation for labor market outcomes. In addition, renewed attention has been devoted to assessing the role of technology versus trade as both can create and destroy jobs. In a world characterized by GVCs, the trade and technology nexus is increasingly merged, as producers play off trade, investment, and technology to maximize profits (Farole et al. 2018).

Drawing on novel datasets with a good coverage of developing countries, this paper re-visits the relationship between trade and jobs across countries at the level of sectors and activities. This study re-examines the relationship between trade and jobs both indirectly, i.e., through econometric analysis applying an instrumental variables (IV) approach, and directly relying on new employment, income and input-output data that allow to characterize changing jobs and job specializations in exports. The combination of these methodologies and different datasets not only allows us to address endogeneity concerns, but also to provide new insights into the various trade and labor relationships, in particular (i) how the type of trade shapes within-sector job creation, (ii) how exports create employment directly in the export sector and indirectly in its supplying sectors, and (iii) which job activities embodied in exports are performed across countries, sectors, and occupations.

Importantly, the analysis aims to disentangle some of the complexities characterizing trade-and-jobs relationships, in particular the role of different types of trade, sectors, activities, and labor market

[5] At the firm level, evidence for LMICs is less ambiguous, suggesting a positive association between a firm's trading status (especially GVC participation) and employment. While the positive link between exporting and productivity and to a lesser extent employment has been established at the firm-level in LMICs, recent research suggests that participation in GVCs magnifies the labor gains from traditional one-way trade. Demand for worker skills also tends to be higher among GVC participating firms relative to non-GVC firms because of higher global quality standards imposed by lead firms in GVCs (World Economic Forum 2015; Criscuolo and Timmis 2017). As a result, GVC-participating firms are on average more productive, larger and more skill-intensive than other types of firms, including firms that export or import only. These gains from trade at the firm level do not necessarily materialize at the aggregate level of sectors and places, if GVC or one-way trading firms pull away workers from domestic only firms.

channels. The findings show that the employment effects vary strongly depending on the type of trade considered (exports, intermediate imports, final imports, GVC participation). Assessing the relationship for employment and labor value added separately, the analysis finds the income channel to be stronger than the employment channel. The trade-and-labor links also critically depend on the sector under study, with manufacturing sectors showing the highest job and income growth associated with expanding exports in a sector. Not surprisingly, the way in which countries engage in GVCs matters for the magnitude of export-employment elasticities. But a country's sectoral specialization also matters for the indirect job creation potential in supplying sectors. Finally, this study sheds light on the types of job activities embodied in exports. From a GVC perspective, tracking job activities that countries specialize in for their export production over time allows to detect upgrading patterns and allows to study aspects of job quality.

This paper contributes to the literature in a number of ways. First, this study provides new descriptive analysis drawing on recent employment-in-exports data covering over 50 high- and middle-income countries (HMICs). A major strength of these employment estimates is that they account for indirect linkages of an export sector to domestic supplying sectors. Increases in exports can lead to domestic job creation not only within the export sector, but also in domestic supplying sectors, allowing for a more accurate representation of the trade and labor links. As our analysis shows, the indirect job creation from manufacturing exports is higher than the direct job creation in these sectors, while for business and especially other services exports the bulk of employment is created directly in these services sectors. Some studies have used direct measures of employment in exports or GVCs, but they focus on measurement aspects and do not cover more recent years (Calì et al. 2016, Horvát, Webb and Yamano 2020) or a narrow set of countries (Timmer et al. 2014).

Second, while trade research focused on skills intensity, labor productivity or average wage rate to capture jobs quality, this paper introduces a novel characterization of job specializations in exports, namely of activities, ranging from managerial, to engineering, to production, to other services activities (Kruse, Timmer, de Vries, and Ye 2023). Such measures reflect the composition of activities in exports, and changes over time, across countries, income levels, sectors, occupations, and for specific country-sector combinations. In the context of GVCs, emphasizing activities that countries specialize in for their export production – rather than the goods and services they export – is meaningful from a measurement and conceptual perspective: (i) the latter could embody a large share of foreign value added from activities performed abroad, and (ii) the concept of a value chain involves a range of value-adding activities. It is also warranted from a development perspective. Case study evidence suggests that moving towards non-production activities offers scope for economic upgrading, both across and within sectors. Adding the occupational dimension to sectoral specialization patterns helps track development trajectories.

Third, conventional methods of assessing trade and labor links econometrically within sectors across countries remain valuable for at least four reasons. (1) First, direct employment in exports measures (e.g., from OECD) are not available for many developing countries, especially those at lower-income levels, while data coverage of trade and employment is better. (2) Second, direct measures focus on jobs embodied in exports only, while econometric analysis allows to link employment to other types of trade, including imports and GVC participation, for which correlates could vary. (3) Third, regression analysis also allows to estimate trade-income elasticities besides trade-employment elasticities to understand which of these two channels is stronger.[6] If trade-income elasticities are larger than trade-employment elasticities, this implies that increases in trade benefit workers more strongly through higher average wage rates rather than through more employment.[7] (4) Finally, comparing elasticities based on formal

[6] This is because labor income or labor value added (LVA) is the product of employment L and the average wage rate w (LVA=L*w).
[7] While the direct measures also allow to assess the income content of exports, a comparison with the employment content of exports is more difficult.

employment with those based on informal employment allows to tentatively assess the role of the informal labor market.

Finally, this study contributes to the econometric literature on the labor market effects of GVC participation at the country-sector level. The majority of earlier sectoral studies focused on the effect of outsourcing, based on national input-output linkages, on the relative demand for workers or total labor demand in one specific country (see, e.g., the seminal study by Feenstra and Hanson 1996), whereas our analysis covers LMICs and also uses GVC measures based on international input-output linkages.[8] This study also relates to the literature on measuring social upgrading through GVC participation, especially with regards to job creation. More research has been dedicated to studying the economic rather than the social impacts of trade and GVC participation. Empirical evidence across and within countries confirms that GVC participation fosters productivity, value-added, and growth (Constantinescu, Mattoo, and Ruta 2019; World Bank 2019; Stolzenburg, Taglioni, and Winkler 2019; Pahl and Timmer 2020). Research suggests, however, that social upgrading does not necessarily follow economic upgrading (Milberg and Winkler 2013; Kruse 2023), for instance due to high labor market adjustment costs (Hollweg et al. 2014).

In section 2, we apply econometric analysis to estimate trade-employment and trade-income elasticities within sectors across countries. Labor demand models can be derived from a variable unit cost function[9] and have been applied widely in the literature at the country-sector-year level (see Appendix 1). The analysis is based on two different data samples: a sample of 48 HMICs covering mainly formal employment and a sample of 37 LMICs capturing both formal and informal employment (for details, see Appendix 2). In addition, the dataset of HMICs enables us to estimate both trade-employment and trade-income elasticities and therefore examine which of these channels is stronger.[10]

We hypothesize that sectoral differences as well as countries' type of engagements in trade and GVCs could explain differences in labor markets outcomes. For instance, recent work found the export-to-employment elasticities for business services to be larger than for manufacturing in a sample of 43 mostly high-income countries using the WIOD database (Goretti et al. 2019). We run the model by broad sector (agriculture, manufacturing, business services, other services) and also at the disaggregated industry level to identify possible differences across sectors. We also assess the role of a country's type of GVC specialization and categorize countries into four basic GVC groups (World Bank 2020), differentiating between countries specialized in (1) commodities, (2) limited manufacturing GVCs, (3) advanced manufacturing and services, and (4) innovative tasks (for details, see Appendix 3).

Sections 3 and 4 use direct measures of employment and job activities in exports. We rely on the OECD Trade in Employment database for estimates of employment in exports for 45 goods and services sectors (based on ISIC Rev. 4 sectors) for over 50 countries for the period 1995-2018. (Appendix 4 describes the underlying computations in more detail). The novel database Job Activities in Exports adds the dimension of occupations and is thus able to provide estimates of jobs in exports for sector-occupation combinations which define the so-called activities in exports (Appendix 5 describes the underlying computations for job activities in exports).

Our paper is structured as follows. Section 2 estimates correlations between various types of trade and employment or labor income within sectors. Section 3 studies the role of job creation in supplying sectors versus export sectors, while section 4 examines job activities in exports across and within sectors. Section 5 explores the role of policy in job creation from exports, while section 6 summarizes and concludes.

[8] The research by Farole et al. (2018) studied the role of GVC participation for the labor value added, the labor share and the relative demand for skills in a cross-country-sector model for selected years between 2001 and 2014. Our proposed work differs with regards to the chosen models, methodologies, datasets and labor market outcomes.

[9] See Brown and Christensen (1981) and an application in Feenstra and Hanson (1996), among many others.

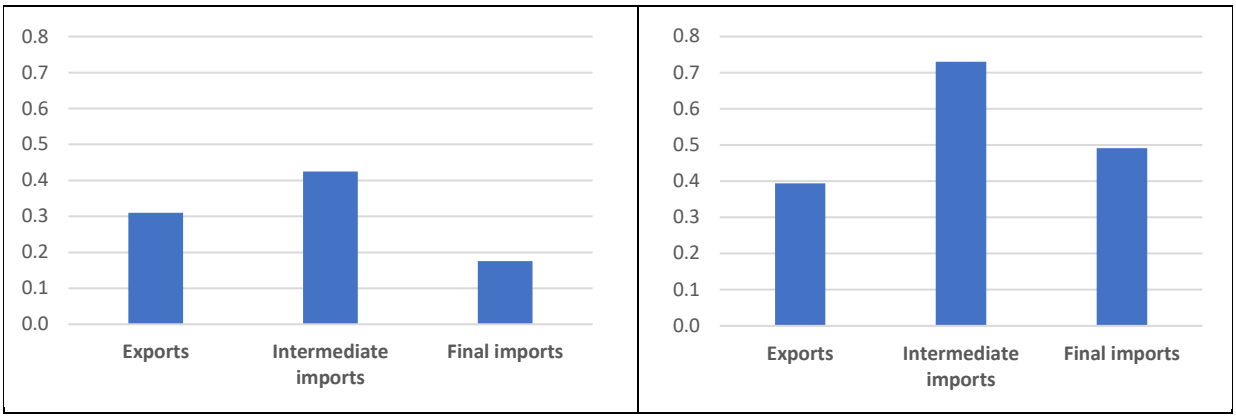
[10] The sample of LMICs only contains employment data and thus prevents us from performing a similar assessment.

2. Estimating trade and employment elasticities within sectors

2.1 Do trade-employment elasticities differ for exports and imports?

Analysis for a sample of 48 OECD and non-OECD countries covering 45 sectors for the period 1995-2018 finds that export-employment elasticities within sectors are positive.[11] Specifically, a 10 percent increase in exports is associated with a 3.1 percent increase in employment (Figure 1, left panel).[12] On the downside, the potential for exports to contribute to job growth within sectors in the country sample was driven by the period before the global financial crisis (i.e., 1995-2006), while estimates for the more recent period (i.e., 2007-2018) are either insignificant or the chosen instruments for the trade variable not valid.[13] A possible explanation may be a growing capital intensity of export production, including the use of labor-substituting technologies, during the more recent period (Hallward-Driemeier and Nayyar 2017).

Figure 1: Trade-employment (left) and trade-income elasticities (right), by type of trade



Source: Own computations. Data: OECD TiE and TiVA data, covering 48 countries (see Appendix 2) and 45 sectors for the period 1995-2018. Note: Trade-employment (trade-income, resp.) elasticities at the country-sector level have been estimated using employment (labor income, resp.) (in natural logs) as dependent variable and the instrumented trade variables (in levels and natural logs) as independent variable. For more information on the instruments, see Appendix 1. The panel data regressions control for country-sector, country-time, and sector-time fixed effects. Only results significant at the 10% level and above the critical value for the Kleibergen-Paap test statistic are reported.

The average intermediate import-employment elasticity is 0.42 percent, while final imports show an elasticity of 0.18 percent – less than half that size (Figure 1, left panel). Intermediate goods and services can be used in domestic production destined either for final consumption or exports and in both cases support job growth. The lower correlation between final imports of goods and services and employment in a sector implies that they also compete with domestic production and therefore employment.

Comparing trade-employment with trade-income elasticities suggests that the income channel is stronger, especially for imports. A 10 percent increase in exports is associated with a 3.9 percent increase in labor incomes over the full period 1995-2018. This implies that while exports have the potential to expand the number of jobs within a sector, they raise incomes more strongly. One explanation could be the productivity gains associated with exports which increase the average wage rate and thus total labor value added. More strikingly, a 10 percent increase in intermediate imports is on average correlated with

[11] We use the Kleibergen-Paap test statistic and reject the hypothesis of weak instruments if the test statistic exceeds 10, following the rule of thumb by Staiger and Stock (1997).

[12] Importantly, this only takes into account direct employment effects within sectors but does not consider indirect effects through job creation in supplying sectors, implying even larger employment potential of exports through supply-chain linkages.

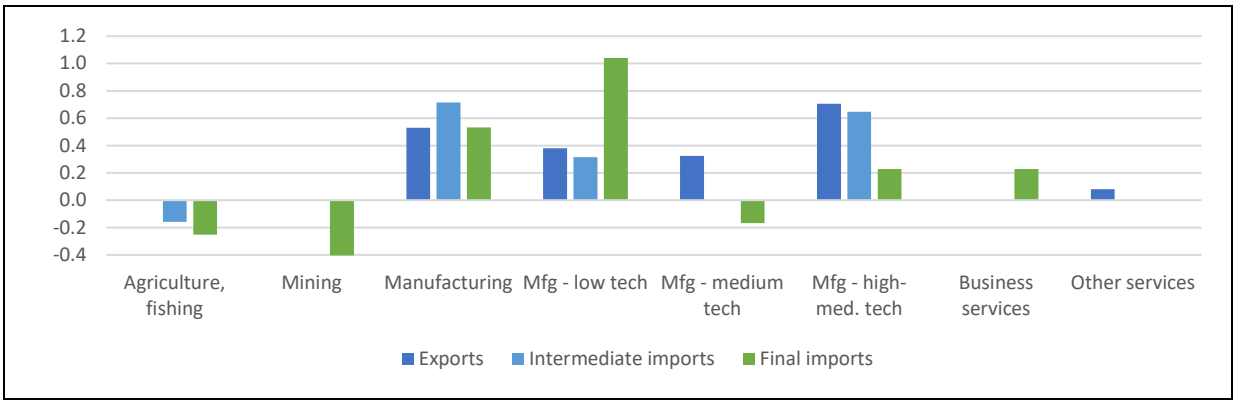
[13] The results of this extended analysis are available upon request.

a 7.3 percent higher labor income, while the gain for final imports is 4.9 percent. Additional analysis by region and country is shown in Appendix Figures 9.1 to 9.3.

2.2 Which sectors are associated with the highest job and income increases?

Manufacturing sectors show the highest job and income growth associated with expanding exports in a sector, in particular those with high-medium technology intensity. Focusing on broad sectors reveals that export-employment elasticities are driven by manufacturing. A 10 percent growth in manufacturing exports is related to a 5.3 percent job growth (Figure 2). The potential for job creation through exports is particularly high in high-medium technology intensity manufacturing, including in motor vehicles, electrical equipment and computer and electronics (Figure 3, upper panel). This is despite the higher capital intensity of high-tech sectors, implying that capital and labor in these sectors are complementary.[14] Similarly, intermediate import growth in high-medium tech manufacturing sectors is related with high job growth which, to a large extent, is also used for export production (Figure 2).

Figure 2: Trade-employment elasticities, by broad sector



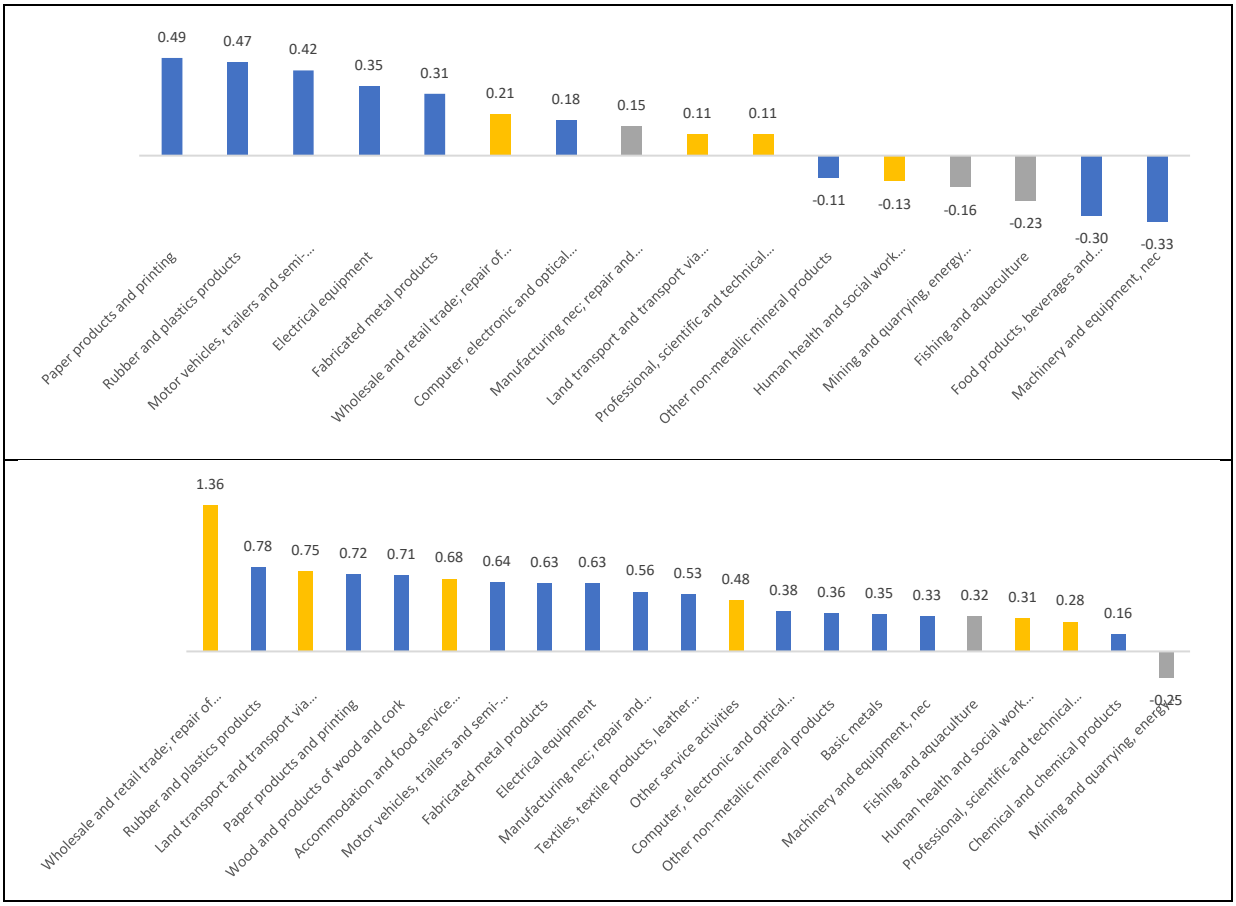
Source: Own computations. Data: OECD TiE and TiVA data, covering 48 countries (see Appendix 2) and 45 sectors for the period 1995-2018. Note: Trade-employment (trade-income, resp.) elasticities at the country-sector level have been estimated using employment (in natural logs) as dependent variable and the instrumented trade variables (in levels and natural logs) as independent variable. For more information on the instruments, see Appendix 1. The panel data regressions control for country-sector, country-time, and sector-time fixed effects. Only results significant at the 10% level and above the critical value for the Kleibergen-Paap test statistic are reported.

While some low- and medium-tech manufacturing sectors create many jobs when exports rise, capital-intensive sectors show workforce contractions. Some low- and medium-tech manufacturing sectors, in particular exports of paper products as well as rubber and plastics, create many jobs. Surprisingly, we do not find a positive link with employment in the textiles and apparel sector, but only with labor incomes (Figure 3). Possible explanations include the strong reduction of apparel jobs in China, India and other emerging countries (as discussed further in section 3). Other sectors have negative export-employment elasticities, most notably machinery, food and beverages, fishing and aquaculture and mining which tend to be capital-intensive, explaining the decline in the number of jobs. This finding could also be partially explained by the country sample excluding low-income countries for which exports in sectors like fishing or small-scale and artisanal mining create job opportunities.[15]

[14] Evidence for Greece during the second half of the 1990s found that high technology and capital-intensive manufacturing sectors contributed most strongly to net employment growth (Voulgaris, Papadogonas, Agiomirgianakis 2005).

[15] Globally, around 40 million people are estimated to work in small-scale mining (https://www.reuters.com/article/us-mining-asm/more-than-40-million-people-work-in-artisanal-mining-report-idUSKCN1S025C), while almost 60 million people work in fisheries and aquaculture (https://www.fao.org/3/cc0461en/online/sofia/2022/fisheries-aquaculture-employment.html).

Figure 3: Export-employment (upper) and export-income elasticities (lower panel), by disaggregated sector



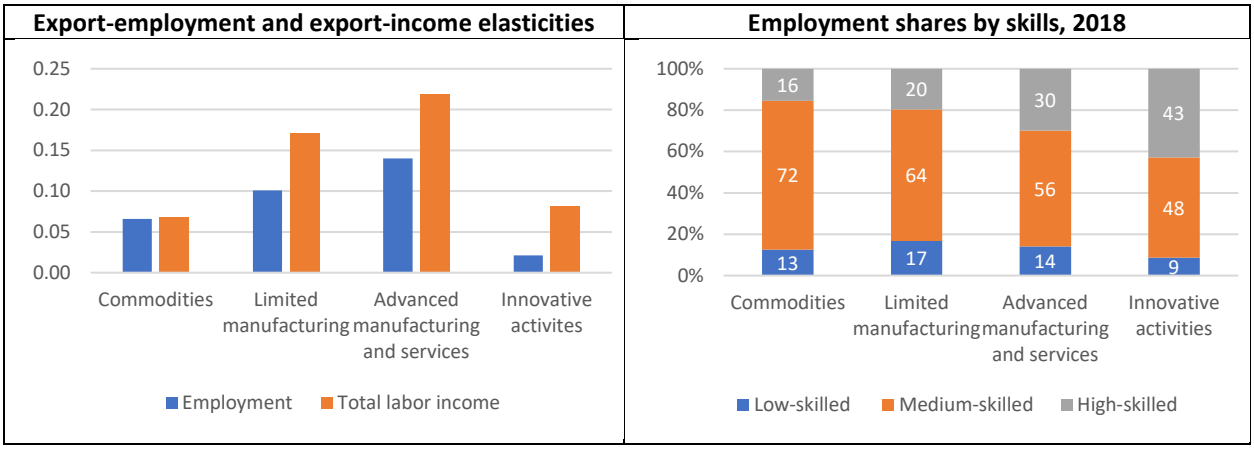
Source: Own computations. Data: OECD TiE and TiVA data, covering 48 countries (see Appendix 2) and 45 sectors for the period 1995-2018. Note: Trade-employment (trade-income, resp.) elasticities at the country-sector level have been estimated using employment (labor income, resp.) (in natural logs) as dependent variable and the instrumented trade variables (in levels and natural logs) as independent variable. For more information on the instruments, see Appendix 1. The panel data regressions controls for country and sector fixed effects. Only results significant at the 10% level and above the critical value for the Kleibergen-Paap test statistic are reported.

In sharp contrast to manufacturing, aggregate business services exports show no significant association with within-sector employment creation, while their potential to generate labor income is much higher. Across the sample of 45 disaggregated sectors, only wholesale and retail trade, land transport, and professional services exports are positively associated with employment growth in these sectors over the period 1995-2018. But the link with labor incomes is even stronger in these business services sectors, in the case of trade and transport more than six times higher. Exports of health services, on the other hand, can reduce employment within the sector, if medical services providers such as doctors or nurses temporarily move to another country to export services. In addition, health services can also be offered to foreign consumers within a country, known as medical tourism. It is therefore not surprising that health exports create higher labor income, as the relative supply of labor in the sector declines with export expansion, while the relative demand for health providers increases which is exacerbated in the case of medical tourism. Interestingly, accommodation and restaurant exports which are associated with tourism do not increase the number of jobs in the sector but raise labor incomes.

2.3 How do GVCs shape the trade-jobs nexus?

A country's type of GVC engagement matters for employment growth through exports. The World Bank (2020) proposed a GVC taxonomy that differentiates between four types of GVC participation: (1) commodities; (2) limited manufacturing; (3) advanced manufacturing and services; and (4) innovative activities. The classification is based on the extent of backward GVC participation of the manufacturing sector, the types of goods and services exported, and measures of innovation (see Appendix 3). Our analysis finds that the way in which countries engage in GVCs seems to matter for the magnitude of export-employment elasticities in the sample of 48 OECD and non-OECD countries (Figure 4). The link between exports and employment for countries participating in commodities (0.06 percent) and innovative tasks (0.02 percent) is less than half the magnitude of countries at the advanced manufacturing and services stage (0.14 percent). A similar and even stronger relationship is found for labor incomes.

Figure 4: Export-employment, export-income elasticities and skills supply, by taxonomy group

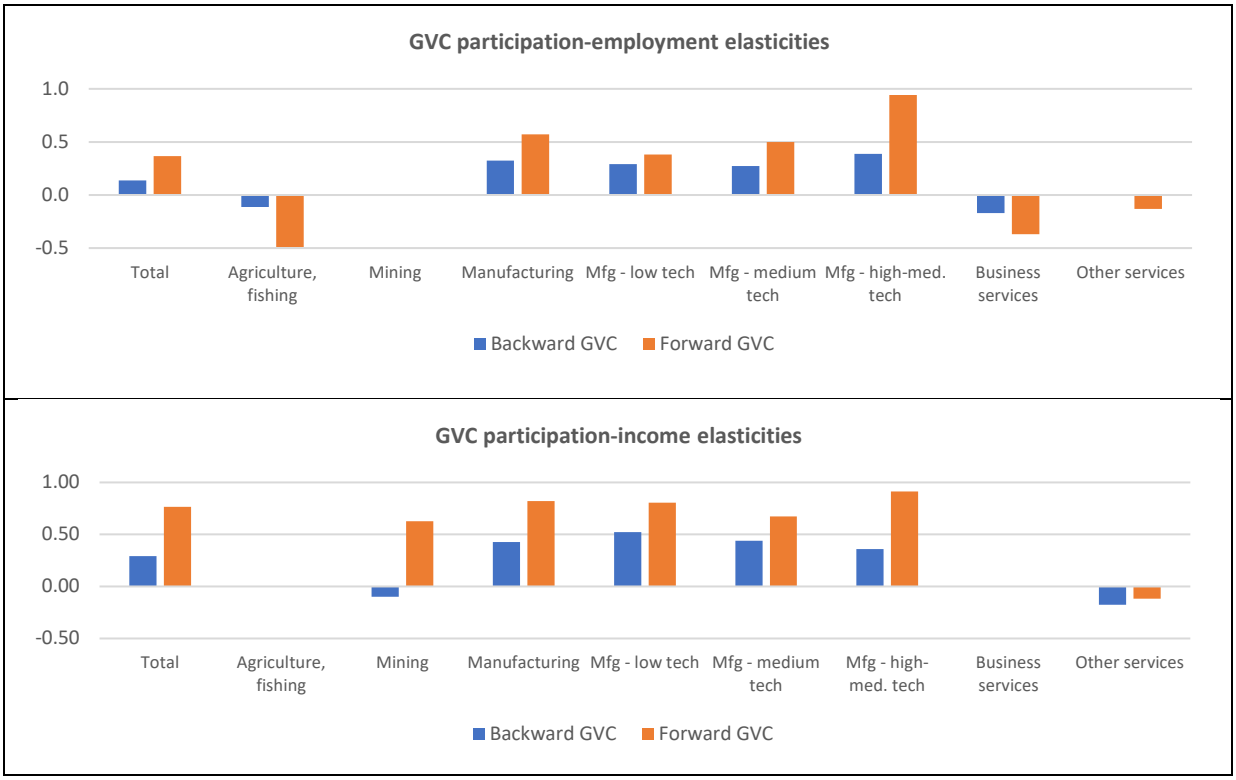


Source: Own computations. Data: OECD TiE and TiVA data, covering 48 countries (see Appendix 2) and 45 sectors for the period 1995-2018. Note: Export-employment (export-income, resp.) elasticities at the country-sector level have been estimated using employment (in natural logs) as dependent variable and the instrumented trade variables (in levels and natural logs) as independent variable. For more information on the instruments, see Appendix 1. The panel data regressions control for country-sector, country-time, and sector-time fixed effects. Only results significant at the 10% level and above the critical value for the Kleibergen-Paap test statistic are reported. GVC taxonomy group by World Bank (2020). Skills (right panel) are determined by ILO statistics depending on their skill levels with high-skilled referring to levels 3 and 4, medium-skilled to level 2 and low-skilled to level 1. See https://ilostat.ilo.org/resources/concepts-and-definitions/classification-occupation/.

Several explanations can be offered for the skewed inverted U-shape of elasticities along the GVC taxonomy groups. Once countries upgrade from exporting mainly commodities (notably agricultural staples) to participation in limited manufacturing GVCs, this boosts export-induced demand for jobs in the manufacturing sector, as workers move out of informal (subsistence farming) into low-wage manufacturing jobs in apparel, electronics and other labor-intensive sectors. Higher exports of countries specializing in advanced manufacturing and services GVCs are linked to the highest employment growth within sectors due to additional demand for jobs alongside low-tech manufacturing jobs, especially in medium-tech manufacturing but also business services (such as trading and transport). Countries specializing in innovative GVC tasks, however, see their elasticities decline. Possible factors for the lower potential of exports to create jobs in these countries include the higher capital intensity of high-tech manufacturing production sectors, increased automation of routine tasks replacing certain types of workers, and offshoring of low-skill intensive tasks to low-cost countries. The composition of labor supply by skill-intensity of occupations for the different country types confirms the described pattern, showing a notable expansion of high-skilled occupations along taxonomy groups (right panel).

Focusing on the type of GVC participation across HMICs (regardless of their specialization in GVCs) suggests a stronger employment and income boost from forward GVC participation. Expanding imports of intermediates used for export production (i.e., backward GVC participation) is positively related to employment and income growth in a sector (Figure 5). A higher share of domestic value added used in third countries' exports (i.e., forward GVC participation) has stronger benefits which seems surprising, given the low elasticities for commodity exporters that are characterized by high forward GVC participation (Figure 4). The lack of low-income countries in the country sample may explain the large positive elasticity of forward GVC participation, as intermediate exports used for further export production in other countries contain higher value-added inputs such as research or design services, as opposed to raw commodities. This confirms earlier results by Stolzenburg et al. (2019) suggesting a stronger correlation between forward GVC participation and value added within sectors in HMICs. The findings confirm the larger strength of the income channel relative to the employment channel.

Figure 5: GVC participation-employment and GVC participation-income elasticities, by sectors, 1995-2018



Source: Own computations. Data: OECD TiE and TiVA data, covering 48 countries (see Appendix 2) and 45 sectors for the period 1995-2018. Note: GVC participation-employment (GVC participation-income, resp.) elasticities at the country-sector level have been estimated using an instrumental variables regression approach with employment (in natural logs) as dependent variable and the instrumented trade variables (in levels and natural logs) as independent variable. The panel data regressions control for country-sector, country-time, and sector-time fixed effects. Only results significant at the 10% level and above the critical value for the Kleibergen-Paap test statistic are reported. For more information, see appendix 1.

A closer look at broad sectors suggests that the employment and income benefits from GVC participation are driven by manufacturing. Manufacturing job growth linked to export growth is higher when those exports are re-exported by a country's trade partners (i.e., forward GVC participation) as opposed to job growth linked to growth of imported inputs in exports (i.e., backward GVC participation), as evidenced by the higher trade-employment elasticities for the former type of trade engagement (0.57 percent vs. 0.32 percent in Figure 5, top panel). The difference is most striking in the high-tech manufacturing sector which includes electronics, machinery, transport equipment and chemicals. In

medium- and low-tech manufacturing sectors, the labor market gains through the income channel appear to be stronger (bottom panel). Higher forward GVC participation in mining also shows a strongly positive association with labor incomes (but not employment). Both forward and backward GVC participation show a negative correlation with employment (but not labor incomes) for agriculture/fishing and business services. Increases in agricultural or business services exports in MICs possibly go hand in hand with labor-saving skill-intensive machinery and technology, thus reducing the demand for workers.[16] Additional analysis by region is shown in Appendix Figure 9.4.

2.4 How are trade-job linkages characterized in lower-income countries?

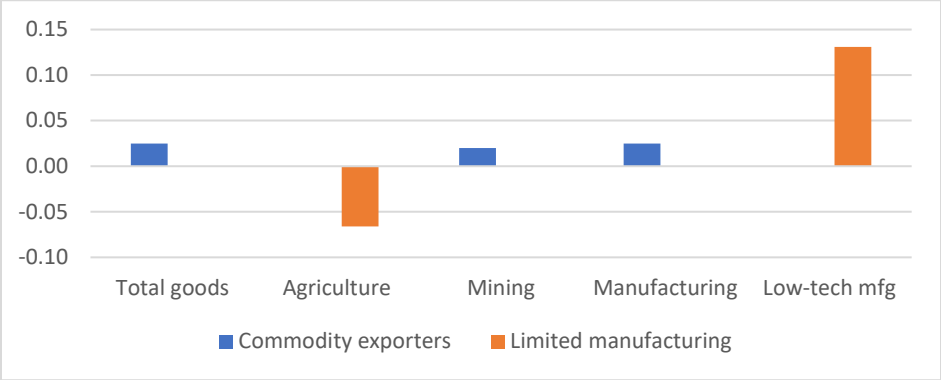
In LMICs, manufacturing exports – especially of low-tech manufactured goods – are associated with larger employment increases than exports within agriculture or mining. This section focuses on the sample of 37 LMICs in EAP, SA, LAC, MENA and SA from the ETD database, differentiating between commodity exporters and countries specialized in limited manufacturing (see Appendix 2). For commodity exporters, total goods exports show a positive association with within-sector employment, although it is very small (coefficient of 0.03 percent). The link is insignificant in agriculture which is land-intensive, but positive in both mining and manufacturing, with a slightly larger coefficient for the latter (Figure 6). For countries specialized in limited manufacturing, exports show a negative relationship with employment in agriculture, possibly driven by more intensive use of agricultural machinery in such countries complementing the increase in land use. By contrast, there is a positive and larger export-employment link in low-tech manufacturing.

However, the link between low-tech manufactured exports in lower-income countries and job creation is substantially smaller than for the full sample of HMICs, possibly driven by the stronger role of informality. A 10 percent increase in exports of low-tech manufactured goods in LMICs specialized in limited manufacturing is associated with a 1.3 percent rise in employment – both formal and informal – within sectors (Figure 6). Compared with the sample of HMICs (Figure 2), the elasticity is only about one-third their magnitude. This can be explained by the fact that informal workers account for a large portion of employment in lower-income countries due to the lack of unemployment benefits. Export expansion thus leads to substitution effects, where workers move from informal to formal employment (including within sectors) resulting in lower net gains for overall employment numbers. As shown in Appendix Figure 9.5, export growth of goods and services over the period 1991-2019 is indeed positively correlated with increases in the share of paid (wage and salaried workers) in total employment across a large set of countries.[17]

[16] Examples for labor-saving technology in agricultural production include tomato harvesters, shake-and-catch systems to harvest tree nuts, and wine grape harvesting machines. In Asia and Africa, agricultural production also increasingly relies on outsourced services providers of agricultural machines such as tractors (Christiaensen, Rutledge, and Taylor 2020). A similar argument could be made for business services exports which increasingly depend on information technology (e.g., travel services exports now rely less on travel agents).

[17] Studies assessing local labor market effects of exports for South Asia and Mexico do not find any effect on the average employment rate, but confirm a reduction in informality (e.g., Artuc et al. 2019, Robertson et al. 2020, Vazquez and Winkler 2023). Second, a large number of manufacturing jobs in SSA have been created in the informal sector. A study by Kruse, Mensah, Sen, and de Vries (2023) based on the same ETD dataset suggests that these SSA countries experienced a 'renaissance' of their manufacturing employment share between 2000 and 2018, driven by unregistered firms that likely serve domestic or regional demand. On the other hand, Diao, Ellis, McMillan, and Rodrik (2021) find that large manufacturing firms in SSA are productive and participate in GVCs, but do not expand employment. The large role of informal activity in creating jobs may be rooted in differences in the enabling environment, a bias against low-wage workers in GVCs, or a combination thereof. A recent study suggests that while GVC participation and manufacturing output shares are positively associated in a large sample of 91 countries, this is driven by HMICs and is insignificant for many low-income countries many of which being commodity exporters. The study

Figure 6: Goods export-employment elasticities in lower-income countries, by type of GVC specialization



Source: Own computations. Data: ETD and Comtrade data, covering 37 countries (see Appendix 2) and 35 sectors for the period 1995-2018. Note: Export-employment elasticities at the country-sector level have been estimated using employment (in natural logs) as dependent variable and the instrumented trade variables (in levels and natural logs) as independent variable. For more information on the instruments, see Appendix 1. The panel data regressions control for country-sector, country-time, and sector-time fixed effects. Only results significant at the 10% level and above the critical value for the Kleibergen-Paap test statistic are reported. GVC taxonomy group by World Bank (2020).

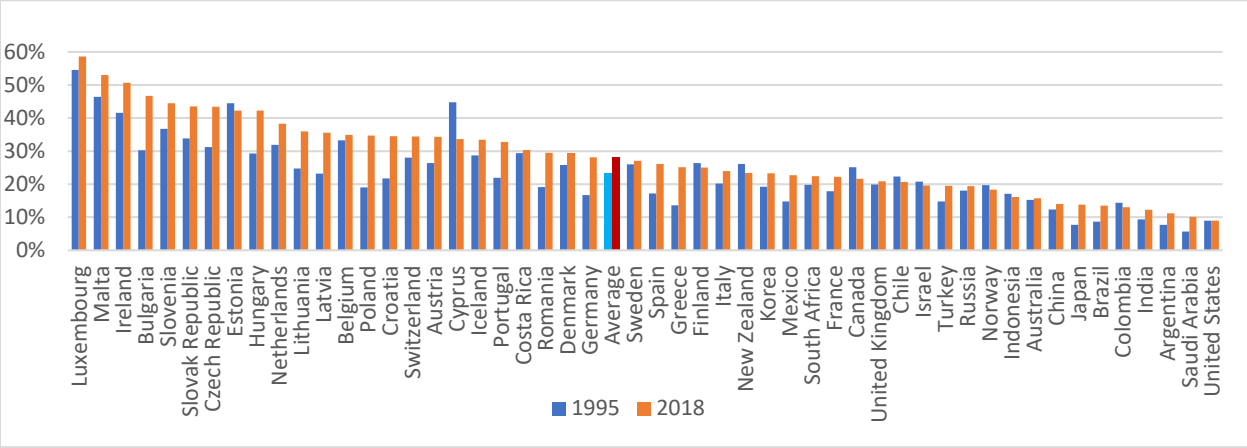
3. Measuring jobs in exports: The role of supplying sectors

3.1 Do jobs in exports grow more strongly than other jobs?

Countries' share of employment in exports in total employment varies considerably and is larger in small economies, but smaller in commodity-exporting countries. Analysis based on the OECD TiE database finds that smaller economies tend to show higher shares of employment in exports in their total employment, because their smaller market size dictates more openness to trade in the first place (Figure 7). The share of employment that is dependent on exports, including employment in supplying sectors, was 50 percent or higher in Ireland, Malta and Luxembourg in 2018, contrasting sharply with the United States where the share was less than 9 percent. However, commodity-exporting countries, even smaller ones, show a smaller dependence on employment in exports. Employment shares in exports range only between 10 and 15 percent in Saudi Arabia, Argentina, Colombia, Brazil and Australia. These low shares imply that exports of extractives in high- and middle-income countries are less labor-intensive, which is further aggravated by the "Dutch disease" reducing the competitiveness of non-commodity sectors or other constraints to diversifying the economy. The case of Argentina illustrates how closely the employment share supported by exports correlates with a country's endowments of natural resources (Figure 8, left panel).

also highlights the role of rigid labor markets, low levels of human capital, underdeveloped capital markets, or an ineffective policy environment as possible factors (Kruse 2023).

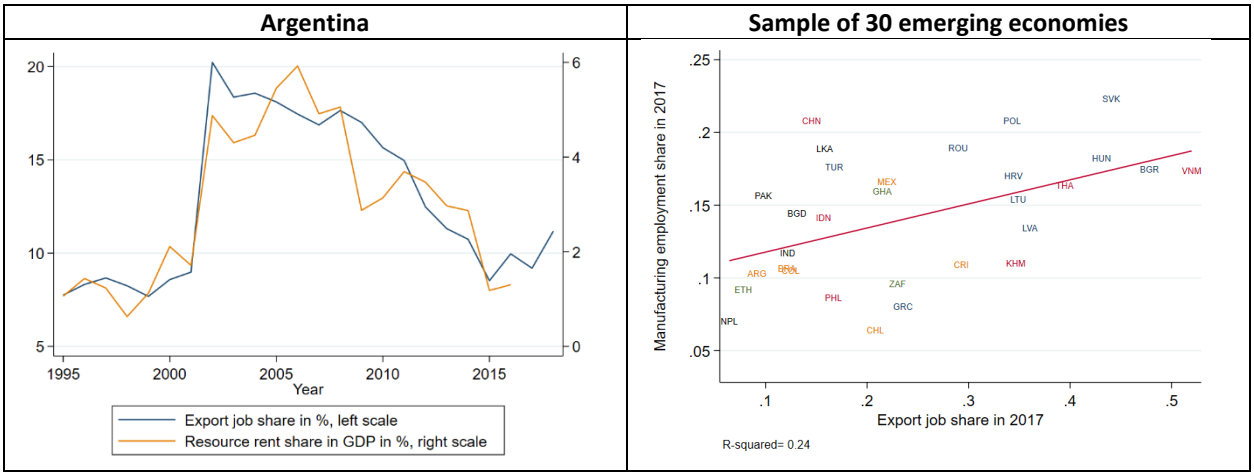
Figure 7: Employment in exports (% of total employment), 2018 vs. 1995



Source: Own computations. Data: OECD TiE. The country sample covers 38 OECD countries plus 13 non-OECD countries. Note: The measures draw on OECD Inter-Country Input-Output tables combined with recent estimates of employment by industrial activity from official sources. For more details, see Horvát, Webb and Yamano (2020).

These ranges highlight that the role of trade for employment can be substantial when accounting for linkages to supplying sectors and confirm the importance of the country context. The measures of employment in exports account not only for the direct job contribution within the export sector, but also consider indirect links to supplying sectors and their job contribution. For instance, coffee exports create jobs not only in the food and beverages sector (i.e., coffee processing), but importantly also in agriculture (i.e., farming). Employment gains from trade within sectors can be significantly higher in some sectors when job dependencies in supplying sectors to the export sector are accounted for.

Figure 8: Share of employment in exports, specialization in natural resources versus manufacturing

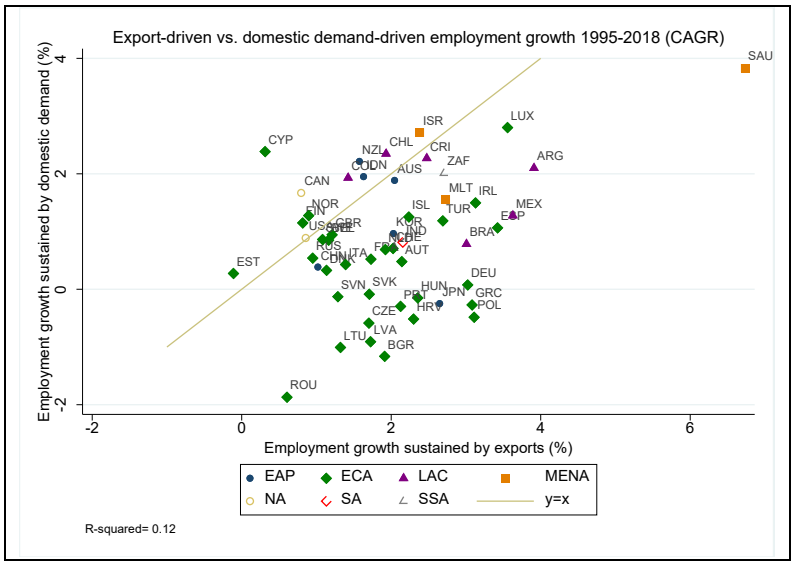


Source: WB staff calculations. Data: WDI, OECD TiE and Job Activities in exports database. Note: For the purpose of assessing the role of endowments and policy, the country sample on the right includes emerging countries from both datasets.

Export-linked employment shares expanded in most countries between 1995 and 2018 except for commodity-exporting countries, implying that jobs in exports grew faster than other jobs. Most countries experienced an increase over the period, growing on average from 23 to 28 percent over 1995-2018. Increases were high across all Eastern European countries, and to a lesser extent also in some Western European countries (e.g., Greece, Spain and Germany). These countries have a relatively developed

manufacturing sector which is associated with a higher share of jobs in exports (Figure 8, right panel). In Poland, for instance, shares increased from 19 to over 34 percent; in other words, over a third of the workforce is now supported by Poland's exports. By contrast, the share of employment in exports stagnated in Cyprus and across many commodity-exporting countries, including in Canada, New Zealand, Chile, Colombia, Norway, and Indonesia. The latter is driven by declines after the commodity boom of the 2000s. Overall, employment growth in exports exceeded employment growth sustained by domestic demand between 1995 and 2018 (Figure 9).

Figure 9: Export-driven vs. domestic demand-driven employment growth, 1995-2018 (CAGR)

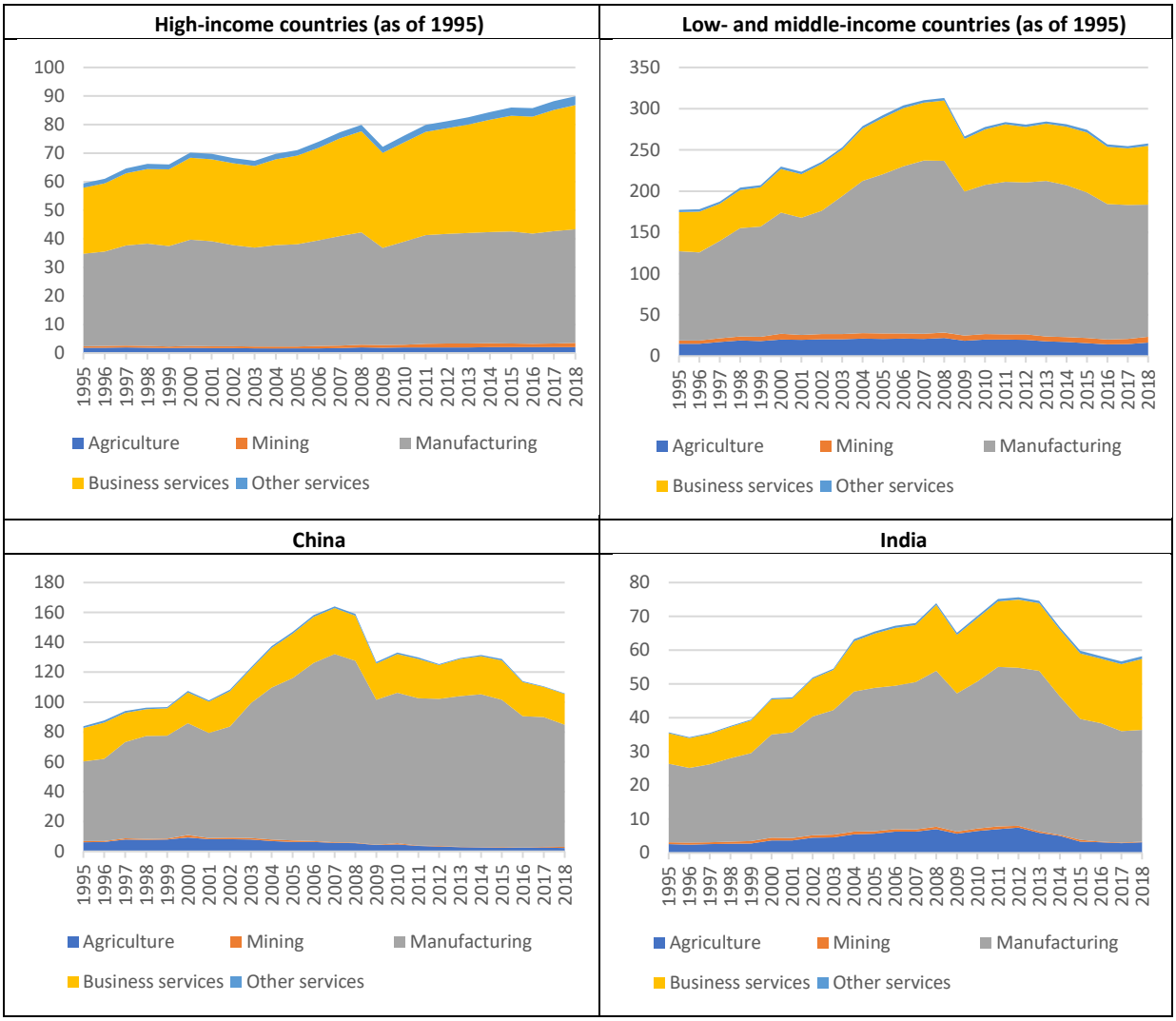


Source: Winkler, Aguilar-Luna, Kruse and Maliszewska (2023). Data: OECD TiE data, covering 51 countries and 45 sectors for the period 1995-2018. The country sample covers 38 OECD countries plus 13 non-OECD countries. The red line indicates employment growth in exports equals employment growth sustained by domestic demand.

3.2 In which countries and sectors are jobs in exports created?

Until the global financial crisis the number of jobs in exports increased strongly in emerging markets, dominated by jobs linked to manufacturing exports, but have started to decline since. Figure 10 plots the development of employment in exports for the sample of 51 countries by broad sector over the period 1995-2018, differentiating between high-income (top left panel) and LMICs (right panel) using the 1995 income categorization (see Appendix 8). In the sample of emerging countries, the number of jobs in exports increased from 177 million to 310 million between 1995 and 2007. This compares with total employment expanding from 1,343 million to 1,642 million over the same period in these countries. China and India alone added over 80 million and 30 million jobs in exports, respectively (bottom left and right panels). The number of jobs in manufacturing exports almost doubled from 107 million to 210 million over this period, representing an increase from 60 to 67 percent of the total, and driven in large part by China and India. However, jobs in exports dropped strongly in 2009 and continued to decline hovering around 255 million jobs between 2016 and 2018. Jobs linked to agriculture and mining exports combined now represent 9 percent of the total in emerging markets, while employment sustained by business services exports makes up over 27 percent. Here, China and India differ strongly, with India's share of jobs in business services exports representing 36 percent in 2018, while China's share makes up less than 20 percent.

Figure 10: Employment in exports (million), by broad sector and income category, 1995-2018



Source: Own computations. Data: OECD TiE data, covering 51 countries and 45 sectors for the period 1995-2018. Income categories as of 1995 are used to classify countries into high- and low- and middle-income countries (see Appendix 8).

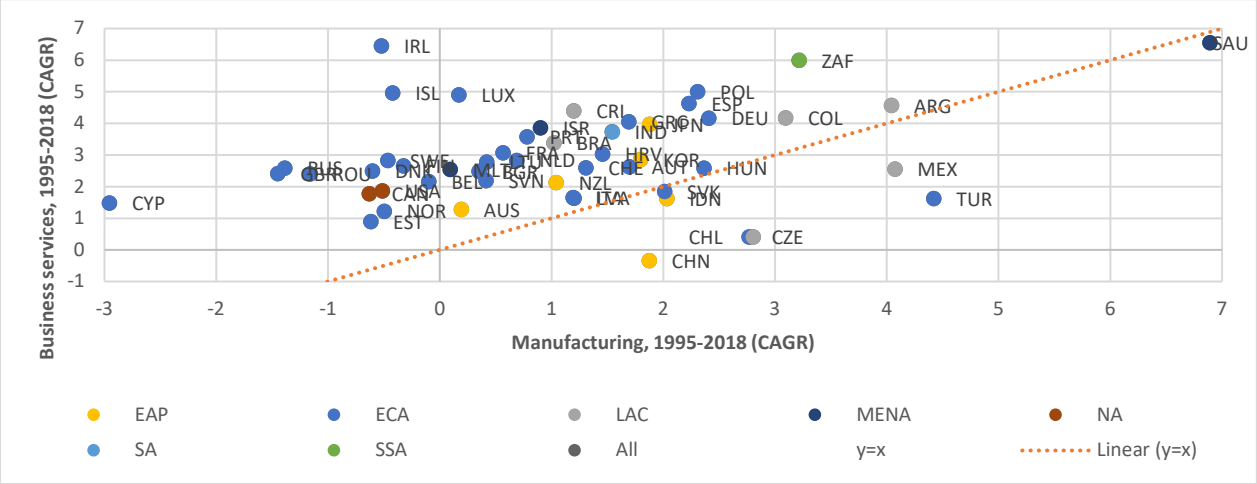
Several underlying factors could explain the decline of export-linked employment in emerging markets over the past decades. While country experiences differ and the data sample does not cover all LMICs, the trend of declining jobs in exports has been linked to increased technology-intensity of production especially within GVCs because new technologies are related to higher-quality standards and high-skilled labor, raising the barriers for low-skilled labor in LMICs to participate in GVCs (Rodrik 2018). As part of their own upgrading efforts, some countries have started to outsource labor-intensive production themselves, most notably China, to lower-cost locations within the region, also increasing intra-regional trade. In fact, the number of jobs sustained by manufacturing exports in China plummeted after the global financial crisis, plateaued at the new lower level until 2015 and declined further (Figure 10, bottom left panel). The emergence of new low-wage countries on the global trade landscape, not included in the dataset, such as Vietnam has further helped this development.

By contrast, the number of jobs in exports increased steadily in high-income countries, driven by business services exports, showing only a brief dip after the global financial crisis. The number of jobs in

exports in our sample of high-income countries (as per their 1995 income category) grew from almost 60 million to around 90 million over the period 1995-2018 (Figure 10, upper left panel). Looking at the composition of employment in exports by broad sector highlights the importance of manufacturing and business services. However, while the share of manufacturing in total employment in exports of high-income countries contracted from roughly 55 to 44 percent over this period, the percentage of business services expanded from 39 to 48 percent. By contrast, other services, mining and agriculture only made up 6 to 7 percent of jobs in exports throughout the period.

Country experiences varied, with jobs in manufacturing exports falling rather in industrialized countries, while jobs sustained by business services exports expanded throughout the sample. Across the sample only roughly a quarter of the 51 countries have faced job losses in manufacturing exports since 1995, especially in industrialized Western European countries, most notably Cyprus, the Russian Federation, the United Kingdom and Romania, as well as the United States (Figure 11). At the same time, the number of jobs in business services exports grew strongly across all countries, in particular Ireland, South Africa, Iceland, Luxembourg, and Poland, reflecting the structural transformation in industrialized and emerging countries away from manufacturing and towards services. A few emerging countries showed higher growth of manufacturing-linked jobs than business services-linked jobs in exports, including Türkiye, Mexico, Chile, Czechia, Indonesia, Slovak Republic, and China, while Saudi Arabia's job growth in exports stood out in both sectors.

Figure 11: Export-driven employment growth, manufacturing vs. business services, 1995-2018



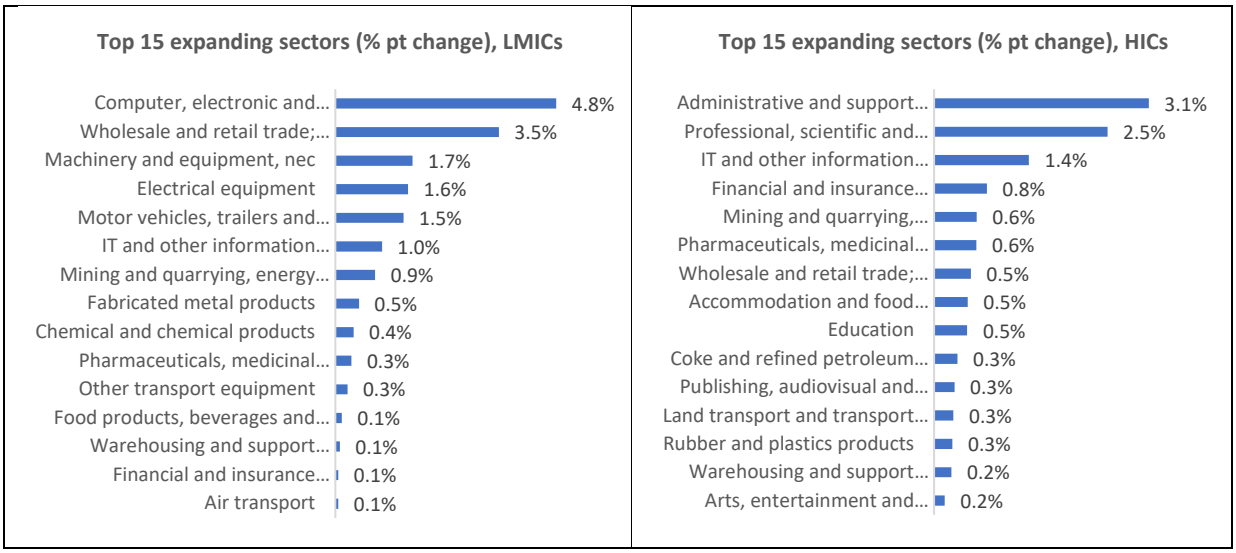
Source: Own computations. Data: OECD TiE data. Note: The country sample covers 38 OECD countries plus 13 non-OECD countries. The orange line indicates the y=x line. CAGR = Compound annualized growth rate.

This trend is also visible at the detailed sector level, with emerging countries expanding more jobs sustained by manufacturing exports and high-income countries creating more jobs linked to business services exports. The top 15 expanding sectors between 1995 and 2018 in terms of jobs in exports (in % change) for low- and middle- versus high-income countries (as per their 1995 income categories) reflects the stronger role of manufacturing for the first group and the stronger role of business services for the latter group (Figure 12). In emerging countries, most jobs sustained by manufacturing exports were created in computer and electronics, whole and retail trade, machinery and equipment, electrical equipment and motor vehicles (left panel). In high-income countries, job creation was strongest in exports of administrative, professional, IT and financial and insurance services (right panel).

The highest job losses in high-income countries are related to manufacturing exports, while emerging markets experienced their largest declines in labor-intensive jobs linked to services, manufacturing and

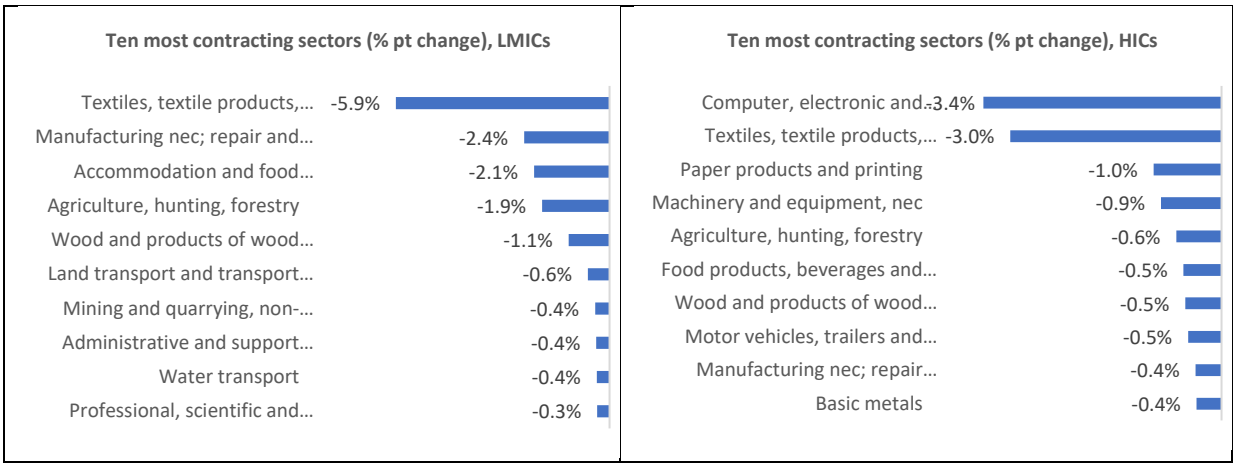
agricultural exports alike. In high-income countries (using the 1995 income classification), the share of jobs supported by computer and electronics exports as well as apparel and textiles experienced the strongest decreases (Figure 13, right panel). In emerging markets, the share of jobs sustained by textiles and apparel exports contracted most sharply between 1995 and 2018, but other labor-intensive jobs related to exports of other manufacturing, accommodation and food services, agriculture, and wood and wood products also showed strong contractions (left panel).

Figure 12: Employment in exports, top 15 expanding sectors (% pt change), 1995-2018, emerging vs. HICs



Source: Own computations. Data: OECD TiE data, covering 51 countries and 45 sectors for the period 1995-2018. Income categories as of 1995 are used to classify countries into high- and low- and middle-income countries (see Appendix 7).

Figure 13: Employment in exports, ten most contracting sectors, (% pt change), 1995-2018, emerging vs. HICs



Source: Own computations. Data: OECD TiE data, covering 51 countries and 45 sectors for the period 1995-2018. Income categories as of 1995 are used to classify countries into low- and middle-income countries (see Appendix 8).

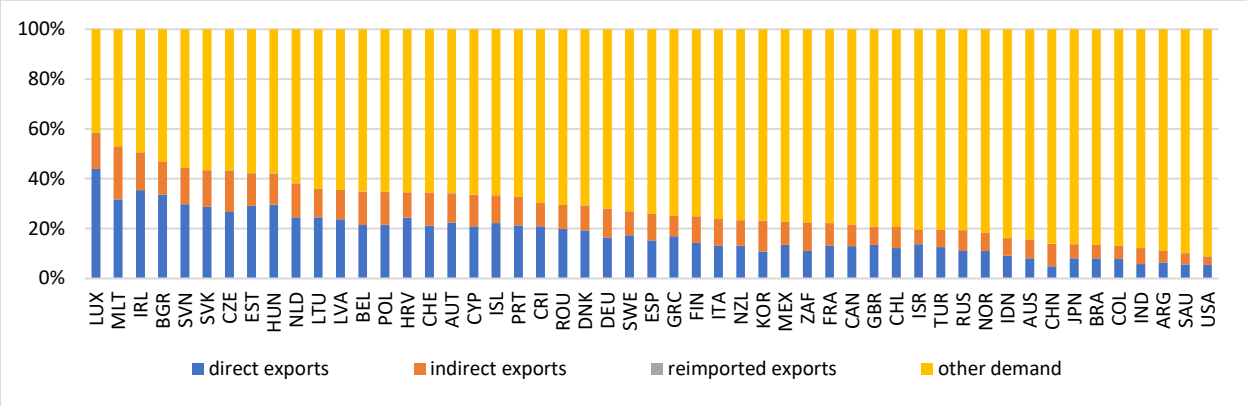
Some of these trends can be explained by offshoring from high-income countries, but also from large emerging countries, most notably China. While part of the job shifts linked to computer and electronics exports may be substitution due to offshoring from high-income to emerging markets, the absolute numbers reveal that emerging markets in the sample added over 14 million jobs, while in high-income countries only 0.77 million jobs were lost. The strong decline in jobs sustained by apparel exports was

driven by the period after the global financial crisis with over 26 million jobs lost between 2007 and 2018, of which 22.5 million can be attributed to China and 4 million to India, while some countries added jobs linked to apparel exports, most notably Indonesia, Türkiye, South Africa, and Mexico.

3.3 Are more jobs created in exporting or supplying sectors?

The sources of employment in exports can be further decomposed into the direct and indirect portions as well as domestic demand. The decomposition of employment in exports allows to identify jobs (1) directly in the exporting sector and (2) indirectly in sectors supplying to the export sector, while (3) the contribution of reimported inputs is negligible. The difference between a country's total employment and employment in exports to a large extent reflects jobs created by domestic demand.[18] Figure 14 plots the full decomposition, ranked by the total employment share in exports. While the contribution of other sources of job creation varies across countries (yellow bar), the indirect contribution of supplying sectors on average tends to be smaller than the direct contribution across all countries, masking strong sectoral differences.

Figure 14: Decomposition of employment in exports and domestic demand, 2018



Source: Own computations. Data: OECD TiE. The country sample covers 38 OECD countries plus 13 non-OECD countries. Note: Employment in exports can be decomposed into its (1) direct contribution in the exporting sector, (2) indirect contribution in sectors supplying to the export sector, and (3) contribution of reimported inputs.

Linkages to supplying sectors have been traditionally high for manufacturing exports, exceeding 62 percent of jobs in exports on average in 2018 (Figure 15). These can include agricultural inputs used in the food and beverages export sectors (such as fruits and vegetables), agricultural inputs used in apparel and shoe exports (such as cotton or hides and skins), but importantly also business services used in all of manufacturing exports (ranging from research and development, to design, to transport and logistics, to marketing services) – which all create jobs. In other words, the high export-employment elasticities found in manufacturing (section 2) underestimated their potential to create jobs in other sectors. Similarly, mining exports are known to create jobs in other sectors, in particular supporting services industries.[19] Interestingly, the share of indirect jobs linked to mining exports has expanded from 46 to 64 percent between 1995 and 2018, or that of direct jobs declined from 54 to 36 percent. This may be linked to

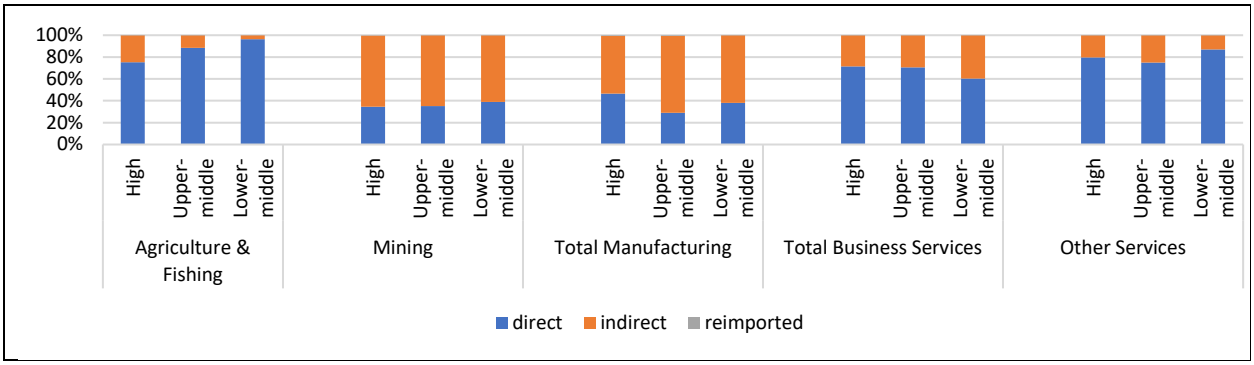
[18] While the computation of jobs sustained by domestic demand would require international input-output data, this is a reasonable estimate.

[19] Estimates of job multipliers in non-mining sectors for Sweden's mining sector range from 0.2 to 0.5 percent, i.e., one mining job supports between 0.2 to 0.5 jobs in other sectors. It is highest in services including retail trade, transport, and hotels and restaurants (Moritz et al. 2017).

increased capital intensity of mining, with the arrival of new labor-saving machines, technology and tools reducing the need for labor directly in the mining sector.[20]

For business and other services exports and especially agricultural exports, the direct employment creation is much larger than the indirect job creation. Direct job creation represented 88 percent of jobs linked to agricultural exports, because linkages to supplying sectors in agriculture are restricted to few inputs such as fertilizers, other chemicals, seeds, and planting materials. However, the share of indirect jobs linked to agricultural exports has doubled since 1995 (not shown). Similarly, business and particularly other services exports create jobs mainly directly within the export sectors, with the indirect contribution representing one-third in business services and one-fifth in other services.

Figure 15: Direct and indirect employment in exports, by broad sector and income level, 2018



Source: Own computations. Data: OECD TiE. The country sample covers 38 OECD countries plus 13 non-OECD countries. Note: Employment in exports can be decomposed into its (1) direct contribution in the exporting sector, (2) indirect contribution in sectors supplying to the export sector, and (3) contribution of reimported inputs.

The analysis highlights different upgrading patterns along countries' income levels for broad sectors. In business and other services, the indirect job creation loses importance for upper-middle and high-income countries (Figure 15). As countries develop, the range of possible services to be exported seems to increase and thus the amount of jobs linked to those exports. For instance, rather than exporting only support services more innovative countries offer sophisticated services exports including research and development, design, IT and programming, or financial services, among others. While the direct contribution is generally lower in manufacturing, it is highest for high-income countries amounting to 46 percent in 2018 compared to less than 30 percent in upper-middle income countries. It may be possible that as countries develop, exports create new job opportunities within the manufacturing sector, such as the increased need for technicians, engineers, and managers (see section 4).[21]

The higher sophistication of services in high-income countries may also explain the patterns in agriculture and mining. In agriculture, the share of indirect jobs created in supplying sectors increases at higher income levels, in line with higher intermediate usage intensity of richer countries in the production of agriculture (Sposi 2019). While the contribution of supplying sectors to jobs in mining exports is much higher than in agriculture, their role increases slightly with higher income levels (Figure 15). Lower-middle income countries tend to create employment mainly in the agricultural export sectors with few linkages to upstream sectors such as necessary transport and logistics services to export these agricultural goods.

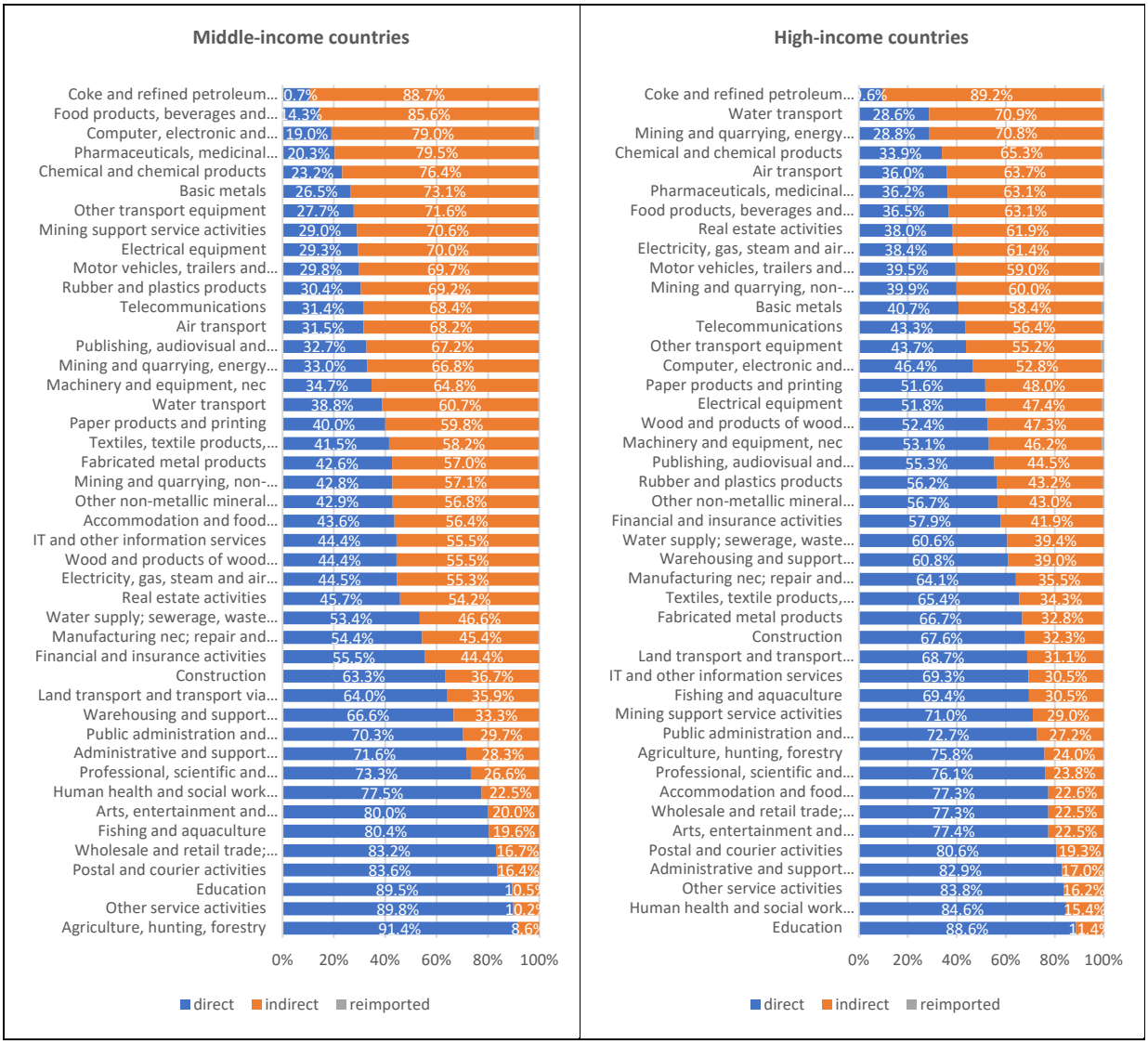
[20] Technological progress in the U.S. copper sector, for instance, has been linked to labor productivity growth in the 1970s, 1980s and 1990s. It includes the use of solver extraction and electrowinning technology, larger trucks, shovels and drills, in-pit mobile crushers and conveyor belt systems, computerized scheduling of trucks, and real-time process controls (Sánchez and Hartlieb 2020).

[21] If these activities are performed within the boundaries of the same company, rather than by an independent services provider, they should be statistically counted as part of the direct job contribution.

High-income countries are characterized by stronger linkages to supplying sectors in which jobs are created, such as in professional services (e.g., technicians or engineers to maintain machines or greenhouses), but also in research and development (e.g., to optimize the ripening process of fruits or to improve the quality of seeds). While mining exports create a much higher percentage of jobs in supplying sectors than agricultural exports, a similar explanation could hold. Additional analysis by broad sector and world region is shown in Appendix Figure 9.6.

Finally, focusing on detailed export sectors for emerging vs. high-income countries separately highlights stark differences, with high-income countries showing a larger direct contribution across most manufacturing and business services sectors. Figure 16 shows the decomposition of employment in exports into their direct, indirect and reimported shares for detailed industries, differentiating between the sample of high-income countries and that of emerging countries (using the 2018 income category).

Figure 16: Direct and indirect employment in exports, detailed sector, 2018



Source: Own computations. Data: OECD TiE. The country sample covers 38 OECD countries plus 13 non-OECD countries. Note: Employment in exports can be decomposed into its (1) direct contribution in the exporting sector, (2) indirect contribution in sectors supplying to the export sector, and (3) contribution of reimported inputs. Income category of 2018 used (see Appendix 8).

In electronics and computers, for example, jobs directly linked to exports make up 19 percent of total jobs in exports in the sector in emerging countries, but 46 percent in high-income countries. In motor vehicles, the direct contribution is around 30 percent for emerging but 40 percent for high-income countries. Similar differences can be found for electrical equipment (29 vs. 51 percent), machinery (35 vs. 53 percent), but also textiles and apparel (41 vs. 65 percent), and all other manufacturing sectors except for coke. Similarly, business services export sectors show a larger direct job contribution in high-income countries such as in IT or professional services than in emerging economies. The direct contribution is smaller in agriculture, mining, and non-tradable services in high-income countries. This again reflects the higher portion of sophisticated services activities directly embodied in such exports.

4. Measuring job activities in exports: The role of occupations

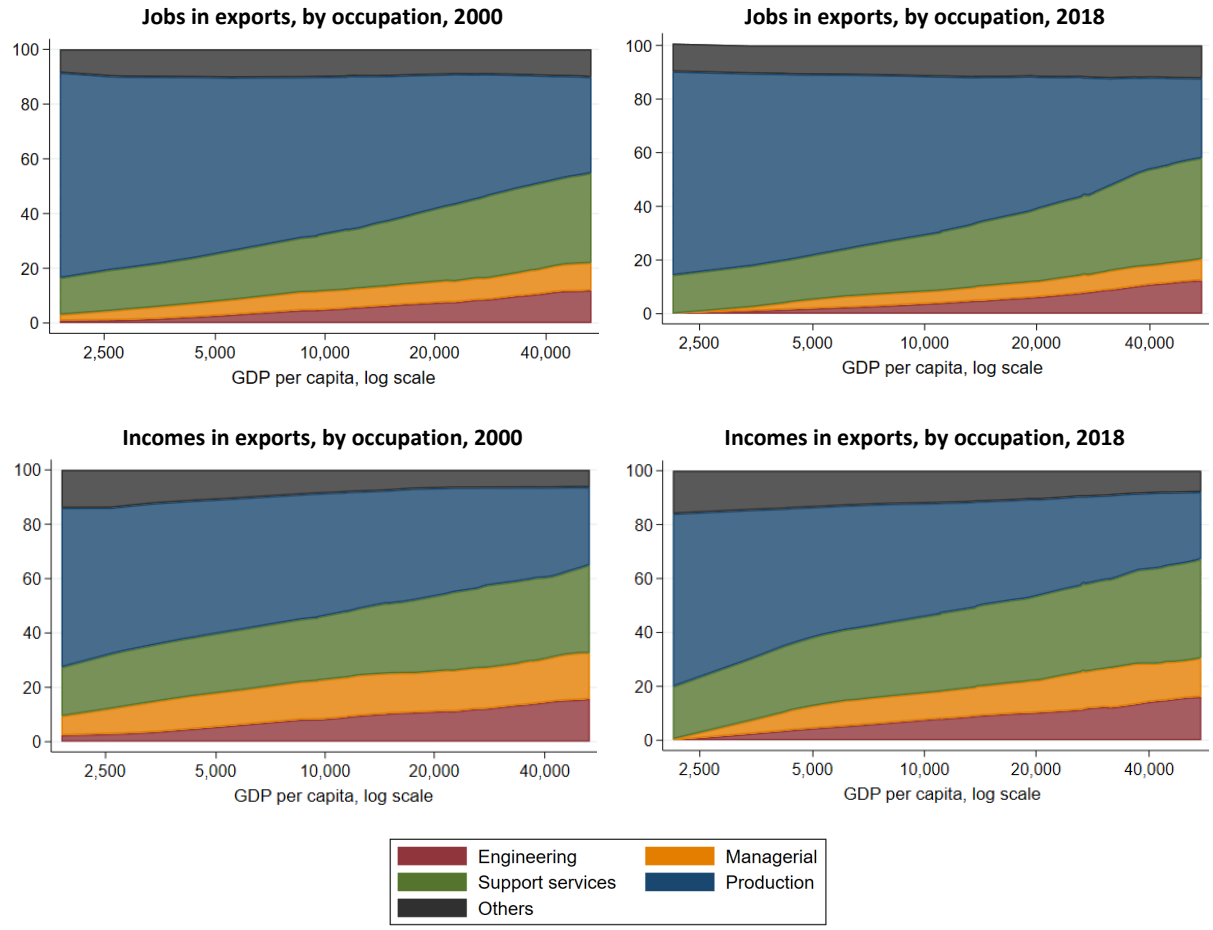
4.1 Upgrading of jobs in exports across sectors

Reporting job numbers created by exports alone masks differences in the activities that countries specialize in along the value chain. The distribution of job activities in exports across five occupation categories (see Appendix 5 for details) in a sample of 59 countries and 20 industries for the years 2000 and 2018 suggests a declining role of production activities (including craft workers, machine operators, and farm laborers, among others), as countries' per capita income progresses (Figure 17, upper panels). For the poorest countries production activities represented almost 70 percent of their exports in 2018, but this percentage dropped by almost half in the richest countries (upper-right panel). In upper-middle income countries, non-production activities become increasingly important for their exports, in particular managerial occupations, but also engineering and support services. The role of support services activities in exports, such as sales representatives or office clerks, magnifies especially for high-income countries, with their share exceeding that of production activities for the richest countries.

Several channels help explain the changing distribution of jobs in exports across occupational groups as countries develop. First, as countries become richer their comparative advantage and thus composition of their export basket changes. Second, GVC upgrading can foster a structural transformation of jobs (World Bank forthcoming). Once countries upgrade into more advanced segments of manufacturing and services GVCs, for instance, more non-production activities are embodied in a country's exports relative to production activities, including managerial, engineering and especially other support services activities. Third, supply linkages between sectors also adjust, with the "servicification" of manufacturing exports gaining in importance as countries develop (Nayyar, Hallward-Driemeier, and Davies 2021). For instance, while food exports in low-income countries often consist of raw commodities or staples, food exports in middle- and high-income countries increasingly rely on sophisticated services embodied in those food exports beyond logistics, transportation and trade services, and include engineering, support and other services (e.g., health inspections).

In addition, changes in productivity trigger changes in relative wages across occupations which are reflected in incomes in exports (rather than jobs in exports) measures. Not surprisingly, managerial and engineering services activities account for a larger share in lower-income countries when using the income in exports measure as opposed to the jobs in exports measure (Figure 17, lower panels). This is because average incomes (and productivity levels) are higher for managers and engineers relative to workers in production and support services occupations in lower-income countries, as they are endowed with a larger relative supply of low-skilled workers (e.g., de Vries, Timmer, and de Vries 2015; McMillan, Rodrik, and Sepulveda 2017). However, such differences decline as countries get richer because relative wage gaps between these occupation categories fall.

Figure 17: Jobs and incomes in exports across all industries and countries, by occupation, 2000 vs. 2018



Source: Kruse, Timmer, de Vries, and Ye (2023). Note: Job activities of exports, covering all 20 industries and 59 countries. The World Bank's income categories as of 2021 are as follows: Low-income: US$1,045 and lower, Lower-middle income: US$1,046 – 4,095, Upper-middle income: US$4,096 -12,695, High income: US$12,695 and above.

While these broad trends remained relatively stable over time, production activities in exports became less relevant in the richest countries in 2018 relative to 2000, possibly due to increased offshoring and automation. Both offshoring and automation could be responsible for the lower share of production activities in 2018. Over the period, the world witnessed an expansion of offshoring of production activities within the realms of GVCs from high-income countries to LMICs. Studies for the United States found that import competition from China has hurt employment jobs in the manufacturing sector (e.g., Autor, Dorn and Hanson 2013). Another possible factor may be the increased automation of firms in high-income countries. Worldwide, the use of industrial robots has grown strongly over the past two decades, fueled by advances in robot technology and falling prices of industrial robots. Industrial robots are still predominantly used by industrialized countries, particularly in the automotive, rubber and plastics, metals, and electronics sectors (World Bank 2020).

Contrasting the development of production activities, support services activities further gained in importance. The relative importance of support services activities in high-income countries has increased between 2000 and 2018. This trend could be related to increased offshoring and automation: governing GVCs requires more services support activities such as lawyers or sales representatives; and firms could decide to invest their savings from automation into support services as part of their servicification strategy to increase value added. Another explanation could be shifting consumption preferences. As countries

grow rich, their relative demand switches from agricultural and basic manufactured goods (which tend to be production-intensive) towards more advanced manufactured goods and services (which tend to be cognitive/non-production-intensive). While incomes expanded in both country groups, many LMICs moved from consuming agricultural to basic manufacturing activities (so production-intensity not changing much), whereas high-income countries monotonically move into paying more for non-production activities (Kongsamut et al. 2001, Comin et al. 2021).

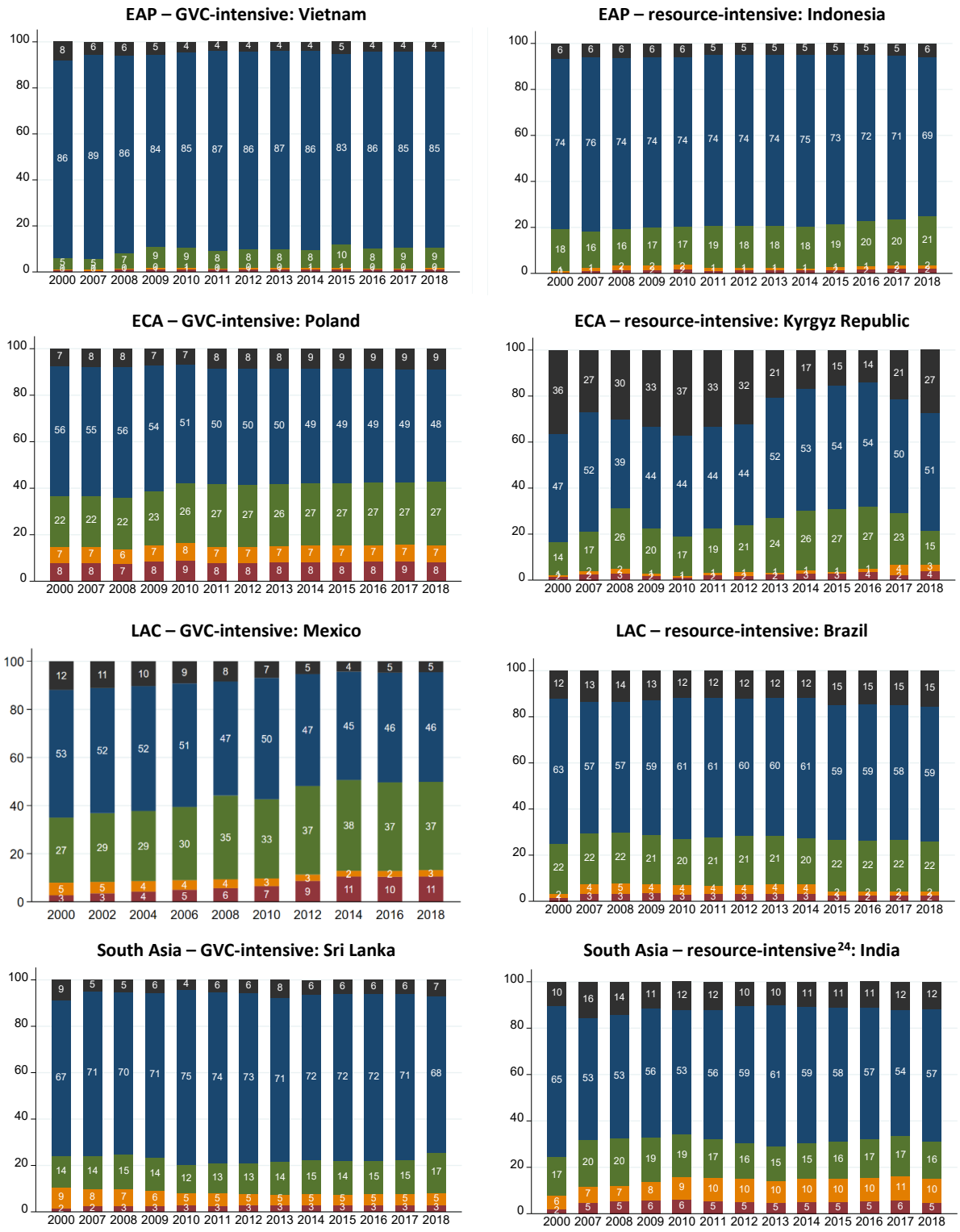
As a result of these different underlying channels, the composition of job activities in exports across select countries varies.[22] The analysis for select countries suggests that resource-intensive countries, like Indonesia, Kyrgyz Republic, Brazil, and Ghana, tend to have smaller shares of production activities in exports compared to GVC-intensive countries such as Vietnam, Mexico, Poland, and Ethiopia (Figure 18). It is well established that countries with a large mining sector depend on a strong services support system, as evidenced by the relatively large shares of support services jobs and other jobs (which mainly consist of services occupations). Managerial and engineering jobs matter more strongly for countries like Poland, Mexico and Sri Lanka that have successfully participated in manufacturing GVCs for several decades. While Vietnam's GVC entry – especially in electronics – has been praised as a success story (World Bank 2020), its main challenge remains to upgrade into more non-production activities in exports with only little progress in the aggregate. Sector-specific analysis reveals even stronger differences between Vietnam and other countries (see section 4.3). Despite its dominance of agriculture, Ethiopia has been considered the posterchild of successful GVC integration, driven largely by the textiles and apparel industry (Fernandes et al. 2023). While in 2000 production activities dominated its jobs in exports with a share of 94 percent, this share dropped to 77 percent by 2018, lower than in Vietnam, whereas support services and other activities gained in importance.

While most countries underwent a transition towards more non-production activities in exports between 2000 and 2018, China's stark upgrading experience was an exception. China's jobs in exports underwent a significant transition between 2000, the year before its accession to the World Trade Organization, and 2018. While over 70 percent of China's jobs in exports were production-related activities in 2000, this share fell to roughly 50 percent by 2018. At the same time, the percentage of non-production activities, especially of support services and engineering, went up (see Appendix 10). China's upgrading trajectory differs from that of Mexico and Poland in two main aspects. First, they differ with respect to the types of activities that are embodied in their exports. While Poland's upgrading trajectory also relied on support services activities, engineering and managerial activities already accounted for important shares of exports in 2000, also owing to its highly educated workforce. Mexico has increased its share of support services (especially in and engineering activities (especially in other manufacturing, machinery and transport equipment) in exports after 2004,[23] while reducing its share of other activities and production activities (Figure 18). Second, China's fast transition pace over just 18 years is remarkable, given that activity employment shares move more slowly than sectoral employment shares. The reason is that workers move from production in agriculture to production in manufacturing at early developmental stages which reflects a sector shift but not a shift in the job activity itself.

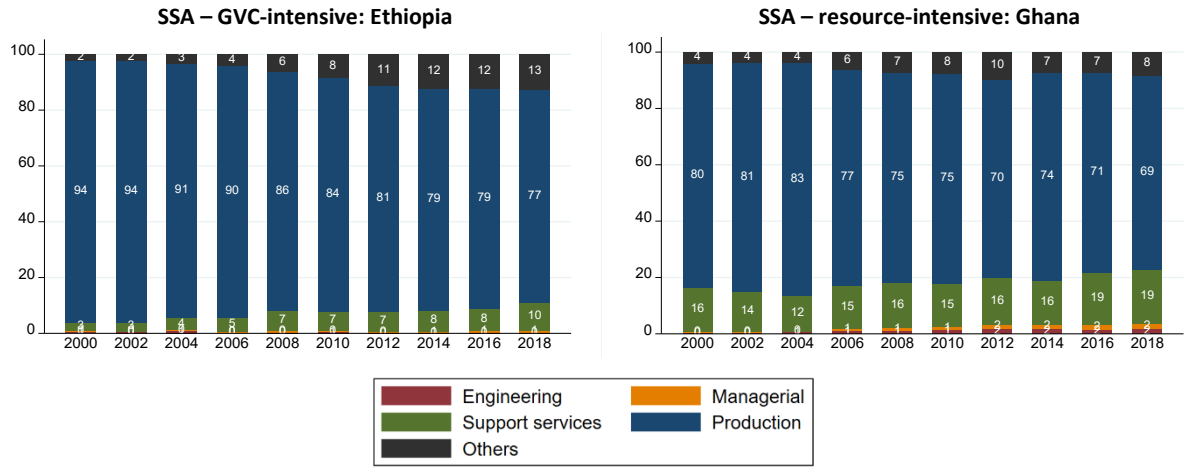
[22] One further way of exploring heterogeneity of activity specializations (instead of over income levels or specific countries) is to compare world regions. This is reported for the aggregate economy in 2000 and 2018 as well as within four broad industries in Appendix Figures 9.7 and 9.8. The results are broadly similar to the income-specific findings.

[23] The increase in support services activities is driven by business services and that in engineering activities by other manufacturing, machinery and transport equipment.

Figure 18: Job activities in exports across all industries, by select countries, 2000-18



[24] While India is not a typical resource-intensive country, the share of agriculture, forestry and fishing in total value added declined from 21.6 percent in 2000 to 16 percent 2018, averaging 17.6 percent over the period (World Development Indicators).



Source: Kruse, Timmer, de Vries, and Ye (2023). Note: Job activity content of exports, covering all 20 industries and 59 countries. The analysis for Ethiopia and Ghana relies on a separate dataset and is based on data from national statistical institutes. The World Bank's income categories as of 2021 are as follows: Low-income: US$1,045 and lower, Lower-middle income: US$1,046 – 4,095, Upper-middle income: US$4,096 -12,695, High income: US$12,695 and above.

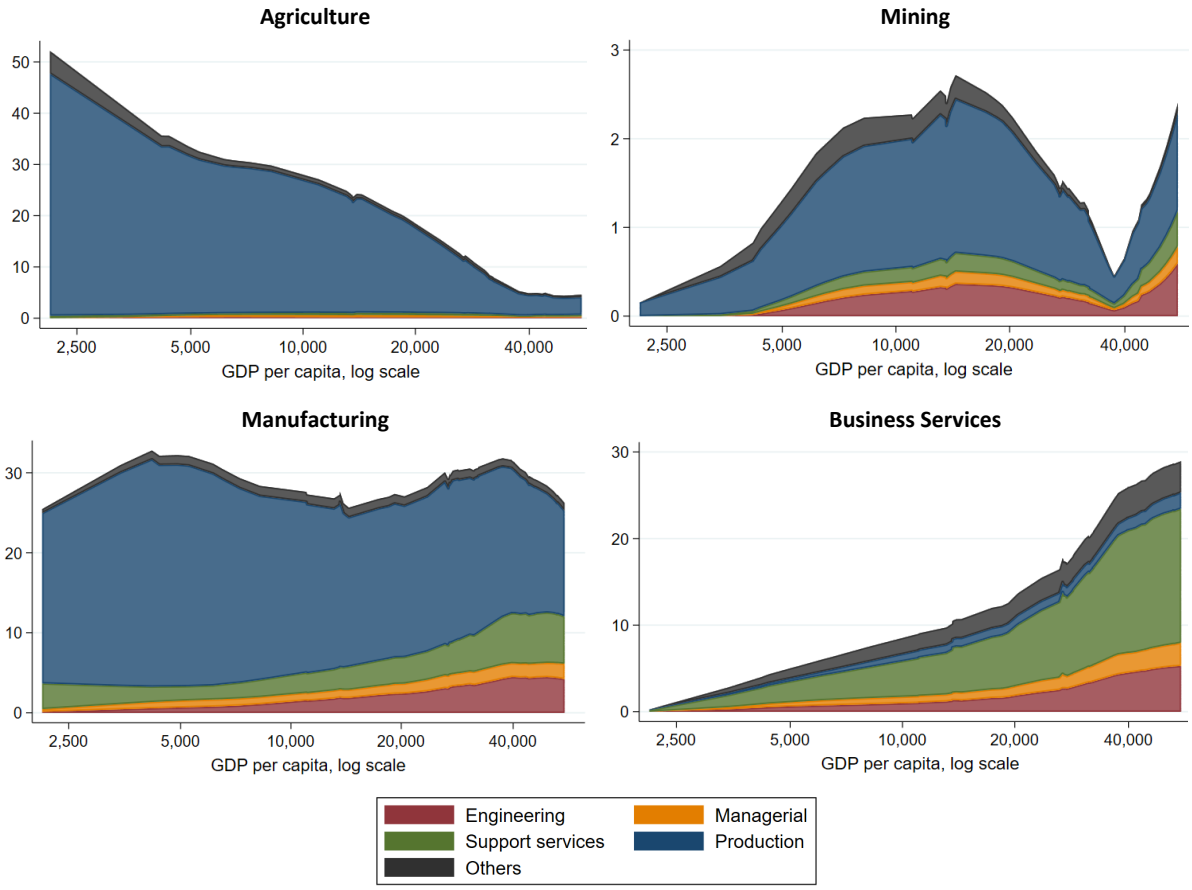
Aggregating across the entire economy might mask dynamics within and between different sectors. Therefore, the next sections explore more disaggregated patterns within sectors across income categories (4.2) and within specific countries over time (4.3).

4.2 Upgrading of job activities in exports within sectors

Zooming in on broad industries reveals substantial changes of activity specialization in exports as countries become richer, including a decline in agricultural jobs. Production activities represent the bulk of jobs in exports in the agricultural sector. The latter represented between 40 and 48 percent of total jobs in exports for LMICs in 2018 (Figure 19), highlighting the importance of agriculture for job creation in developing countries. High production activity job shares from exporting in agriculture can especially be observed among countries in SSA (Appendix Figure 9.8). Once economies reach high-income status, their dependence on agricultural jobs in exports declines, but stabilizes again among the richest countries. One possible explanation includes the goal of food security in industrialized countries, as evidenced by high subsidies extended to agricultural producers in the United States and the European Union.

In contrast to agriculture, job activities within mining do not offer many jobs at any income level. This is evidenced by the very low share of jobs in exports in the mining sector, reaching at most 2 to 2.5 percent in some upper-middle and high-income countries in 2018 (Figure 19). In addition, the relationship with the level of development takes an inverse U-shaped form, i.e., activities in exports within mining matter more strongly for upper-middle and high-income countries than for lower-income countries, but their share declines again as countries become richer. Interestingly, some very rich countries exhibit a large share of activities in mining, such as Australia or Norway. In these countries, engineering activities matter as strongly as production activities (of mining laborers), while in other countries production activities still represent the largest category. Compared with agriculture, non-production activities matter more strongly in mining across all income levels, notably engineering and support services activities, but also other services activities (at lower income categories).

Figure 19: Job activities in exports across all countries, by broad industries, 2018



Source: Kruse, Timmer, de Vries, and Ye (2023). Note: Job activity content of exports covering 59 countries. Business services include ISIC Rev. 4 sectors 31 and 34-39 (covering post and telecommunications, financial intermediation, real estate activities, renting of machinery and equipment and other business activities). The World Bank's income categories as of 2018 are as follows: Low-income: US$1,025 and lower, Lower-middle income: US$1,026-3,995, Upper-middle income: US$3,396-12,375, High income: above US$12,375.

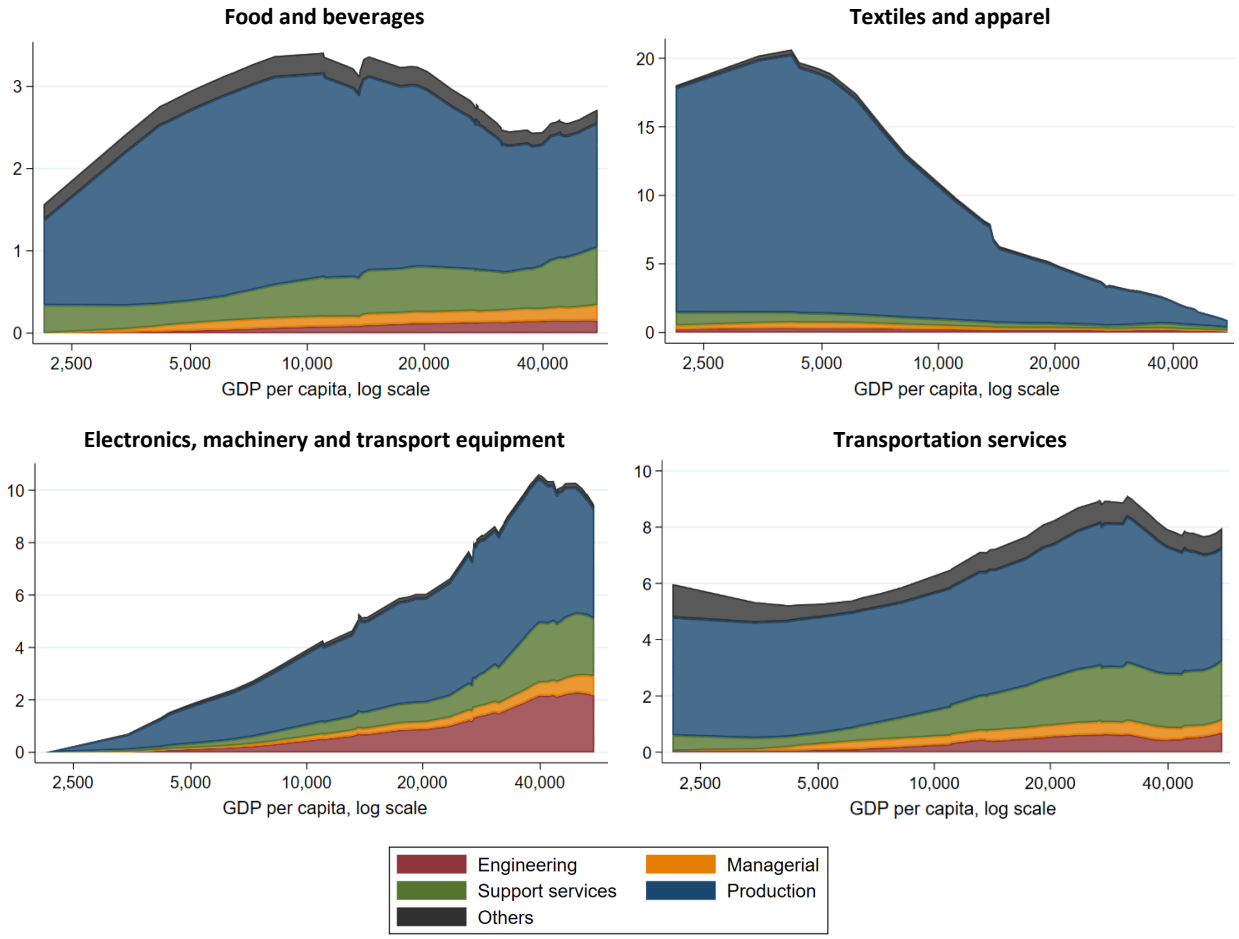
Non-production job activities in exports increase with higher incomes per capita, especially in the business services sector, contrasting the development of agriculture and mining. While business services only represent 10 percent or less of total job activities in exports for LMICs in 2018, their share increases steeply along higher income categories, reaching almost 30 percent for the richest countries (Figure 19). Within the sector, support services activities in exports matter most strongly across all developmental levels, representing more than half of the sector's job activities in exports. And while engineering and managerial activities have similar weights at lower income levels, the former increases in importance once countries reach high-income status. At the detailed services sector, professional and administrative services (not shown) follow the general trend of business services, whereas the transportation services sector is characterized by a much larger production activity share (Figure 20), reflecting the activities of drivers (classified as production-related occupations).

The analysis also highlights the fundamental shift in manufacturing activities taking place between 2000 and 2018, reflecting the 'second unbundling' of production. In 2000, manufacturing jobs in exports increased as countries developed, and only declined at very high-income levels due to the larger role of services activities in exports, known as the hump-shaped pattern of structural transformation (not shown). By 2018, however, the pattern has changed taking the shape of two humps (Figure 19). This

change in patterns reflects the offshoring of manufacturing activities from high-income to lower-income locations, also named the 'second unbundling' (Baldwin 2011).

Nonetheless, the average graph for manufacturing masks strong sectoral differences in the activity composition of exports along income categories. In food and beverages, job activities in exports grow in importance until countries reach high-income level but start declining again after (Figure 20). Within food and beverages, the dominance of production job activities gives way to support services job activities at higher income categories. Interestingly, the role of textiles job activities clearly falls as countries become richer, driven by the decline in production activities which dominate the job content of exports in this sector. This has enabled several developing countries to participate in the textiles GVC, including Bangladesh, Cambodia, Ethiopia, Indonesia and Vietnam. The high-tech manufacturing sector, i.e., electronics, machinery and transport equipment combined, stands in sharp contrast, where the share of jobs in exports expands as countries' income per capita progresses. Within the high-tech sector, lower-income countries expand their production job activities, while job activities increasingly consist of engineering and support services in middle- and high-income countries.

Figure 20: Job activity content of exports across all countries, select sectors, 2018

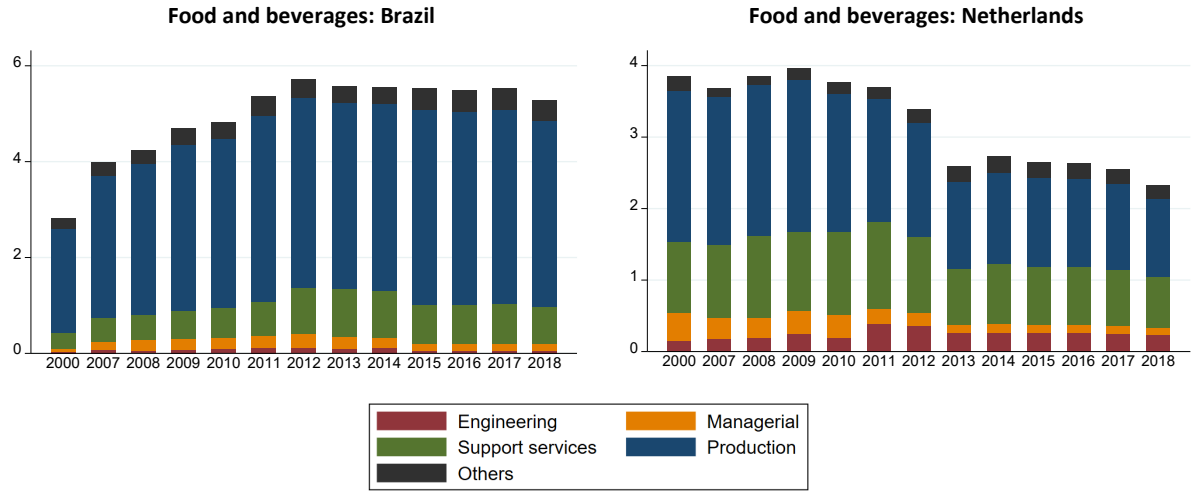


Source: Kruse, Timmer, de Vries, and Ye (2023). Note: Job activity content of exports covering 59 countries. The World Bank's income categories as of 2018 (2000) are as follows Low-income: US$1,025 and lower, Lower-middle income: US$1,026-3,995, Upper-middle income: US$3,396-12,375, High income: above US$12,375.

4.3 Upgrading of job activities in exports within select sectors and countries

The aggregate analysis in the previous two sections masks different activity specializations and upgrading trajectories for select sectors and countries over time which is the focus of this section. Focusing on activities in the food and beverages sector in Brazil and the Netherlands, the analysis first suggests that the job contribution of exports in the sector is roughly twice as high in Brazil (around 5 percent of total jobs in exports in 2018) than in the Netherlands (less than 2.5 percent). But more importantly, they substantially differ in their activity specialization (Figure 21). Brazil's activities in food and beverages are dominated by production activities, although the share of support services jobs has expanded since 2000, especially since 2012. In the Netherlands, engineering activities play a much larger role in the food and beverages sector, while support services activities also gained in relevance (e.g., engineers developing green houses to be manufactured for the Dutch food industry). The role of managerial activities, by contrast, has declined.

Figure 21: Job activities in exports, food and beverages and textiles and apparel, select countries, 2000-2018

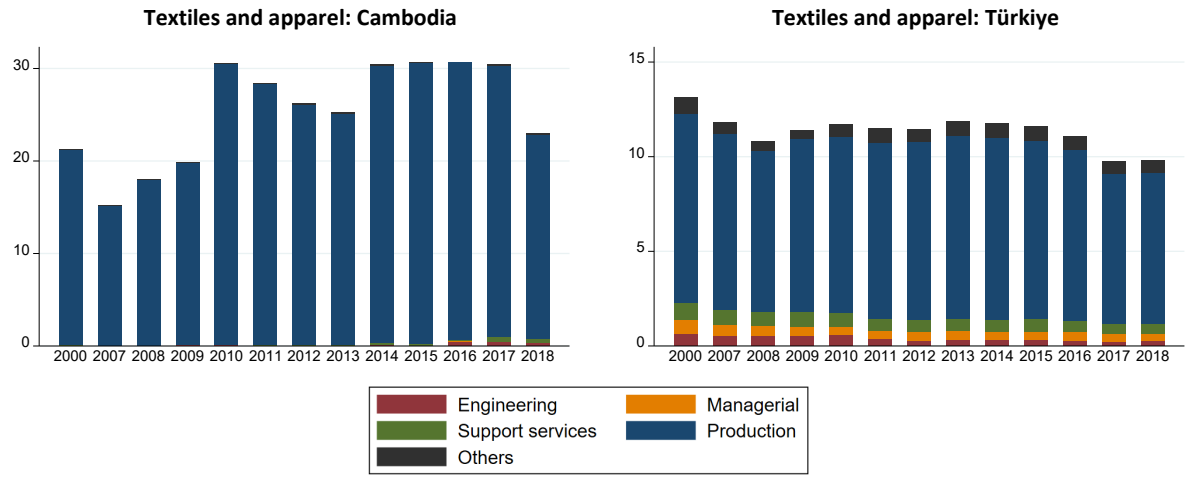


Source: Kruse, Timmer, de Vries, and Ye (2023). Note: Job activities in exports.

Similarly, the composition of job activities of Cambodia and Türkiye's textiles and apparel sector differ, highlighting their different positions in the GVC (Figure 22). In the textiles and apparel sector, Cambodia has been stuck in the low value-added production activities over the past two decades, focusing on the cut-make-and-trim segment only. Given Cambodia's strong dependence on the textiles and apparel sector, making up around 30 percent of total jobs in exports, upgrading its GVC position is a prerequisite for the country to create higher value-added jobs. In this context, the weak diversification into non-production activities in recent years is a positive sign. Türkiye's textiles and apparel sector, by contrast, shows a more diversified composition of job activities throughout the period 2000-2018, including in support services, managerial, engineering and other activities (Figure 22). The country managed to upgrade its apparel value chain into original design and original brand manufacturing activities (Fernandez-Stark, Gereffi, Frederick 2011), as evidenced by its designer jeans Mavi which successfully entered the German denim market.[25]

[25] https://www.the-spin-off.com/news/stories/Anniversary-Mavi-How-Turkish-jeans-have-conquered-Germany-12714

Figure 22: Job activities in exports, textiles and apparel, select countries, 2000-2018



Source: Kruse, Timmer, de Vries, and Ye (2023). Note: Job activities in exports.

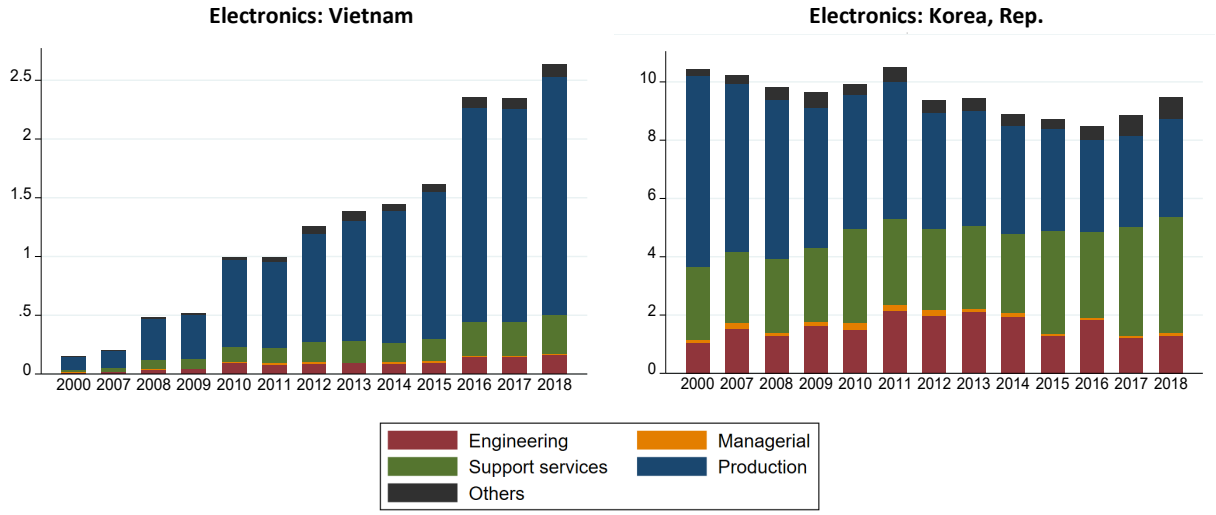
In the electronics sector, Vietnam's activity specialization is dominated by production, contrasting sharply with the Republic of Korea's composition (Figure 23). Vietnam owes its successful entry into the electronics export sector to a combination of factors, including a favorable trade and investment climate and an abundance of low-skilled production workers. It became the second-largest smartphone exporter, producing 40 percent of Samsung's global mobile phone products and employing 35 percent of its global staff in less than a decade (World Bank 2020). While production activities in the electronics sector still represent the largest group, export growth in recent years has also benefited support services as well as engineering activities (left panel). In 2012, the Samsung Vietnam Mobile Research and Development Centre (SVVMC), the company's largest research and development facility in Southeast Asia, was established. The skills and capacity of the center's staff are comparable to other Samsung Research and Development Centers in the world, with 90 percent of engineers attaining Samsung's global standards (Hollweg, Smith, and Taglioni 2017). In Korea, the share of electronics has declined from roughly 10 percent of total jobs in exports in 2000 to around 8 percent in 2016 but increased again in recent years (right panel). The main force behind this decline were production activities, possibly reflecting offshoring and/or automation trends, whereas the share of support service activities expanded over time and that of engineering activities declined slightly in recent years.

In business services industries, the composition of job activities in exports of the Philippines and India reveal their different specializations in business process outsourcing versus information, communication and technology (ICT) services (Figure 24). India's activities in the business services sector account for around 15 percent of the country's total jobs in exports, compared with 12 percent in the Philippines. India has specialized in exports of business services for several decades, as reflected in its high share of support services, engineering (including programmers and software developers), and managerial activities as early as 2000. While support services activities declined, engineering activities further expanded in the subsequent decade and stabilized afterwards (right panel). Job activities in Philippines' business services sector, by contrast, are dominated by support services and other activities (left panel), reflecting the country's importance of the business process outsourcing sector which include activities like call centers, sales and marketing professionals.

The differences in activity specialization likely reflect India's larger endowments with high-skilled workers compared to the Philippines. Market research, for instance, generally requires workers with a minimum of a bachelor's degree, and the highest value-added tasks often are carried out by workers with

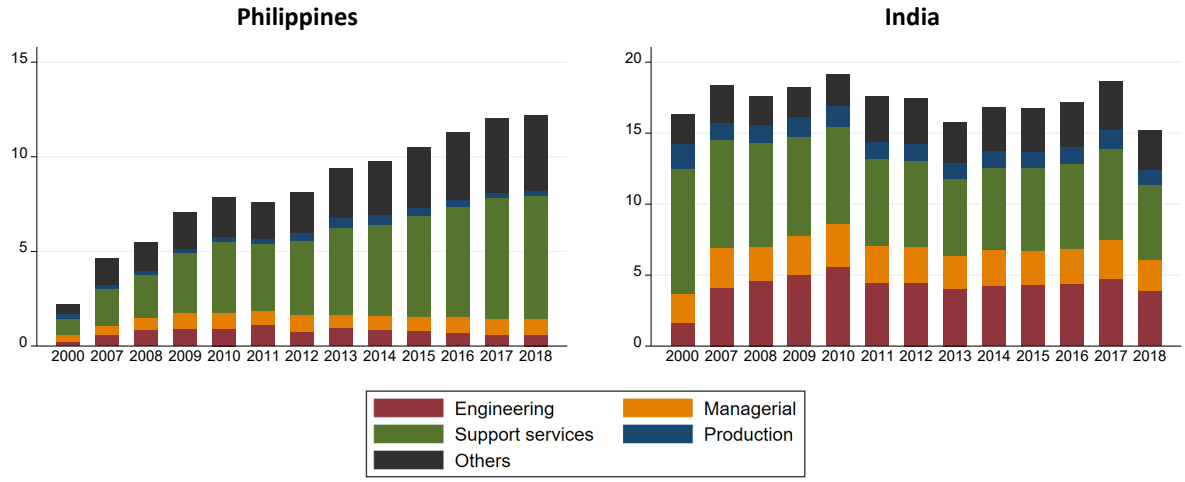
master's degrees or PhDs. Call centers or routine business process outsourcing activities can be performed by workers with a high school diploma (Gereffi and Fernandez-Stark 2010).

Figure 23: Job activities in exports, electronics, select countries, 2000-2018



Source: Kruse, Timmer, de Vries, and Ye (2023). Note: Job activities in exports.

Figure 24: Job activities in exports in the business services industry, Philippines vs. India, 2000-2018



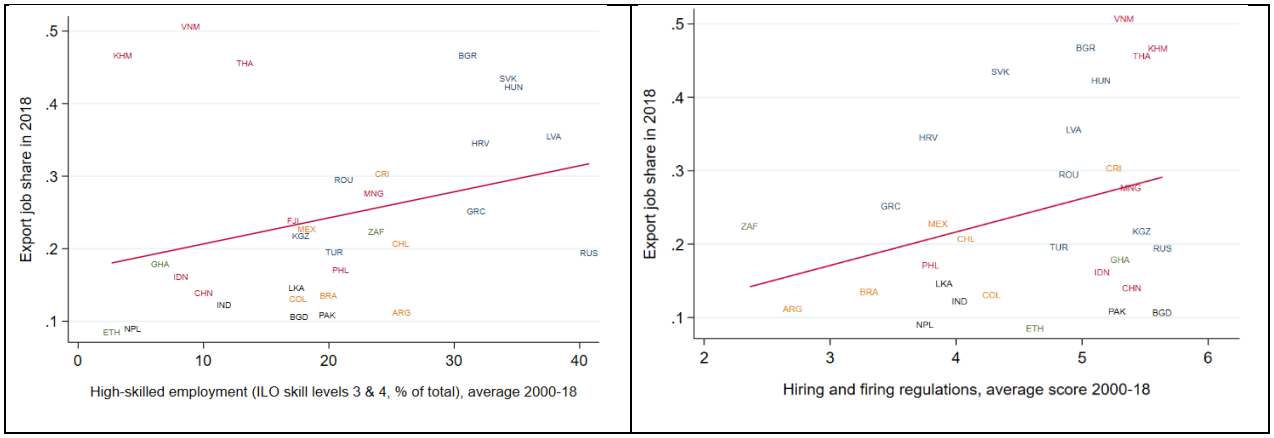
Source: Kruse, Timmer, de Vries, and Ye (2023). Note: Job activity content of exports.

5. The role of policy for the export job share

The analysis of this paper provided a large body of evidence that trade creates opportunities for more and better job creation. It also highlighted that trade-job linkages differ across trade dimensions, sectors, occupations, as well as geographically (regions, countries). However, our analysis so far has largely been silent on the role of policy in supporting these benefits. While trade policy is one obvious instrument to scale up aggregate labor-market gains from trade, long-run effects also crucially depend on minimizing adjustment costs for workers to reallocate towards job opportunities linked to trade. Adjustment costs depend on countries' macroeconomic environments, labor market conditions, financial markets, infrastructure, and institutional quality, among others.

Skill development through education helps economies take advantage of the opportunities offered by trade and mediates its effect on labor market outcomes. Education shapes the supply of skills and therefore comparative advantage. Countries that are relatively more endowed with human capital have a comparative advantage in knowledge-intensive activities and therefore engage more intensively in trade – especially in GVCs. A higher share of high-skilled employment in the workforce over the period 2000-18 is associated with a larger percentage of jobs in exports in 2018 in a sample of emerging and developing countries (Figure 25, left panel). Countries with a high share of export jobs and a less-skilled workforce face the challenge of upgrading into higher value-added activities. These countries include Cambodia, Vietnam, and to a lesser extent Thailand. For these countries to move out of production into non-production activities requires investments in skills upgrading.

Figure 25: Skill intensity and labor market flexibility as correlates of countries' export job shares in 2018

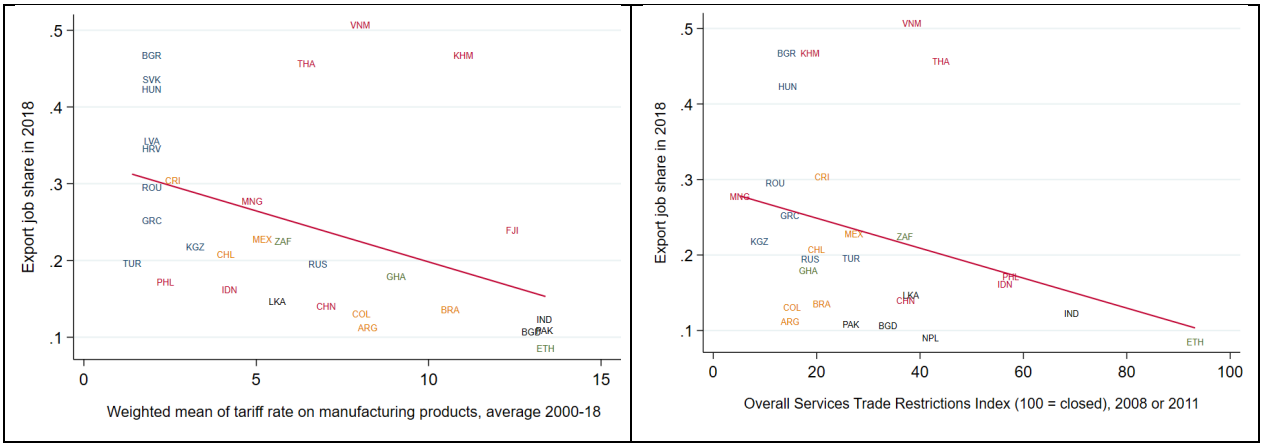


Source: Own computations. Data: OECD TiE, Job activities in exports database, WEF, ILO. Note: The country sample includes emerging and developing countries from the OECD TiE and Job activities in exports datasets. Left chart p-value = 0.111 (0.043 excluding outliers Russia and Argentina). Hiring and firing regulations are ranked from 1 to 7, with a higher score indicating more flexibility. Right chart p-value = 0.082. The bivariate regressions do not control for any covariates.

To fully realize the gains from trade, workers must be able to move across occupations, places, and sectors. Labor market regulations can inhibit the movement of workers. More labor market flexibility, as indicated by lower regulations on hiring and firing, over the period 2000-18 is correlated with a higher percentage of jobs in exports in 2018 in a sample of emerging and developing countries (Figure 25, right panel). Importantly, promoting mobility of people within the economy is a multi-faceted problem that cannot be solved simply by loosening regulations around hiring and firing. It is also important to consider issues like portability of social benefits such as health insurance and retirement savings across jobs and administrative boundaries. High labor mobility also requires flexible housing markets and the capacity of locations to absorb migrants.

Reductions in tariffs and non-tariff measures (NTMs) help reduce trade costs and thus enlarge effective market size. An increase in exports resulting from lower trade costs has been linked to higher employment, especially in non-commodity exporting developing countries. Lower manufacturing import tariffs over the period 2000-18 correlate with a higher percentage of jobs in exports in 2018 in a sample of emerging and developing countries (Figure 26, left panel). Again, Cambodia, Vietnam, and Thailand are outliers, combining high export job shares with medium manufacturing import tariffs. NTMs have shown to be more harmful than import tariffs. More restrictive services trade policy measures – including NTMs – were associated with a decline in the percentage of jobs in exports in telecommunications, finance, transportation, retail, and professional services sectors (right panel).

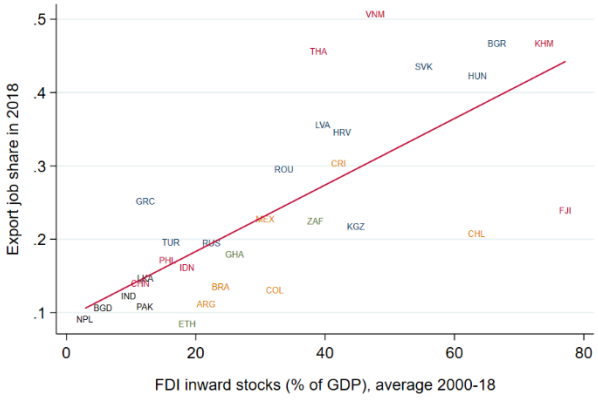
Figure 26: Trade restrictions on goods and services as correlates of countries' export job shares in 2018



Source: Own computations. Data: OECD TiE, Job activities in exports database, WDI. Note: The country sample includes emerging and developing countries from the OECD TiE and Job activities in exports datasets. Left chart p-value = 0.016. Right chart p-value = 0.104 (0.046 excluding outliers Argentina, Colombia, and Pakistan). The bivariate regressions do not control for any covariates.

Encouraging foreign direct investment (FDI) in export sectors can boost output and labor demand. This is especially important for countries that are scarcely endowed with capital, technology, and knowledge. Boosting FDI is one way of increasing local production, which in turn increases the demand for local workers. This process is part of the broader mechanism by which competitive export sectors expand and absorb workers displaced from import-competing sectors. Indeed, a higher share of FDI stocks in a country's GDP over the period 2000-18 shows a strong positive correlation with its export job share in 2018, especially in Cambodia, Thailand, and Vietnam, but also in Bulgaria, Hungary, and Slovakia (Figure 27).

Figure 26: FDI as correlate of countries' export job shares in 2018



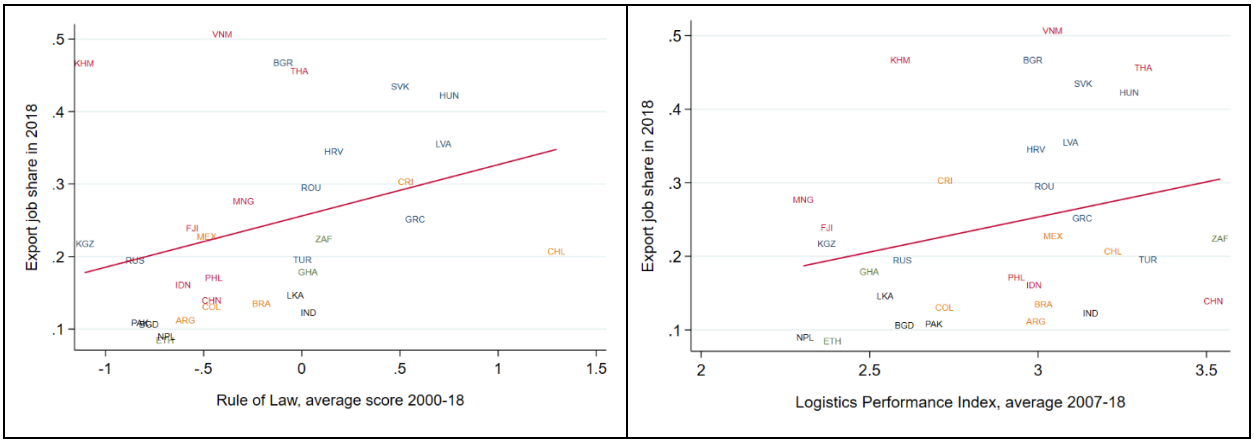
Source: Own computations. Data: OECD TiE, Job activities in exports database, WDI. Note: The country sample includes emerging and developing countries from the OECD TiE and Job Activities in exports datasets. P-value = 0.000. The bivariate regressions do not control for any covariates.

The quality of a country's institutions shapes how it engages in trade and GVCs and thus its potential to generate more and better jobs. Competition policy, contract enforcement mechanisms, and the protection of property rights increase market efficiency and investor confidence. They also facilitate the reallocation of resources towards contract-intensive sectors, such as electronics, electrical equipment, and transport manufacturing, that require relationship-specific investments and have been linked to growth in employment and labor incomes. Higher institutional quality is positively correlated with a higher

share of jobs in exports. A higher average rule-of-law score over the period 2000-18 is positively associated with a larger percentage of jobs in exports in 2018 among emerging and developing countries (Figure 28, left panel).

Physical and digital connectivity and infrastructure can lower trade costs at borders or behind them, thereby facilitating trade in goods and services and lowering effective distance to key markets (Figure 28, right panel). Therefore, it is also linked to higher job and income creation. A higher score in the World Bank's Logistics Performance Index over the period 2007-18 is positively correlated with a country's export job share in 2018, albeit with considerable variation. All countries with very high export job shares show relatively high logistics performance, Cambodia being the exception. But logistics performance can also be high in countries with low export job shares, either because of their large size (China, India) or their strong reliance on commodity exports, which do not support many jobs (Argentina, Brazil).

Figure 27: Rule of law and connectivity as correlates of countries' export job shares in 2018



Source: Own computations. Data: OECD TiE, Job activities in exports database, WGI, LPI. Note: The country sample includes emerging and developing countries from the OECD TiE and Job activities in exports datasets. Left chart p-value = 0.075. Right chart p-value = 0.141 (0.042 excluding outliers China and South Africa). The bivariate regressions do not control for any covariates.

6. Summary and conclusions

The relationship between trade and jobs depends on the type of trade engagement, the country and sector context and the period under study. Both exports and imports of goods and services are linked to increased average employment within sectors over the period 1995-2018 in a sample of 48 HMICs. However, the findings also suggest that the relationship with average labor incomes has been stronger. A 10 percent increase in exports is associated with a 3.1 percent increase in employment and a 3.9 percent gain in labor incomes. Intermediate imports of goods and services are even more strongly associated with employment and income gains. The role of final imports was also positive, but less pronounced because they also compete with domestic production (and thus employment) in a sector.

The analysis highlighted the strong role of the manufacturing sector in creating jobs, in both the HMIC and LMIC samples. The positive relationship between exports and employment (and incomes) in the sample of 48 HMICs was driven by the manufacturing sector. A 10 percent increase in exports is correlated with an employment expansion within manufacturing of 5.3 percent and was particularly high in medium- and high-tech sectors. The overall gains were highest for countries participating in advanced manufacturing and services and limited manufacturing GVCs. Increased GVC participation for LMICs specialized in limited manufacturing is related to much larger within-sector employment growth than for commodity-exporting LMICs.

Examining patterns of total jobs in exports highlighted the importance of domestic supplying sectors in creating jobs and different patterns of sectoral specialization in high-income versus emerging countries. In manufacturing, employment in exports is higher in supplying sectors (e.g., services or agriculture) than in the exporting sectors themselves. Emerging countries added more jobs in manufacturing exports, while high-income countries created more jobs linked to business services exports. The latter made up for falling jobs in manufacturing exports (e.g., the US and Western Europe). The findings also highlight the growing number of jobs in business services exports across all countries, reflecting the structural transformation away from manufacturing and towards services in the sample of HMICs. A few emerging countries showed higher growth of manufacturing-linked jobs than business services-linked jobs in exports, including Türkiye, Mexico, Chile, Czechia, Indonesia, the Slovak Republic, and China.

Adding the occupational dimension to sectoral specialization patterns allowed us to assess different upgrading trajectories at the level of activities. Services activities in exports, such as support, engineering, and managerial services, are becoming increasingly important as countries get richer, while production activities continue to dominate the exports of lower-income countries. The analysis highlighted the fundamental shift in manufacturing activities taking place between 2000 and 2018, offering more opportunities for structural change in lower-income countries. The analysis also suggested that GVC-intensive countries such as Vietnam, Mexico, Poland, and Ethiopia tend to have larger shares of production activities in exports compared to resource-intensive countries, like Indonesia, Kyrgyz Republic, Brazil, and Ghana. Even among countries that export similar products, the activities that workers perform have different implications for growth. For example, in Cambodia, textile workers have been stuck in low value-added production activities for two decades. On the other hand, in Türkiye, the labor composition of textile exports is more diverse and includes sophisticated managerial and engineering services.

Tailored policies are essential to harness the job creation benefits from trade. While trade policies are a fundamental instrument, long-term success also relies on minimizing worker adjustment costs influenced by macroeconomic conditions, labor markets, and infrastructure. Education plays a crucial role in enabling economies to seize trade opportunities by shaping skill supply and comparative advantage. Countries with a highly skilled workforce are better poised to engage in knowledge-intensive trade activities. Labor market flexibility, characterized by fewer regulations, supports worker mobility and correlates with higher export-driven employment. Lowering tariffs and non-tariff measures enlarges market size, especially in non-commodity exporting developing countries. Foreign direct investment in export sectors can boost labor demand and productivity, especially in countries with limited resources. Strong institutions, effective competition policies, and infrastructure are vital for generating high-quality jobs. Considering these factors can help policy makers maximize the job creation potential from trade while minimizing adjustment costs for workers.

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Appendices

Appendix 1: Estimating the static effects of trade on employment and incomes

Trade-employment elasticities

A linearly homogeneous cost function, conditional on the level of output *Y*, is given as follows:

$$CV = CV(Y, w, r, p, T)$$

where *w* designates wages, *r* the rental rate on capital, p intermediate input prices, and *Y* the constant output. The technology shifter *T*=*T*(*trade*) is defined as a function of trade. Trade is measured in levels (in logs) and includes exports, imports (final and intermediate), and backward and forward global value chain (GVC) participation.

Applying Shephard's Lemma[26] and allowing for scale effects unconditional on output, the labor demand function (where *L* denotes labor) is derived and can be written in log-linear form as:

$$\ln L_{cst} = \alpha + \beta_1 \ln trade_{cst} + D_{cs} + D_{ct} + D_{st}$$

Due to the lack of comparable data for r and p, we rely on a vector of country-sector, country-time and sector-time fixed effects. While data for w are available, we exclude wages from the regressions to be able to directly compare trade-employment with trade-income elasticities.[27]

Trade-income elasticities

We apply the same estimation equation, with the exception of the dependent variable which becomes labor value added (LVA).

$$\ln LVA_{cst} = \alpha + \beta_2 \ln trade_{cst} + D_{cs} + D_{ct} + D_{st}$$

Since LVA = w*L, a larger (smaller, resp.) trade-income elasticity than trade-employment elasticity, $\beta_2 > \beta_1$ ($\beta_2 < \beta_1$, resp.), implies that the income channel is stronger (weaker, resp.) than the employment channel in a given context.

Estimation strategy

The regression analysis applies an instrumental variables (IV) approach to account for the endogeneity between the trade variables and employment (and labor incomes). According to trade theory, a trade shock (such as the reduction of trade costs) results in a change in relative prices. An increase in the relative price of a sector's output incentivizes producers to expand and export more, thus leading to a reallocation of resources, including employment, towards sectors of comparative advantage within countries.

However, it is possible that the process of resource reallocation itself leads to further trade expansion, for instance, by motivating firms to adopt imported technologies and to rely more strongly on imported inputs to support their export production. The causality between trade and employment (and labor incomes) can thus run both ways.

The analysis therefore uses two types of instruments at the country-sector level at time t, namely (i) trade of a country c's neighboring countries,[28] and (ii) trade of other countries that are part of the same GVC taxonomy group as country c (see Appendix 3 for further details on the taxonomy).

[26] According to Shephard's Lemma factor demand is determined by the first partial derivative of the cost function with respect to the corresponding factor price, regardless of the kind of production function.

[27] Our results suggest that elasticities are very similar in both specifications.

[28] For some island countries, we manually selected 'neighboring' countries, based on whether countries shared a maritime border and geographical distance. This included Australia, Japan, and New Zealand.

Several studies focusing on the local labor market effects of trade, including the China shock literature (e.g., Autor, Dorn and Hanson 2013), use trade trends of other countries at the sector level as an instrument for a country's own sectoral trade trends. It can be expected that other countries' trade is correlated with country c's own trade in sector s at time t, especially for neighboring countries or structurally similar countries, but that it does not affect country c's employment in sector s. While unobserved correlated productivity shocks between country c and similar countries in a sector s could affect their comparative advantage, trade flows and subsequently employment (and labor incomes), respectively, they are addressed by using sector-time fixed effects.

Specifically, for each export and import measure at the country-sector level, the model uses four instruments, namely (i) exports of neighboring countries, (ii) imports of neighboring countries, (iii) exports of other countries in the same GVC taxonomy group, and (iv) imports of other countries in the same GVC taxonomy group. This is to acknowledge that exports and imports at the country-sector level are linked. Those instruments are computed based on either total, intermediate or final trade flows to be consistent with the endogenous trade variable.

Similarly, for each backward and forward GVC participation measure at the country-sector level, the model uses four instruments, namely (i) backward GVC participation of neighboring countries, (ii) forward GVC participation of neighboring countries, (iii) backward GVC participation of other countries in the same GVC taxonomy group, and (iv) forward GVC participation of other countries in the same GVC taxonomy group. This is to acknowledge that backward and forward GVC participation at the country-sector level are closely linked.

Appendix 2: Datasets for econometric analysis

Sample of high- and middle-income countries

The first dataset covers 48 HMICs,[29] drawing on the OECD Trade in Employment (TiE) and OECD Trade in Value Added (TiVA) databases to obtain employment, labor value added, trade (exports, intermediate imports, final imports) and backward and forward GVC participation measures for 45 sectors over the period 1995-2018 (see Appendix 6 and 7 for the country and sector coverage).

Backward GVC participation measures the portion of imported inputs embodied in exports. Forward GVC participation measures the portion of domestic value added that is exported to a partner country and then re-exported by that country. We deflated the trade data, using value-added deflators for four broad sectors (agriculture, non-manufacturing industry, manufacturing and services) in the OECD dataset.

Domestic employment by industry statistics are drawn from various sources such as OECD's Annual National Accounts and Structural Analysis (STAN) databases, official national statistics and, in a very few cases, from research projects such as, for example, India KLEMS (Das et al., 2017). Employment is defined as persons engaged in production activity within the National Accounts boundary of the resident institutional unit (domestic concept) and includes both employees and self-employed. If there are no estimates of employment by industry in official National Accounts statistics, then Labor Force Survey (LFS) statistics are exploited. National Accounts are preferred to LFS as a source for employment by industry since LFS are usually based on residential households and thus exclude non-resident workers while including resident workers commuting abroad (national concept).

The countries include:

- 37 OECD member countries: Australia, Austria, Belgium, Canada, Chile, Colombia, Costa Rica, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Israel, Italy, Japan, Republic of Korea,

[29] Only China, India and Indonesia had low-income status for some years during this period.

Latvia, Lithuania, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Türkiye, United Kingdom, United States

- 11 non-OECD countries: Argentina, Brazil, Bulgaria, China (People's Republic of), Croatia, India, Indonesia, Romania, Russian Federation, Saudi Arabia, South Africa.

Sample of middle- and low-income countries

The second dataset covers 37 LMICs with employment data obtained from the Economic Transformation Database (ETD) covering 19 sectors (see Appendix 6 and 7 for the country and sector coverage). The analysis only includes countries that are commodity exporters or specialized in limited manufacturing as per 2015 (see Appendix 8).

The data are merged with export data from UN Comtrade and precomputed GVC measures of backward and forward GVC participation from Borin and Mancini (2019) drawing on EORA as data source. Backward GVC participation measures the portion of imported inputs embodied in exports. Forward GVC participation measures the portion of domestic value added that is not directly absorbed by the trade partners, but re-exported to other countries. These GVC participation measures are only available for 1995-2015.

While the original ETD consists of 12 broad sectors, with manufacturing only available in the aggregate, we obtained employment shares for nine disaggregated manufacturing sectors (based on UNIDO INDSTAN data) which were multiplied with total manufacturing employment from ETD to obtain employment levels, yielding employment information for a total of 20 sectors.[30] To be able to merge the ETD data with GVC participation measures from EORA, we further aggregated “Computer & Electronics" and "Machinery” into one sector, yielding a total of 19 sectors.

We used value added deflators for 12 sectors from the ETD database to obtain trade measures in real terms. For comparability with the sample of HMICs, the analysis covers the period 1995-2018.

The countries include:

- 9 East-Asia and Pacific (EAP) and South Asian (SA) countries: Bangladesh, Cambodia, Indonesia, the Lao People’s Democratic Republic, Myanmar, Nepal, Pakistan, Sri Lanka, and Vietnam**.**
- 8 Latin American countries (LAC): Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, and Peru.
- 3 Middle East and Northern African (MENA) countries: the Arab Republic of Egypt, Morocco, and Tunisia.
- 17 Sub-Saharan African (SSA) countries: Botswana, Burkina Faso, Cameroon, Ethiopia, Ghana, Kenya, Lesotho, Malawi, Mozambique, Namibia, Nigeria, Rwanda, Senegal, South Africa, Tanzania, Uganda and Zambia.

[30] These data draw on Pahl and Timmer (2019).

Appendix 3: 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 non-commodity 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, Czechia, Estonia, India, Lithuania, the Philippines, Poland, Portugal, Romania, Thailand, and Türkiye.

Czechia 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. 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 (2019b, p. 22-23).

Appendix 4: Measures of employment in exports

Employment in exports

Domestic employment in gross exports, y, can be computed as follows:

$$\mathbf{y} = \mathbf{c}(\mathbf{I} - \mathbf{A^D})^{-1}\mathbf{e}$$

e is a vector of exports with N designating the number of goods and services industries, $\mathrm{A^D}$ the N x N domestic coefficient matrix denoting the amount of domestic products used in the production of goods or services, I the N x N identity matrix with ones on the diagonal and zeros elsewhere, such that$(\mathbf{I} - \mathbf{A^D})^{-1}$ is the Leontief inverse. The latter ensures that all output related to exports is considered, not only that from the export sector, but also of other domestic sectors that contribute through the delivery of intermediate inputs.

c is a 1 x N vector with domestic employment over output coefficients in industry n.

Employment in exports for a country can be further decomposed into three elements:

- Direct: employment in industry n used in the production of goods and services exported by industry n.
- Indirect: employment in other, upstream, domestic industries (different from industry n) that is embodied in the exports of industry n.
- Re-imported: employment by any industry, used to produce exports of intermediate goods or services subsequently embodied in imports used in the production of exports by industry n.

Our analysis relies on precomputed measures from OECD's Trade in Employment database (2021 release), covering the period 1995-2018. For more details, see Horvát, Webb and Yamano (2020) "Measuring employment in global value chains".

Appendix 5: Measures of job activities in exports

The job activities in exports data provide estimates of the number of jobs embodied in aggregate exports for 59 countries. These jobs are split into 100 activities – where activities are defined as sector-occupation pairs – based on 5 occupations and 20 sectors. Similarly, the income activities in exports estimates the labor compensation embodied in aggregate exports which form the basis for the paper "Structural Change in Export Activities: An exploration using occupations data" (Kruse, Timmer, de Vries, and Ye 2023). The approach builds on the methodologies developed in "Functional specialisation in trade (2019)[31] and "Tracing value-added and double counting in gross exports: comment (2016)".[32]

Both estimates include (i) the direct job and income activity content of exports created within a sector (e.g., food and beverages exports) and (ii) the indirect job and income activity content created in domestic supplying sectors (e.g., agriculture) and are computed as:

$$\mathbf{z} = \mathbf{b}(\mathbf{I} - \mathbf{A^D})^{-1}\mathbf{e}$$

where z is a N x 1 vector with employment by occupation-sector-year in a country's exports, hence the job activity of exports.

b is a 1 x N vector with domestic employment over output coefficients in occupation and sector.

[31] Timmer et al. (2019).
[32] Los et al. (2016).

To obtain job activities in exports estimates, data on occupational employment and income by sector are combined with time series input-output tables for a large set of developed and developing countries covering the period from 2000 to 2018 (or sub-periods thereof).

Occupational grouping	Description	ISCO 88 codes	Activity
1	Legislators	[11]	Managerial
2	Managers	[12–13]	Managerial
3	Engineering professionals	[21, 31]	Engineering
4	Health professionals	[22, 32]	Other
5	Teaching professionals	[23, 33]	Other
6	Other professionals	[24, 34]	Support services
7	Clerical support workers	[41–42]	Support services
8	Personal service workers	[51, 910, 912–916]	Other
9	Sales workers	[52, 911]	Support services
10	Craft workers and machine operators	[71–74, 81–82, 93]	Production
11	Agricultural workers	[60-61, 92]	Production
12	Other, including armed forces	[01-03, 90,99]	Other
13	Drivers	[83]	Production

Activities are identified through a mapping from occupational categories of workers in detailed sectors and include five categories – engineering, managerial, support services, production and other activities. The concordance table of occupational groupings drawing on ISCO codes to these five activities is shown in the table below. Engineering includes (3) engineering professionals; Managerial includes (2) managers and (1) legislators; Support services include (6) other professionals, (7) clerical support workers, and (9) sales workers; Production includes (10) craft workers and machine operators, (11) agricultural workers, and (13) drivers; Others include (4) health professionals, (5) teachers, (8) personal support workers, and (12) others.

The analysis currently covers 52 countries included in the ADB MRIO database (2021 release) drawing on the ADB MRIO inter-country input-output tables to distinguish domestic from imported intermediate inputs, labor shares by sector (including compensation of employees and income from own-account workers), and detailed occupation by sector wages and employment that are nationally representative. Drawing on individual supply-use tables, a further set of Latin American (Chile, Colombia and Costa Rica) and Sub-Saharan African (SSA) countries (Ethiopia and Ghana) are included.

Appendix 6: Country samples, regression analysis

	OECD sample		
	Country	**iso3**	**Taxonomy**
1	Argentina	ARG	limited
2	Australia	AUS	commodity
3	Austria	AUT	innovation
4	Belgium	BEL	innovation
5	Brazil	BRA	limited
6	Bulgaria	BGR	limited
7	Canada	CAN	innovation
8	Chile	CHL	commodity
9	China	CHN	advanced
10	Colombia	COL	commodity
11	Costa Rica	CRI	limited
12	Croatia	HRV	limited
13	Cyprus	CYP	limited
14	Czechia	CZE	innovation
15	Denmark	DNK	innovation
16	Estonia	EST	advanced
17	Finland	FIN	innovation
18	France	FRA	innovation
19	Germany	DEU	innovation
20	Greece	GRC	limited
21	Hungary	HUN	advanced
22	India	IND	advanced
23	Indonesia	IDN	limited
24	Ireland	IRL	innovation
25	Israel	ISR	innovation
26	Italy	ITA	innovation
27	Japan	JPN	innovation
28	Korea, Rep.	KOR	innovation
29	Latvia	LVA	limited
30	Lithuania	LTU	advanced
31	Mexico	MEX	advanced
32	Netherlands	NLD	innovation
33	New Zealand	NZL	commodity
34	Norway	NOR	commodity
35	Poland	POL	advanced
36	Portugal	PRT	advanced
37	Romania	ROU	advanced
38	Russian Federation	RUS	commodity
39	Saudi Arabia	SAU	commodity
40	Slovak Republic	SVK	advanced
41	Slovenia	SVN	advanced
42	South Africa	ZAF	limited
43	Spain	ESP	innovation
44	Sweden	SWE	innovation
45	Switzerland	CHE	innovation
46	Türkiye	TUR	advanced
47	United Kingdom	GBR	innovation
48	United States	USA	innovation

	ETD sample		
	Country	**iso3**	**Taxonomy**
1	Argentina	ARG	limited
2	Bangladesh	BGD	limited
3	Bolivia	BOL	commodity
4	Botswana	BWA	commodity
5	Brazil	BRA	limited
6	Burkina Faso	BFA	commodity
7	Cambodia	KHM	limited
8	Cameroon	CMR	commodity
9	Chile	CHL	commodity
10	Colombia	COL	commodity
11	Costa Rica	CRI	limited
12	Ecuador	ECU	commodity
13	Egypt, Arab Rep.	EGY	commodity
14	Ethiopia	ETH	limited
15	Ghana	GHA	commodity
16	Indonesia	IDN	limited
17	Kenya	KEN	limited
18	Lao PDR	LAO	commodity
19	Lesotho	LSO	commodity
20	Malawi	MWI	commodity
21	Morocco	MAR	limited
22	Mozambique	MOZ	commodity
23	Myanmar	MMR	commodity
24	Namibia	NAM	limited
25	Nepal	NPL	limited
26	Nigeria	NGA	commodity
27	Pakistan	PAK	limited
28	Peru	PER	commodity
29	Rwanda	RWA	commodity
30	Senegal	SEN	commodity
31	South Africa	ZAF	limited
32	Sri Lanka	LKA	limited
33	Tanzania	TZA	limited
34	Tunisia	TUN	limited
35	Uganda	UGA	commodity
36	Vietnam	VNM	limited
37	Zambia	ZMB	commodity

Source: World Bank. Note: Taxonomy group as of 2015.

Appendix 7: Sector coverage, regression analysis

Code	OECD TiVA sectors
D01T02	Agriculture, hunting, forestry
D03	Fishing and aquaculture
D05T06	Mining and quarrying, energy producing products
D07T08	Mining and quarrying, non-energy producing products
D09	Mining support service activities
D10T12	Food products, beverages and tobacco
D13T15	Textiles, textile products, leather and footwear
D16	Wood and products of wood and cork
D17T18	Paper products and printing
D19	Coke and refined petroleum products
D20	Chemical and chemical products
D21	Pharmaceuticals, medicinal chemical and botanical products
D22	Rubber and plastics products
D23	Other non-metallic mineral products
D24	Basic metals
D25	Fabricated metal products
D26	Computer, electronic and optical equipment
D27	Electrical equipment
D28	Machinery and equipment, nec
D29	Motor vehicles, trailers and semi-trailers
D30	Other transport equipment
D31T33	Manufacturing nec; repair and installation of machinery and equipment
D35	Electricity, gas, steam and air conditioning supply
D36T39	Water supply; sewerage, waste management and remediation activities
D41T43	Construction
D45T47	Wholesale and retail trade; repair of motor vehicles
D49	Land transport and transport via pipelines
D50	Water transport
D51	Air transport
D52	Warehousing and support activities for transportation
D53	Postal and courier activities
D55T56	Accommodation and food service activities
D58T60	Publishing, audiovisual and broadcasting activities
D61	Telecommunications
D62T63	IT and other information services
D64T66	Financial and insurance activities
D68	Real estate activities
D69T75	Professional, scientific and technical activities
D77T82	Administrative and support services
D84	Public administration and defence; compulsory social security
D85	Education
D86T88	Human health and social work activities
D90T93	Arts, entertainment and recreation
D94T96	Other service activities
D97T98	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use

ISIC Rev. 4	ETD sectors
A	Agriculture
B	Mining
C	Manufacturing
	Manufacturing; Computer & electrical, machinery
	Manufacturing; Food
	Manufacturing; Furniture, others
	Manufacturing; Mineral and metals
	Manufacturing; Petrol, chemicals and rubber
	Manufacturing; Textiles
	Manufacturing; Transport
	Manufacturing; Wood, paper and print
D+E	Utilities
F	Construction
G+I	Trade services
H	Transport services
J+M+N	Business services
K	Financial services
L	Real estate
O+P+Q	Government services
R+S+T+U	Other services

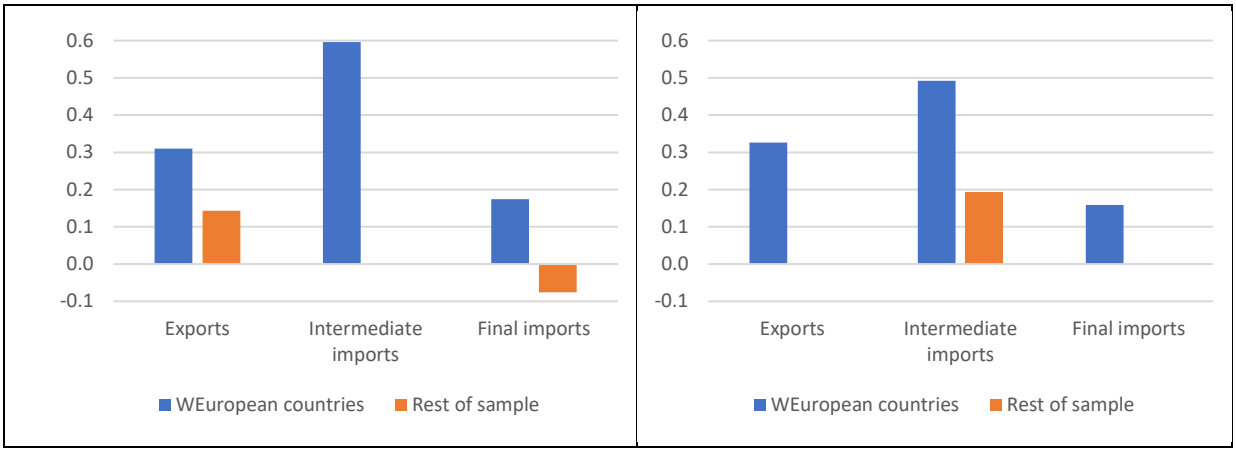
Appendix 8: World Bank income classifications, 1995, 2007 and 2018

iso3	income1995	income2007	income2018
arg	UM	UM	UM
aus	H	H	H
aut	H	H	H
bel	H	H	H
bgr	LM	UM	UM
bra	UM	UM	UM
can	H	H	H
che	H	H	H
chl	UM	UM	H
chn	L	LM	UM
col	LM	LM	UM
cri	LM	UM	UM
cyp	H	H	H
cze	UM	H	H
deu	H	H	H
dnk	H	H	H
esp	H	H	H
est	LM	H	H
fin	H	H	H
fra	H	H	H
gbr	H	H	H
grc	UM	H	H
hrv	UM	UM	H
hun	UM	H	H
idn	LM	LM	LM
ind	L	LM	LM
irl	H	H	H
isl	H	H	H
isr	H	H	H
ita	H	H	H
jpn	H	H	H
kor	H	H	H
ltu	LM	UM	H
lux	H	H	H
lva	LM	UM	H
mex	UM	UM	UM
mlt	UM	H	H
nld	H	H	H
nor	H	H	H
nzl	H	H	H
pol	LM	UM	H
prt	H	H	H
rou	LM	UM	UM
rus	LM	UM	UM
sau	UM	H	H
svk	LM	H	H
svn	UM	H	H
swe	H	H	H
tur	LM	UM	UM
usa	H	H	H
zaf	UM	UM	UM

Source: World Bank.

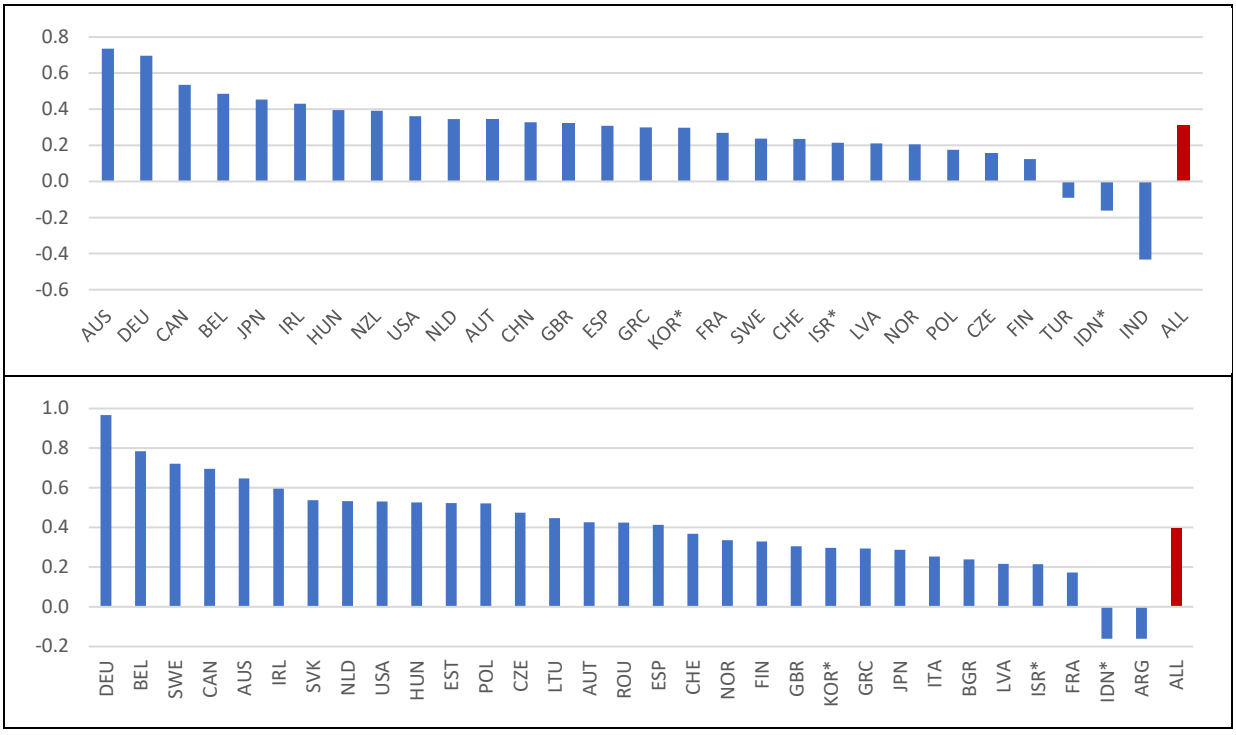
Appendix 9: Additional figures

Figure 9.1: Trade-employment (left) and trade-income elasticities (right), Western Europe vs. rest of sample



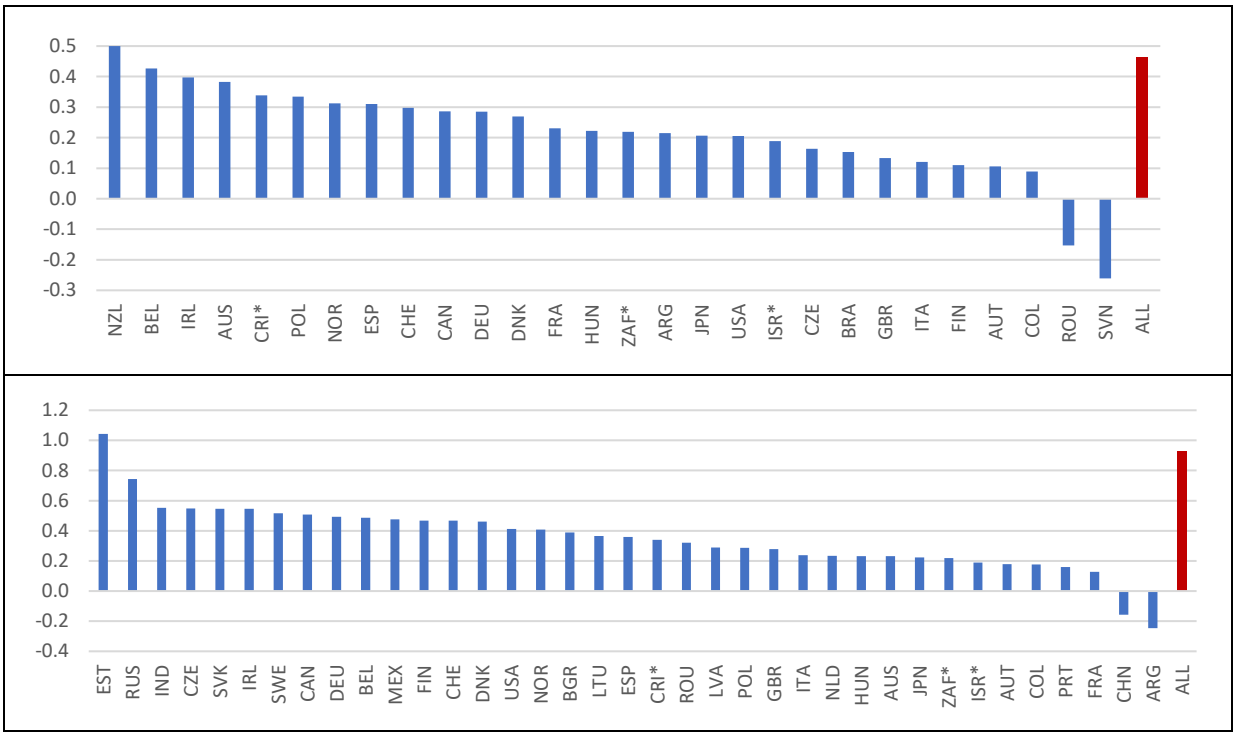
Source: Own computations. Data: OECD TiE and TiVA data, covering 48 countries and 45 sectors for the period 1995-2018. Note: Trade-employment (trade-income, resp.) elasticities at the country-sector level have been estimated using an instrumental variables regression approach with employment (labor income, resp.) (in natural logs) as dependent variable and the instrumented trade variables (in levels and natural logs) as independent variable. The panel data regressions control for country-sector, country-time, and sector-time fixed effects. Only results significant at the 10% level and above the critical value for the Kleibergen-Paap test statistic are reported. For more information, see Appendix 1. WEuropean = Western European countries which include the EU, Norway, Switzerland and United Kingdom.

Figure 9.2: Export-employment (upper panel) and export-income elasticities (lower panel), by country



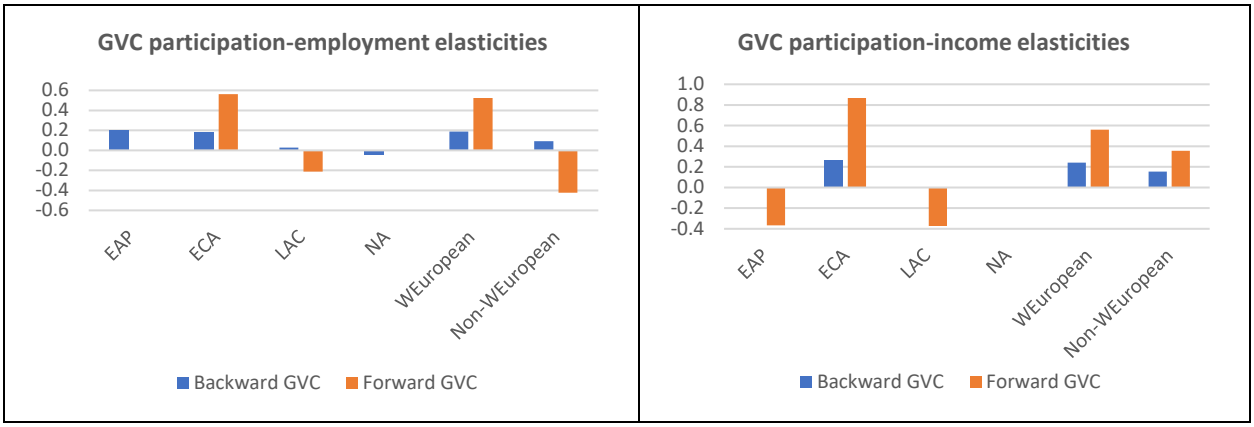
Source: Own computations. Data: OECD TiE and TiVA data, covering 48 countries and 45 sectors for the period 1995-2018. Note: Export-employment (export-income, resp.) elasticities at the country-sector level have been estimated using an instrumental variables regression approach with employment (labor income, resp.) (in natural logs) as dependent variable and the instrumented trade variables (in levels and natural logs) as independent variable. The country-level panel regressions controls for country and sector fixed effects. Only results significant at the 10% level and above the critical value for the Kleibergen-Paap test statistic are reported. *Regressions with an asterisk did not have sufficient neighboring countries, so applied only one instrument (other countries' trade within the same taxonomy group). For more information, see Appendix 1.

Figure 9.3: Import-employment (upper panel) and import-income elasticities (lower panel), by country



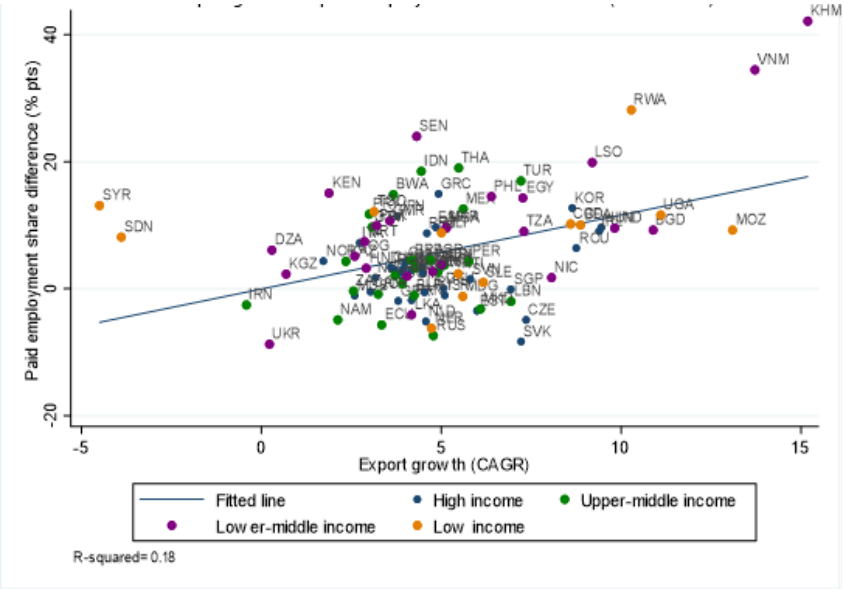
Source: Own computations. Data: OECD TiE and TiVA data, covering 48 countries and 45 sectors for the period 1995-2018. Note: Import-employment (import-income, resp.) elasticities at the country-sector level have been estimated using an instrumental variables regression approach with employment (labor income, resp.) (in natural logs) as dependent variable and the instrumented trade variables (in levels and natural logs) as independent variable. The country-level panel regressions controls for country and sector fixed effects. Only results significant at the 10% level and above the critical value for the Kleibergen-Paap test statistic are reported. *Regressions with an asterisk did not have sufficient neighboring countries, so applied only one instrument (other countries' trade within the same taxonomy group). For more information, see Appendix 1.

Figure 9.4: GVC participation-employment and GVC participation-income elasticities, by region



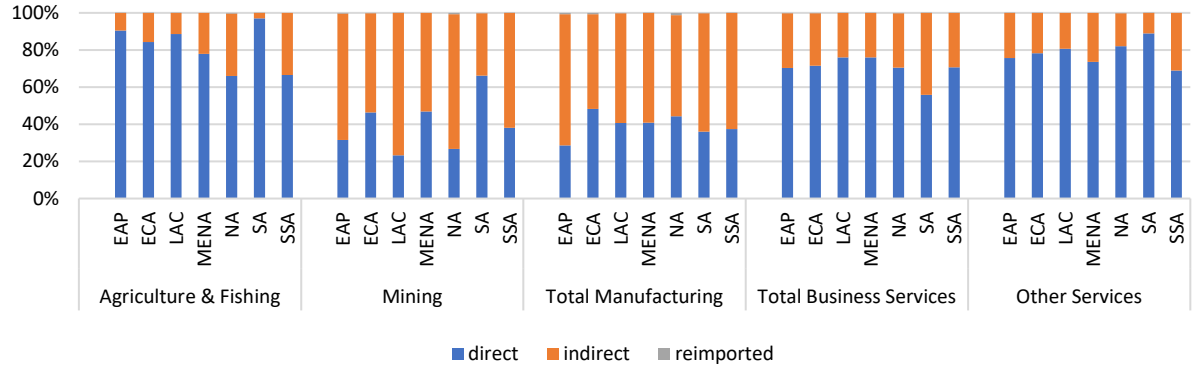
Source: Own computations. Data: OECD TiE and TiVA data, covering 48 countries (see Appendix 2) and 45 sectors for the period 1995-2018. Note: GVC participation-employment (GVC participation-income, resp.) elasticities at the country-sector level have been estimated using an instrumental variables regression approach with employment (in natural logs) as dependent variable and the instrumented trade variables (in levels and natural logs) as independent variable. The panel data regressions control for country-sector, country-time, and sector-time fixed effects. Only results significant at the 10% level and above the critical value for the Kleibergen-Paap test statistic are reported. GVC taxonomy group by World Bank (2020). For more information, see appendix 1. EAP = East Asia and Pacific, ECA = Europe and Central Asia, LAC = Latin America and Caribbean, NA = North America, WEuropean = EU, Norway, Switzerland, United Kingdom. Other world regions did not have sufficient country coverage.

Figure 9.5: Export growth vs. paid employment share difference (1991-2019)



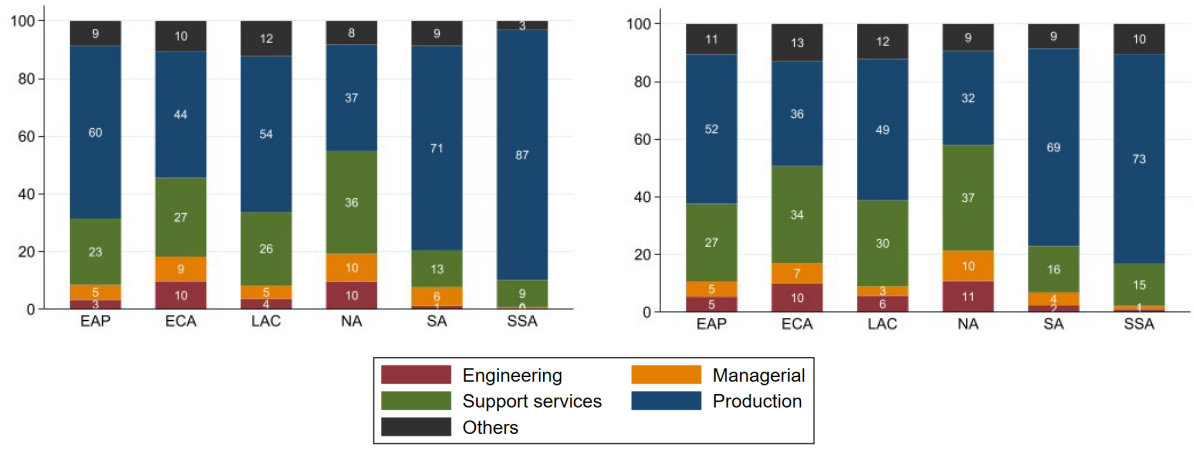
Source: Own computations. Data: Exports of goods and services and paid employment shares are from WDI.

Figure 9.6: Direct and indirect employment in exports, by broad sector and region, 2018



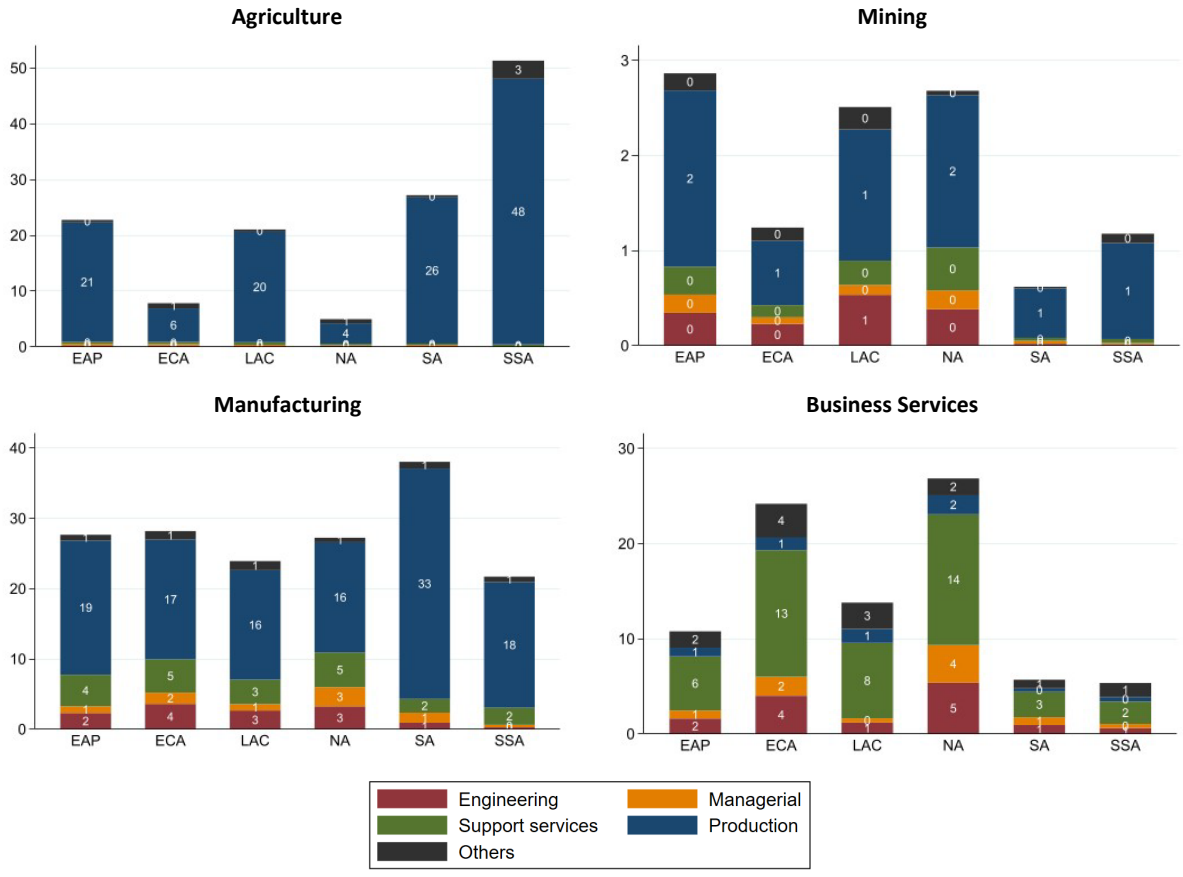
Source: Own computations. Data: OECD TiE. The country sample covers 38 OECD countries plus 13 non-OECD countries. Note: Employment in exports can be decomposed into its (1) direct contribution in the exporting sector, (2) indirect contribution in sectors supplying to the export sector, and (3) contribution of reimported inputs. MENA only consists of Israel, Malta and Saudi Arabia, while South Africa is the only SSA country and India the only SA country in the sample.

Figure 9.7: Jobs in exports, by occupation and regions, 2000 (left) and 2018 (right)



Source: Kruse, Timmer, de Vries, and Ye (2023). Note: Job Activities in Exports Database covering 59 countries and 20 sectors. SSA includes Ethiopia and Ghana only. See Appendix 5 for details.

Figure 9.8: Job activities in exports, by broad industries and regions



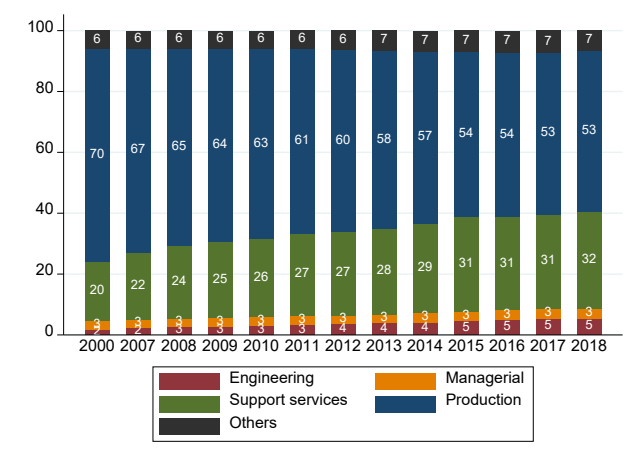
Source: Kruse, Timmer, de Vries, and Ye (2023). Note: Job Activities in Exports Database covering 59 countries. The graphs refer to 2018. Business services include ISIC Rev. 4 sectors 31 and 34-39 (covering post and telecommunications, financial intermediation, real estate activities, renting of machinery and equipment and other business activities). See Appendix 7 for details. SSA contains only Ethiopia and Ghana.

Appendix 10: China's upgrading of jobs in exports

While declines in backward GVC participation have been observed across many countries during the 2010s that were already strongly engaged in GVCs, China's decline has been recorded already before the global financial crisis. Drawing on firm-level customs transaction data and manufacturing firm survey data, estimates suggest an increase in China's domestic value added in exports between 2000 and 2007 from 65 to 70 percent (Kee and Tang 2015). This mainly reflected the substitution of foreign for domestic inputs of Chinese processing exporters. The latter went hand in hand with the increasing volume and variety of domestic inputs, fueled by liberalization of trade and foreign direct investment in the 2000s. The analysis rules out other possible drivers, such as increasing wages, firm entry and exit, and the changing composition of exports sectors towards higher domestic value added (Kee and Tang 2015).

Analyzing the jobs composition of China's exports between 2000 and 2018 complements the above finding in several aspects. First, our analysis (Appendix Figure 10.1) highlights in which occupational groups domestic value added in exports has been created. Between 2000 and 2007, China's composition of jobs in exports show a slight decline of production activities, while support services activities gained in importance. These trends accelerated in the subsequent years, with production activities representing only around 50 percent of China's exports in 2018, down from roughly 70 percent in 2007. While this shift was mainly offset by the larger role of support services activities, we also find a growing importance of engineering activities embodied in China's exports (Appendix Figure 10.1).

Figure 10.1: Job activities in exports, China, 2000-2018



Source: Kruse, Timmer, de Vries, and Ye (2023).