

Global value chains and employment in developing economies

Claire H. Hollweg (World Bank Group)

ABSTRACT

The emergence of global value chains – whereby goods that used to be produced within one country are now fragmented and distributed across global networks of production – has offered developing countries new opportunities to integrate into the global economy. This has also had fundamental impacts for workers in developing countries. The chapter shows that higher earnings and employment within sectors and firms is associated with GVC integration, which also supports other spillovers that operate through labor markets. But it has also had distributional implications of where jobs go and the types of jobs they are. Jobs growth has occurred directly in the export sector, as well as indirectly through

linkages of exporting firms to domestic, input-supplying firms. Employment creation and wage gains have been biased towards more skilled workers in developing countries, which contrasts with the predictions of trade theory. The skill-biased nature of GVC trade is associated with increased complexity of global supply chains as well as increased use of skill-intensive inputs, notably services. New emerging trends, including automation and digitization, may further determine how employment in developing countries will be affected by GVC trade in the future. The findings point to education as well as trade and labor policies as important factors for strengthening the GVC-labor relationship.

- The emergence of GVCs has offered developing countries opportunities to integrate into the global economy, which has had a significant impact on jobs and income in GVC sectors and firms. Integration can have additional benefits for the wider economy as most jobs are generated through upstream domestic supply chains.
- Across the developing world, demand for skilled labor is rising. GVCs reinforce this trend by supporting more complex industrial organization and by relying on complementary skill-intensive services inputs.
- The impacts of technological change and increased productivity on employment linked to GVCs have been offset by growing consumer demand.

1. Introduction

The emergence of global value chains – whereby goods that used to be produced within one country are now fragmented and distributed across global networks of production – has offered developing countries new opportunities to integrate into the global economy. Countries no longer need to develop entire industries to export; firms instead can access global markets by specializing in specific products or tasks within a value chain. Today, significant parts of the developing world are deeply involved in GVCs, with developing countries' share in global GVC trade estimated at about 33 percent in 2011 (Kummritz and Quast 2017).

Though powered by new technologies, the economic incentives for GVC trade were largely driven by access to lower-cost labor. Offshoring happened initially in assembly activities in light manufacturing, but GVCs have since expanded to agricultural and services sectors, as well as higher technology and more knowledge intensive manufacturing industries. This unbundling of production is expected to have implications for labor markets – where jobs go, who gets them, and what type of jobs they are (Farole 2015).

There are reasons to expect that the nationwide employment effects of GVC integration are different in developing than in developed countries. For example, workers in developing countries often participate in different segments and tasks within GVCs than do workers in developed countries. Similarly, the introduction of new technologies may impact the GVC participation of developed and developing countries differently. GVCs are a channel for the transmission of new technologies from developed to developing countries, which could also result in additional spillover effects of participation in terms of learning. Trade is also shown to increase the demand for skills, but the implications for workers may be different in developing countries that are abundant in unskilled labor and tend to participate in lower-skilled segments of value chains.

This chapter focuses on the nationwide implications of GVC integration for workers in developing countries, in terms of jobs and wages, sector of employment, and skills. It also explores technological change from the perspective of GVCs and its implication for jobs and skills going forward. The chapter considers that GVC trade may not have the same effects on developing countries as non-GVC trade does, and takes a GVC focus when looking at these impacts. In doing so, it addresses four policy-relevant questions.

First, how do GVCs impact jobs and earnings in developing countries? Supporting better jobs and higher wages are a primary policy objective, which necessitates an understanding of the relationship between GVC participation and these labor market outcomes.

Second, does GVC trade have other development impacts on workers? There is a large literature showing that exporting and importing raise productivity. Many of these impacts happen through labor markets, for example through learning

and technology dissemination. Whether and how these spillovers occur through GVC trade is important for policy.

Third, is GVC trade associated with increased demand for skilled labor in developing countries? And if so, through what channels? The factor-endowment theory of trade predicts that trade will reduce returns to unskilled labor in advanced economies while raising returns to capital and skilled labor. However, the developing world shows rising relative demand for skilled labor, similar to advanced economies. Whether these trends are associated with GVC participation is important to understanding the implications of GVCs for workers.

Fourth, how are technological advancements within GVC trade affecting jobs and skills in developing countries? New technologies are transforming the production process and altering our world of work (Hallward-Driemeier and Nayyar 2017), and many policy makers are deeply concerned about the impact of automation on assembly jobs in important GVC sectors.

The chapter shows that GVC integration has supported jobs and earnings, as well as other spillovers that operate through labor markets. Job and wage gains have been achieved not only within the exporting sector, but indirectly through linkages of exporting firms to domestic, input-supplying firms. However, GVC expansion in developing countries is also associated with higher relative demand for skilled workers. The chapter illustrates that characteristics of GVCs themselves, by supporting more complex industrial organization, as well as services inputs that are complementary to value chains, can be skill-biased.

The chapter also shows that technological advancements that largely get diffused through global value chains are affecting how GVCs support jobs in developing countries. Evidence suggests that changes in efficiency in GVCs has negative impacts on employment linked to countries' participation in the global production of products, all else equal. Technological innovation has also lowered the demand for low-skilled workers relatively more than compared to high-skilled workers. Nevertheless, the adverse effects of changing production technologies and efficiencies on employment have been offset by increased consumer demand, whereby the domestic consumption expenditures in large emerging economies such as China and India will generate new demand for labor for the global economy.

The chapter proceeds as follows. Section 2 surveys the empirical literature linking GVC participation to nationwide job and wage trends in developing countries. Section 3 discusses other spillovers resulting from features specific to GVCs that operate through countries' labor markets. The potential links between GVC participation and the relative demand for skilled labor in developing countries are examined in Section 4, including specific features of GVCs that could be behind this trend. Section 5 analyzes the potential implications of new technologies for GVCs from the perspective of labor markets. Section 6 identifies policy considerations for developing countries to achieve better labor-market outcomes from GVC participation. Section 7 concludes.

2. GVCs and nationwide jobs and earnings in developing economies

A first step in analyzing the employment impact of GVCs on developing countries should consider not only the direct impact on jobs and wages, but also the nationwide implications for workers across sectors of the economy.

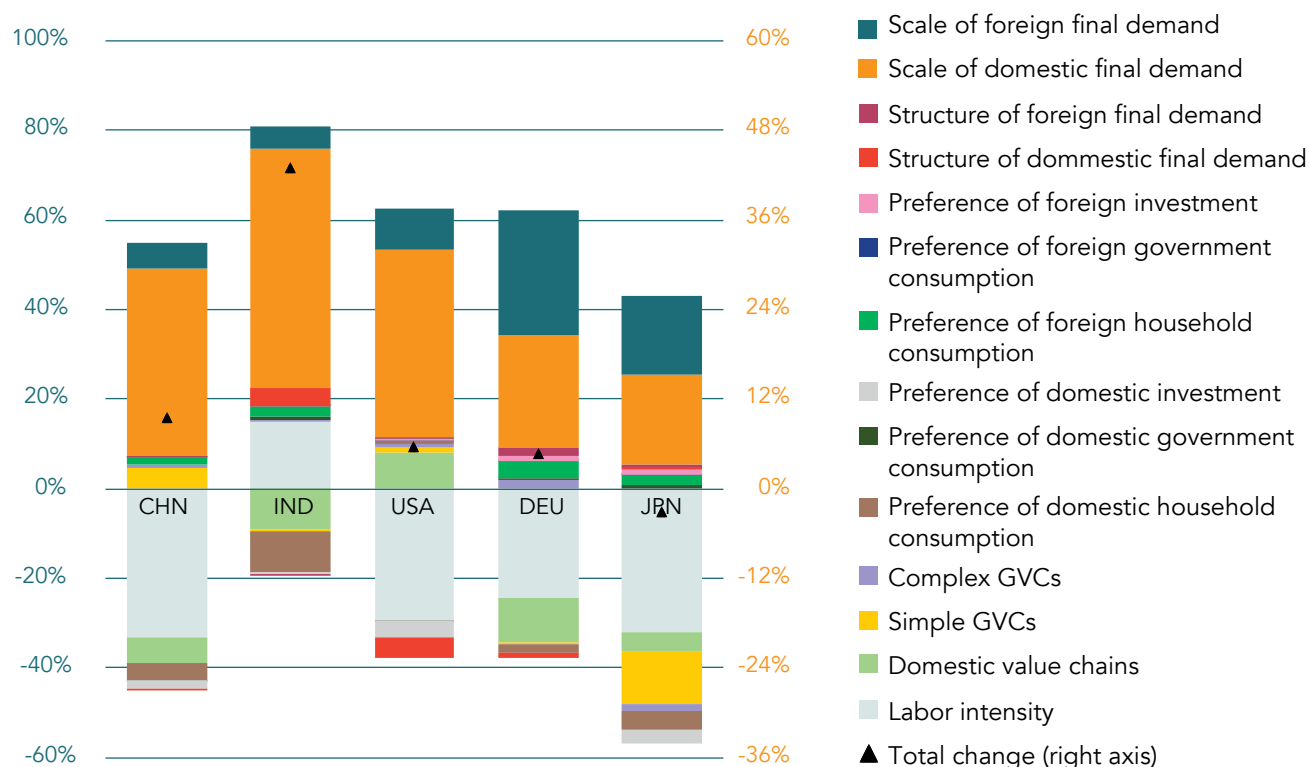
How do GVCs impact jobs and earnings in developing countries? While there is a decades-long catalogue of literature on the labor market impact of trade, the literature on the relationship between GVCs and labor market outcomes is more nascent, though growing. Empirical studies are often limited to individual country studies and have focused mainly on high-income countries, although some contributions have focused on developing countries.

Meng, Xiao, and Ye (2018) use a GVC-based structure decomposition analysis to identify determinant factors associated with the change in employment at the country level. Their decomposition is based on the World Input-Output Database (WIOD) at constant prices for the period of 2002-2007, 2007-2009, and 2009-2014. The objective is to better understand how GVCs affect employment at the country level.

Using the structural decomposition methodology, the change in employment between two different points of time can be explained by several factors, such as the change in domestic final demand, domestic production technology, exports and imports. In addition, this tool can be used to measure how much of the change in employment is caused by each of these factors. Unlike previous work, this chapter follows the approach used in Wang et al. (2017) to explicitly separate the impact of international trade into that related to traditional trade, simple GVCs and complex GVCs. This not only helps identify how changes in GVC participation affect employment, but also helps measure how other factors impact employment via various GVC routes.

In the model, a change in a country's employment is decomposed into the change in labor productivity, the change in GVC production networks (further explained by the change in pure domestic value chains, simple GVCs, and complex GVCs), and the change in final demand (further explained by the change in the level of final demand, the change in household / government / investment preferences, and the change in the structure of domestic expenditure). The results are presented in Figure 3.1 for the most recent period 2009 to 2014 for selected countries including China, India, the United States, Germany and Japan.

FIGURE 3.1 Decomposition of the change of a country's labor between 2009 and 2014



For each country, the figure plots the percentage change in jobs due to each of the separate effects, holding all else equal. Summing across all effects gives the total percent change in jobs at the country level.

Increased participation in GVCs – especially in complex GVCs whereby cross-border transactions happen more than twice – is associated with employment increases in all five countries. However, the positive impacts from increased participation in complex GVCs from 2009 to 2014 are getting smaller compared to the earlier periods analyzed in Meng, Xiao and Ye (2018). The impact of the change in simple GVCs is no longer positive for all countries, as it had previously been. Thus, the role played by GVCs in increasing employment has fallen since 2002-2007 and 2007-2009. The most important factors for employment growth are increases in domestic and foreign final demand, while labor productivity (output per worker) is the most important factor associated with reduced employment.

Other literature confirms the positive association between GVC participation and employment growth. The 2016 World Bank book *Stitches to Riches* (Lopez-Acevedo and Robertson, 2016) shows, based on data on the apparel sector in South Asia between 2000 and 2010, that when a country experiences a 1 percent increase in apparel output (which is used as a proxy for apparel exports), there is a 0.3-0.4 percent increase in employment. This increased overall welfare as workers moved out of agriculture or the informal sector toward these better paying, higher value-added jobs. Shingal (2015) summarizes case studies on Vietnamese and Bangladeshi garments, Vietnamese and South African textiles, and Kenyan and South African horticulture. Overall, these case studies show that GVC-participation is welfare improving, in the sense that it provides opportunities for employment and income gains.

Shepherd and Stone (2012) empirically test the relationship between labor outcomes and GVC participation using a cross-section of firm-level data for OECD and emerging economies of Brazil, India, Indonesia, China and South Africa and fixed effect regressions. They show that firms with the strongest international linkages, i.e. that import, export, and are foreign-owned, which serves as a proxy for GVC participation, show the highest employment levels. The positive effects of internationalization on labor demand is stronger for emerging markets than for OECD countries. Shepherd and Stone (2012) also find that firms with the strongest international linkages pay higher wages.

The relationship between GVC integration and level of employment is not necessarily positive in all contexts. Imports of goods and services (backward GVC participation) matter as much as exports of intermediates (forward GVC participation) to be successful in GVCs, where opening up to imports is often a pre-condition to successfully export. However, there may be import-competing effects in labor markets. In the case of India, Banga (2016) examines the industry-level impact of participation in GVCs on employment during 1995-2011. Using fixed effects and GMM estimation techniques, the author analyzes how increasing foreign value added in output, foreign value added in exports, and domestic value added in exports of intermediate goods can affect employment growth. The results reveal that higher backward linkages have negatively

influenced employment growth in India, more so in the non-manufacturing industries. However, higher forward linkages did not have any significant impact on employment.

Evidence as well as intuition suggests that GVC participation will have other distributional implications with respect to where jobs go, the types of jobs they are, and who gets them. For example, GVC participation has also had important implications for gender outcomes (see Box 3.1). Shepherd and Stone (2012) find that firms with international linkages hire a larger share of female workers, providing evidence that international linkages provide greater opportunities for women to enter the formal labor market. Women who previously had difficulty accessing this type of wage work have filled many of these jobs (Barrientos, Gereffi, and Rossi 2010).

Employment and wage growth can happen both directly within exporting firms as well as indirectly through these firms' demand for goods and services from the domestic economy, suggesting other distributional consequences. The extent to which GVCs interact with domestic labor thus depends on the linkages of exporting firms to domestic, input-supplying firms. Viet Nam is an example of a country that has benefitted greatly from trade opportunities, where exports support jobs both directly and indirectly (see Box 3.2).

The type of jobs also depends on the type of activities undertaken by firms within value chains, which also matters for GVCs development impact. As noted by Shepherd and Stone (2012), the labor market impacts of assembly operations, which are relatively low wage and low skill, are different from those of more high technology production processes, which tend to be associated with stronger relative demand for skilled labor and higher relative wages. For example, the boom in exports to the United States following the US-Viet Nam Bilateral Trade Agreement of 2001 was particularly beneficial to wages of unskilled workers, reduced the skill premium, and was a key driver of poverty reduction in Viet Nam because it was concentrated in unskilled, labor-intensive GVC sectors, most notably textiles (Fukase 2013; McCaig 2011).

3. GVCs and nationwide spillovers through labor markets

Are there other development impacts for workers of GVC trade? The opportunity for GVCs to impact labor markets goes beyond their direct and indirect impact on jobs and wages. There exists a large literature on spillover effects of learning by exporting as well as learning by importing. To the extent that GVC participation supports domestic firms in developing countries to import and export, this can be a key channel by which GVC participation supports spillovers.

First, this can happen through access to information and open markets (Shepherd and Stone 2012), or by importing inputs that contain knowledge and technology. The governance structure of GVC relationships between lead firms and suppliers suggest additional mechanisms for knowledge spillovers. Buyers and

BOX 3.1**GVCs and gender outcomes**

Evidence shows that women take on a larger share of jobs in labor-intensive value chains than do men. In sectors most intensively traded in GVCs – such as apparel, footwear, and electronics – lower-skilled, young, female workers account for the largest share of employment. In the Kenyan and Ugandan floriculture GVCs, women represent 65-75 percent of the labor force, working mostly in packhouses that offer higher incomes than on-farm labor does. In the apparel sector globally, women are a majority of the workforce. For example, in Turkey, two million of the three million workers in this sector in 2008 were women. In Bangladesh, approximately 80 percent of the garment workers in the same year were women (Kumar 2017).

Yet global value chain participation does not necessarily lead to gender equality. Gender inequalities in GVC participation can manifest in a number of ways and for a number of reasons. For example, there is gender segregation both across and within

sectors. Women workers are more likely to be located in lower value-added components of value chains, are paid less than men, and are more likely to face problematic working conditions. The benefits of women's participation in GVCs largely reflect greater numbers of jobs rather than opportunities to work in higher-paying jobs within a sector (Bamber and Staritz 2016).

The disadvantages women often face in endowments, including assets, education, experience, and social capital, make it difficult for them to access the better jobs resulting from participation in GVCs. This was found to be the case in call centers in Egypt, where limited access to education, training, promotion and networks made it difficult for women to take advantage of the rising demand for higher technical skills generated by product upgrading (Ahmed 2013). These gender-intensified constraints can restrict a country's ability to remain competitive and upgrade to higher-value segments of the chain.

BOX 3.2**Labor content of Viet Nam's exports¹**

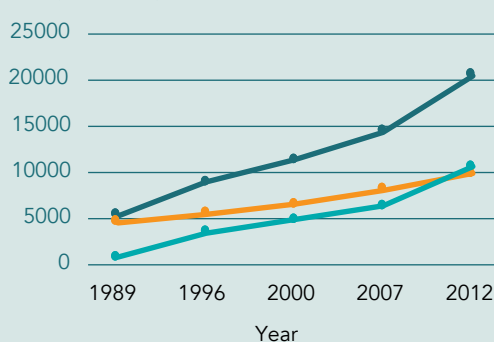
Exports have become increasingly important for jobs in Viet Nam. Following the methodology of Cali *et al.* (2016), Hollweg (2017) computes the jobs content of Viet Nam's exports using a panel of Viet Nam's input-output tables between 1989 and 2012, matched with sectoral employment data from Viet Nam's statistical yearbook. The calculations yield a set of linkages, both direct and indirect, across sectors of the number of jobs employed in export production. From 1989 to 2012, the total number of jobs supported by Viet Nam's

exports – taking into account both the direct and indirect jobs – increased from 5.3 million to 20.5 million, or from less than 1 in 5 jobs to more than 2 in 5 (19% employed directly by exports and another 21% of the workforce indirectly).

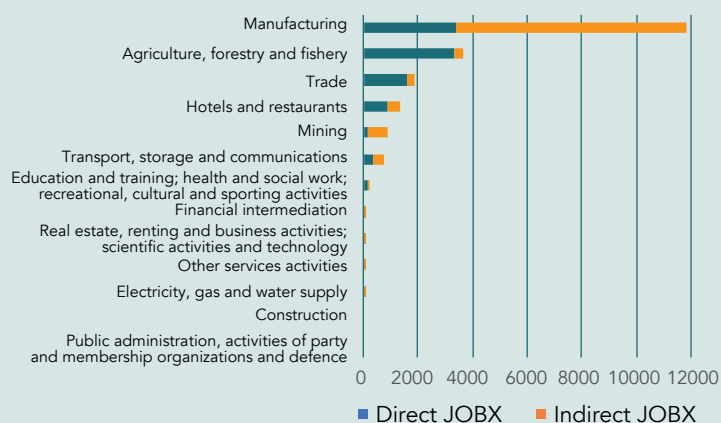
The manufacturing sector dominates the number of jobs in exports. In 2012, manufacturing exports supported 11.8 million jobs, or 58 percent of total export jobs, more than a 12-fold increase since 1989. However, most of these export jobs are indirect—about 71 percent in 2012.

FIGURE 3.2 Direct, indirect (backward) and total jobs content of exports, total (left) and across sectors (right)

Jobs (thousands)



— Total JOBX — Direct JOBX — Indirect JOBX



Source: Hollweg (2017). Calculations using Viet Nam's IO tables and employment data from Viet Nam's Statistical Yearbook.

BOX 3.3**China's import penetration in developed vs. developing countries**

What has been the impact of increasing imports of Chinese intermediate goods, including on labor markets, in other countries? Increased availability of Chinese goods and services is argued to have put pressure on employment in import-competing sectors in other countries. Autor, Dorn, and Hanson (2013) and Acemoglu *et al.* (2016) have shown a negative employment effect from Chinese import penetration. Bernard, Jensen, and Schott (2006), Mion and Zhu (2013) and Bloom, Draca, and Van Reenen (2016) also show import competition effects on firm employment, survival, technology and innovation.

In the context of shared international production, however, cheaper intermediate goods from China may also offer some countries competitive opportunities. Boffa, Santoni, and Taglioni (2018) quantify the impact of China's increased import penetration of intermediate goods in terms of output and value added of partner countries. The authors build a trade-weighted measure of China's import penetration, and empirically relate it with the growth rate of output and value added in partner countries. Since countries' imports from China depend on their own domestic production structure, this relationship may be endogenous. To overcome this endogeneity, Boffa, Santoni, and Taglioni (2018) instrument China's import penetration with the weighted average Chinese intermediate import penetration in all trade partners. Rather than using trade weights (which may also be endog-

enous), an orthogonal set of weights are constructed using a gravity-model specification to predict cross-country intermediate flows based on bilateral exogenous determinants.

The authors show that China's import penetration shock matters for output and value added in trading partners, but with differing effects across income groups with winners and losers (Figure 3.3). For high-income countries, higher import penetration of Chinese goods is associated with declines in gross output and value added. However, upper middle-income countries appear to have benefitted through deepening trade integration with China, where higher import penetration is associated with higher growth in gross output as well as value added. For low-income countries, the results are inconclusive, as there is no relationship once additional controls are added. Overall, China's market penetration has been an opportunity, rather than a threat, for some developing economies.

The degree of complementarity or substitution of domestic production with China's imports is one factor potentially driving these varying results. If production structures are substitutes, Chinese import penetration may displace local producers. On the other hand, China's trading partners may benefit in terms of value added and output if their production structures are complementary to China's. China requires inputs for its own production, which may stimulate foreign supply due to interregional linkages.

FIGURE 3.3 Estimated effect of China import penetration on gross output and value added



Note: Results of two-stage least squares estimates reported. Only significant estimates reported.

Source: Boffa, Santoni and Taglioni (2018).

suppliers exchange not only goods and services, but also know-how and technology. Based on qualitative data, Gyeke-Dako *et al.* (2017) find that firms that are inserted into GVCs in Ghana, whereby governance structures are characterized by lead firms, are more likely to have employment strategies that improve the quality of employment compared with firms that do not have links with lead firms. Learnings effects and feedback loops in tacit knowledge also occurs from using more sophisticated technology (MacGarvie, 2006). Similarly, there exist self-reinforcing complementarities between importing and innovation capabilities (Boeler, Moxnes, and Ulltveit-Moe, 2015).

Second, employer-sponsored training within GVCs can also be an effective mechanism for skills development. In Cambodia, exporters and foreign firms have a higher incidence of providing training to workers than non-exporters or domestic firms. A 2012 Employer Skills Needs Survey undertaken by the ILO and National Employment Agency (NEA) have information on training by ownership (foreign, Cambodian), and main market (international, national, local). Nearly three quarters of foreign firms and export firms provide training to workers, compared to 57 percent of domestic firms and 61 percent of firms that service the national market.

Third, better working conditions may also result from GVC participation, as governments seek to comply with buyers' standards on health, safety and treatment of workers. Where GVC employment generates better rights and protection for workers, it can enhance social upgrading. But often this employment is insecure and unprotected, and there are significant challenges ensuring decent work and pay for more vulnerable workers. The downward pricing pressure found in many GVCs has simultaneously led to negative social impacts. However, these outcomes do not necessarily occur automatically, and policies can support better working conditions (discussed below).

Fourth, growth and productivity spillovers can also materialize for developing countries that participate in GVCs. For example, access to cheaper or more diversified varieties and complementarities between imported inputs and domestic products leads to gains in scope and productivity, which is found to matter more than direct benefits from lower prices or higher quality of foreign inputs (Goldberg *et al.*, 2010; Halpern, Koren, and Szeidl, 2015). Boffa, Santoni and Taglioni (2018) show that the increased supply of intermediate products by China has had output and value added gains for middle-income countries (see Box 3.3).

4. GVCs and the relative demand for skilled labor

The hallmark of globalization is big developing countries opening up and joining global trade. In general, such economies are abundant in unskilled labor and scarce in skilled labor and capital relative to global averages. The factor-endowment theory of trade predicts that trade will reduce returns to unskilled labor in advanced economies while raising returns to capital and skilled labor. This trend has generally been observed. But the

opposite trend should occur in developing countries that open up: wages of unskilled workers, clearly the most abundant factor in many developing countries, should rise faster than other factor rewards. This has not happened in most developing countries; rather, employment creation and wage gains have been biased towards more skilled workers.

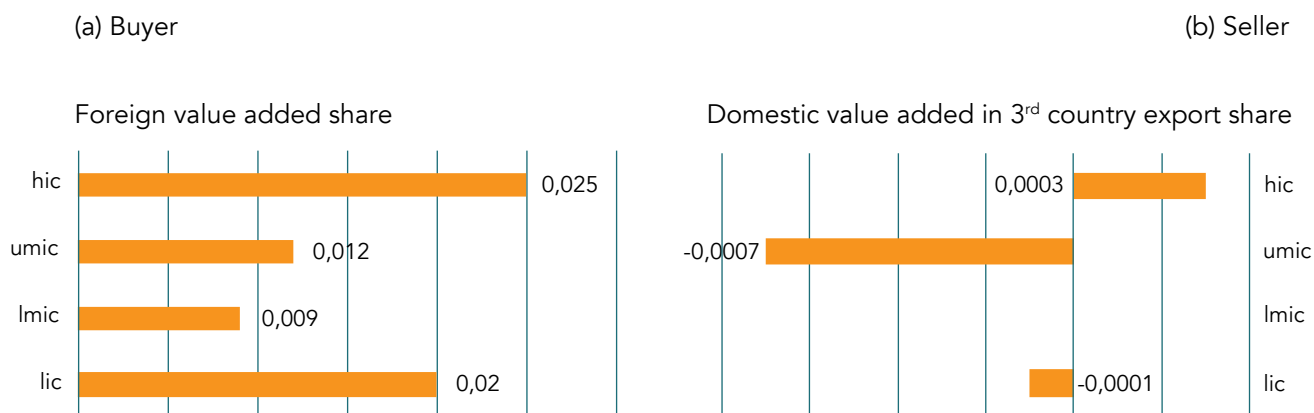
Is GVC trade associated with increased demand for skilled labor in developing countries? And if so, through what channels? A recent paper by Farole, Hollweg, and Winkler (2018) focuses on two specific patterns of GVC integration – backward (or 'buying-side') and forward (or 'selling-side') – to empirically relate changes in GVC integration to changes in the relative demand for skilled labor.

Forward integration is defined by the incorporation of a firm's exports in the production of exports by a third country, in other words, supplying intermediate inputs for other countries' exports. For example, the Czech Republic may produce exhaust systems that are incorporated into an automobile produced in Germany, or Malaysia may produce microchips that are included in US-developed iPhone manufactured in China. This is often measured at the country-sector level in terms of overall levels (domestic value added embodied in third-country exports) and in terms of intensity (share of domestic value added embodied in third-country exports).

Backward integration is defined by the use of foreign inputs in production that is exported; in other words, buying foreign inputs in order to export. For example, Bangladesh may import textile fabric produced in Pakistan that is used to make clothing exported by Bangladesh. This is often measured at the country-sector level in terms of overall levels (foreign value added in exports) and in terms of intensity (foreign share of total value added in exports).

Farole, Hollweg, and Winkler (2018) use data from the World Bank's Labor Content of Exports (LACEX) database of 57 sectors for the years 2001, 2004, 2007, 2011, and 2014 and about 120 countries. The database uses input-output data from the Global Trade Analysis Project to measure the direct and indirect wages paid to produce exports by worker type. The labor market outcome is the relative demand for skilled labor (measured as wages paid to produce exports to skilled versus unskilled labor). It includes both the direct wages paid to workers in the exporting sector, as well as the indirect wages paid to workers supplying domestic inputs to exports. The authors regress the labor market outcome on the log of the measure of GVC participation controlling for log of output at the country, sector and year level as well as country-sector, sector-year, and country-year fixed effects. The authors then interact the trade measure with a series of dummy variables that take the value of 1 to reflect country income level (high income, upper middle income, lower middle income, low income) and 0 if not, to detect the joint effect for that dummy of interest.

The estimated coefficient on the measure of GVC participation is presented in Figure 3.4. The authors find that greater returns to skilled labor is correlated with GVC expansion on the buying side. This holds across all income categories, in particular

FIGURE 3.4 Relationship between relative demand for skilled labor and GVC participation

Note: Coefficient estimate reported when statistically significant. hic = high income country; umic = upper middle income country; lmic = lower middle income country; lic = low income country.

Source: Farole, Hollweg, and Winkler (2018).

high- and low-income countries, resulting in a U-shaped effect. The strong correlation in low-income countries runs counter to the discourse that GVC integration leads to specialization based on comparative advantage, which would presumably result in an increased demand for unskilled (low wage) labor in these countries. The positive skill-biased effect associated with GVC participation as a buyer happens primarily in input-supplying sectors, with lower relative demand for skills directly in the exporting sectors. The authors find no correlation in the overall sample between GVC participation as a seller and the relative demand for skilled labor. However, high income countries show a positive relationship.

Firm-level analysis also confirms a positive and significant relationship between GVCs and skilled labor. Shepherd and Stone (2012) find a positive and significant relationship between the number of skilled workers and firms with international linkages (that import, export, and are foreign owned). Applying propensity score matching techniques to firm-level data in a sample of 27 transition economies, Crinò (2012) find that importing inputs increases the relative demand for skilled labor. Specifically, it explains more than one quarter of the unconditional difference between importers and non-importers in the employment share of high skill workers.

Recent theories point out several channels through which trade can lead to an increasing demand for skills. For instance, an increase in the relative demand for high-skill workers can come from a trade-induced change in the firm composition. When trade liberalization opens new trading opportunities, the most productive firms try to seize them and expand their production. At the same time, international trade stiffens competition in the domestic market, leading the least efficient firms to reduce their sales or close down. High-productivity expanding firms tend to be more skill-intensive than low-productivity downsizing firms,

and therefore this change in firm composition may translate into an increase in the relative demand for high-skill workers irrespective of the industry specialization (Helpman, Itshkoki, and Redding 2010). In addition, trade may increase the rewards for skill-biased technical change which further raises skill demand (Bustos 2011). Some studies attribute the labor demand bias against less-educated workers to both GVC participation and technological progress (discussed below).

This chapter explores three additional channels specific to GVC trade: (1) the importance of services for GVC trade, (2) the increased complexity of industrial organization in GVC trade, and (3) the skills composition of different activities performed within GVCs.

GVCs and services inputs

The emergence of GVCs has been accompanied by important changes in the services sector, where services have become critical for countries' trade, including participation and upgrading in global value chains. Services play a dual role—as inputs into manufacturing and agriculture value chains and as value chains of their own. Much of the value of manufactured goods comes from inputs of services industries; some studies estimate that services account for 40 percent of the value added of world trade (Lanz and Maurer 2015).

Differences in skills intensity across sectors mean distributional implications of GVC participation on labor markets when GVC participation changes the relative demand for inputs across more- or less-skill intensive sectors. For example, services jobs are needed to manage the complexity of the supply chain and preserve production throughout the chain. Examples include management, financial services, telecommunications, and other services such as auditors and lawyers (Tagliani and Winkler, 2016), which tend to be more skill intensive.

Cali and Hollweg (2017) show for South Africa that enhanced GVC participation in GVC-intensive sectors had distributional implications for skilled versus unskilled labor. Using the World Bank Labor Content of Exports database, the authors measure the direct and indirect labor content embodied within South Africa's exports between 2001 and 2011. They find that enhanced GVC participation in automotives and wearing apparel was associated with a decline in the relative demand for skilled labor directly employed in these GVC sectors, and an increase in the relative demand for skilled labor indirectly employed in sectors that produce inputs for GVC sectors, in particular services sectors.

Other literature confirms that GVC integration entails the use of upstream inputs that are not only more labor intensive than non-GVC exports, but also more skills intensive, as non-GVC exports rely on relatively more commodified upstream inputs (Farole and Pathikonda, 2017; Taglioni and Winkler, 2016). A case study of the impact of the Japanese Multinational Company on skilled labor in Malaysia shows that the integration of the subsidiary's production network into its GVC spurred increasing needs for skill development, particularly in management and engineering services (Iberahim 2013). Fernandez-Stark, Bamber, and Gereffi (2010) show that the Chilean offshore services sector typically employs more skilled workers than other sectors: employees are typically younger, more likely to be male, and hold some level of tertiary education, most often from a technical education institution rather than a university.

GVCs and complex industrial organization

A recent study by Kidder and Dollar (2018) shows that GVC integration can be biased towards more skilled workers in developing countries. This happens because (i) GVCs are associated with more complex industrial organization, and (ii) more complex industrial organization is associated with more skilled labor in countries that export in GVCs.

First, Kidder and Dollar (2018) construct an average measure of the value chain length, proposed by Wang *et al.* (2017), as a measure of complex industrial organization. That is, industries with longer value chains are considered to be more complex. The measure is the weighted average number of production processes within the chain, starting from the product – for example, machinery – to the product's raw inputs – for example, metal. The authors use global input-output data for 2008 from the World Input-Output Database. They also consider the length of the domestic portion of the value chain. Value chain length serves as an indication of how complex the production process has become.

The authors find a positive association between firms' sourcing decisions of foreign intermediate inputs and the foreign market's value chain length. That is, trading partners are more likely to import intermediate products from country-industries that have longer value chains. As an example, Figure 3.5 shows the destinations in which the manufacturing sectors in Mexico, China, Germany and the United States are sourcing their machinery. On the x-axis is the domestic value chain length of the source country. On the y-axis is the log of the share of foreign intermediates

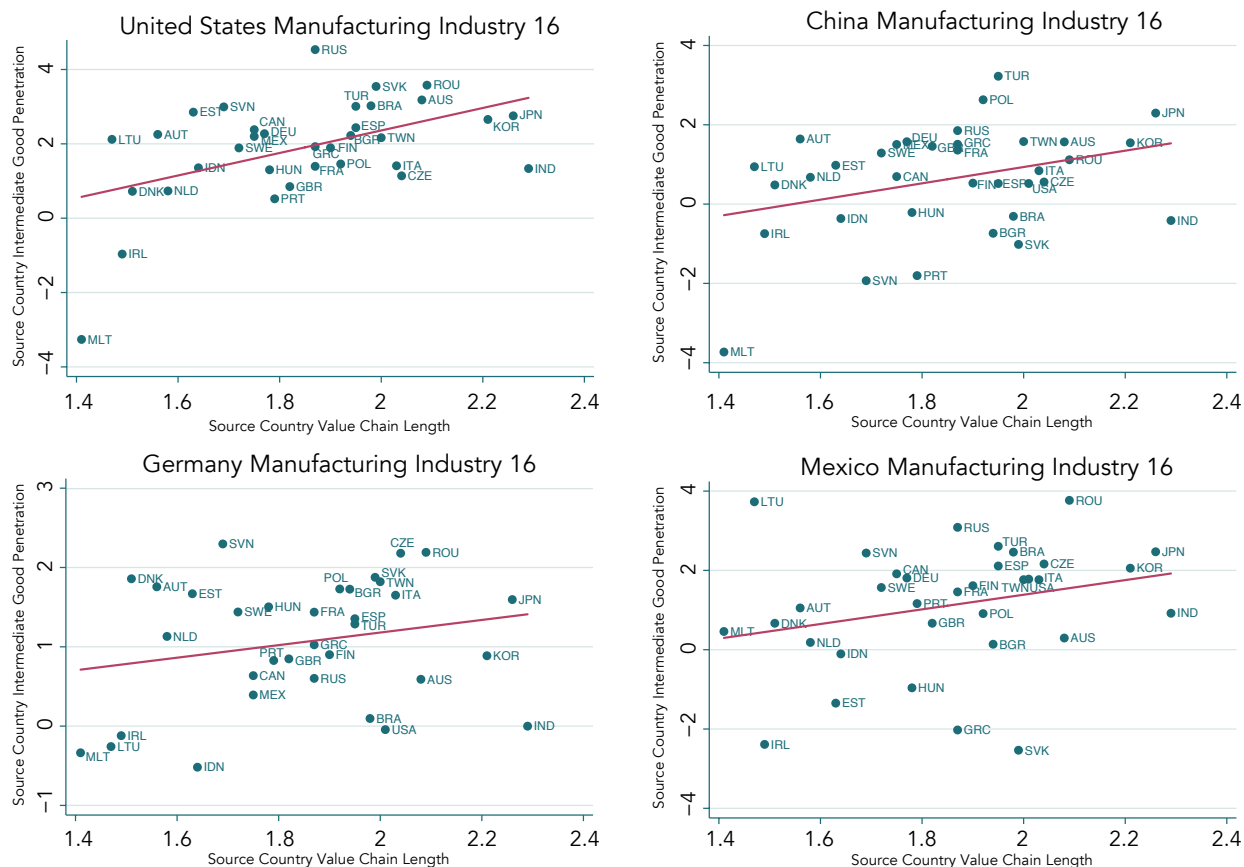
from the source country as a share of total foreign intermediates (i.e. the import share) in Mexico, China, Germany and the United States. There is a clear positive association between the domestic value chain length of the supplier and the import share from that supplier. Moreover, the strength of this correlation varies across levels of economic development; the correlation is stronger when the seller is from a high-income country. In sum, buyers import more from partners who have longer domestic value chains for all levels of development, but longer supply chains are more strongly correlated for high-income sellers.

What could drive this association? Buyers may prefer to establish relationships with suppliers that have longer value chains, as a way to reduce the transaction costs in international trade. External transaction costs are high in international trade, and they are incurred at both the product level as well as the trading partner level. At the trading partner level, these transaction costs could include asymmetric information problems, language barriers, cultural differences, unfamiliar foreign contractual enforcement institutions, among others. Longer value chains within the supplier therefore reduces transaction costs for the importer.

Second, Kidder and Dollar (2018) empirically test the relationship between domestic value chain length and the skill composition of the labor force, to determine to what extent lengthening of the value chain might be capable of explaining patterns in the distribution of skills. They regress the share of skilled labor in a country, industry and year on the upstream global value chain length of the industry, as well as other control variables for 2000-2008, and find a positive correlation between higher skills and longer global value chains (skills are concentrated in sectors with longer value chain length). To identify the direction of causality of this relationship, the authors then use an instrumental variables approach by instrumenting value chain length with China's trade liberalization, treated as an exogenous "China-shock".

China is used as an exogenous shock to global value chain length of Chinese trading partners who are downstream of Chinese production. Imports into China are influenced by Chinese import tariffs. The impact of reducing import tariffs on partner countries' value chain length will vary with the inherent tradability of sectors, as well as the distance to China. Kee and Tang (2015) show that the reduction in costs due to lower import tariffs led Chinese manufactures to substitute out of foreign goods and into domestic varieties. This in turn increased the value chain length of Chinese goods, which increases the global value chain length of trade partners who import intermediates from China. Thus, the import tariff reduction had a direct impact on both the Chinese domestic and Chinese global value chains. By interacting the Chinese tariffs with measures of tradability and distance, Kidder and Dollar (2018) come up with an instrument for value chain length that varies across sectors and trading partners. The authors show that the instrument is a good predictor of trading partners' imports of intermediate products from China.

Kidder and Dollar (2018) find that value chain length itself affects the skills composition of the work force. In developed economies, there are strong positive effects on high-skilled labor, as well as moderate positive effects on medium-skilled

FIGURE 3.5 Source destination and value chain length

Note: Machinery industry 13 refers to WIOD industry code 13 'machinery nec' (which corresponds to NACE industry 29). Manufacturing industry 16 refers to WIOD industry code 16 'manufacturing nec' (which corresponds to NACE industry 34135). The graph plots the share of machinery industry 13 from each source country used by the manufacturing industry 16 in the United States, China, Germany and Mexico.

Source: Kidder and Dollar (2018).

labor. In developing economies, the results are a modest positive effect on both high and medium skills. The low-skill labor share is negatively affected by value chain length in both developed and developing countries.

The results are consistent with the idea that expansion of GVCs modified the usual effects of trade on the demand for factors. Services are the likely mechanism at play, as discussed above. First, skilled labor is needed to manage the value chain, in sectors like logistics and transport. Second, skilled labor is also needed in services inputs that are complementary to value chains, such as finance, telecommunications, and business services.

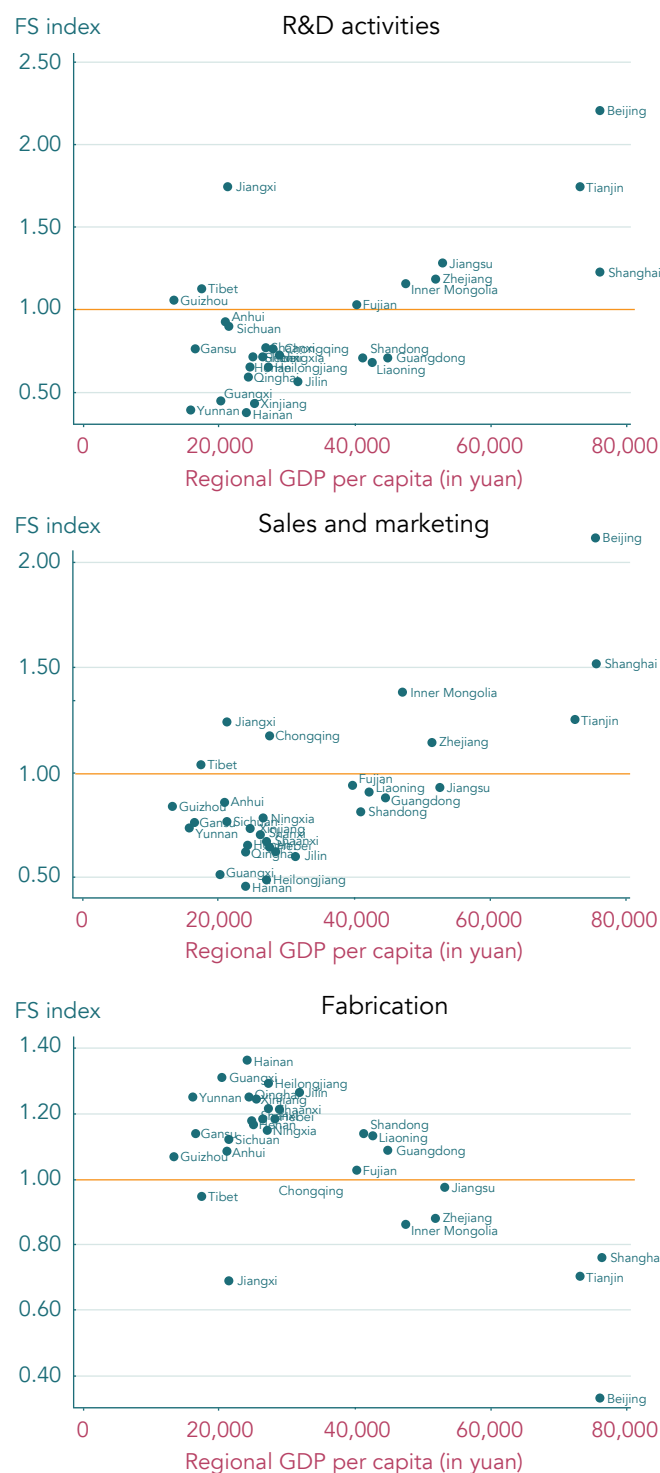
GVCs and upgrading

The changing nature of tasks and activities performed within value chains can also impact the relationship between GVC participation and the relative demand for skilled labor. For example, higher-value added activities such as research and development, design, branding, sourcing, and customer support that make up important components of GVCs are also relatively more skill intensive.

China offers an interesting case study. Unlike the experience in other developing countries, China's domestic value-added content in exports increased during the 2000s. Chen *et al.* (2018) analyze China's domestic value added from activities in exports between 2002 and 2012, to understand whether this increase reflects a movement up the value chain towards higher value-added, skill-intensive activities.

The authors analyze China's domestic value added from the perspective of activities in exports between 2002 and 2012. The authors used occupational data as well as inter-provincial input-output tables to distinguish between four possible business activities: R&D, fabrication, marketing, and other support services. The contribution of an activity is the wage income of workers that perform it, based on their occupation. Data is available for 42 industries in 31 provinces of China. A functional index of specialization (FS index) is constructed, which measures the relative specialization of a province for each of the possible business activities. A province is considered to have a relative specialization in the business activity if the FS index is above 1.

FIGURE 3.6 Specialization by Chinese provinces and functions, 2012



Note: The functional specialization (FS) index measures the income share of the function in exports in a province relative to the income share of the function in exports in all Chinese provinces. If the FS index is above one, the province is said to be specialized in that function.

Source: Chen et al. (2018).

Figure 3.6 plots the FS index against provincial GDP per capita in 2012.

Findings suggest that the increase in China's domestic value added in exports arose from an expansion of fabrication activities in provinces such as Guangdong, Jiangsu, and Zhejiang. Moreover, there is a negative relationship between specialization in fabrication activities and the GDP per capita of Chinese provinces (bottom panel of Figure 3.6). However, there is a clear sub-national variation in domestic value added from activities in exports. Richer provinces increasingly specialized in higher value added activities including R&D and sales and marketing, particularly Beijing, Tianjin, and Shanghai (top and middle panels of Figure 3.6). The changing nature of global value chain activities that the economy performs therefore has skill implications.

5. GVCs, technological change, and labor markets

Technology is advancing rapidly, and innovations are increasingly disrupting production patterns around the world. Recent World Bank research shows that the increasing adoption of industrial automation, data exchange, advanced robotics, smart factories, the Internet of Things, and 3D printing – referred to as “Industry 4.0”, or the fourth industrial revolution – are transforming the manufacturing process and altering our world of work (Hallward-Driemeier and Nayar 2017).

The introduction of these new technologies in production in developing countries often takes place through GVCs, where lead firms disseminate technology to their suppliers (Rodrik, 2018). As discussed throughout this report, these technological advancements are also shaping global value chains, and ultimately the domestic implications of GVC participation. Policymakers in many developing countries engaged in GVCs are concerned about the impact of Industry 4.0, such as automation and digitization, on manufacturing assembly jobs and skills, and ultimately the welfare of their citizens.

Innovation will always be disruptive, and for the most part, Industry 4.0 can bring new opportunities for developing countries to engage in and achieve the benefits of GVC participation. Digital technologies are reducing entry costs into manufacturing by reducing the impact of distance. 3-D printing may lower transport costs, lessen the importance of achieving economies of scale for manufacturers, and make it easier to manufacture high-quality products. New technologies in the production process can boost productivity, drive down costs, and support the speed of technological diffusion and catch-up. E-commerce platforms allow small-scale producers to sell goods directly to consumers, both domestically and for export. The information revolution has provided new opportunities for developing countries to go beyond traditional services exports, such as tourism and transport, to export modern services. Many ICT-enabled professional services – which can be developed without a manufacturing core – can be exported electronically and also be a source of innovation or technology diffusion (Nayar 2017).

Industry 4.0 also poses risks for developing countries, many of which would be felt within labor markets. Looking ahead, to the degree that new technologies associated with Industry 4.0 may be labor-saving, the concern is that robotics will replace low-skilled assembly jobs in developing countries. FoxConn recently replaced 60,000 Chinese factory workers with industrial robots (Wakefield 2016). In addition to being a risk of job loss for some countries, Industry 4.0 may also be one of missed opportunities for other countries. Robotics, 3-D printing, and other advances raise the possibility of “re-shoring” of routine activities from labor-abundant developing economies back to developed economies. For instance, there is a concern that the expected migration of labor-intensive activities from China to poorer economies with lower labor costs, such as those in Sub-Saharan Africa, might not happen; a re-shoring of manufacturing activity from developing back to developed countries may take place instead.

How are technological advancements within GVC trade affecting jobs and skills in developing countries? A recent study by Bertulfo, Gentile, and de Vries (2019) provides analytical evidence on this question, focusing specifically on the impact of the acceleration of technological progress within GVCs on jobs. The authors apply a structural decomposition method to examine the drivers of the changes in GVC jobs in 12 developing Asian economies between 2005 and 2015 using regional input output tables and labor force survey data.² GVC jobs are defined as the jobs in a country linked to participation in global production of a particular set of products (Timmer *et al.* 2014; Meng, Peters, and Wang 2015). GVC jobs are further disaggregated by skill type (low, medium, high skilled) and business activity (R&D, production, logistics / sales / marketing, administration / back office, and headquarter workers).

The decomposition of the change of employment is presented in the top panel of Figure 3.7. The total change in employment in each economy can be separated into changes due to: (i) shifts within GVCs, resulting from changes within the production structure of the GVC of a specific final product; (ii) shifts between GVCs, resulting from changes in consumer demand for different products; or (iii) shifts due to changes in global demand for goods and services, which is separated between domestic or foreign demand (ADB 2018). For example, if consumers increase their demand for services and lower their demand for manufactured goods, then employment would rise in services sectors and decline in manufacturing (shifts between GVCs). And if income increases in either the domestic or foreign economies, then employment will rise to meet the higher demand for goods (shifts due to changes in demand driven by income growth).

Shifts within GVCs are further separated into: (i) technology within GVCs, or changes in employment associated with changes in efficiency within a specific GVC; (ii) task relocation, or changes in employment as the location changes for one or more production tasks; and (iii) country-level efficiency, or changes in employment from efficiency changes in an economy that participates in GVCs (ADB 2018). Technological progress is measured as a change in the efficiency units of labor, which is determined by the technical production requirements in terms of intermediate

inputs. Increased efficiency in a GVC will, *ceteris paribus*, lead to lower demand for jobs in a particular skill type or activity. For example, if machines replace workers in some of the production tasks in the supply chain, then this will lower the number of GVC jobs, all else equal (technology within GVCs). On the other hand, if garment manufactures decide to outsource some jobs to another economy, then the number of jobs is unchanged, but fewer workers are employed in the outsourcing economy, and more in the receiving economy (task relocation). Efficiency is also allowed to vary across economies. If productivity in an economy catches up to the productivity leader then fewer jobs would also be needed to produce the same amount of output (country-level efficiency).

The results of the structural decomposition are presented in the bottom panel of Figure 3.7. For each economy, the figure plots the percentage change in GVC jobs due to each of the separate effects, holding all else equal. Summary across all effects give the total percent change in GVC jobs at the country level.

The study finds that technology within GVCs, or changes in efficiency within a specific GVC, is associated with a decrease in the levels of employment across all sectors in developing Asia. For example, increases in efficiency would have reduced GVC jobs by about 50 percent in developing Asia, holding all else equal. The estimated effect is smaller in services than in agriculture and manufacturing. Efficiency gains within economies has also negatively affected employment levels. For example, GVC jobs would have been lower by about 20 percent holding all else equal in developing Asia.

Nevertheless, the adverse effects of changing production technologies and efficiencies on employment have been offset by increased consumer demand. Demand for goods and services from a new Asian middle class in particular has increased employment levels. In developing Asia, for example, the increase in employment associated with own-country income is 80 percent, versus 8 per cent due to increased income from the rest of the world. The findings also suggest that the domestic consumption expenditures in large emerging economies such as China and India will generate new demand for labor for the global economy. The impact on employment of task relocation between economies that participate in GVCs is smaller and mixed.

The interaction of GVC expansion and technological change has distributional consequences. The results of Bertulfo, Gentile, and de Vries (2019) suggest that technological change in GVCs has been skill biased in developing Asian economies. The authors separate employment into routine and non-routine occupations, to understand how technology is impacting the skill profile of GVC-related jobs. Routine tasks include occupations such as craft and related trade workers, plant and machine operators, or clerical support workers. Nonroutine tasks include services and sales workers, managers, professionals, or technicians. Job losses due to the implementation of technology along GVCs have been associated with a decline in both routine and nonroutine employment levels. However, the share of nonroutine (cognitive) employment has increased, meaning these types of occupations are becoming relatively more important in GVCs.

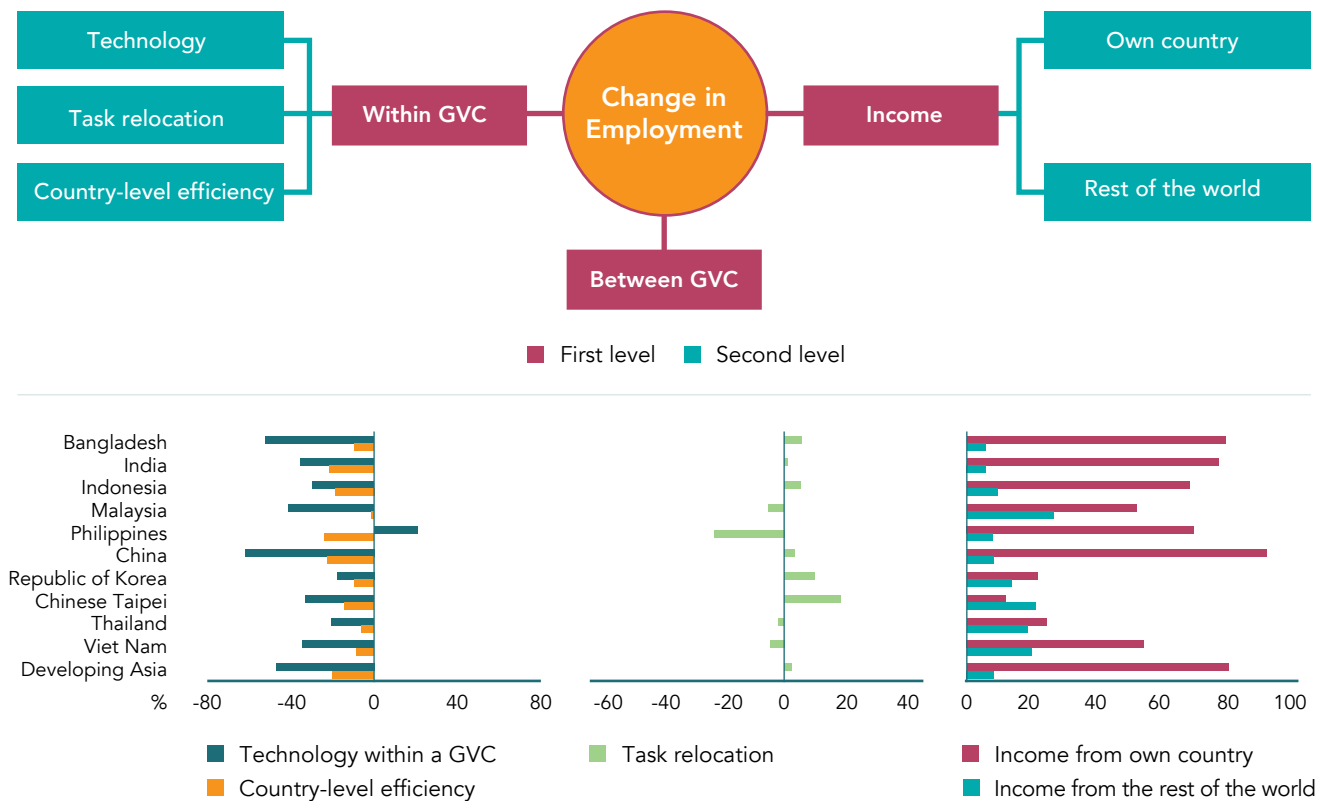
Using a similar methodology and country coverage but for the periods 2000-2011, de Vries *et al.* (2016) look at changes in GVC jobs by business activities due to technological change. The results suggest that technological change within GVCs had a big effect on the relative demand for higher value added and more skill-intensive activities, such as R&D and headquarter jobs. For example, improvements in GVC technology lowered demand for production workers by about 55 million workers in China, but hardly affected demand for R&D jobs. This is suggestive evidence of technological change being to the benefit of more knowledge-intensive activities, as well as changing the sectoral profile. While automation will likely reduce the number of traditional manufacturing jobs, new service jobs will also be created within the chain. The skills required for workers in these positions is less industry-specific, and more related to learning the software programs and basic computer skills (Frederick 2018).

Recent advances in automation have also sparked concerns over the impact on jobs within global value chains, particularly assembly. For example, a recent study by Chang *et al.* (2016) estimate that as many as 88% of Cambodian, 86% of Vietnamese and 64% of Indonesian wage workers could face possible replacement by automation. Nevertheless, tradable goods such as textiles, garments, and footwear continue to be labor intensive and do not feature much automation yet (Box 3.4).

6. Policy considerations for strengthening the labor-GVC relationship

The evidence above illustrates how integration and upgrading in GVCs has implications for labor markets in developing countries. Policy can support the relationship between labor and GVC

FIGURE 3.7 Decomposing changes in labor demand



Note: Because manufacturing excludes the industry subsectors electricity, gas and water supply and construction, “all sectors” is larger than the sum of agriculture, manufacturing and services. Developing Asia in the decomposition analysis includes Bangladesh, China, India, Indonesia, the Republic of Korea, Malaysia, Mongolia, the Philippines, Sri Lanka, Chinese Taipei, Thailand, and Viet Nam.

Source: Bertulfo, Gentile, and de Vries (2019) and ADB (2018).

BOX 3.4**Automation in the apparel value chain**

Automation in the apparel industry is complex. Automating a production process typically occurs because: (1) it is expensive to hire people to do the job; (2) the product has the potential to be contaminated if handled; or (3) the task is repetitive with minimal changes. Apparel, particularly the sewing segment, does not meet these requirements. There has historically been a pool of low cost labor from a global perspective, contamination is not an issue, and whereas the task is repetitive, it changes often. For these reasons, there has been minimal demand to automate most parts of the apparel supply chain.

Recent advances in automation have led to assessments that the apparel sector could be vulnerable to disruptive change. One report concludes that the broader textiles, clothing and footwear industry faced higher automation risks than workers in automotive and auto parts; electronics and electrical parts; business process outsourcing; and retail value chains (Chang *et al.* 2016). ASEAN nations could be in a precarious situation, according to this analysis.

The first robotic, automated production line for apparel could be operational by the end of 2018 with larger-scale implementation further ahead (Stacey and Nicolaou, 2017). Softwear Automation produces a clothes-making robot called "Sewbot." The system was being installed in a facility in the United States with the expectation of producing 1.2 million t-shirts per year at a price that is competitive with manufacturing and shipping the same material in low-wage locations (Peters, 2017). Large-volume buyers such as Walmart have expressed interest in the technology, partnering with Softwear on trial projects (Stacey and Nicolaou, 2017). In the case of the Sewbot for t-shirts, its developers claim that one operator overseeing a t-shirt line can carry out the tasks of 10 operators in approximately half the time (Barrie, 2017). There have been similar advancements in related industries, such as footwear, in which companies such as Adidas have used computerized knitting technologies for shoe mesh at facilities in Europe and North America (Emont, 2018). In the longer-term, firms from other industries that have been more modular and automated for decades may also move into the apparel industry and bring production model knowledge that creates new opportunities for automation that have not yet been seriously

considered. Flextronics is an example of a company in electronics that is now rapidly pursuing how to use their operating model in industries such as footwear.

There are, however, reasons to believe that the spread of automation in the apparel industry will not be widespread in the immediate future. The Sewbot is designed primarily for t-shirts with possible expansion to jeans. T-shirts are relatively simple to produce, with production consisting of 13 separate tasks, from quality inspection to heat transfer to collar and label attachment to steaming and hemming. Jeans, on the other hand, involve some 30-40 operations, while a dress shirt with pockets has 78 steps, or six times the number of operations to make a t-shirt (Barrie, 2017). Moreover, Sewbot's executives believe the technology is ill-suited for more complex designs and concede that low-cost locations such as Bangladesh are likely to still have significant competitive advantages (Bain, 2018; Peters, 2017).

Another limitation is that these machines are expensive and are often only purchased by multinational enterprises (MNEs) that serve global buyers from various destinations around the world. They do this to ensure products are the same and because their production volumes are high enough to warrant the capital expenditures.

A final critical element that makes robotic automation more difficult in apparel is the fact that fabrics are flexible (drape, soft). This makes them difficult to handle through automation because tension needs to be applied in various degrees depending on the desired aesthetics of the product. The look and feel are key drivers of apparel purchasing, so if these important elements are compromised by automation, they are far less likely to be used. Similarly, given the high cost of investment, apparel manufacturers will be hesitant to purchase machinery until it is proven to be a reliable replacement for human workers. There are nascent technologies that might enable firms to address some of the challenges associated with handling soft materials. Yet even with these developments, Crystal Group, the largest clothing manufacturer in the world, has expanded production in Bangladesh and Viet Nam, with its CEO specifically stating that robots could not compete with humans (Bain, 2018).

Source: Frederick (2018).

participation in different ways. This chapter considers policies that (i) support participation of developing countries in GVCs, (ii) foster positive spillovers from GVC participation, (iii) induce upgrading to higher value added tasks within GVCs, and (iv) mediate negative effects, such as increased inequality.

First, to the extent the GVC participation supports better jobs and higher wages, policies that support developing countries to participate in GVCs can support these outcomes. Tagliani and Winkler (2016) provide a thorough review of policies that can foster GVC participation of developing countries. Key

areas include trade policy, trade infrastructure, and labor market flexibility.

A country's trade policy shapes the amount and type of foreign investment and, thus, influences the potential of GVC integration to influence labor markets. Open trade regimes may be more likely to attract foreign investors than inward-oriented regimes, since they are less constrained by the size and efficiency of the local market (Crespo and Fontoura 2007). Foreign investors might also be more export-oriented in an open setting, increasing chances for local suppliers to become exporters, too. Moreover, foreign investors in an open trade setting are globally more integrated and therefore adopt the newest technologies (Meyer and Sinani 2009). Others, however, argue that foreign investors in an outward-oriented trade setting might focus more strongly on international distribution and marketing, while foreign firms in an inward-oriented policy regime might bring newer technologies to the host countries (Crespo and Fontoura 2007).

Connective trade infrastructure, firm capabilities, and developing standards also influence GVC participation. Improving trade facilitation and developing more competitive trade logistics sectors to compete effectively in an environment that requires seamless importing and exporting are key recommendations for strengthening GVC participation (Taglioni and Winkler 2016).

Higher labor market flexibility – in absolute terms as well as relative to the level in the foreign investor's home country – is also shown to have a positive effect on the chances of securing initial foreign investment (Javorcik and Spatareanu 2005).

Second, how GVC participation and labor markets interact can also be influenced by policy. Different structural conditions, endowments, and policies may play a role in mediating the trade-labor relationship and fostering the positive spillovers that can occur. The literature confirms that education and skills influence the share of human capital in firms and are particularly important for expanding trade integration and spillovers from FDI in developing countries (Farole and Winkler 2014). Meyer and Sinani (2009) show evidence that the share of workers with tertiary education significantly affects FDI spillovers. This relationship takes a U-shaped form, that is, only below or above certain threshold levels of human capital does the extent of spillovers increase (Meyer and Sinani 2009). Tytell and Yudaeva (2007) find for Romania that productivity spillovers from foreign direct investment (FDI) in manufacturing are significantly lower in regions with a low share of education. Farole and Winkler (2014) confirm for a sample of 78 low- and middle-income countries that a country's government spending on education as a percentage of GDP has a strongly positive productivity effect. Kummritz, Taglioni, and Winkler (2017) measure the positive impact of skills building on the value-added gains from GVC integration as a seller in a sample of 61 countries. A higher expected number of years of schooling (Barro and Lee 2013), the share of workers with a secondary degree, or higher, in the total workforce (WDI 2018), as well as better educational quality (WEF 2018) all show positive interaction terms with GVC integration.

Trade policy also affects domestic firms. Local firms in an open trade regime are more exposed to competitive pressures through

international trade, which prepares them to better absorb FDI spillovers. Overall, studies confirm that FDI spillovers are larger in countries that are more open towards trade (Meyer and Sinani 2009; Du, Harrison, and Jefferson, 2011; Havranek and Irsova 2011).

Labor market regulations may also influence the effect of GVC integration on domestic firms through various channels. Labor market regulations, and, in particular, wage constraints, can affect skills in a firm, and hence their absorptive capacity (Hale and Long 2011). Overly rigid labor markets can reduce the likelihood of labor turnover and GVC spillovers. Conversely, overly flexible labor markets may generate frequent labor turnover, which reduces the time for domestic workers to acquire skills and knowledge from foreign firms. Kummritz, Taglioni, and Winkler (2017) find that labor freedom tends to increase the value-added gains from GVC integration as a buyer and seller. Thus, the policy environment can mediate better labor market outcomes from GVC participation.

Third, policies can influence the activities that countries undertake in GVCs. If the nature of GVC participation matters for the types of jobs it supports, then policies can support better types of GVC participation. As noted by Shepherd and Stone (2012), policies that are designed to help firms — in a non-distortionary way — to move through GVCs to positions of higher value added are likely to help promote the beneficial labor market effects of GVC participation. Education and training, as well as infrastructure development, and backbone services sectors can also help firms to successfully internationalize in higher value added activities. Human capital, for example, may influence the quality and availability of workers.

However, better conditions for workers within GVCs does not necessarily follow from greater GVC participation (Milberg and Winkler 2011). Social upgrading can be fostered by labor regulations, such as those for occupational safety, health and environment standards in GVC sites. For example, Hollweg and Kanz (2018) use firm-level data from the ILO-IFC Better Work Viet Nam program to assess the relationship between transparency on working conditions and firm compliance in the apparel sector in Viet Nam between 2010 and 2018. The authors find that while continued participation in the Better Work Viet Nam program has the strongest effect on changes in firm compliance with labor standards over time, the public disclosure of firms' names that fail to comply with critical labor issues is also associated with increase compliance. The effects are stronger in some compliance points including occupational health and safety, work time, and child labor.

Fourth, if GVCs tend to be associated with greater inequality by increasing the relative demand for skilled labor in developing countries, then policy has an important role to play in ensuring that the gains from trade are shared evenly (see Chapter 2). Complementary policies are likely to play a vital role. As noted by Shepherd and Stone (2012), GVCs could have stronger effects on inequality in the absence of education and training policies designed to promote workforce and human capital development. Well-functioning labor markets are also important, because integrating into GVCs generates faster growth and transformation, and require economy-wide adjustment (see Chapter 2).

7. Conclusions

Today, significant parts of the developing world are deeply involved in GVCs. The unbundling of production is expected to have significant implications for labor markets – where jobs go, who gets them, and what type of jobs they are (Farole 2015). The labor market impacts of GVC participation, as well as the impact that future megatrends will have on labor markets, are a principal concern to policymakers in developing countries.

The chapter focused on nationwide implications of GVC integration for workers in developing countries, from the perspective of nationwide jobs and wages, nationwide spillovers, and the relative demand for skilled versus unskilled labor. It also analyzed the potential implications of new technologies for GVCs from the perspective of labor markets.

The chapter showed that, while GVC participation has been important for jobs and wages, it also has had distributional consequences for where jobs go and the types of jobs available. GVC integration has supported jobs and earnings, as well as

other development impacts that operate through labor markets. Job and wage gains have been achieved not only within the exporting sector, but indirectly through linkages of exporting firms to domestic, input-supplying firms. Employment and wage gains have been biased towards more skilled workers, which contrasts with the predictions of trade theory. The skill-biased nature of GVC trade is also associated with increased complexity of global supply chains as well as increased use of skill-intensive inputs, notably services. New emerging trends, including automation and digitization, may further determine how developing countries will be affected by GVC trade in the future.

Policies also play an important role in mediating the relationship between GVCs and employment in developing countries. These include policies that support (i) participation of developing countries in GVCs, (ii) fostering positive spillovers from GVC participation, (iii) upgrading to higher value-added tasks within GVCs, and (iv) mediating negative effects from winners, such as skilled versus unskilled labor.

Notes

1. Note that the estimates are likely upward biased as exporting firms in particular are likely to have higher import content than non-exporting firms and higher productivity and current input-output based tables are not able to differentiate between the two.
2. Bangladesh, China, India, Indonesia, the Republic of Korea, Malaysia, Mongolia, the Philippines, Sri Lanka, Chinese Taipei, Thailand, and Viet Nam.

References

- ADB (2018). Asian Development Outlook 2018: How Technology Affects Jobs. Manila: Asian Development Bank.
- Acemoglu, D., D. Autor, D. Dorn, and G. H. Hanson (2016). "Import Competition and the Great US Employment Sag of the 2000s." *Journal of Labor Economics* 34(1): 141-98.
- Ahmed (2013). "Global Value Chains, Economic Upgrading, and Gender in the Call Center Industry." In C. Staritz and J. G. Reis (Eds.), *Global Value Chains, Economic Upgrading and Gender: Case studies of the horticulture, tourism and call center industries* (2013). Washington, DC: World Bank.
- Autor, D. H., D. Dorn, and G. H. Hanson (2013). "The China Syndrome: Local labor market effects of import competition in the United States." *American Economic Review* 103(6): 2121-68.
- Bain, M. (2018). "The World's Largest Clothing Maker Isn't Betting on Automation Replacing Cheap Human Labor." Quartz. Available at: <https://qz.com/1169397/crystal-group-is-investing-in-low-wage-labor-not-robots-after-its-ipo/>
- Bamber, P., and C. Staritz (2016). *The Gender Dimensions of Global Value Chains*. Geneva: International Center for Trade and Sustainable Development.
- Banga, K. (2016). "Impact of Global Value Chains on Employment in India." *Journal of Economic Integration* 31(3): 631-73.
- Barrie, L. (2017). "Sewbots Pave the Way for the Apparel Factory of the Future." Just-Style. Available at: https://www.just-style.com/analysis/sewbots-pave-the-way-for-the-apparel-factory-of-the-future_id130877.aspx.
- Barrientos, S., G. Gereffi, and A. Rossi (2010). "Economic and Social Upgrading in Global Production Networks: Developing a framework for analysis." *Capturing the Gains Working Paper 2010/-3*, University of Manchester, United Kingdom.
- Bernard, A. B., J. B. Jensen, and P. K. Schott (2006). "Survival of the Best Fit: Exposure to low-wage countries and the (uneven) growth of U.S. manufacturing plants." *Journal of International Economics* 68(1): 219-37.
- Bertulfo, D., E. Gentile, and G. de Vries (2019). "The Employment Effects of Technological Innovation and Participation in Global Value Chains: Evidence from Asia." *Economics Working Paper Series No. 572*, Asian Development Bank, Manila.
- Bloom, N., M. Draca, and J. Van Reenen (2016). "Trade Induced Technical Change? The impact of Chinese imports on innovation, IT and productivity." *The Review of Economic Studies* 83(1): 87-117.
- Boeler, E. A., A. Moxnes, and K. H. Ulltveit-Moe (2015). "R&D, International Sourcing, and the Joint Impact on Firm Performance." *American Economic Review* 105(12): 3704-39.
- Boffa, M., G. Santoni, and D. Taglioni (2018). "From China with Love." Mimeo, World Bank, Washington, DC.
- Bustos, P. (2011). "Trade Liberalization, Exports and Technology Upgrading: Evidence on the impact of MERCOSUR on Argentinian firms." *American Economic Review* 101(1): 304-40.
- Cali, M., J. Francois, C. H. Hollweg, M. Manchin, D. A. Oberdabernig, H. Rojas-Romagosa, S. Rubinova, and P. Tomberger (2016). "The Labor Content of Exports Database." *Policy Research Working Paper No. 7615*, World Bank Group, Washington, DC.

- Cali, M., and C. H. Hollweg (2016). "How Much Labor Do South African Exports Contain?" Policy Research Working Paper No. 8037, World Bank Group, Washington, DC.
- Chang, J.-H., G. Rynhart, and P. Huynh (2016). ASEAN in Transformation: Textiles, clothing and footwear: Refashioning the future. Geneva: International Labor Organization (ILO), Bureau for Employers' Activities.
- Chen, Q., Y. Gao, J. Pei, G. de Vries, and F. Wang (2018). "Formerly Assembled, But Now Designed in China? Assessing the domestic value-added of activities in gross exports." GGDC Research Memorandum 180, University of Groningen, Groningen, Netherlands.
- Crespo, N., and M. Fontoura (2007). "Determinant Factors of FDI Spillovers: What do we really know?" *World Development* 35(3): 410-25.
- Crinò, R. (2012). "Service Offshoring and the Skill Composition of Labour Demand." *Oxford Bulletin of Economics and Statistics* 74(1): 20-57.
- de Vries, G., Q. Chen, R. Hasan, and Z. Li (2016). "Skills and Activity Upgrading in Global Value Chains: Trends and drivers for Asia." Economics Working Paper Series No. 496, Asian Development Bank, Manila.
- Du, L., A. Harrison, and G. Jefferson (2011). "FDI Spillovers and Industrial Policy: The role of tariffs and tax holidays." NBER Working Paper No. 16767, National Bureau of Economic Research, Cambridge, MA.
- Emont, J. (2018). "The Robots are Coming for Garment Workers: That's good for the US, bad for poor countries." *Washington Street Journal*. Available at: www.wsj.com/articles/the-robots-are-coming-for-garment-workers-thats-good-for-the-u-s-bad-for-poor-countries-1518797631.
- Farole, T. (2015). *Factory South Africa? SACU in Global Value Chains*. World Bank: Washington, DC.
- Farole, T., C. H. Hollweg, and D. Winkler (2018). "Trade in Global Value Chains: An Assessment of Labor Market Implications." Mimeo, World Bank, Washington, DC.
- Farole, T., and V. Pathikonda (2017). "The Capabilities Driving Participation in Global Value Chains." *Journal of International Commerce, Economics and Policy* 8(1): 1750006.
- Farole, T., and D. Winkler (2014). "The Role of Mediating Factors for FDI Spillovers in Developing Countries: Evidence from a global dataset." In T. Farole and D. Winkler (Eds.), *Making Foreign Direct Investment Work for Sub-Saharan Africa: Local Spillovers and Competitiveness in Global Value Chains*. Washington, DC: World Bank.
- Fernandez-Stark, K., P. Bamber, and G. Gereffi (2010). "Workforce Development in Chile's Offshore Services Value Chain." Center on Globalization, Governance and Competitiveness, Duke University, Durham, NC.
- Frederick, S. (2018). "Apparel Skills Mapping and Functional Upgrading in Cambodia: Jobs diagnostic." Mimeo, World Bank, Washington, DC.
- Fukase, E. (2013). "Export Liberalization, Job Creation and the Skill Premium: Evidence from the US-Vietnam Bilateral Trade Agreement." Policy Research Working Paper No. 6419, World Bank, Washington, DC.
- Goldberg, P. K., A. K. Khandelwal, N. Pavcnik, and P. Topalova (2010). "Imported Intermediate Inputs and Domestic Product Growth: Evidence from India." *The Quarterly Journal of Economics* 125(4): 1727-67.
- Gyeke-Dako, A., A. D. Oduro, F. E. Turkson, P. T. Baffour, and E. N. Abbey (2017). "Ghana's Participation in Global Value Chains: The employment effects." R4D Working Paper No. 2017/05, World Trade Institute, University of Bern, Switzerland.
- Hale, G., and C. Long (2011). "Did Foreign Direct Investment Put an Upward Pressure on Wages in China?" *IMF Economic Review* 59: 404-30.
- Hallward-Driemeier, M., and G. Nayyar (2017). *Trouble in the Making? The future of manufacturing-led development*. Washington, DC: World Bank.
- Halpern, L., M. Koren, and A. Szeidl (2015). "Imported Inputs and Productivity." *American Economic Review* 105(12): 3660-703.
- Havranek, T., and Z. Irsova (2011). "Estimating Vertical Spillovers from FDI: Why results vary and what the true effect is." *Journal of International Economics* 85: 234-44.
- Helpman, E., O. Itskhoki, and S. Redding (2010). "Inequality and Unemployment in a Global Economy." *Econometrica* 78(4): 1239-83.
- Hollweg, C. H. (2017). "How Do Exports Support Labor in Vietnam?" Mimeo, World Bank, Washington, DC.
- Hollweg, C. H., and M. Kanz (2018). "Firm Compliance and Public Disclosure in Vietnam." Mimeo, World Bank, Washington, DC.
- Iberahim, H. (2013). "Vertical Integration into Global Value Chains and Its Effects on Skill Development." *IEEE Business Engineering and Industrial Applications Colloquium*: 28-33.
- Javorcik, B., and M. Spatareanu (2005). "Do Foreign Investors Care about Labor Market Regulations?" *Review of World Economics* 141(3): 375-403.
- Kee, H. L., and H. Tang (2015). "Domestic Value Added in Exports: Theory and firm evidence from China." Policy Research Working Paper No. 7491, World Bank Group, Washington, DC.
- Kidder, M., and D. Dollar (2018). "The Effect of Production Fragmentation on Skills Reallocation: Is it felt equally across levels of development?" Mimeo, The Research Institute of Global Value Chains, Beijing.
- Kumar, R. (2017). "Global Value Chains: A way to create more, better and inclusive jobs." Jobs Development Blog, World Bank, Washington, DC.
- Kummritz, V., and B. Quast (2017). "Global value chains in developing economies." *Vox EU*. Available at: <https://voxeu.org/article/globa-value-chains-developing-economies>.
- Kummritz, V., D. Taglioni, and D. Winkler (2017). "Economic Upgrading through Global Value Chain Participation Which Policies Increase the Value Added Gains?" Policy Research Working Paper No. 8007, World Bank, Washington, DC.
- Lanz, R., and A. Maurer (2015). "Services and Global Value Chains: Some evidence on servicification of manufacturing and services networks." Working Paper ERSD-2015003, World Trade Organization, Geneva.
- Lopez-Acevedo, G., and R. Robertson (2016). *Stitches to Riches? Apparel Employment, Trade, and Economic Development in South Asia*. Washington, DC: World Bank.
- MacGarvie, M. (2006). "Do Firms Learn from International Trade?" *Review of Economics and Statistics* 88(1): 46-60.
- McCaig, B. (2011). "Exporting Out of Poverty: Provincial poverty in Vietnam and US market access." *Journal of International Economics* 85(1): 102-13.
- Meng, B., G. Peters, and Z. Wang (2015). "Tracing CO2 Emissions in Global Value Chains." Discussion Paper No. 486, Institute of Developing Economies, Japan External Trade Organization, Tokyo.
- Meng, B., H. Xiao, and J. Ye (2018). "A Global Value Chain Based Structure Decomposition Analysis on the Change of Employment." Mimeo.

- Meyer, K., and E. Sinani (2009). "When and Where Does Foreign Direct Investment Generate Positive Spillovers? A meta-analysis." *Journal of International Business Studies* 40(7): 1075-94.
- Milberg, W., and D. Winkler (2011). "Economic and Social Upgrading in Global Production Networks: Problems of theory and measurement." *International Labour Review* 150(3-4): 341-65.
- Mion, G., and L. Zhu (2013). "Import Competition from and Offshoring to China: A curse or blessing for firms?" *Journal of International Economics* 89(1): 202-15.
- Nayyar, G. (2017). "The Future of Manufacturing-Led Development in Rwanda." Mimeo, World Bank, Washington, DC.
- Peters, A. (2017). "This T-shirt Sewing Robot Could Radically Shift the Apparel Industry." *Fast Company*. Available at: www.fastcompany.com/40454692/this-t-shirt-sewing-robot-could-radically-shift-the-apparel-industry.
- Rodrik, D. (2018). "New Technologies, Global Value Chains, and Developing Economies." NBER Working Paper No. 25164, National Bureau of Economic Research, Cambridge, MA.
- Shepherd, B., and S. Stone (2012). "Global Production Networks and Employment: A developing country perspective." Working Paper TAD/TC/WP(2012)29, Trade and Agriculture Directorate, Trade Committee, Organisation for Economic Co-operation and Development, Paris.
- Shingal, A. (2015). "Labour Market Effects of Integration into GVCs: Review of literature." R4D Working Paper 2015/10, World Trade Institute, University of Bern, Switzerland.
- Stacey, K., and A. Nicolaou (2017). "Stitched Up by Robots: The threat to emerging economies." *Financial Times*. Available at: www.ft.com/content/9f146ab6-621c-11e7-91a7-502f7ee26895.
- Taglioni, D., and D. Winkler (2016). *Making Global Value Chains Work for Development*. Washington, DC: World Bank.
- Timmer, M. P., A. A. Erumban, B. Los, R. Stehrer, and G. J. de Vries (2014). "Slicing Up Global Value Chains." *Journal of Economic Perspectives* 28(2): 99-118.
- Tytell, I., and K. Yudaeva (2007). "The Role of FDI in Eastern Europe and New Independent States: New channels for the spillover effect." In K. Liebscher, J. Christl, P. Mooslechner and D. Ritzberger-Grünwald (Eds.), *Foreign Direct Investment in Europe: A changing landscape*, Edward Elgar, Cheltenham, UK and Northampton, MA, USA.
- Wakefield, J. (2016). "Foxconn replaces '60,000 factory workers with robots." *BBC News*. Available at: <https://www.bbc.com/news/technology-36376966>.
- Wang, W., S.-J. Wei, X. Yu, and K. Zhu (2017). "Characterizing Global Value Chains: Production length and upstreamness." NBER Working Paper No. 23261, National Bureau of Economic Research, Cambridge, MA.