

**POLICY DIALOGUE ON AID FOR TRADE**

# **GLOBAL PRODUCTION NETWORKS AND EMPLOYMENT: A DEVELOPING COUNTRY PERSPECTIVE**



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GLOBAL PRODUCTION NETWORKS AND EMPLOYMENT: A DEVELOPING COUNTRY  
PERSPECTIVE

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*This paper was prepared by Ben Shepherd (External Consultant) and Susan Stone (TAD/DD). It has benefited from comments made by TAD colleagues and Margit Molnar (Development Centre and referee).*

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## TABLE OF CONTENTS

Executive summary.....	3
Global Production Networks and Employment: A Developing Country Perspective .....	4
I. Introduction.....	4
II. Global Value Chain and Developing Economies.....	4
Employment Effects.....	6
III. Data and Preliminary Analysis.....	9
IV. Econometric Models and Results.....	12
Labour Demand Model .....	12
Wage Model.....	14
Skill Model.....	16
Gender Model.....	17
V. Conclusion and Policy Implications.....	19
References.....	21
Data Annex .....	23

## EXECUTIVE SUMMARY

The purpose of this paper is to provide econometric evidence on the links between Global Value Chains (GVCs) and labour markets, focusing on developing economies, particularly the OECD's Key Partner countries (Brazil, India, Indonesia, China, and South Africa). The literature generally indicates that firms with international linkages—which we use here as a proxy for GVC involvement—tend to employ more workers, pay higher wages, and employ more skilled workers than firms that deal exclusively with the domestic market. Because of their capacity to act as vectors of skill-biased technical change, internationalization of firms can also be associated with increased wage inequality. All of these findings depend to some extent, however, on the countries involved and the types of activities undertaken by the firms involved in the study. The labour 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 labour and higher relative wages. Thus, the evidence from developed countries may not apply to developing economies.

Overall our results are consistent with existing evidence found in developed economies. Internationalised firms tend to hire more workers and pay higher wages in developing economies as well. We also find a positive significant relationship between the number of skilled workers and firms with international linkages. However, this comes more from exporting than importing. We attribute the latter finding to the predominance of assembly work performed in many of the economies under consideration. Unskilled workers tend to dominate this work. Finally, larger, more productive firms generally employ lower shares of female workers. Firms with international linkages, on the other hand, are shown to hire a larger share of female workers providing evidence that international linkages provide greater opportunities for women to enter the formal labour market.

From a policy point of view, our findings suggest that GVCs have considerable potential to promote desirable labour market outcomes, particularly in non-high income countries. However, it is important to stress that complementary policies are likely to play a vital role. The fact that firm internationalization tends to increase the relative demand for skilled labour could be a factor tending to increase wage inequality, and it would have stronger effects in the absence of education and training policies designed to promote workforce and human capital development.

A second policy implication is that the place a firm occupies within a GVC is likely to be a crucial determinant of the labour market effects of GVC participation. Firms and countries involved primarily in simple assembly tasks are likely to see different labour market outcomes from those involved in offshored research and development activities. Policies that are designed to help firms—in a non-distortionary way—move through GVCs to positions of higher value added are likely to help promote the beneficial labour market effects of GVC participation. Education and training have already been mentioned as important complementary policies. Other examples include infrastructure development and regulation of backbone services sectors, both of which can provide firms with the foundation they need to successfully internationalize in high value added activities.

## GLOBAL PRODUCTION NETWORKS AND EMPLOYMENT: A DEVELOPING COUNTRY PERSPECTIVE

Ben Shepherd and Susan Stone

### I. Introduction

1. The rise of global value chains (GVCs) in a variety of industries has been a salient feature of the world economy over recent years (World Bank, 2003; de Backer and Yamano, 2012). GVCs are characterised by a fragmentation of research and development, production, and assembly processes across different countries, with distribution taking place on a largely global basis.<sup>1</sup> GVCs, like the famous one used to produce Apple's iPhone, are inherently complex phenomena: they do not rely on a linear supply chain, but instead use a network-based approach in which components move across borders multiple times during the production process, and component production takes place in different locations from where assembly is undertaken.

2. This fragmentation and geographical expansion of international production and trade networks in the global economy has had a marked effect on labour markets. The types of jobs demanded as well as where these jobs are placed is shifting at an ever increasing rate (Roach 2003 and A.T. Kearney, 2011). The increase in job mobility has occurred at the same time as a massive shift in the size and composition of the global labour market. Following the break-up of the former Soviet Union in 1989 and the end of the Cold War, about three billion workers from China, India, Russia and Eastern Europe – half of the world's labour force – joined the capitalist world economy, creating a labour supply shock on a scale unlike anything experienced before. Freeman (2006) estimates that the entry of China in the WTO alone increased global labour supply by an amount equivalent to about a third of the OECD labour force. Technological changes associated with the Internet allowed a dramatic expansion of outsourcing and offshoring options in services in addition to those existing in manufacturing.

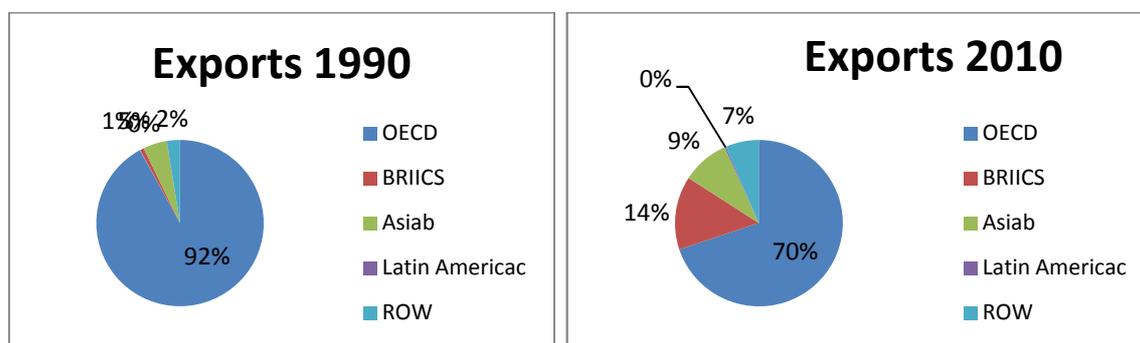
### II. Global Value Chain and Developing Economies

3. Developing economies are increasing their role in global trade of intermediate goods, a widely used indication of GVC participation. If we look at trade in parts and components (P&C), a subset of intermediate goods trade, we see that non-OECD economies have increased their share of this trade steadily over the past 20 years (Figure 1). Between 1990 and 2010, the share of BRIICS economies in the exports of P&C increased from 0.78% to over 14%. Non-OECD, non-BRIICS, Asia more than doubled their share in the same time period, from 4.6% to over 9% in 2010. OECD countries' share, at the same time, declines from over 92% of all exports of P&C to 70% by 2010. While the export story is well known, the import side is important as well, for it is often an indication of GVC participation (Cattaneo *et al.* 2010). For most of these economies, their share of imported P&C trade has increased as well. Here the share of OECD economies fell to a similar extent as exports (from 86% to 64%) while the share of BRIICS and rest of Asia increased significantly.

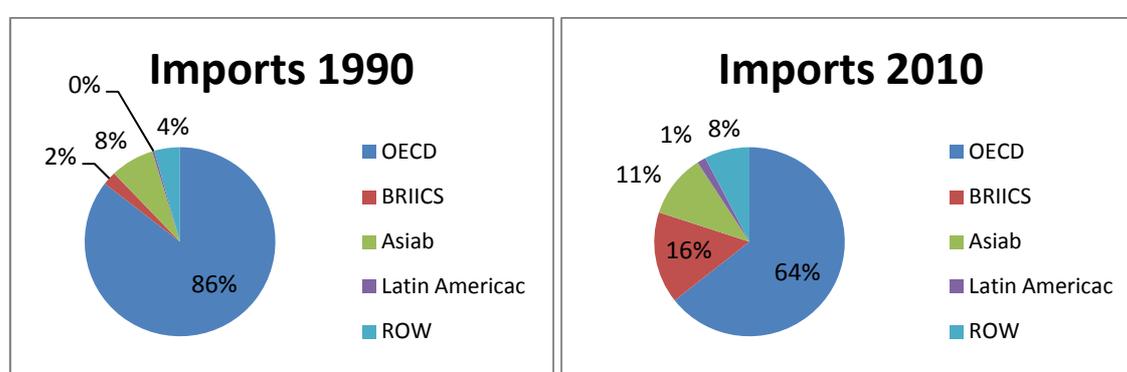
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<sup>1</sup> The concept of GVCs is closely related to those of global production networks (GPNs) and global commodity chains (GCCs). The main difference is that the GVC concept is inherently non-linear, as it is based on complex network interactions. However, we make use of findings from the literature on GPNs and GCCs as appropriate, in light of the closely linked nature of these concepts.

Figure 1. (a) Share of Parts and Components Exports



(b) Share of Parts and Components Imports

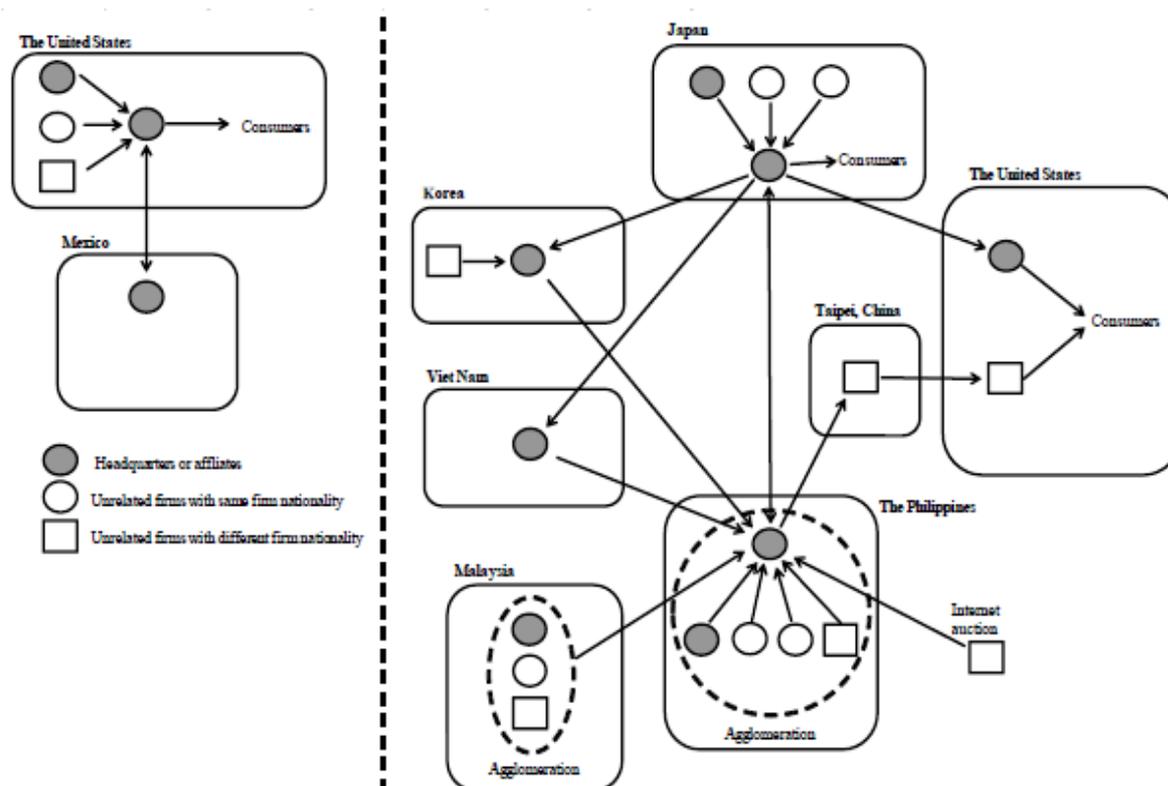


Source: UN COMTRADE.

4. Increasing participation in GVC activity has benefits to the domestic economy.<sup>2</sup> The trade, investment and knowledge flows that underpin GVCs can provide mechanisms for rapid learning, innovation and industrial upgrading, leading to better job outcomes in developing economies (Lall, 2000; Humphrey and Schmitz, 2002). GVCs can provide better access to information, open up new markets, and create opportunities for fast technological learning and skill acquisition. Because GVC-linked transactions and investments typically come with quality control systems and prevailing global business standards that can exceed those in domestic economies. Thus, suppliers and individuals can be “pushed” to acquire new competencies and skills through their participation in GVCs (Flanagan and Khor, 2012). In the most deeply linked developing countries, these business process improvements can be felt beyond the immediate exporting firms and sectors. Local firms can achieve greater success in their own markets by combining domestic and foreign intermediate inputs and creating economies of specialisation that leverage cross-border complementarities. Indeed, Kimura and Obashi (2011) argue that the success of GVCs in East Asia, especially compared with Latin America, relies heavily on these inter-linkages with the domestic and foreign market (Figure 2). Thus the opportunity for positive employment impacts generated by GVCs goes beyond their immediate circle.

<sup>2</sup> In an effort to expand GVC participation, APEC has announced a target of increasing supply chain efficiency by 10% by 2015.

Figure 2. Production Networks: Mexico versus East Asia



Source: Kimura and Ando (2005).

5. GVC-driven trade has clearly brought investments in new productive capacity and massive infrastructure improvements in developing economies (OECD, 2011). Key producing countries such as China, have developed enormous factory complexes whose output is sent to world markets through vast new port facilities. Participation in GVC activities has boosted employment, enabled increased specialisation and larger scale production, driven more efficient geographical allocation of industrial activities, and increased the availability of a variety of intermediate goods in the developing world (Gereffi, 2006). As a result, GVCs tend to “compress” the development experience, making non-linear catch up possible, as has been the case in China (Whittaker *et al.*, 2010). Still, GVCs are not necessarily a panacea for development. On the negative side, compressed development can create a host of new policy challenges in the realms of economic and social development (Whittaker *et al.*, 2010).

### Employment Effects

6. The impact of GVCs on developing countries’ labour markets often depends on the activity undertaken. Looking at offshoring as an indication of GVC activity, Bronfenbrenner and Luce (2004) looked at the labour market impacts in three main offshoring destinations for production shifts from the United States: China, India and Mexico. Each of these countries attracts a different mix of industries and jobs. China was the preferred location for the broadest range of industries: it captured all production shifts for sporting goods and toys; 40% of production in electronics and electrical equipment, apparel and footwear; and one-third of US production shifts in aerospace, appliances, household goods, and wood and paper products. While the range of industry is broad, the majority of jobs associated with this offshoring have been filled mainly by low-skilled workers. Mexico won out in a different set of industries but similar

type jobs: auto parts (68% of US shifts), plastics, glass and rubber (58%), appliances (56%), industrial equipment and machinery (53%), and wood and paper products (50%). Meanwhile, India accounted for nearly all US production shifts in finance, insurance, and real estate, and one-third of those in communications and information technology (Bronfenbrenner and Luce, 2004), and while these jobs were higher-skilled, they were not always ‘high’ skilled.

7. A different set of job opportunities emerged in the 1980s and 1990s as lead firms in capital- and technology-intensive value chains, such as automobiles and electronics, set up international production networks not only to assemble their finished goods, but also to develop a supply base for key intermediate products and sub-assemblies. At the uppermost tiers of these production networks, the suppliers tend to be very large and technologically sophisticated. Global contract manufacturers in electronics and mega-suppliers in the motor vehicles industry established an international presence that has created a demand for different kinds of jobs than was characteristic of the labour-intensive, buyer-driven value chains (Gereffi, 2006).

8. While these new global supply systems created higher paying, higher skilled job opportunities, this model of supplier-oriented upgrading also has some negative implications for jobs in the developing world (Sturgeon and Lester, 2004). First, industry co-evolution drives consolidation in the global supply base. Large and technologically sophisticated suppliers tend to concentrate “good” jobs in relatively few locations. The hard disk drive industry illustrates this pattern. Jobs in the US hard disk drive industry migrated to South-east Asia over a 20-year period beginning in the late 1970s. By the mid-1990s, 80% of the jobs (which tended to be higher skilled and better paying than traditional offshored jobs) shifted to Singapore and other countries in South-east Asia, such as Malaysia (Gereffi, 2006).

9. So what does all of this mean for jobs in developing economies? The evidence of offshoring in general is one of expanding opportunities for both developed and developing economies (Newfarmer and Sztajerowska, 2012). Yet, there are certainly job losses associated with these changes. Most studies find a moderate, negative impact on employment in developed economies from global outsourcing (e.g. Amiti and Wei, 2005 and Liu and Trefler, 2008), and there is also evidence of sector and occupation specificity in outcomes (Molnar *et al.*, 2008). However, there is less evidence for what is happening in developing economies (McMillan, 2010). There are quite a few studies that cover a specific country and/or a specific agreement (for example the work by Gordon Hanson examining the effect of NAFTA on Mexico (e.g. Hanson, 2007)) but these often relate to a specific industry or country and thus the generalisability of the results are open to question. Indeed, according to Hoekman and Winters (2005) surprisingly little evidence is available on the nature and extent of employment impacts in developing countries. The labour market effects of GVCs have become increasingly important from a policy point of view, as they are closely linked to the concepts of economic upgrading and social upgrading within GVCs. Barrientos *et al.* (2010) and Milberg and Winkler (2011) provide reviews of the issues in this area. They argue that economic upgrading—the process of moving into higher value-added activities within a GVC—only sometimes translates into improvements for workers, and proceed to examine the situations in which both can take place simultaneously.

10. The purpose of this paper is to provide econometric evidence on the links between GVCs and labour markets, focusing on both the OECD and developing economies, particularly the OECD’s Key Partner countries (Brazil, India, Indonesia, China, and South Africa). Since a companion paper (Shepherd, *Forthcoming*) provides a full review of the available literature on this question as it affects developing countries, we do not repeat that exercise in detail here. We simply note that there is already a wealth of econometric evidence on the nature of firms that export, import, and have foreign investor involvement, and that there is an emerging literature on the labour market effects of such firms. Specifically, the literature generally indicates that firms with international linkages—which we use here as a proxy for GVC involvement—tend to employ more workers, pay higher wages, and employ more skilled workers than

firms that deal exclusively with the domestic market. Because of their capacity to act as vectors of skill-biased technical change, internationalisation of firms can also be associated with increased wage inequality. All of these findings depend to some extent, however, on the countries involved and the types of activities undertaken by the firms involved in the study. The labour 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 labour and higher relative wages.

11. This paper builds on and extends the existing literature by using a firm-level dataset from the World Bank's Enterprise Surveys project to investigate four questions concerning the labour market impacts of GVCs:

1. Is the internationalization of firm activity associated with stronger labour demand?
2. Is the internationalization of firm activity associated with the payment of higher wages?
3. Is the internationalization of firm activity associated with stronger relative demand for skilled labour?
4. Is the internationalization of firm activity associated with stronger relative demand for female labour?

12. As noted above, in each case we are using firm internationalization—participation in exporting, importing, or being foreign owned—as a proxy for participation in a GVC. Our dataset covers firms in the OECD's Key partner countries, a large number of other developing countries, and a small number of non-high income OECD countries. We take care to distinguish the labour market impacts of GVCs in these different subsamples. In the OECD case, however, it is important not to generalise from the experience of non-high income countries to high income countries: as noted above, GVC activities can be fundamentally different in the two cases, with corresponding differences in labour market outcomes.

13. An additional restriction that needs to be kept in mind is that the focus of this paper is on empirical evidence and data analysis. As a result, the analysis should be interpreted as indicative of the links between GVCs and formal labour markets in developing countries. Data are generally not available on informal labour markets, even though these latter mechanisms can be important sources of employment in developing countries. Some of the policy literature expresses the concern that GVC participation might be linked with increased informality of work. This concern may, or may not, be valid, but it cannot be assessed on the basis of the data currently available. Although informality is a major issue in some developing countries, it should be remembered that it is typically the parts of the GVC performing the least sophisticated activities—and which tend therefore to be linked with other domestic firms rather than having direct international linkages—that are most likely to be involved in informal practices. Similarly, the fundamental economic forces of supply and demand for skilled and unskilled labour can sometimes have similar effects on the price of labour (wages) in informal markets as in formal markets, although the difference between the two levels can be substantial due to the failure to pay mandated benefits such as health insurance or unemployment insurance in the informal sector.

14. With this background in mind, the paper proceeds as follows. Section 3 provides an overview of our dataset and conducts a preliminary analysis of the four research questions presented above using graphical methods. The following section presents our empirical models and discusses results. Section 5 concludes and discusses policy implications of our findings.

### III. Data and Preliminary Analysis

15. Despite their importance for the world economy, GVCs are relatively understudied by economists due to the difficulty in obtaining data on intra-network transactions. Most of the extensive research that has been carried out in other disciplines on GVCs and related concepts tends to be based on case studies or policy analysis, rather than data and quantification. In this paper, we prefer to focus on the second path in analyzing the labour market implications of GVCs using firm-level data and econometric methods. Due to data limitations, it is necessary, however, to proceed by analogy, focusing on the types of firms and activities that GVCs would typically involve, even though it is impossible to tell in the data whether or not those firms are actually involved in particular GVCs or not. For example, our dataset contains rich firm-level information on the characteristics of firms that export, import, and have foreign investor involvement: all three activities are commonly observed within GVCs, and many GVC participants engage in all three activities simultaneously. From information on the behaviour of these types of firms, it is possible to make inferences about the likely impacts of GVCs on national economies, including labour markets.

16. In this section, we present the dataset used for the empirical analysis, and conduct some preliminary tests using descriptive statistical and graphical methods. Our data source for the econometric analysis below is the World Bank's Enterprise Surveys dataset. The full dataset currently has information on over 100 000 firms from 115 mostly developing and transition economies, including all five enhanced engagement countries. We take the 2006-2010 sample, which covers 108 countries and then add earlier data for China (2003) and India (2006).<sup>3</sup> Our sample is limited to 14 manufacturing industries only, and we exclude services firms from the dataset.

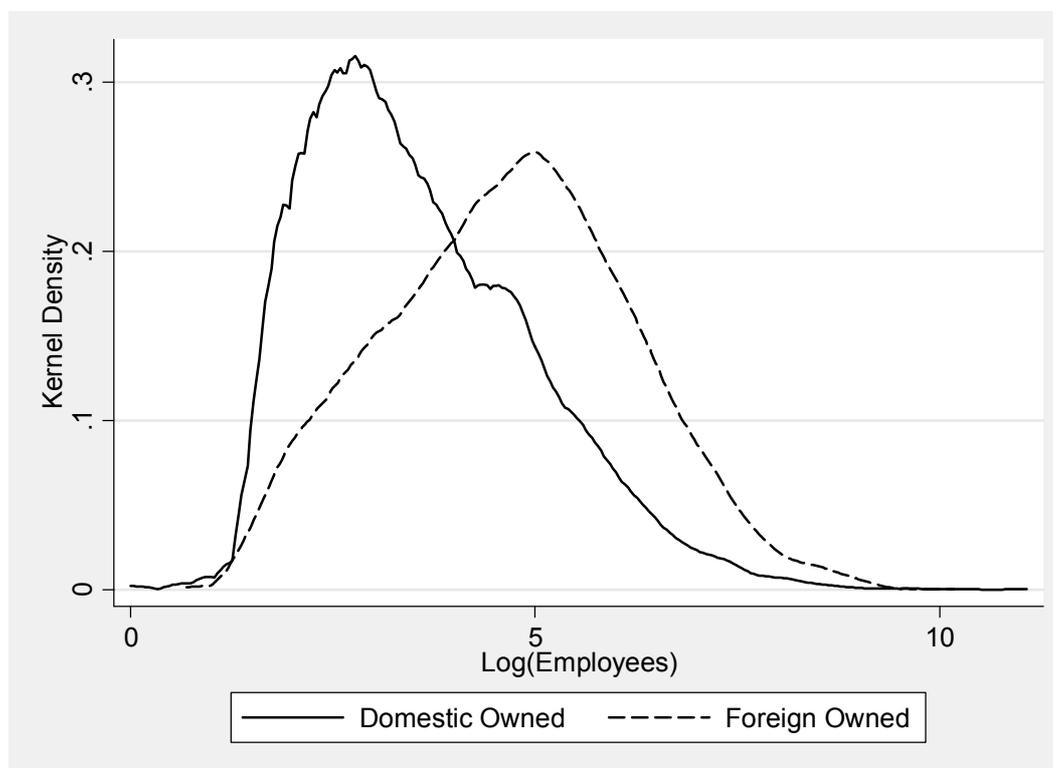
17. The Enterprise Surveys dataset provides basic information on firm performance that allows us to analyze factors such as labour demand (employment), wages, skill composition of the workforce, and gender issues. The data also identify firms with international linkages in a number of areas. Specifically, we can identify firms that export part of their production, those that import part of their intermediate input supply, and those that are majority foreign owned. The data do not specifically identify firms that are part of GVCs, so there is no way for us to explicitly estimate the impacts of participation in networked production on employment outcomes. However, we can use the three international linkages variables as proxies for the types of relationships that are common in GVCs, and then analyze the connections between these proxies and labour market outcomes in order to draw some inferences about the likely labour market impacts of GVCs. All our findings are therefore subject to the caveat that they relate primarily to international linkages of the type commonly found in GVCs, but do not capture the impact of production networks as such.

18. The first hypothesis we examine in the data is whether internationally-linked firms tend to employ more workers than those that deal with the domestic market only. As an example, we compare foreign-versus domestic-owned firms using kernel densities (Figure 3).<sup>4</sup> The density for foreign firms is clearly shifted to the right, which shows that they tend to employ more workers than domestically owned firms.

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<sup>3</sup> See Data Annex for details.

<sup>4</sup> In this section, we do not provide graphical analysis for all international linkage variables, but simply take representative examples of each hypothesis for illustrative purposes.

**Figure 3. Kernel densities of log(employees) for domestic- and foreign-owned firms**

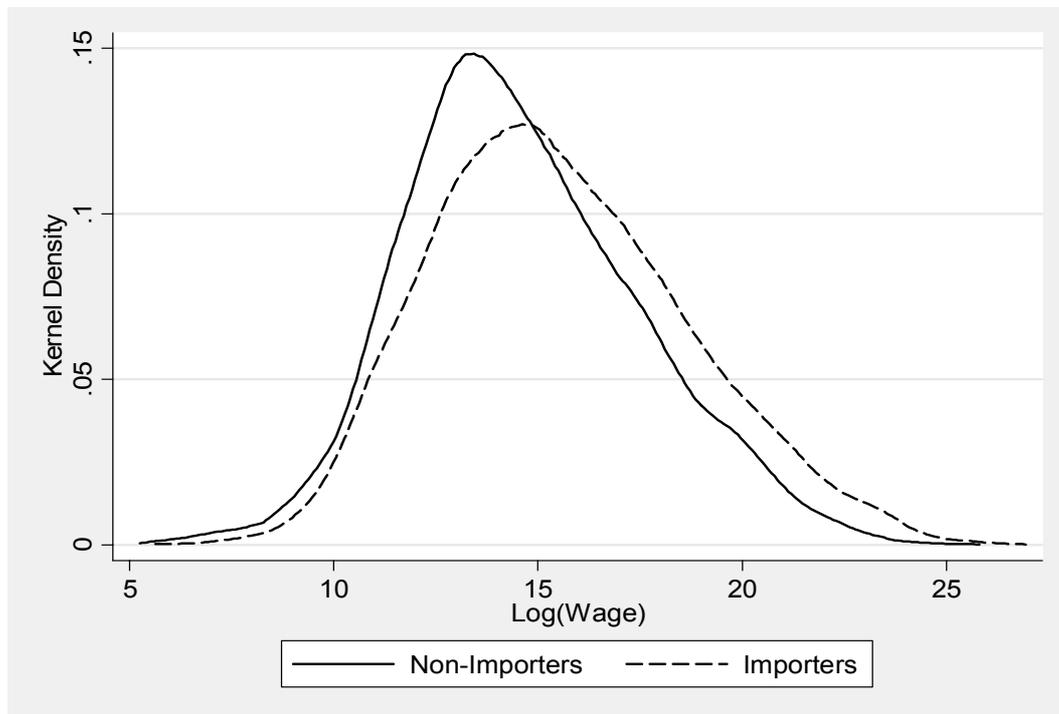
Source: Authors' calculations.

19. Figure 4 repeats the same exercise for wages, this time distinguishing between firms that import intermediate goods and those that source their inputs exclusively from the domestic market. Again, we see that the density for internationalized firms is shifted to the right. This finding is consistent with the idea that internationalized firms tend to pay higher wages than those firms that operate exclusively in the domestic market.

20. In Figure 5 we present kernel densities for the percentage of skilled workers in a firm's total workforce, distinguishing between firms that are foreign owned and those that are domestically owned. In this case, the graphical evidence is inconclusive: there is no obvious difference between the densities in the two cases. This preliminary analysis therefore does not indicate strongly either way in terms of the hypothesis that foreign firms might employ a greater proportion of skilled workers than domestically owned firms. We emphasize, however, that this finding is subject to revision in light of the econometric analysis conducted below, which controls for a range of other influences that are excluded from this simple graphical analysis.

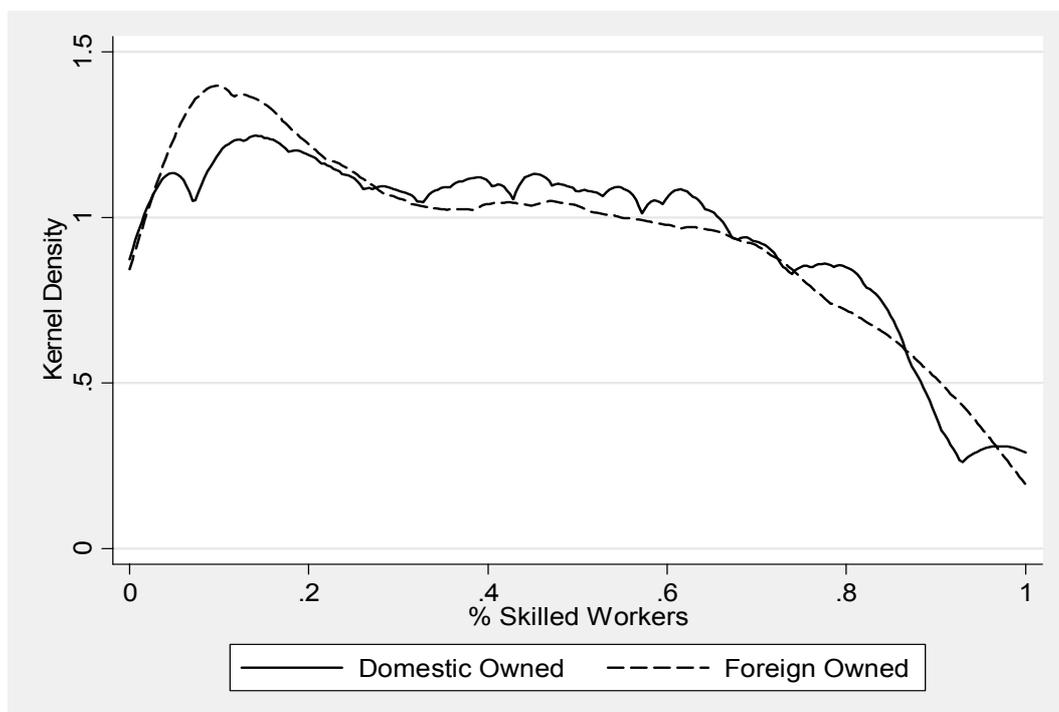
21. Finally, we use kernel densities to examine the hypothesis that internationalized firms tend to employ a higher percentage of female workers (Figure 6). To do this, we distinguish between exporters and non-exporters (firms that sell to the domestic market only). Although the two curves are close together, the density for exporters is clearly shifted towards the right. This finding therefore provides some preliminary evidence that firms with international linkages tend to be relatively higher shares of female labour.

**Figure 4. Kernel densities of log(wage) for importers of intermediates and firms that use domestically-sourced intermediates**

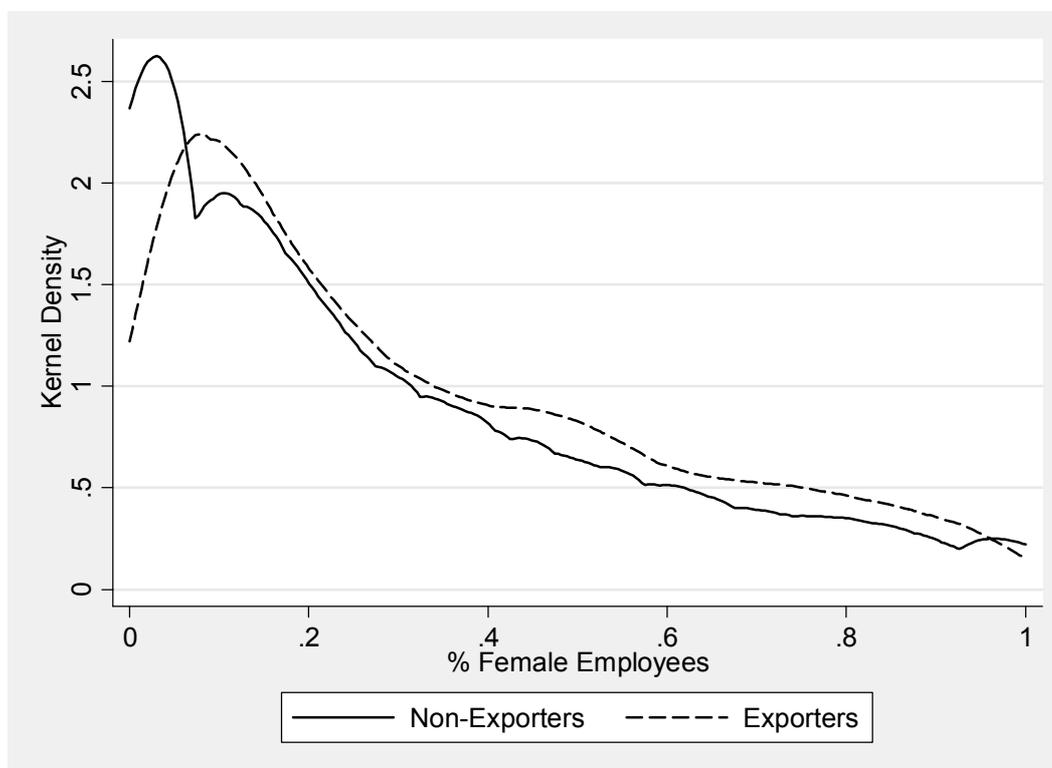


Source: Authors' calculations.

**Figure 5. Kernel densities of the percentage of skilled workers for foreign-owned and domestically-owned firms**



Source: Authors' calculations.

**Figure 6. Kernel densities of the percentage of female workers for exporters and non-exporters**

Source: Authors' calculations.

22. This graphical analysis provides some preliminary evidence suggesting that international linkages of the type found in GVCs are associated with stronger labour demand, higher wages, and higher female employment. We investigate these hypotheses in detail below using fully-specified econometric models that account for a range of other influences that are not included in this simple graphical analysis. We also examine the impact of internationalization of firm activities on the demand for skilled labour, even though the graphical analysis was inconclusive on that point.

#### IV. Econometric Models and Results

23. This section provides a more detailed analysis of the associations between international linkages and employment outcomes at the firm level using the Enterprise Surveys data. We deploy a series of econometric models that control for other influences, in addition to capturing the impact of international linkages on employment, wages, and skill. It is important to use fully-specified models in addition to the descriptive work in the previous section because it accounts for intervening factors that might also affect employment, but which cannot be picked up in simple bivariate analysis of the type used above. We first examine the links between international linkages and employment demand, then we move on to look at wages, then skill composition of the workforce, and finally we consider the gender makeup of the workforce.

##### *Labour Demand Model*

24. In order to examine whether internationally-linked firms tend to employ more workers than firms working exclusively with the domestic market, we adopt a standard labour demand specification augmented with variables designed to capture international linkages of the sort that commonly define

GVCs. We focus in particular on firms that export, those that import intermediates, and those that are foreign owned. As noted above, the Enterprise Surveys data allow us to identify these international linkages even though they do not specifically distinguish between firms that are part of GVCs and those that are not.

25. Our labour demand model takes the following form, which is similar to Stone and Bottini (2012):

$$\begin{aligned}
 (1) \log(\text{Employees}_{fscst}) & \\
 &= f_{cst} + b_1 \log(\text{sales}_{fscst}) \\
 &+ b_2 \log(\text{wage}_{fscst}) + b_3 \log(\text{capital}_{fscst}) + b_4 \text{direct exporter}_{fscst} + b_5 \text{foreign}_{fscst} \\
 &+ b_6 \text{importer}_{fscst} + e_{fscst}
 \end{aligned}$$

where employees is the total number of workers employed by the firm, sales is the value of total sales, wage is the firm's total wage bill, capital is the firm's total capital stock proxied by the net book value of total assets, exporter is a dummy variable equal to unity for firms that export directly (i.e., not through an intermediary), foreign is a dummy variable equal to unity for firms that are majority foreign owned, and importer is a dummy variable equal to unity for firms that import intermediate goods. The final term  $e$  is a residual satisfying standard assumptions. We estimate the model by OLS, using a full set of fixed effects by country-sector-year to control for factors that are common to firms within each sector, such as macroeconomic fluctuations and regulatory measures.

26. Results are presented in Table 1. Column 1 includes all countries for which data are available, while column 2 is limited to Brazil, India, Indonesia, China, and South Africa, and column 3 includes only OECD member countries for which data are available (Chile, the Czech Republic, Hungary, Mexico, Poland, the Slovak Republic, Slovenia, and Turkey). Taking the full sample results first, we see that bigger firms (higher sales) tend to employ more workers, as do those that pay higher wages, and those with larger capital stocks. These results are in line with expectations. In terms of our variables of interest, we find that all three international linkages dummy variables have the expected signs and statistically significant coefficients: exporters, foreign-owned firms, and importers of intermediate goods all tend to employ more workers than other firms, which could be an indication that internationalization of production has positive effects on the labour markets included in the analysis. The effect of exporting is particularly strong, while the effects of foreign ownership and importing intermediate goods are similar in magnitude.

27. Results for the key partner countries in column 2 are in line with the full sample results: larger firms, those that pay higher wages, and those with larger capital stocks tend to employ more workers. Again, we find that firms with international linkages tend to employ more workers than those that are limited in scope to the domestic market: this is true for exporters, foreign-owned firms, and importers of intermediate goods, as all three dummy variables have positive and statistically significant coefficients. Interestingly, all three coefficients are much larger for the key partner regression than the full-sample regression, which indicates that international linkages have stronger positive effects on labour demand in those countries than they do on average elsewhere. Although we are not directly able to isolate the effect of GVCs due to lack of data, this result is consistent with a mechanism in which labour markets in emerging markets benefit more strongly than those in developed markets due to the offshoring of parts of the production process.

28. Results for the OECD in column 3 confirm the above impression. Firm size, wages, and capital stock all have a positive impact on labour demand, as expected. Being an exporter or an importer of intermediate goods is also associated with stronger labour demand, but the effect is considerably weaker than in the key partner countries. Moreover, foreign ownership is not associated with any significant changes in labour demand in the OECD countries, whereas it has a strong effect in the key partner countries. These results further suggest that the strength of the impact of international production linkages can differ across country groups. One important caveat is that data availability for OECD countries is

limited to those considered by the World Bank to be non-high income countries, so it is unlikely that these results generalize to OECD countries at higher income levels than those in the sample, which tend to be sources for offshoring, rather than host countries.

**Table 1. Labour demand regression results**

	(1)	(2)	(3)
	All	Key Partner	OECD
Log(Sales)	0.168*** (0.000)	0.203*** (0.000)	0.267*** (0.000)
Log(Wage)	0.362*** (0.000)	0.162*** (0.001)	0.358*** (0.000)
Log(Capital)	0.064*** (0.000)	0.072*** (0.000)	0.044*** (0.001)
Exporter	0.262*** (0.000)	0.480*** (0.000)	0.165*** (0.000)
Foreign	0.066** (0.010)	0.270* (0.075)	-0.036 (0.531)
Importer	0.062*** (0.000)	0.151** (0.012)	0.088*** (0.005)
Observations	20741	1891	3422
R2	0.277	0.363	0.343

Notes: The dependent variable is log(employees) in all cases. Estimation is by OLS with fixed effects by country-sector-year. P-values based on robust standard errors clustered by country-year-sector are in parentheses below the parameter estimates. Statistical significance is indicated by: \* (10%), \*\* (5%), and \*\*\* (1%).

### *Wage Model*

29. In the second part of our analysis, we examine whether firms with international linkages tend to pay higher wages than other firms. Our model takes the following form:

$$\begin{aligned}
 (2) \log(wage_{fcst}) &= f_{cst} + b_1 \log(sales_{fcst}) \\
 &+ b_2 \log\left(\frac{sales_{fcst}}{employees_{fcst}}\right) + b_3 \log(capital_{fcst}) + b_4 exporter_{fcst} + b_5 foreign_{fcst} \\
 &+ b_6 importer_{fcst} + e_{fcst}
 \end{aligned}$$

where all variables are defined as above. We include labour productivity (sales per employee) in this regression but not in the first set of regressions because calculating it using the number of employees led to estimation difficulties for the labour demand models.

30. Results are presented in Table 2 with column 1 including all countries for which data are available, column 2 being limited to Brazil, China, India, Indonesia, and South Africa, and column 3 being limited to OECD member countries for which data are available. Taking column 1 first, as expected we find that larger firms and those with bigger capital stocks pay higher wages. However, the coefficient sign on productivity is contrary to expectations: we would normally assume that firms with more productive workers have to pay higher wages, but in this case the data appear to suggest the opposite. The reason is most likely that labour productivity (sales per worker) is a noisy measure of productivity, but data availability constraints mean that we cannot use alternative methods to estimate total factor productivity, which would be a more reliable measure. By contrast, the three international linkages variables all have

positively signed coefficients that are statistically significant. These results suggest that firms that export, those that are foreign-owned, and those that import intermediate goods, tend to pay higher wages than other firms. Again we stress that the data do not allow us to specifically identify an effect of GVCs on wages, but our results are certainly consistent with a scenario in which international linkages typical of participation in GVCs contribute not only to higher levels of employment (see above) but also higher wages.

**Table 2. Wage regression results**

	(1)	(2)	(3)
	All	Key Partner	OECD
Log(Sales)	0.952*** (0.000)	0.878*** (0.000)	0.943*** (0.000)
Log(Labour Productivity)	-0.500*** (0.000)	-0.189*** (0.000)	-0.556*** (0.000)
Log(Capital)	0.051*** (0.000)	0.093*** (0.001)	0.043*** (0.001)
Exporter	0.046*** (0.007)	-0.002 (0.969)	0.094** (0.041)
Foreign	0.052* (0.060)	0.086 (0.417)	0.090 (0.293)
Importer	0.030* (0.055)	0.028 (0.556)	0.080** (0.031)
Observations	20741	1891	3422
R <sup>2</sup>	0.814	0.859	0.765

Notes: The dependent variable is log(wages) in all cases. Estimation is by OLS with fixed effects by country-sector-year. P-values based on robust standard errors clustered by country-year-sector are in parentheses below the parameter estimates. Statistical significance is indicated by: \* (10%), \*\* (5%), and \*\*\* (1%).

31. Results for the key partner countries in column 2 are weaker than for the full sample, probably due to the much smaller number of observations. Although the three control variables—size, capital stock, and productivity—have the same signs and significance as in the full sample regression, the three international linkages variables have statistically insignificant coefficients. There is thus no discernible impact of international linkages on wage rates in these data for the key partner countries. Combining this result with the finding from the previous section suggests that the effects of GVCs may be primarily felt in emerging markets through increased employment rates rather than higher wages. The reason for this result could be that labour supply is relatively elastic at the skill levels primarily involved in internationalized production, although we stress that given the data available, this possibility remains a matter of conjecture. It would be necessary to use industry-level or economy-wide data, rather than firm-level data, to investigate such a possibility. It would also be necessary to broaden the estimation sample somewhat to include a wider range of developing countries before extrapolating from the key partners' experience to that of developing countries as a whole.

32. Results for the OECD countries in column 3 are stronger than for the key partner countries. As in the two other regressions, firm size and capital stock are positively related to wages, but productivity is negatively associated, which remains an unexpected result. In terms of international linkages, two of the three variables have positive and statistically significant coefficients: the exporter dummy and the dummy for importing intermediate goods. Both coefficients are considerably larger than in the full sample regression in column 1, which suggests that it may be primarily in developed economies that the effects of international production linkages are felt through wages, since we do not find such evidence for the large emerging markets of the key partner countries. As mentioned above, however, caution is required in

generalizing these results since they are based on data for OECD countries that are not in the World Bank's high income group, and results may well be different for high income OECD economies.

### ***Skill Model***

33. A third possible way in which international production linkages could impact employment is through the skill composition of the workforce. It is possible that internationally-linked firms tend to employ more skilled workers than other firms, which would be advantageous for the economy by creating increased incentives for individuals to develop their human capital and increase productivity, but could also contribute to wage inequality as it shifts the relative demand for skilled workers. In other words, international production linkages could act as a vector for skill-biased technological change. We test this hypothesis using a skill share equation of the following form:

$$(3) \frac{\text{skilled production workers}_{fcst}}{\text{employees}_{fcst}} = f_{cst} + b_1 \log(\text{sales}_{fcst}) + b_2 \log\left(\frac{\text{sales}_{fcst}}{\text{employees}_{fcst}}\right) + b_3 \log(\text{wage}_{fcst}) + b_4 \log(\text{capital}_{fcst}) + b_5 \text{exporter}_{fcst} + b_6 \text{foreign}_{fcst} + b_7 \text{importer}_{fcst} + e_{fcst}$$

where all variables are defined as in the previous sections. Because the dependent variable is bounded between zero and unity, OLS will not provide consistent estimates. We therefore use the fractional logit model of Papke and Wooldridge (1996). To provide an intuitive measure of model fit, R2 is calculated as the squared correlation between the actual and fitted values of the dependent variable.

34. Results are in Table 3. As in the previous sections, the first column includes all countries for which data are available, whereas the second is limited to Brazil, China, India, Indonesia, and South Africa only, and the third includes only those OECD countries for which data are available. Taking column 1 first, we see that larger firms tend to have a smaller proportion of skilled production workers in total employment. This is perhaps a surprising result, but it might stem from the fact that large firms have significant numbers of relatively unskilled employees performing functions such as assembly. More importantly, we find that firms that pay higher wages, those that are more productive, and those with larger capital stocks tend to have a more skilled workforce. These results are in line with expectations. The same is also true for one of the three international linkages variables: foreign owned firms tend to employ a relatively higher proportion of skilled production workers, and the effect of this international linkage is statistically significant. However, we have an unexpected result for firms that import intermediate goods: they tend to have a less skilled workforce than other firms. One explanation might be that firms that import a high percentage of their intermediates are perhaps involved in relatively low-skilled assembly operations, rather than the development and manufacturing of new products, which would require a more skilled workforce.

35. Results for the key partner countries in column 2 essentially mirror our findings for the full sample, but are again weaker in relation to international linkages because of the much smaller sample size. The control variables generally have the same signs as in column 1 and, with the exception of productivity and capital stock, are statistically significant. By contrast, none of the international linkages dummy variables has a statistically significant coefficient.

36. Results for the OECD are also weak (column 3). The four control variables have the same signs as in the first regression, and all coefficients except for wages are statistically significant. Of the international integration variables, only the dummy for firms that import intermediate goods is statistically significant, but it has an unexpected negative sign. One possible explanation for this result is that the OECD sample is

relatively limited, and does not include high income economies. As a result, importing intermediates might be associated with relatively low technology assembly activities, and thus a lower level of workforce skill. (We would expect to see this result replicated in the key partner regression, but it is not.) Again, caution is required in extrapolating these results to the high income OECD countries that are not included in the sample: firms there are much less likely to be involved in low-skill assembly tasks, and so the finding may well be reversed with different data.

**Table 3. Skill regression results**

	(1)	(2)	(3)
	All	Key Partners	OECD
Log(Sales)	-0.164*** (0.000)	-0.100** (0.015)	-0.107*** (0.000)
Log(Wage)	0.067*** (0.000)	0.065*** (0.001)	0.019 (0.447)
Log(Labour Productivity)	0.138*** (0.000)	0.012 (0.731)	0.104*** (0.000)
Log(Capital)	0.015** (0.014)	-0.001 (0.890)	0.041*** (0.003)
Exporter	0.033 (0.152)	-0.030 (0.702)	0.015 (0.716)
Foreign	0.079*** (0.007)	0.060 (0.498)	0.043 (0.585)
Importer	-0.053*** (0.009)	-0.067 (0.313)	-0.086** (0.028)
Observations	19275	1882	3387
R <sup>2</sup>	0.225	0.109	0.176

Notes: The dependent variable is % skilled workers in all cases. Estimation is by fractional logit with fixed effects by country-sector-year. P-values based on robust standard errors clustered by country-year-sector are in parentheses below the parameter estimates. Statistical significance is indicated by: \* (10%), \*\* (5%), and \*\*\* (1%). R2 is calculated as the square of the correlation coefficient between the actual and fitted values of the regression.

### Gender Model

37. Gender represents an additional way in which a firm's international linkages could impact the labour market. Specifically, internationalized firms might be more or less intensive in female labour than other firms, which would have implications for female labour demand and thus for the possibility for women, particularly in developing countries, to participate in the formal labour market. We examine this possibility using a gender share equation of the following form:

$$\begin{aligned}
 (4) \quad & \frac{\text{female workers}_{fcst}}{\text{employees}_{fcst}} \\
 & = f_{cst} + b_1 \log(\text{sales}_{fcst}) \\
 & + b_2 \log\left(\frac{\text{sales}_{fcst}}{\text{employees}_{fcst}}\right) + b_3 \log(\text{wage}_{fcst}) + b_4 \log(\text{capital}_{fcst}) + b_5 \text{exporter}_{fcst} \\
 & + b_6 \text{foreign}_{fcst} + b_7 \text{importer}_{fcst} + e_{fcst}
 \end{aligned}$$

where all variables are defined as in the previous sections. As for the skill share equation, we estimate using the fractional logit model of Papke and Wooldridge (1996) to take account of the fact that the

dependent variable is bounded between zero and unity. To provide an intuitive measure of model fit, R2 is calculated as the squared correlation between the actual and fitted values of the dependent variable.

38. Results are in Table 4. As in the previous sections, the first column includes all countries for which data are available. We see that more productive firms and those with a higher capital stock generally employ a lower proportion of female workers, and the effects are statistically significant at the 1% level. By contrast, firms that pay higher wages tend to employ more female workers (statistically significant at the 1% level). Two of the three international linkage variables have positive and statistically significant coefficients: the exporter dummy, and the importer of intermediate goods dummy. These results therefore suggest that internationalized firms might, on average, tend to be relatively more intensive in their use of female labour than firms that serve the domestic market only. As such, internationalization—including through the growth of GVCs—could be a positive force for bringing women into the formal labour market.

39. Column 2 of Table 6 contains results for the key partner countries. The coefficients on wages and capital stock have the same signs as in the full sample regression, and are statistically significant. However, the remaining control variables in the model do not have statistically significant coefficients. Among the international linkages variables, only the exporter dummy has a positive and statistically significant coefficient. The data therefore disclose some limited evidence that internationalized firms tend to be more intensive in female labour in the key partner countries.

40. Column 3 presents results limited to the OECD countries for which data are available. As in previous sections, results are generally weaker than for the other regressions. Firm size, wages, and capital stock do not have statistically significant coefficients in this case. However, as in the full sample regression, labour productivity is negatively associated with the proportion of female employees. By contrast, the foreign ownership dummy has a positive and statistically significant coefficient. There is thus some evidence that firms with international linkages tend to use female labour relatively intensively in the OECD. Development of international linkages through FDI—as through the growth of GVCs—could therefore have positive implications for the female labour market in OECD countries. Again, however, it should be kept in mind that the OECD sample considered here only includes non-high income countries, and the results cannot automatically be generalized to the OECD as a whole.

**Table 4. Gender regression results**

	(1)	(2)	(3)
	All	Key Partners	OECD
Log(Sales)	-0.008 (0.701)	-0.019 (0.731)	0.051 (0.220)
Log(Wage)	0.051*** (0.000)	0.082*** (0.008)	0.008 (0.758)
Log(Labour Productivity)	-0.058*** (0.002)	-0.045 (0.372)	-0.143*** (0.000)
Log(Capital)	-0.028*** (0.000)	-0.077*** (0.000)	-0.013 (0.337)
Exporter	0.139*** (0.000)	0.157* (0.088)	0.083 (0.125)
Foreign	0.029 (0.433)	-0.056 (0.578)	0.109** (0.015)
Importer	0.088*** (0.003)	0.011 (0.911)	0.026 (0.561)
Observations	20237	1583	3364
R <sup>2</sup>	0.455	0.370	0.336

Notes: The dependent variable is % female workers in all cases. Estimation is by fractional logit with fixed effects by country-sector-year. P-values based on robust standard errors clustered by country-year-sector are in parentheses below the parameter estimates. Statistical significance is indicated by: \* (10%), \*\* (5%), and \*\*\* (1%). R2 is calculated as the square of the correlation coefficient between the actual and fitted values of the regression.

## V. Conclusion and Policy Implications

41. This paper has examined the labour market implications of GVCs using firm internationalization—participation in exporting, importing, and being foreign owned—as a proxy for GVC participation. It is necessary to proceed by proxy due to current data limitations that make it impossible to identify particular firms or transactions that exist within the structure of a particular GVC. Specifically, this paper contributes four sets of findings on the labour market effects of GVCs, covering the following areas: labour demand, wages, demand for skilled labour, and demand for female labour.

42. First, we find that firm internationalization is associated with stronger labour demand. Using data for all countries, we find that exporting, importing intermediate goods, and being foreign owned are all associated with stronger labour demand. Quantitatively, the effect of exporting is strongest. These findings are largely replicated in sub-samples of the key partner countries and non-high income OECD countries respectively. Interestingly, the positive effects of internationalization on labour demand are stronger in the key partner countries than in the OECD, which suggests that the continued progress of GVCs could be a particularly favourable factor for labour markets in the main emerging markets.

43. Second, our data show that firms with international linkages tend to pay higher wages than those that deal with the domestic market only. In the full sample, exporting, importing, and being foreign owned are all associated with higher wages. The biggest impact comes from being foreign owned. In the OECD subsample, we find that exporting and importing are both associated with higher wages, with similar quantitative effects in both cases. For the key partner countries, on the other hand, none of the internationalization variables have a significant impact on wages. Putting these results together, we conclude that the positive wage effects of GVC involvement are primarily felt in the non-high income OECD countries and non-key partner developing countries. In the key partner countries, the primary labour market effect of GVC involvement appears to be increased labour demand, rather than higher wages.

44. Third, we find that firms with some types of international linkages—specifically foreign ownership—tend to experience stronger relative demand for skilled labour. The reverse is true for firms that import intermediate goods. The importing result stands for the OECD sub-sample, but none of the internationalization variables has a statistically significant coefficient in the key partner regression. We therefore conclude that the primary impact of GVCs on the relative demand for skilled labour is in the non-key partner developing countries, i.e. the smaller and less-developed emerging markets.

45. Finally, we use data on workforce composition to show that firm internationalization also affects the demand for female labour. In the full sample, exporters and importers both have higher proportions of female workers, but the effect is strongest for exporters. In the non-high income OECD sample, we find that foreign owned firms employ higher proportions of female workers. However, in the key partner sample, only exporting is associated with a greater proportion of female workers. We interpret these results as providing some preliminary evidence to the effect that GVCs can have gender implications in developed and developing economies alike, but that there appears to be some support for the proposition that labour force growth due to GVCs is relatively intensive in female labour. This finding clearly has positive implications from a gender equity standpoint, as it indicates the inclusion of greater numbers of women in the formal labour market.

46. It is important to be clear about one caveat to these results. There is the possibility of endogeneity in each of the models estimated. Indeed, the causal linkages among variables are likely to be complex and could run in both directions simultaneously. The results presented here therefore highlight associations in the data, but do not establish a causal relationship. To establish such relationships, a different empirical approach would be required, for instance using instrumental variables techniques. However, data

limitations—particularly the lack of availability of true panel data for firms—mean that it is not possible to proceed with such strategies using the Enterprise Surveys data.

47. From a policy point of view, our findings suggest that GVCs have considerable potential to promote desirable labour market outcomes, particularly in non-high income countries. Shepherd (Forthcoming) reaches a similar conclusion based on a review of the existing evidence. As in that paper, however, it is important to stress that complementary policies are likely to play a vital role. The fact that firm internationalization tends to increase the relative demand for skilled labour could be a factor tending to increase wage inequality, and it would have stronger effects in the absence of education and training policies designed to promote workforce and human capital development.

48. A second policy implication, which is again linked to the findings of the literature review by Shepherd (Forthcoming), is that the place a firm occupies within a GVC is likely to be a crucial determinant of the labour market effects of GVC participation. Firms and countries involved primarily in simple assembly tasks are likely to see different labour market outcomes from those involved in offshored research and development activities. Policies that are designed to help firms—in a non-distortionary way—move through GVCs to positions of higher value added are likely to help promote the beneficial labour market effects of GVC participation. Education and training have already been mentioned as important complementary policies. Other examples include infrastructure development and regulation of backbone services sectors, both of which can provide firms with the foundation they need to successfully internationalize in high value added activities.

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## DATA ANNEX

1. The World Bank Enterprise Surveys would be used to study the behaviour of SMEs in manufacturing activities. The World Bank's *Enterprise Surveys* dataset includes survey information as recent as 2010. This dataset currently has information on over 100 000 firms from 115 mostly developing and transition economies, including all five Key Partner countries. The Enterprise Surveys sample firms from official government statistics offices, tax authorities or licensing authorities in each country. In some cases, lists are obtained from Chamber of Commerce and business associations or other non-governmental sources.

2. The sample is obtained using stratified random sampling with replacement to generate a sample representative of the whole non-agriculture, non-governmental, economy. The surveys are stratified according to three criteria.

*Sector of activity* from a population of industries including manufacturing sector, construction, services, transport storage, communications and computer and related activities.

*Firm size* from a population including small firms (5-19 employees), medium firms (20-99 employees) and large firms (over 100 employees).<sup>5</sup>

*Geographic location* selected based on centres of economic activity within each country.

**Table A1. Country coverage in the 2006-2010 Enterprise Surveys sample (bold = OECD member or key partner country)**

Afghanistan 2008	<b>Chile 2006</b>	Guinea 2006	Micronesia 2009	<b>Slovak Republic 2009</b>
Albania 2007	<b>Chile 2010</b>	Guinea Bissau 2006	Moldova 2009	<b>Slovenia 2009</b>
Angola 2006	Colombia 2006	Guyana 2010	Mongolia 2009	South Africa 2007
Angola 2010	Colombia 2010	Honduras 2006	Montenegro 2009	St Kitts and Nevis 2010
Argentina 2006	Congo 2009	Honduras 2010	Mozambique 2007	St Vincent and Grenadines 2010
Argentina 2010	Costa Rica 2010	<b>Hungary 2009</b>	Namibia 2006	Swaziland 2006
Armenia 2009	Croatia 2007	<b>Indonesia 2009</b>	Nepal 2009	Tajikistan 2008
Azerbaijan 2009	<b>Czech Republic 2009</b>	Ivory Coast 2009	Nicaragua 2006	Tanzania 2006
Bahamas 2010	DRC 2006	Jamaica 2010	Nicaragua 2010	Timor Leste 2009
Bangladesh 2007	DRC 2010	Kazakhstan 2009	Niger 2009	Togo 2009
Belarus 2008	Dominican Republic 2010	Kenya 2007	Nigeria 2007	Tonga 2009
Benin 2009	Ecuador 2006	Kosovo 2009	Panama 2006	Trinidad and Tobago 2010
Bhutan 2009	Ecuador 2010	Kyrgyz Republic 2009	Panama 2010	<b>Turkey 2008</b>
Bolivia 2006	El Salvador 2006	Lao PDR 2009	Paraguay 2006	Uganda 2006
Bolivia 2010	El Salvador 2010	Latvia 2009	Paraguay 2010	Ukraine 2008
Bosnia and Herzegovina 2009	Eritrea 2009	Lesotho 2009	Peru 2006	Uruguay 2006
Botswana 2006	<b>Estonia 2009</b>	Liberia 2009	Peru 2010	Uruguay 2010
Botswana 2010	Fiji 2009	Lithuania 2009	Philippines 2009	Uzbekistan 2008
<b>Brazil 2009</b>	FYR Macedonia 2009	Madagascar 2009	<b>Poland 2009</b>	Vanuatu 2009
Bulgaria 2007	Gabon 2009	Malawi 2009	Romania 2009	Venezuela 2006
Bulgaria 2009	Gambia 2006	Mali 2007	Russia 2009	Venezuela 2010
Burkina Faso 2009	Georgia 2008	Mali 2010	Rwanda 2006	Vietnam 2009
Burundi 2006	Ghana 2007	Mauritania 2006	Samoa 2009	Yemen 2010
Cameroon 2009	Grenada 2010	Mauritius 2009	Senegal 2007	Zambia 2007
Cape Verde 2009	Guatemala 2006	<b>Mexico 2006</b>	Serbia 2009	
Chad 2009	Guatemala 2010	<b>Mexico 2010</b>	Sierra Leone 2009	

<sup>5</sup> The choice of a minimum of 5 employees was to limit the survey to the formal sector. However, often firms shrink over the survey period and thus 1.8% of our sample report less than 5 employees.

**Table A2. Variable definitions and sources**

Variable	Definition	Year	Source
% Female Workers	Number of female permanent production and non-production workers divided by the number of employees for the last fiscal year	Various	Enterprise Surveys
% Skilled Workers	Number of skilled production workers divided by the number of employees for the last fiscal year	Various	Enterprise Surveys
Direct Exporter	Dummy variable equal to unity for firms that recorded non-zero direct exports as a percentage of total sales for the last fiscal year	Various	Enterprise Surveys
Foreign Importer	Dummy variable equal to unity for firms that were owned more than 50% by foreign private individuals, companies, or organizations	Various	Enterprise Surveys
Indirect Exporter	Dummy variable equal to unity for firms that had non-zero imports as a percentage of total intermediate goods purchases for the last fiscal year	Various	Enterprise Surveys
Log(Capital)	Dummy variable equal to unity for firms that recorded non-zero indirect exports as a percentage of total sales for the last fiscal year	Various	Enterprise Surveys
Log(Employees)	Logarithm of the net book value of total assets for the last fiscal year	Various	Enterprise Surveys
Log(Sales)	Logarithm of the total number of permanent full time employees and full time seasonal/temporary workers for the last fiscal year	Various	Enterprise Surveys
Log(Wage)	Logarithm of total sales for the last fiscal year	Various	Enterprise Surveys
	Logarithm of the total annual cost of labour, including wages, salaries, bonuses, and social payments for the last fiscal year	Various	Enterprise Surveys

**Table A3. Summary Statistics**

Variable	Observations	Mean	Standard Deviation
Share of Foreign Owned	35855	9.0%	28.6%
Share of Direct Exporters	35852	24.9%	43.2%
Share of Importers	30674	59.4%	49.1%
Number of Employees	35906	145.4	627.6
Share of Skilled Workers	29936	42.5%	27.5%
Share of Female Workers	27359	28.8%	26.7%
Log Sales	33436	16.14	3.97
Log Labour Productivity	33243	12.48	3.72
Log Wages	30792	14.71	3.47
Log Capital	21927	15.80	3.43