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Global Value Chain Participation and the Relative Demand for Skilled Labour in East Asia

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Abstract: *Global value chains (GVCs) may have distributional consequences for the relative demand for skilled labour. This study relates GVC participation to the share of skilled labour in total compensation, focusing on the experience of 12 East Asian countries. It applies a macro-level analysis covering 114 countries and 27 sectors for intermittent years from 2001 to 2011. It uses a widely accepted measure of backward GVC participation – the share of foreign value added in exports.*

This study finds that while GVC participation is positively associated with the relative demand for skilled labour in the global data set, the positive correlation is smaller for the sample of East Asian countries and negative in a few cases. This could reflect East Asia's specialisation in manufacturing GVCs, which tend to make intensive use of lower-skilled labour. In agriculture, the direction of the correlation depends on a country's position in the agribusiness value chain and its skill intensity, while the results for services do not show any statistically significant correlations. Finally, the study assesses if policy matters for the relationship between backward GVC participation and the relative demand for skilled labour, and finds that higher labour market flexibility increases the positive relationship.

Keywords: trade, global value chain participation, relative labor demand, skilled labor, labor market policy

JEL categories: F1, F2, F6

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1. Motivation

Global value chain (GVC) participation can provide countries with the opportunity to foster development by integrating more domestic firms, benefiting from increased imports and exports, absorbing higher productivity gains, and creating more and better jobs. This is because low- and middle-income countries can now industrialise by joining GVCs and focusing on specific tasks without the need to build their own supply chain from scratch (Taglioni and Winkler, 2016; Baldwin, 2011). East Asian countries have increasingly integrated into manufacturing GVCs. However, GVC participation is a necessary but not sufficient condition for development. Policymakers are concerned about increasing value addition in a country (economic upgrading) and ensuring that participation in GVCs benefits the domestic society (social upgrading). In particular, GVCs may have distributional consequences in terms of demand for certain skills and their implications for wages, i.e. the relative demand for skilled labour. Depending on the skill requirements of a GVC segment a country specialises in, the relative demand for skilled versus other types of labour can either increase or decrease.

Much research has focused on globalised production as a driver for the lower relative demand for less-skilled workers in industrialised countries, starting with the seminal contributions of Feenstra and Hanson (1996, 1999), which estimated the effect of offshoring on the relative wage share of skilled labour in the United States (US). Many subsequent studies came to a similar conclusion.[2] However, there is a lacuna of empirical literature on developing economies that specialise in low-skilled segments of the global production network. In developing countries that specialise in low-skilled tasks such as the cut, make, and trim segment of the apparel value chain, enhanced GVC participation could favour unskilled labour.[3] The availability of inter-country input–output data, combined with the creation of new measures of GVC participation,

[2] Studies on the impact of offshoring on the relative demand for skilled labour include (i) Slaughter (2000); Morrison and Siegel (2001); and Crinò (2010) for the US; (ii) Anderton and Brenton (1999) and Hijzen, Görg, and Heine (2005) for the United Kingdom (UK); (iii) Hansson (2000, 2005); Anderton, Brenton, and Oscarsson (2002); and Ekholm and Hakkala (2006) for Sweden; and (iv) Falk and Koebel (2002); Helg and Tajoli (2005); Geishecker (2006); Becker, Eckholm, and Muendler (2009); and Winkler (2009, 2013) for Germany. For a literature review, see Crinò (2009) and Winkler (2013).

[3] This hypothesis is in line with the findings of Calì and Hollweg (2017) and Farole, Hollweg, and Winkler (2018).

has led to new vibrant research which covers a wider range of countries, including those at lower income levels.

This study relates GVC participation to the share of skilled labour in compensation at the country-sector level, focusing on the experience of 12 East Asian countries. It applies a macro-level econometric analysis covering 114 countries, more than 70 of which have low- and middle-income status, and 27 sectors.[4] The analysis combines the World Bank's Labor Content of Exports (LACEX) (Calì et al., 2016) and Export of Value Added (EVA) (World Bank 2015) data sets, which draw on underlying inter-country input–output data by the Global Trade Analysis Project (GTAP). While the LACEX data set enables us to obtain the total compensation in a country and sector by skill level, the EVA data set allows us to single out the foreign value added portion of gross exports,[5] which has been widely used as a measure of backward GVC participation in recent GVC research and statistical databases (e.g. Organisation for Economic Cooperation and Development (OECD)–World Trade Organization (WTO) Trade in Value Added (TiVA) database). The foreign value added in exports is a well-suited measure of GVC participation, as it relates to the concept of 'importing-to-export', where a country imports parts that are incorporated in its exports (Baldwin and Lopez-Gonzalez, 2013).[6]

We focus on 12 East Asian countries included in the global data set: Cambodia; China; Hong Kong; Indonesia; Japan; the Republic of Korea (henceforth, Korea); the Lao People's Democratic Republic (Lao PDR); Malaysia; the Philippines; Singapore; Thailand; and Viet Nam. These countries vary strongly in terms of their income levels and economic structure in 2011, making them interesting cases to study. This heterogeneity requires us to undertake the empirical analysis of this study at the country level. In many cases, the only common factor that countries like Cambodia and China have is their geographical proximity, while their country size, income levels, economic structure, skills composition, and position in GVCs vary greatly.

This study finds that while GVC participation is positively associated with the relative demand for skilled labour in the global data set, the positive correlation is

[4] Data are available for intermittent years from 2001 to 2011 (2001, 2004, 2007, and 2011).
[5] Gross exports can be decomposed into the foreign and domestic value added portions.
[6] While other cross-country data sets, such as the OECD–WTO TiVA data, could have been an alternative for this analysis, our data set has the advantage of covering a much larger set of lower-income countries. In addition, computations of compensation are readily available.

smaller for the sample of East Asian countries and negative in a few cases. This could reflect East Asia's specialisation in manufacturing GVCs which tend to be intensive in low-skilled labour relative to business services. In agriculture, the direction of the correlation depends on a country's position in the agribusiness value chain and its skill intensity, while the results for services do not show any statistically significant correlations. Finally, the study assesses if policy matters for the relationship between GVC participation and the relative demand for skilled labour, and finds that labour market flexibility increases the relationship.

This study fills at least three research gaps. First, by including low- and middle-income countries in the analysis, it contributes to the vibrant GVC research based on inter-country input–output data, which still lack new evidence for developing countries.[7] Second, the analysis uses the foreign value added share embodied in gross exports (FVAXSH) as a measure of GVC participation, which goes beyond the measures of offshoring commonly used in previous studies and has been recently developed and broadly accepted in the literature.[8] Finally, this study assesses if policy matters for the relationship between GVC participation and the relative demand for skilled labour, focusing on labour market flexibility, government spending on tertiary education, and trade facilitation.

The study is structured as follows. Section 2 reviews the relevant empirical literature. Section 3 introduces the empirical model and data sets. Section 4 shows stylised facts and reports the econometric results, while section 5 concludes.

2. Literature Review

Enhanced GVC participation may affect the relative demand for skilled workers. From an advanced country perspective, offshoring of low-skill-intensive tasks could lower the relative demand for unskilled labour and increase the relative demand for skilled labour. The seminal studies by Feenstra and Hanson (1996, 1999) first tested

[7] Inter-country input–output data, such as the World Input-Output Database (WIOD) or OECD–WTO TiVA, on which measures of GVC integration are built, do not include lower-income countries or only a few.

[8] The measure of offshoring captures the share of imported inputs in total inputs. Since imported inputs could contain domestic value added portions, particularly in the context of GVCs where inputs and components cross borders multiple times, FVAXSH more accurately reflects the true 'foreign' value added content in exports.

this hypothesis empirically for the US, and many studies have followed (footnote 2). Other studies have used matched employer–employee data and link offshoring to an increased wage disparity between skilled and unskilled labour in Denmark (Hummels et al., 2014) and Italy (Borghi and Crinò, 2013). The econometric studies generally confirm the increase in the relative demand for skilled labour resulting from offshoring across OECD countries.

This line of research does not question the lower relative demand for less-skilled workers in industrialised and emerging countries, but has not found a consensus on the underlying cause: trade or technology. Early research focused on the role of global trade in reallocating the demand for labour (e.g. Bhagwati and Kosters, 1994; Wood, 1994). Another line of literature pointed to technology – 'skills-biased technological progress' – as the primary culprit (e.g. Krueger, 1993; Acemoglu, 1998; and Berman, Bound, and Machin, 1998). Economists favoured skills-biased technological progress as the main explanation for the higher jobless rate amongst less-skilled workers, since the relative appreciation of skills was observed more strongly within rather than between industries.

The emergence of GVCs has offered an alternative explanation, however, as a large portion of trade is no longer in final, but rather intermediate, goods and services because of the increased global fragmentation of production.[9] Purchasing intermediate inputs from low-skill-intensive countries could result in an intra-industrial downward shift of less-skilled labour in advanced countries (Winkler, 2009, 2013). In addition, the distinction between trade and technology in the context of GVCs becomes increasingly merged, which has fundamental implications on where jobs go, who gets them, and what types of jobs they are (Farole, 2016). Reijnders, Timmer, and Ye (2016) found evidence that both offshoring and technological progress lower the demand for non-educated workers in advanced countries, while Michaels, Natraj, and

[9] Feenstra and Hanson (2001) also argued for international trade as the main driver behind the appreciation of high-skilled labour: 'The argument against trade is based, in part, on a misreading of the data. Stable trade to GDP ratios, an apparent increase in the relative price of skill-intensive goods, and employment shifts towards skilled workers that occur mainly within, rather than between, industries are all cited as evidence that trade cannot have contributed to rising […] inequality. This line of reasoning emphasizes trade in final goods and ignores the globalization of production and recent dramatic increases in trade in intermediate inputs' (Feenstra and Hanson, 2001: 46).

Van Reenen (2014) and Goos, Manning, and Salomons (2014) postulated that technological change, rather than offshoring, is the main culprit.

Some studies have started to question the skills-biased effect of offshoring in favour of skilled labour. Winkler (2009, 2013) suggested that the effect of services offshoring in Germany was negative for the relative demand for high-skilled German labour employed in the manufacturing sector over 1995–2004. Similarly, Foster-McGregor, Pöschl, and Stehrer (2016) found for advanced economies that the negative impact of offshoring is larger for high-skilled workers, which is attributed to increasing offshoring of high-tech components. Other studies have suggested that medium-skilled workers suffer most from offshoring. Autor (2010) found that job opportunities in the US have only fallen for middle-wage, medium-skilled jobs since the late 1980s, which he also relates to the offshoring of medium-skill 'routine' tasks. Similarly, while Foster-McGregor, Stehrer, and de Vries (2013) found for a sample of 40 World Input-Output Database (WIOD) countries over 1995–2009 that offshoring had negative labour demand effects across all skill categories, they found the effect to be largest for medium-skilled workers. While these studies vary in terms of their country contexts and somewhat in their findings, they all suggest that medium- and high-skilled workers are no longer shielded from the effects of offshoring.

Other studies have focused on tasks rather than skills, and tend to support the view that non-routine tasks are less likely to be offshored. Drawing on the German Qualification and Career Survey, the classification of non-routine tasks includes, for example, the use of precision-mechanical, special tools or most occupations of workers handling computers, while interactive tasks include transportation, but also computer-based user support and training (Becker, Ekholm, and Muendler, 2009). Several studies on Germany have postulated a shift towards non-routine and interactive tasks (Becker, Ekholm, and Muendler, 2009); more complex tasks (Hogrefe, 2013); and a higher degree of personal interaction and non-routine content (Baumgarten, Geishecker, and Görg, 2013) as a result of offshoring. Ottaviano (2015) also confirmed for the US that non-routine abstract or manual tasks which require more problem solving or personal interactions are less likely to be offshored. Bramucci et al. (2017) found that offshoring in manufacturing has negative implications for less qualified (manual) and more routinised (clerical) types of jobs. Akcomak, Kok, and Rojas-

Romagosa (2013) came to a different conclusion for the United Kingdom (UK) and showed that while offshoring reduces employment, it does not affect tasks.

Focusing more directly on GVC participation from an emerging country perspective, several studies confirm the bias in favour of skilled labour. Timmer et al. (2013) found that higher foreign value added content of production is associated with a shift away from low-skilled labour, towards capital value added and high-skilled labour, across a sample of WIOD countries. This finding also holds for emerging economies, such as China and India. De Vries et al. (2016) postulated an ongoing specialisation process towards high-skilled, knowledge-intensive activities across Asian countries, in particular in China, which results from technological change in GVCs. Applying propensity score matching techniques to firm-level data, Crinò (2012) confirmed for a sample of 27 transition economies that importing inputs increases the relative demand for skilled labour.

According to neoclassical trade theory (Heckscher-Ohlin model), a country's relative endowments with factors of production, e.g. abundance in low-skilled labour, determine its comparative advantage and specialisation in export sectors. Developing countries with a high abundance in low-skilled labour are expected to specialise in labour-intensive low-wage export industries such as apparel. More GVC participation in that model increases the relative demand for the factor of production which is abundant. In a developing country context, we can therefore expect an increase in the relative demand for low-skilled labour.

While the relationship between GVC participation and the relative demand for skills is predictable based on trade theory, there is a lacuna of empirical literature on developing economies. Calì and Hollweg (2017) showed for South Africa that enhanced GVC participation in GVC-intensive sectors such as the automotive and apparel industries was associated with a decline in the relative demand of skilled labour directly employed in GVC sectors. However, the relative demand of skilled labour indirectly employed in sectors that produce inputs for GVC sectors, in particular the services sectors, increased. Similarly, Farole, Hollweg, and Winkler (2018) confirmed the negative correlation between the foreign value added share in exports and the relative demand for skills in the GVC sector, and the positive correlation in the supplying sectors. Similar to the South African case, these results could be driven

by the large number of developing countries in the sample that specialise in low-skilled tasks favouring the relative demand for unskilled (rather than skilled) labour. However, connected upstream sectors such as services may be characterised by a higher relative demand for professional skills. The study covers a sample of around 120 countries, 57 GTAP sectors, and intermittent years from 2001 to 2014.

In summary, most studies have suggested that offshoring and GVC participation result in increased skill polarisation in favour of skilled labour, which holds for industrialised countries and emerging economies such as China, India, and Malaysia. Other studies have postulated that offshoring, in particular of services, may no longer favour skilled labour in advanced economies and could especially hurt medium-skilled workers. A small number of studies has focused on tasks, rather than skills, and has tended to find that non-routine tasks are less likely to be offshored. In developing countries that specialise in low-skilled tasks, by contrast, enhanced GVC participation could favour unskilled labour.

3. Model and Data

3.1. Econometric Model

A variable unit cost function CV is specified following Feenstra and Hanson (1996) and Geishecker (2006):

$$CV=CV(Y, w^{HS}, w^{LS}, k, T) \quad (1)$$

where Y denotes the output and w_{HS} and w_{LS} are the exogenous wages for the variable input factors high-skilled labour L^{HS} and less-skilled labour L^{LS}.[10] Capital is considered a quasi-fixed input factor in the form of capital intensity k. The technology shifter $T=T(GVC)$ is defined as a function of GVC participation.

Using the transcendental logarithmic (translog) form of the variable unit cost function as introduced by Brown and Christensen (1981) and applying Shephard's Lemma,[11] the following factor demand function can be derived:

[10] Most models cannot differentiate between more than two types of skill levels because of the absence of skill-specific wage and employment data.

[11] According to Shephard's lemma (1953), factor demand is determined by the first partial derivative of the cost function with respect to the corresponding factor price, regardless of the kind of production function.

$$\boldsymbol{S^{HS} = \alpha + \beta_1 \ln Y + \beta_2 \ln(w^{LS}/w^{HS}) + \beta_3 \ln k + \gamma GVC} \quad \textbf{(2)}$$

S^{HS} is the cost share of L_{HS} in variable costs CV. Since w^{HS} and w^{LS} are the only variable costs in equation (1), CV is determined by the sum of the products of the variable factor costs with their respective factors, $CV = w^{HS}L^{HS} + w^{HS}L^{HS} = wL$, where w designates the average wage per labour input L, regardless of the qualification. A decrease of S_{HS} can reflect both a fall in L^{HS} and/or a fall in w^{HS}, which implies a rise in S^{LS} and thus an increase in L^{LS} and/or in w^{LS}. Hence, the composite term $S^{HS} = w^{HS}L_{HS} / wL$ can be considered the relative demand for high-skilled labour.

We specify the following equation at the cross-country level:

$$\boldsymbol{S^{HS}_{cst} = \alpha + \beta_1 \ln Y_{cst} + \gamma GVC_{cst} + \alpha_{cs} + \alpha_{st} + \alpha_{ct} + \varepsilon_{cst}} \quad \textbf{(3)}$$

The relative demand for skilled labour is measured as a sector's skilled compensation as a percentage of total compensation. We also control for total output Y. The coefficient sign of output Y, $ß_1$, is not unambiguously predictable. An increase in Y normally leads to a higher overall wage bill and therefore to larger variable costs CV. If the cost increase is equally distributed between less-skilled and high-skilled labour, there should be no influence on S^{HS}.

GVC participation is captured by the foreign value added share embodied in gross exports, FVAXSH. The influence of GVC participation on S_{HS} is not easily predictable, as GVC participation could be a substitute for high-skilled ($\gamma < 0$) or less-skilled labour ($\gamma > 0$). Due to the unavailability of relative wages and capital intensity in the data set, we add country-sector, sector-time, and country-time fixed effects to the equation. We acknowledge that leaving out these control variables could bias the results,[12] but including the three sets of fixed effects will capture some of this variation.

We interact the GVC measure with a country dummy, *ctry*, taking the value of 1 if the country-sector data applies to a certain country, and 0 if not, to detect the joint effect for that country of interest.

Equation (3) then turns into:

[12] If the wage bill of less-skilled labour increases more than proportionally, e.g. because of better bargaining power, this results in a higher L^{LS} and/or w^{LS}, and SHS is expected to fall ($ß_2 < 0$). An increase in the capital intensity, k, is predicted to increase SHS, since capital can be considered a substitute for less-skilled labour rather than for high-skilled labour ($ß_3 > 0$).

$$S^{HS}_{cst} = \alpha + \beta_1 \ln Y_{cst} + \gamma GVC_{cst} + \delta GVC_{cst} * ctry_c + \alpha_{cs} + \alpha_{st} + \alpha_{ct} + \varepsilon_{cst} \quad (4)$$

The average effect of GVC participation for the country of interest across all sectors and the full-time dimension is then given by the sum of $\gamma + \delta$, while the effect for the rest of the country sample is given by γ only.

We also rerun the model in equation (4) by sector (agriculture, manufacturing, services) to detect if the correlation across countries varies with regard to sectors.

3.2. The Mediating Role of Policy

We also assess the role of policy in mediating the relationship between trade and the relative demand for skills as follows:

$$S^{HS}_{cst} = \alpha + \beta_1 \ln Y_{cst} + \gamma GVC_{cst} + \delta GVC_{cst} * policy_c + \zeta GVC_{cst} * policy_c * ctry_c + \alpha_{cs} + \alpha_{st} + \alpha_{ct} + \varepsilon_{cst} \quad (5)$$

The mediating effect of a certain type of policy for the relationship between GVC participation and the relative demand for skilled labour for a country of interest, *ctry*, is then given by $\gamma + (\delta+\zeta)*policy_c$, while the effect for the rest of the country sample is given by $\gamma + \delta*policy_c$ only. Note that the policy variables in our study are measured as the average across the period for two reasons: first, some policy measures are not available for the full period under study; and second, our data set only covers intermittent years during 2001–2011.

We include two labour market policy variables: (i) labour market flexibility and (ii) government spending on tertiary education. Labour market regulations can influence the effect of GVC participation on labour demand for a specific type of labour in a country. Overly rigid labour markets can reduce the likelihood of labour turnover and thus shifts in the skills composition of workers because of GVC participation. Kummritz, Taglioni, and Winkler (2017) found a positive mediating effect of higher labour market flexibility for the value added gains from backward and forward GVC participation in a sample of 61 emerging and industrialised countries.[13]

[13] In their study, policy variables enter the equation as averages over the period considered.

Shifting the focus to the labour market effects from offshoring, Winkler and Milberg (2015) found for a sample of 14 OECD countries covering 21 manufacturing sectors for 1995–2008 that the negative effect of offshoring on the labour share is mitigated by stricter employment protection legislation. The difference between these studies could be attributed to the different country samples used (emerging and industrialised versus industrialised), but more importantly also to differences in the dependent variables. While value added could be increased because of GVC participation, Winkler and Milberg (2015) focused on the distribution of value added between labour and capital. More labour market flexibility could benefit firms (or the profit share) more strongly than workers.

Our second variable focuses on government spending on tertiary education. More spending on tertiary education relative to other types of education can be expected to increase the availability of skilled labour, which has implications for their wages relative to unskilled labour. Indeed, recent research by Farole, Hollweg, and Winkler (2018) suggested that a higher number of years of schooling and a better quality of education positively mediates the relationship between the foreign value added share in exports and the relative demand for skilled labour. Kummritz, Taglioni, and Winkler (2017) confirmed the positive mediating effect of skills building for the value added gains from forward GVC participation. Shifting the focus to the labour market effects from offshoring, Winkler and Milberg (2015) found for the US manufacturing sector that the negative effect of offshoring on the labour share from 1995 to 2008 was mitigated by higher spending on education and a higher share of workers with tertiary education in the previous year.

Finally, we include a measure of trade facilitation, which captures the time and cost to import and export. Many countries cannot join certain stages of GVCs because of their inability to meet the requirements for timely production and delivery. A day of delay in exporting has a tariff equivalent of 1% or more for time-sensitive products (Hummels at al., 2007). Slow and unpredictable land transport keeps most of Sub-Saharan Africa out of the electronics value chain (Christ and Ferrantino, 2011). Sellers are often willing to pay more for airfreight. Delays in GVCs also create uncertainty, inhibiting countries from participating in GVCs for goods such as electronics or fruits and vegetables (Arvis, Raballand, and Marteau, 2010).

Regarding cost reduction, GVCs have changed the perspective on traditional barriers to trade, such as tariffs. The World Economic Forum (WEF, 2013) suggested that reducing supply-chain barriers to trade – border administration, transport and communications infrastructure, and related services – would have a greater impact on the growth of gross domestic product (GDP) and trade than the complete elimination of tariffs. Cutting supply-chain barriers to trade could increase GDP by nearly 5% and trade by 5%, against less than 1% and 1%, respectively, for complete tariff removal (WEF, 2013). Developing countries would be the main benefactors of trade facilitation. Transport costs, according to developing-country suppliers, remain the main obstacle to entering, establishing, or upgrading in GVCs (OECD and WTO, 2013). Kummritz, Taglioni, and Winkler (2017) confirmed that improved trade facilitation, including better internet coverage and higher performance with regard to customs procedures and logistics as well as shorter export and import times, has the capacity to magnify value added through GVC participation as a seller. Focusing on backward GVC participation, only better customs procedures seem to increase the value added gains.

3.3. Data

The cross-country analysis draws on the LACEX (Calì et al., 2016) and EVA (World Bank, 2015) data sets, which were assembled and published by the World Bank. Both data sets were computed on the basis of a panel of global input–output data spanning intermittent years from 2001 to 2011 from the GTAP.

While the LACEX data set emphasizes the value of the compensation of employees linked to exports and total production by sector/country/year (Calì et al., 2016), it also allows us to obtain labour-related variables at the country-sector level, including the compensation overall and by skill category. The dependent variable is the relative demand for skilled labour, S^{HS}, which is the ratio of skilled (i.e. professional) compensation to the total compensation of the country-sector. The shares are computed based on national sources or estimated based on GDP and educational attainment information (Walmsley and Carrico, 2016). The data set also includes information on gross output and gross exports.

The EVA data set is published at the 27 sector level. We used a concordance table to merge the LACEX data, which are available for all 57 GTAP sectors, with the

EVA data set (Appendix 1). The availability of data on the value added of exports enables us to compute the foreign value added that is embodied in a country-sector's gross exports – the backward GVC participation measure – by subtracting value added from gross exports.[14]

We created deflators based on value added data in constant and nominal terms that are published by the World Development Indicators for agriculture, industry, manufacturing, and services. Commodities are obtained by subtracting manufacturing from industry. In cases where manufacturing value added data were unavailable, we applied the broader industry deflators for both the manufacturing and commodity sectors. The following East Asian countries are included in the data sets: Cambodia, China, Hong Kong, Indonesia, Japan, Korea, the Lao PDR, Malaysia, the Philippines, Singapore, Thailand, and Viet Nam.[15]

The policy section focuses on two types of labour market policies: (i) labour market flexibility and (ii) government spending on tertiary education. Labour market flexibility is examined using an index of *hiring and firing* provided by the WEF (2018) based on their Executive Opinion Survey as a qualitative measure. WEF scores range from 1 to 7, with 7 being the optimal value.[16] Another aspect of labour market policy is government spending on education. Here, we focus on government spending on tertiary education as a percentage of total government spending on education from the World Development Indicators (World Bank, 2018a).

We also include a measure of *trade facilitation* using the Doing Business (World Bank, 2018b) trading across borders variable, which is based on various indicators measuring the time and costs to import and export. The score indicates the distance of a country to the 'frontier', representing the highest performance. The highest-performing country (frontier) obtains 100, while the lowest performing country obtains 0. Since labour market flexibility and trade facilitation data are only available from 2006, policy variables enter the regressions as averages over the full period.

[14] It is worth noting that this analysis does not include forward GVC participation, which measures the share of domestic value added that is used for export production by the partner countries. Empirically, forward integration tends to be high in countries with larger endowments in natural resources, such as Indonesia, which are embodied in a variety of downstream processes. Since natural resources, including agriculture and mining, rely on low-skilled labour inputs, it could be expected that forward GVC integration is negatively linked to the relative demand for skilled labour.

[15] While Taiwan is included in the data sets, we had to drop it because of missing deflators.

[16] While this measure is perception-based, it is available for the large range of developing countries in our sample and covers several years of our analysis. Labor Market Regulation data by the World Bank, for instance, have only been included in the 2018 publication of the Doing Business Indicators.

Differences can thus only be explained by cross-country variations. The summary statistics are shown in Table 1.

Table 1: Summary Statistics

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
Relative demand for skilled labour$_{cst}$	10,600	0.241	0.148	0.000	0.775
Output (in logarithms)$_{cst}$	9,985	8.093	2.434	-1.782	15.672
Backward GVC participation$_{cst}$	10,600	0.279	0.177	0.000	1.000
Labour market flexibility$_{c}$	10,215	3.846	0.814	2.122	5.844
Government spending on tertiary education$_{c}$	9,486	21.253	7.185	5.829	42.647
Trade facilitation$_{c}$	10,600	68.804	19.833	15.384	95.382

GVC = global value chain, Min. = minimum, Max. = maximum, Obs. = observations, Std. Dev. = standard deviation.
Sources: Calì et al. (2016); WEF (2018); and World Bank (2015, 2018a, and 2018b).

4. Analysis

4.1. Summary Statistics

This section describes the East Asian experience in terms of sectoral specialisation, GVC participation, and the share of skilled labour in total compensation. While agriculture in low- and lower-middle-income countries still represents a higher share of domestic value added, especially in Cambodia, the Lao PDR, and Viet Nam (20%–35%) and to a lesser extent in Indonesia and the Philippines (12%–14%), high-income countries such as Hong Kong, Japan, Korea, and Singapore show no or very little value added shares in agriculture. In addition, all countries reduced their reliance on agriculture in total value added from 2001 to 2011.

Table 2: Domestic Value Added Distribution and Income, East Asian Countries, 2001 vs. 2011 (%)

Country	2011 Income	Value Added 2001				Value Added 2011			
		Agr	Ind	Mfg	Serv	Agr	Ind	Mfg	Serv
Cambodia	L	43.5	18.9	12.5	37.6	35.3	25.3	17.3	39.4
China	UM	16.4	42.0	n.a.	41.6	9.1	46.9	n.a.	44.1
Hong Kong	H	0.1	11.9	3.5	88.0	0.1	7.3	1.7	92.7
Indonesia	LM	16.7	48.1	24.0	35.2	13.9	43.7	22.5	42.4
Japan	H	1.4	28.8	18.3	69.8	1.1	27.7	20.4	71.2
Korea	H	3.3	34.4	25.1	62.3	2.3	38.6	31.6	59.0
Lao PDR	LM	42.3	19.2	5.9	38.4	29.4	35.0	7.7	35.7
Malaysia	UM	11.6	49.3	24.1	39.2	10.2	39.4	23.5	50.3
Philippines	LM	14.8	33.7	23.6	51.5	12.2	32.0	21.7	55.8
Singapore	H	0.1	26.2	19.3	73.7	0.0	27.7	21.6	72.3
Thailand	UM	13.2	36.3	27.9	50.5	11.1	38.0	29.3	50.9
Viet Nam	LM	24.1	35.8	13.2	40.0	20.5	37.0	15.8	42.5

Agr = agriculture, H = high, Ind = industry, L = low, Lao PDR = Lao People's Democratic Republic, LM = lower-middle, Mfg = manufacturing, Serv = services, UM = upper-middle.
Note: Green shading indicates high percentages, yellow shading indicates intermediate percentages, and red shading indicates low percentages.
Sources: Author's illustration; data from World Bank (2018a).

On the other hand, manufacturing value added shares exceed 20% in most countries except for Cambodia, Hong Kong, the Lao PDR, and Viet Nam, and reach around 30% in Korea and Thailand.[17] Manufacturing value added shares expanded in most countries over 2001–2011, with the exception of Hong Kong, Indonesia, Malaysia, and the Philippines. Services make up the bulk of Hong Kong and Singapore's total value added (93% and 72%, respectively), but also exceed 50% in Korea, the Philippines, Thailand, and Malaysia. The Philippines is an exception, as the only lower-middle-income country with a high services value added percentage. The only countries whose services value added share declined over the period are Korea, the Lao PDR, and Singapore.

Similarly, there are strong differences in terms of the relative demand for skilled labour (SHS) and GVC participation (FVAXSH) amongst these East Asian countries, as reported in Table 3. The relative demand for skilled labour, SHS, is measured as the

[17] Data for 2016 reveals manufacturing value added shares of more than 18% in Cambodia and Viet Nam, while Singapore's share declined to 18% as well.

share of skilled labour in total compensation, where the latter equals total compensation. For example, for Cambodia, the SHS in 2011 means that skilled workers only made up 16.6% of total compensation, while unskilled workers represented 83.4%.

Four countries have high-income status – the Asian Tigers (Hong Kong, Korea, and Singapore) and Japan. These countries show the highest contribution of skilled labour to compensation, SHS, ranging from 31% in Korea to 43% in Hong Kong in 2011, and remained relatively stable over the period. At the same time, the foreign value added portion embodied in gross exports in these countries grew more quickly than exports, resulting in an expansion of FVAXSH. The only exception is Singapore, which saw its foreign value added share in exports decline to 50%, albeit from a very high percentage of 65% in 2001.

Table 3: SHS and GVC Participation, East Asian Countries, 2001 vs. 2011 (%)

Country	SHS		FVAXSH	
	2001*	2011	2001*	2011
Cambodia*	16.2	16.6	48.4	53.1
China	19.3	25.2	25.2	21.6
Hong Kong	44.0	43.6	24.9	29.0
Indonesia	21.8	20.2	24.6	17.2
Japan	37.8	38.0	12.1	21.5
Korea	29.7	31.4	37.7	48.0
Lao PDR*	13.8	14.9	30.9	34.5
Malaysia	23.3	24.8	44.3	40.2
Philippines	29.1	29.0	33.0	37.3
Singapore	38.0	38.1	65.6	50.4
Thailand	27.3	29.9	42.9	45.1
Viet Nam	19.4	21.4	50.9	54.2

FVAXSH = foreign value added in exports as a percentage of exports, GVC = global value chain, Lao PDR = Lao People's Democratic Republic, SHS = share of skilled labour in compensation.
* 2004 data for Cambodia and the Lao PDR.
Note: Green shading indicates high percentages, yellow shading indicates intermediate percentages, and red shading indicates low percentages.
Sources: Author's illustration; data from Calì et al. (2016) and World Bank (2015).

Three countries have upper-middle-income status (China, Malaysia, and Thailand) and show compensation shares of skilled labour of 25%–30%. While Malaysia and Thailand increased their relative demand for skilled labour only slightly, China showed a strong expansion over the period, pointing to a shift in its economic specialisation to higher-skilled activities. At the same time, China and Malaysia reduced their foreign value added share in exports, FVAXSH, to 21% and 40%,

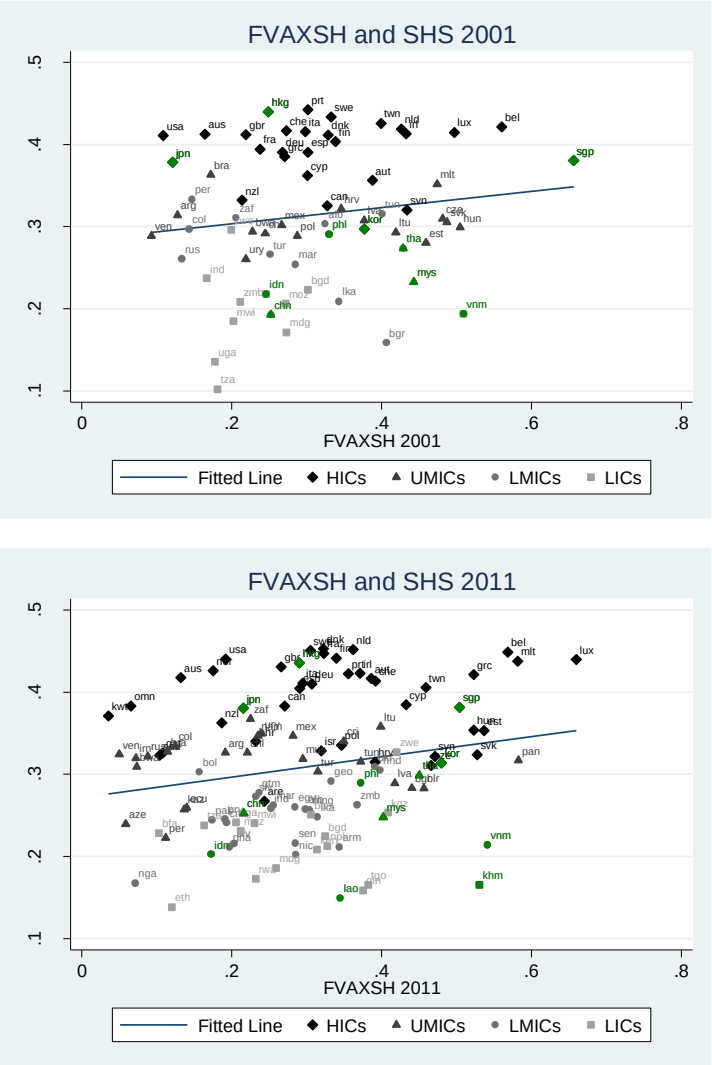
respectively, over the period, whereas Thailand increased its dependence on foreign value added in its exports to 45%.

Finally, five countries have lower-middle (Indonesia, the Lao PDR, the Philippines, and Viet Nam) and low-income status (Cambodia), which correlates to their lower share of skilled labour in compensation (15%–21%), with the remarkable exception of the Philippines (29%). Interestingly, these countries, with the exception of Indonesia, expanded their foreign value added shares in exports over the period, which range from 34% to 37% in the Lao PDR and the Philippines to more than 50% in Viet Nam and Cambodia. Indonesia is an outlier, seeing both its relative demand for skills and backward GVC participation decline over the period. This could be the result of increasing orientation towards commodities away from manufacturing during the 2000s commodity boom.

To fix ideas on the relationship between GVC participation and the relative demand for skills, Figure 1 shows the scatterplot across all countries for 2001 and 2011.[18] The scatterplot suggests a positive correlation between the foreign value added share in exports, FVAXSH, and the share of skilled labour in total compensation, SHS.

[18] As some countries did not publish data for 2001, Appendix 2 shows the scatterplot for 2004.

Figure 1: FVAXSH and SHS, 2001 and 2011



FVAXSH = foreign value added in exports as a percentage of exports, HIC = high-income country, LIC = low-income country, LMIC = lower-middle-income country, SHS = share of skilled labour in compensation, UMIC = upper-middle-income country.
Note: See Appendix 2 for 2004 data. For country abbreviations, see International Organization for Standardization (ISO), https://www.iso.org/obp/ui/#search.
Sources: Author's illustration; data from Calì et al. (2016) and World Bank (2015).

The graphs also suggest that the countries' relative demand for skilled labour is positively related to their income levels. By contrast, we find countries with varying GVC participation amongst all income categories. Amongst high-income countries, for example, there are oil-exporters on the top left, larger OECD countries in the top middle, and smaller OECD countries in the top right part of the graph.

East Asian countries vary drastically in terms of their position in the scatterplots, requiring an analysis at the country level. It appears that in 2011 most countries show medium to high overall participation in GVCs, measured as a share of foreign value added in exports, FVAXSH, with Indonesia being an outlier exhibiting a relatively low share. By contrast, Viet Nam, Cambodia, and Singapore can be found on the upper end of the spectrum with very large foreign value added shares in their exports (see also Table 2).

4.2. Baseline Regressions

This section presents the results of the regression analysis, following the specification in equation (4). Since the regressions control for country-sector, sector-time, and country-time fixed effects, we ensure that the observed results are not driven by differences in country size or other fixed effects. We apply the fixed effects estimator, which allows unobserved time-constant sector-specific effects, α_{cs}, to be correlated with some explanatory variable (output or GVC measure). In the event of such correlation, the fixed effects estimator only uses variation over time to estimate consistent coefficients. All estimations produce standard errors robust to heteroscedasticity (Huber-White sandwich estimators).

It is important to note that this analysis is unable to postulate causality between GVC participation and the relative demand for skilled labour because of endogeneity between the FVAXSH and SHS variables, since both are simultaneously determined as equilibrium relationships in the GTAP data. If backward GVC participation is endogenous to changes in the relative demand for skilled labour, the causality can run in both directions. For example, more GVC participation can lead to a higher share of skilled labour in total compensation (e.g. because of skills upgrading and knowledge spillovers), while a higher share of skills in total compensation can foster additional skill-intensive GVC-related investments and activities. When interpreting the results, the focus in the following is on better understanding the relationship between the two

variables. This study also presents ideas for future research which may be able to measure causal effects.[19]

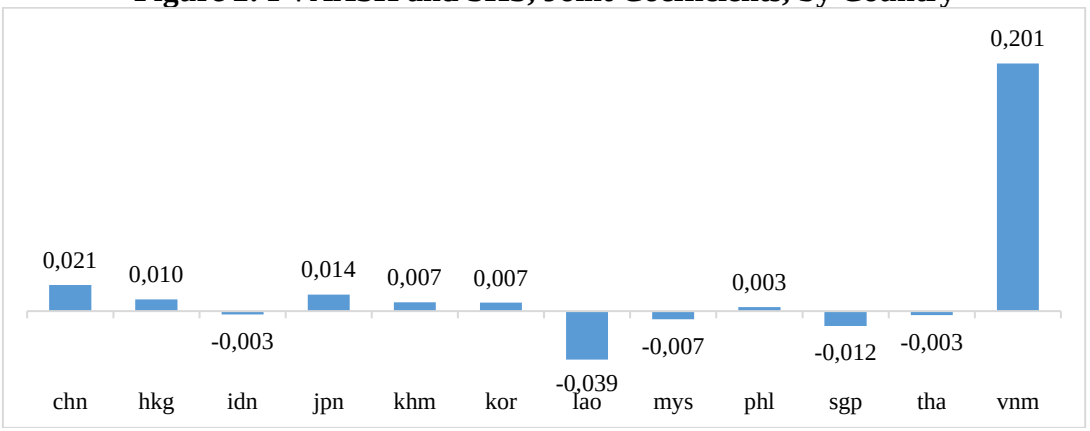
Table 4 shows the results, which suggest a positive correlation between the foreign value added share in exports, FVAXSH, and the relative demand for skilled labour, SHS, across all specifications, confirming our hypothesis.[20] Similarly, a higher output is positively associated with an increased relative demand for skills. For each of the 12 East Asian countries, the table reports the result of the interaction term with the respective country dummy, *ctry*. The F-test of joint significance tests whether the coefficients of the GVC variable and the interaction term are equal to zero and can be rejected in all specifications. Almost all the interaction terms are negative (with the exception of China and Viet Nam), pointing to a lower correlation between the GVC variable and the relative demand for skilled labour in the country compared with the rest of the sample of 114 countries. This could reflect East Asia's specialisation in manufacturing GVCs, which tend to make intensive use of lower-skilled labour.

Figure 2 reports the joint coefficients by country. The positive correlation between the foreign value added share in exports and the share of skilled labour in total compensation in Viet Nam stands out (0.201). Viet Nam's foreign value added share in exports grew by 3.2 percentage points from 50.9% in 2001 to 54.2% in 2011 (Table 2). Holding all other variables constant, this implies that backward GVC participation is associated with an increase of the relative demand for skilled labour of 0.65 percentage points. Putting this number into perspective, recall that the share of skilled labour in compensation expanded by 2 percentage points over the same period (from 19.4% to 21.4%; see Table 2).

[19] It is extremely challenging to find suitable instruments for FVAXSH to apply an instrumental variables econometric approach. Even 1-year lags cannot be included, since the time series is not continuous and only has observations for 2001, 2004, 2007, and 2011.

[20] One needs to be cautious about interpreting an increase in FVAXSH as domestic 'value added erosion' (Jiang and Carabello, 2017). This view suggests that the foreign and domestic value added portions of exports, FVAX and DVAX, are substitutes, i.e. an increase in FVAX reduces DVAX, which is only the case if exports remain constant. In reality, however, the domestic and foreign value added portions in exports can have a complementary relationship. This is particularly important in the context of developing countries that enter a new GVC which requires foreign machinery and imported inputs to be able to create domestic value added. If FVAX grows at a faster pace than DVAX, countries would still see their FVAXSH expand, but their domestic value added would not erode.

Figure 2: FVAXSH and SHS, Joint Coefficients, by Country



FVAXSH = foreign value added in exports as a percentage of exports, SHS = share of skilled labour in compensation.

Notes:

1. Based on regressions in Table 4.
2. Only joint effects are reported, for which the F-test of joint significance between $fvaxsh_{cst}$ and $fvaxsh_{cst} * ctry_c$ (Prob > F) was significant at the 10% level.

Sources: Calì et al. (2016) and World Bank (2015).

Table 4: FVAXSH and SHS, by Country

Dependent variable: S^{HS}_{cst}	(1) **chn**	(2) **hkg**	(3)	(4) **idn**	(5) **jpn**	(6) **khm**	(7) **kor**	(8) **lao**	(9) **mys**	(10) **phl**	(11) **sgp**	(12) **tha**	**vnm**
$\ln Y_{cst}$	0.0034***			0.0034***	0.0034***		0.0034***		0.0034***	0.0034***		0.0034**	
		0.0035***		0.0034***	0.0034***		0.0034***		0.0034**				
$fvaxsh_{cst}$	(0.010)	(0.010)		(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.009)	(0.010)	(0.010)	(0.010)	(0.010)
	0.0154***			0.0154***	0.0155***		0.0154***		0.0154***	0.0154***		0.0159***	
$fvaxsh_{cst}*chn_c$		0.0157***		0.0155***	0.0157***		0.0155***		0.0127**				
	(0.009)	(0.009)		(0.009)	(0.009)	(0.009)	(0.009)	(0.007)	(0.008)	(0.009)	(0.008)	(0.008)	(0.018)
$fvaxsh_{cst}*hkg_c$	0.0058												
	(0.785)												
$fvaxsh_{cst}*idn_c$		-0.0058											
		(0.589)											
$fvaxsh_{cst}*jpn_c$			-0.0183										
			(0.119)										
$fvaxsh_{cst}*khm_c$				-0.0019									
				(0.871)									
$fvaxsh_{cst}*kor_c$					-0.0081								
					(0.463)								
$fvaxsh_{cst}*lao_c$						-0.0086							
						(0.439)							
$fvaxsh_{cst}*mys_c$							-0.0552**						
							(0.049)						
$fvaxsh_{cst}*phl_c$								-0.0223***					
								(0.002)					

$fvaxsh_{cst}$*sgp_c								-0.0123				
								(0.133)				
$fvaxsh_{cst}$*tha_c									-0.0277**			
									(0.049)			
$fvaxsh_{cst}$*vnm_c										-0.0188		
										(0.286)		
constant											0.1884	
											(0.284)	
	0.2065***		0.2065***	0.2065***		0.2065***		0.2065***	0.2065***		0.2068***	
		0.2063***	0.2066***	0.2065***		0.2065***		0.2066***				
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	9,599	9,599	9,599	9,599	9,599	9,599	9,599	9,599	9,599	9,599	9,599	9,599
R-squared	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.15
F-test of joint sign[a]	0.0231	0.0286	0.0298	0.0185	0.0240	0.0308	0.0097	0.0071	0.0284	0.0193	0.0283	0.0295

FVAXSH = foreign value added in exports as a percentage of exports, SHS = share of skilled labour in compensation.

Notes:

1. p*<0.1, p**<0.05, p***<0.01 (p-values in parentheses).
2. All regressions include country-sector, sector-year, and country-year fixed effects.

[a] F-test of joint significance between $fvaxsh_{cst}$ and $fvaxsh_{cst}$ *$ctry_c$ (Prob > F). *fvaxsh* = foreign value added share embodied in gross exports.

Sources: Calì et al. (2016) and World Bank (2015).

What could explain the large correlation between backward GVC participation and the relative demand for skilled labour in Viet Nam? The findings in section 4.3 show that Viet Nam's stronger specialisation in manufacturing exports and reliance on foreign value added, as reflected in a growing FVAXSH, is strongly associated with a larger relative demand for *unskilled* labour. By contrast, Viet Nam's services sector seems to be positively correlated with demand for higher-skilled labour. Such services could also be embedded in manufacturing exports and include logistics, transportation, and information technology, amongst others.

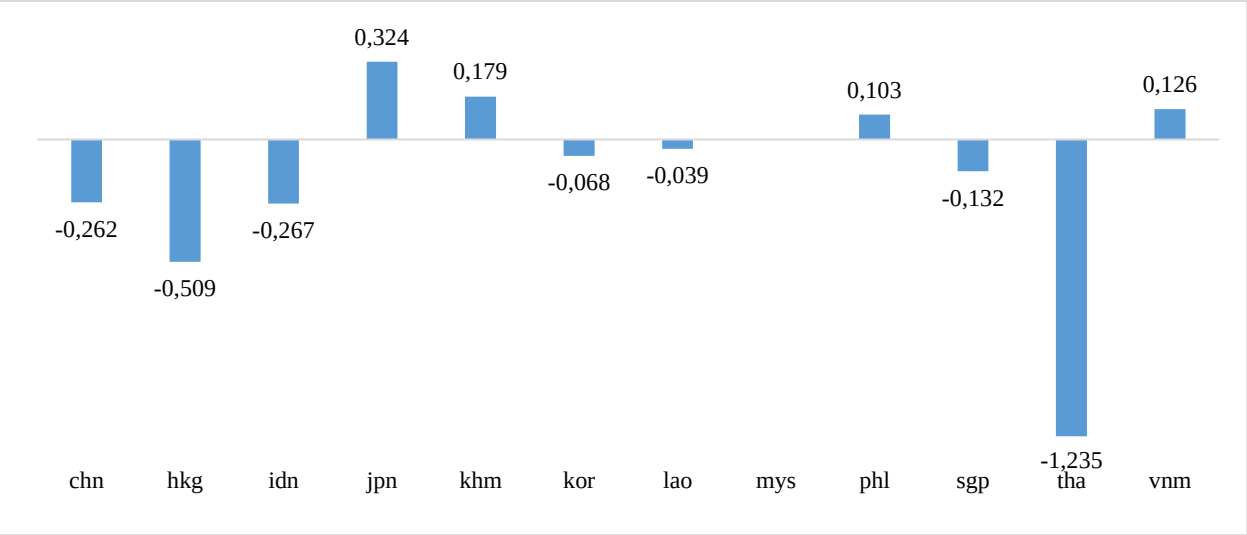
The correlation is also positive, but smaller, for China and Japan (0.02 and 0.013, respectively), and smaller for Hong Kong, Cambodia, Korea, and the Philippines. The relationship between the foreign value added share in exports, FVAXSH, and the share of skilled labour in total compensation is negative for Indonesia, the Lao PDR, Malaysia, Singapore, and Thailand. The negative correlation for Indonesia, the Lao PDR, and Thailand is surprising, as Indonesia saw an average decline in both variables over the period, whereas the Lao PDR and Thailand experienced an increase in both. There could be underlying sectoral differences that go in the opposite directions. Malaysia and Singapore, on the other hand, saw their percentage of foreign value added in exports decline, while the share of skilled labour in compensation increased. In these countries, a stronger orientation towards services could have driven these outcomes as this depends more strongly on skilled labour than manufacturing.

4.3. Sectoral Differences

This section examines sectoral differences across the 12 East Asian countries. Figure 3 reports the joint coefficients for agriculture using the share of foreign value added in exports, FVAXSH, as the explanatory variable (see Appendix 3 for underlying regression results). Only results are reported for which the F-test suggested a joint significance of the backward GVC measure and its interaction term with the country dummy, implying that the country-specific results are statistically significant. Interestingly, while the joint coefficients are significant for agriculture across all East Asian countries, country experiences vary strongly. The relationship is negative in seven countries, i.e. stronger backward GVC participation (e.g. imports of seeds and fertilisers) is associated with a higher relative demand for *unskilled* labour in agriculture, particularly in Thailand. The exceptions are Japan, Cambodia, Viet Nam,

and the Philippines, where the joint coefficients are positive, i.e. the relationship with the relative demand for *skilled* labour is positive. This pattern could be expected for Japan, where the agricultural sector is more capital-intensive because of the use of agricultural machinery, which requires more skills.

Figure 3: FVAXSH and SHS in Agriculture, Joint Coefficients, by Country



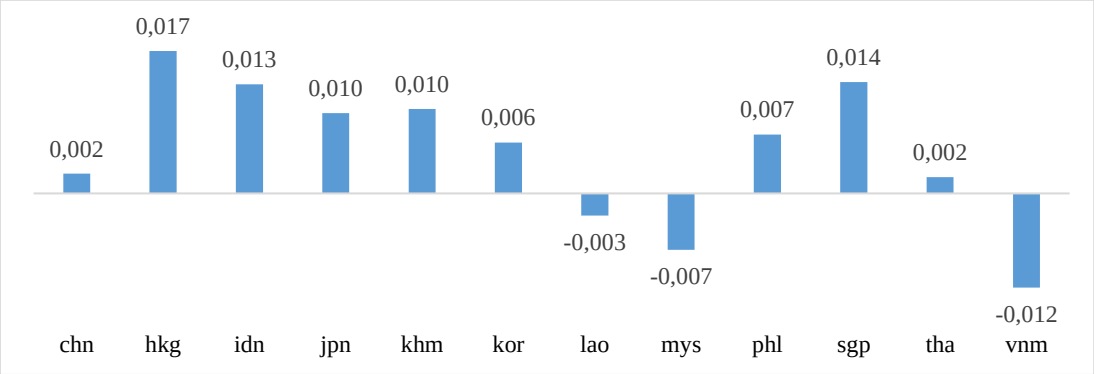
FVAXSH = foreign value added in exports as a percentage of exports, SHS = share of skilled labour in compensation.
Notes:
1. Based on regressions in Appendix 3.
2. Only joint effects are reported, for which the F-test of joint significance between $fvaxsh_{cst}$ and $fvaxsh_{cst}$ *$dummy_c$ (Prob > F) was significant at the 10% level.

Sources: Calì et al. (2016) and World Bank (2015).

In manufacturing, we find a positive relationship between the foreign value added in exports and the relative demand for skilled workers across most countries, with the exception of Viet Nam, Malaysia, and the Lao PDR (see Appendix 4 for underlying regression results). In Malaysia, the findings confirm the earlier hypothesis of a middle-income trap, where production is specialised in lower-skill manufacturing activities given the average skill level of the Malaysian workforce. In the Lao PDR, the negative relationship between the relative demand for skilled labour in manufacturing and backward GVC participation could point to low skill supply in the first place (Table 2). The strong negative joint coefficient for Viet Nam stands out, suggesting that its GVC participation appears to depend more strongly on low-skilled labour compared with other East Asian countries (Figure 4). An alternative explanation for Viet Nam could be binding minimum wages for GVC-integrated sectors, which

increase the share of compensation for production workers and thus lower the share of skilled labour in total compensation.

Figure 4: FVAXSH and SHS in Manufacturing, Joint Coefficients, by Country



FVAXSH = foreign value added in exports as a percentage of exports, SHS = share of skilled labour in compensation.

Notes:

1. Based on regressions in Appendix 4.
2. Only joint effects are reported, for which the F-test of joint significance between $fvaxsh_{cst}$ and $fvaxsh_{cst}$ *$dummy_c$ (Prob > F) was significant at the 10% level.

Sources: Calì et al. (2016) and World Bank (2015).

Note that the regression results for services do not show statistically significant correlations across all countries. Interestingly, Viet Nam shows the largest positive joint coefficient which, while insignificant, could point to larger relative demand for skills in the services sector and explain the huge overall coefficient in Figure 2.

4.4. Role of Policy

This section assesses if policy matters for the relationship between GVC participation and the relative demand for skilled labour. We focus on two types of labour market policies – labour market flexibility and expenditure on tertiary education – as well as trade facilitation, as measured by the Doing Business trading across borders distance to frontier score (see section 3.2).

There are major differences in labour market policy amongst the East Asian countries (Table 5). Singapore and Hong Kong show the most flexible labour markets over the period, followed by Indonesia, Thailand, and Viet Nam. Malaysia, Cambodia, and China show medium labour market flexibility in terms of hiring and firing practices, while Korea, Japan, and the Philippines have the most rigid labour markets. East Asian countries also vary in terms of their spending on tertiary education relative to other types of education (Table 5). While the governments of Singapore, Malaysia,

and Hong Kong spend more than 30% of their education expenses on tertiary education, these shares are 15%–20% in Thailand, the Lao PDR, Japan, and Viet Nam. The shares represent 12%–14% in Korea, Indonesia, and the Philippines and are lagging in Cambodia, with only 5.8% of government spending on education dedicated to tertiary education.

Table 5: Policy Indicators, Average over Period*

Country	**Labour market flexibility** (1–7, best)	**Expenditure on tertiary education** (%)	**Trading across borders** (0–100, DTF)
Cambodia	4.1	5.8	60.9
China	4.1	n.a.	69.9
Hong Kong	5.6	31.5	92.1
Indonesia	4.3	13.0	69.2
Japan	3.2	17.6	86.4
Korea	3.7	13.6	89.1
Lao PDR	n.a.	18.0	43.4
Malaysia	4.2	34.7	88.8
Philippines	3.2	12.6	74.6
Singapore	5.8	34.4	95.4
Thailand	4.3	20.0	77.6
Viet Nam	4.3	16.5	71.1

Lao PDR = Lao People's Democratic Republic.
*2006 to 2011, except for expenditure on tertiary education (2001 to 2011).
Notes:
1. DTF = distance to frontier (0–100, best).
2. Labour market flexibility measured as hiring and firing practices (1–7, best).
3. Government expenditure on tertiary education (% of total government expenditure on education).
4. Trading across borders measures the time and costs to import and export (0–100, best).
5. Average based on available years in data set.
6. Green shading indicates high values, yellow shading indicates intermediate values, and red shading indicates low values.

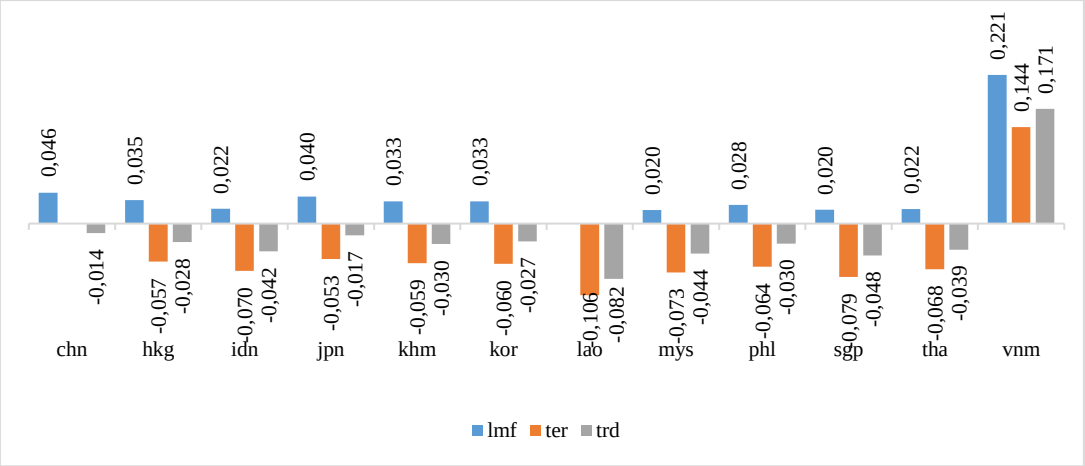
Sources: Author's illustration; data from WEF (2018) and World Bank (2018a, 2018b).

In terms of trade facilitation, East Asian countries tend to be close to the frontier. The Asian Tiger countries in the sample (Singapore, Hong Kong, and Korea), Japan, and Malaysia show the highest performance in terms of time and cost to import and export. They are followed by Thailand and the Philippines, while Viet Nam, China, and Indonesia show slightly lower scores. Cambodia and in particular the Lao PDR are trailing their Asian peers. This heterogeneity in labour market policy and trade facilitation suggests a need to study the mediating role of policy at the country level.

In the following, we apply the specification of equation (5) in section 3.2. In a first step, we assess whether differences in labour market flexibility shape the relationship between backward GVC participation and the relative demand for skilled labour. The results in Appendix 5 suggest that increased labour market flexibility mediates positively with FVAXSH ($\delta > 0$). Focusing on the triple interaction terms, including country dummies, we find a negative interaction term across all countries ($\zeta < 0$), with the exception of China, Japan, and Viet Nam ($\zeta > 0$). The negative triple interaction terms are significant for Indonesia, Malaysia, and Singapore. Note that while the individual coefficients are insignificant, the F-tests suggest a joint significance between FVAXSH and the interaction terms across all East Asian countries.

In a next step, we quantify the overall mediating role of policy based on the regression results. The overall mediating role of a policy for the relationship between FVAXSH and the relative demand for skilled labour, SHS, in a country is given by $(\delta+\zeta)*policy_c$ (see section 3.2). For the policy measures, we use the average values over 2001–2011, as reported in Table 5, while the coefficients δ and ζ are directly taken from the regression results (Appendix 5). The overall mediating role of labour market flexibility is shown in Figure 5 (blue bars, *lmf*). The results suggest that labour market flexibility positively shapes the correlation between FVAXSH and the share of skilled labour in compensation in East Asia, in particular Viet Nam. The mediating role of labour market flexibility is smallest in Malaysia, Singapore, Thailand, and Indonesia.

Figure 5: Mediating the Role of Policy, FVAXSH, by Country



FVAXSH = foreign value added in exports as a percentage of exports, *lmf* = labour market flexibility, SHS = share of skilled labour in compensation, *ter* = government expenditure on tertiary education as a percentage of total expenditure on education, *trd* = trading across borders score (distance to frontier).

Notes:

1. Based on regressions in Appendices 5–7.
2. The mediating role of policy by country is computed as $(\delta+\zeta)*policy_c$.
3. Only results are shown for which the F-test of joint significance between $fvaxsh_{cst}$ and $fvaxsh_{cst}*policy_c$ and $fvaxsh_{cst}*policy_c*ctry_c$ (Prob > F) is significant at the 10% level.

Sources: Calì et al. (2016); WEF (2018); and World Bank (2015, 2018a, 2018b).

Second, we assess the moderating role of government expenditures on tertiary education (Appendix 6). While the interaction term is negative and insignificant across all specifications, the F-test suggests joint significance between FVAXSH and the interaction term in all countries. The triple interaction term is negative and significant in Indonesia, Cambodia, Korea, the Lao PDR, and Malaysia, and negative but insignificant in Japan and Thailand. The F-tests again suggest joint significance between FVAXSH and the interaction terms across all countries.

Quantifying the overall role of expenditure on tertiary education for the relationship between FVAXSH and the relative demand for skilled labour in Figure 5 (orange bars, *ter*) suggests a negative mediating role across all countries except Viet Nam. In other words, countries that invest more strongly in tertiary education show a lower correlation between GVC participation and the share of skilled labour in compensation. These counterintuitive results may be linked to the measure of tertiary education spending, which does not capture the quality of education. Indonesia and Korea, for example, spend a similar share on tertiary education (Table 5), but the quality of schooling differs greatly.

Finally, we assess the role of trade facilitation for the nexus between the foreign value added share in exports, FVAXSH, and the wage share of skilled labour in total compensation, SHS (Appendix 7). The interaction term is negative and insignificant across all specifications, but the F-test suggests joint significance between FVAXSH and the interaction term in all countries. The triple interaction term is negative for most countries and significant for the Lao PDR and Malaysia, while it is positive and insignificant for China, Hong Kong, Japan, and Viet Nam. However, the F-test suggests joint significance between FVAXSH and the interaction term in all countries.

Quantifying the overall mediating role of trade facilitation in Figure 5 suggests a negative role in all East Asian countries for the relationship between GVC participation and the relative demand for skilled labour, except Viet Nam. This finding is unexpected and could imply that for countries with high performance in trade facilitation, the demand for skills may be driven by other factors than GVC participation, such as technological progress.

Viet Nam is an outlier with regard to all three types of policies. More flexible labour markets, higher expenditure on tertiary education, and trade facilitation appear to be most beneficial for the relationship between FVAXSH and the skilled wage share in this country.

5. Conclusions

GVCs may have distributional consequences in terms of demand for certain skills and their implications for wages, i.e. the relative demand for skilled labour. Depending on the skill requirements of the GVC segment in which a country specialises, the relative demand for skilled versus other types of labour can either increase or decrease. This study relates backward GVC participation to the share of skilled labour in compensation, focusing on the experience of 12 East Asian countries and applying a macro-level analysis covering 114 countries and 27 sectors for intermittent years from 2001 to 2011. The East Asian countries are heterogeneous with regard to their income levels, economic structure, skills composition, and participation in GVCs, requiring us to undertake the empirical analysis at the country level.

This study finds that while GVC participation is positively associated with the relative demand for skilled labour in the global data set, the correlation is smaller for

the sample of East Asian countries and negative in a few cases. This could reflect East Asia's specialisation in manufacturing GVCs, which tend to be low-skill-intensive relative to business services sectors. The positive relationship is particularly large for Viet Nam.

The study also examines if there are differences across broad sectors. In agriculture, stronger backward GVC participation is associated with higher relative demand for *unskilled* labour in seven countries, particularly in Thailand. On the other hand, we find a positive relationship with the relative demand for skills in other countries, suggesting that the direction of the correlation depends on a country's position in the agribusiness value chain and its skill intensity. In manufacturing, we find a positive relationship across most countries with the exception of Viet Nam, Malaysia, and the Lao PDR. While the findings point to a 'middle-income trap' in Malaysia, with specialisation in low-skill activities, low skill supply could be driving the results in the Lao PDR. The strong negative joint coefficient for Viet Nam stands out, suggesting that its GVC participation appears to depend more strongly on low-skilled labour than in other East Asian countries. The results for services do not show any statistically significant correlations.

Finally, the study assesses if policy matters for the relationship between GVC participation and the relative demand for skilled labour. The findings suggest that labour market flexibility positively mediates the correlation between GVC participation and the share of skilled labour in compensation in all countries, particularly Viet Nam. Policymakers should thus ensure that the relative demand for skills is not hampered by overly rigid labour markets. Surprisingly, expenditure on tertiary education negatively mediates the relationship between backward GVC participation and the relative demand for skilled labour in all East Asian countries except Viet Nam. These counterintuitive results may be linked to the measure of tertiary education spending, which does not capture the quality of education. Lastly, it appears that more trade facilitation is associated with a smaller correlation between the demand for skilled labour and backward GVC participation. This finding is unexpected and could imply that for countries with high performance in trade facilitation, the demand for skills may be driven by other factors than GVC participation, e.g. technological progress.

One major finding of the study is the positive correlation between GVC participation and the relative demand for skilled labour. However, demand for skills must also meet skills supply. Policymakers should focus on the skill development of workers to improve their employment prospects. Skill development is a key element of competitiveness, participation in GVCs, and economic and social upgrading within GVCs. Economic upgrading requires new skills and knowledge, either by increasing the skill content of a country's activities (and thus workforce) or by developing competencies in niche market segments (Humphrey and Schmitz, 2002).

Public–private partnerships are an important channel of skill development. They can include supplier development programs by foreign or large domestic investors, but also less comprehensive training offered by firms to their joint venture partners, suppliers, or farmers. Linkage development can also happen through industry associations, private universities, private non-profit organisations, or other non-governmental forms, and in some cases through former employees of foreign firms who found their own companies.

Future research may focus on individual country cases in developing countries to explore how GVC participation over time shapes the relative demand for skilled labour. This includes (i) testing for forward GVC participation; (ii) including more control variables, such as relative wages, which requires improved access to time-varying sectoral wage data; (iii) applying an estimation strategy that is better suited to establish causality (e.g. an instrumental variables approach), which is mainly subject to the availability and quality of data; (iv) testing the mediating role of a wider set of policy variables (e.g. investment and trade policy, business climate, innovation, and standards); and (v) uncovering empirically the transmission channels through which GVC participation can influence the relative demand for skilled labour (e.g. demand, training, and labour turnover effects from multinationals), which requires access to firm-level or survey data.

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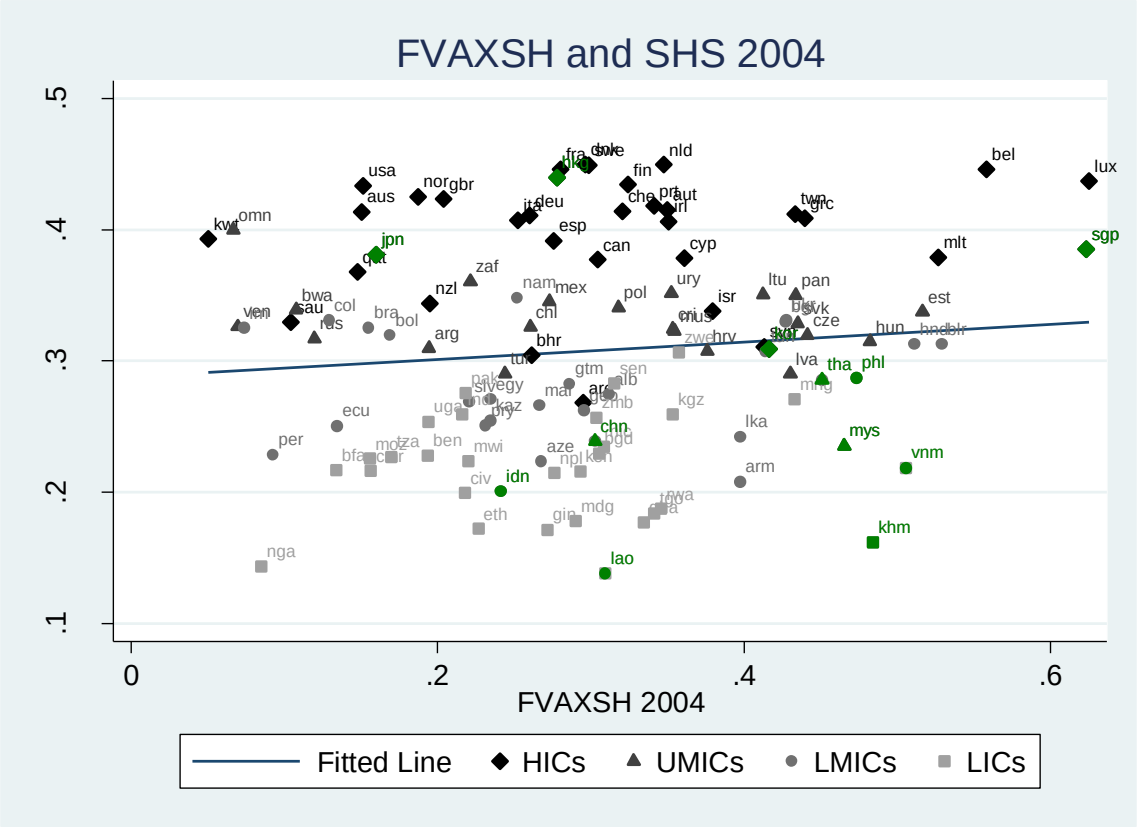
Appendix 1: Concordance Table, LACEX to EVA

Sectors in EVA	GTAP sectors in LACEX
Beverages and tobacco products	b_t
Chemicals, rubber, and plastic products	crp
Wearing apparel	wap
Metal products	fmp
Leather products	lea
Wood products	lum
Machinery and equipment n.e.c.	ele ome
Ferrous metals and metals n.e.c.	nfm i_s
Mineral products n.e.c.	nmm
Manufactures n.e.c.	omf
Paper products and publishing	ppp
Processed foods	cmt mil ofd omt pcr sgr vol
Textiles	tex
Transport equipment	mvh otn
Communications	cmn
Construction	cns
Distribution and trade	trd
Finance	ofi
Insurance	isr
Other business and ICT	obs
Other consumer services	ros
Other services	osg dwe
Transport	atp otp wtp
Water supply	wtr
Energy extraction	coa gas oil p_c ely gdt
Other primary	frs fsh omn
Primary agriculture	v_f wht wol c_b ctl gro oap ocr osd pdr pfb rmk

EVA = export value added, GTAP = Global Trade Analysis Project, ICT = information and communication technology, LACEX = Labor Content of Exports, n.e.c. = not elsewhere classified.
Note: For the list of GTAP sectors, see GTAP. Sectors. https://www.gtap.agecon.purdue.edu/databases/v9/v9_sectors.asp (accessed 30 May 2018).
Sources: Calì et al. (2016) and author's illustration.

Appendix 2: FVAXSH and SHS, 2004



FVAXSH = foreign value added in exports as a percentage of exports, HIC = high-income country, LIC = low-income country, LMIC = lower-middle-income country, SHS = share of skilled labour in compensation, UMIC = upper-middle-income country.
Sources: Author's illustration; data from Calì et al. (2016) and World Bank (2015).

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Appendix 3: FVAXSH and SHS in Agriculture, by Country

Dependent variable: S^{HS}_{cst}	(1) **chn**	(2) (3) **hkg**	(4) **idn**	(5) **jpn**	(6) **khm**	(7) **kor**	(8) **lao**	(9) **mys**	(10) **phl**	(11) **sgp**	(12) **tha**	**vnm**
lnY_{cst}	0.0077	0.0076	0.0076	0.0078	0.0076	0.0077	0.0080	0.0074	0.0076	0.0097	0.0077	0.0076
	(0.443)	(0.451)	(0.450)	(0.444)	(0.449)	(0.445)	(0.428)	(0.469)	(0.448)	(0.322)	(0.446)	(0.453)
$fvaxsh_{cst}$	0.0908	0.0902	0.0908	0.0898	0.0899	0.0909	0.0964	0.0902	0.0899	0.1396***		0.0904
		0.0888										
$fvaxsh_{cst}*chn_c$	(0.128)	(0.129)	(0.127)	(0.130)	(0.130)	(0.128)	(0.120)	(0.129)	(0.134)	(0.007)	(0.127)	(0.149)
	-0.3527***											
$fvaxsh_{cst}*hkg_c$	(0.002)											
		-0.5990***										
$fvaxsh_{cst}*idn_c$		(0.000)										
			-0.3579***									
$fvaxsh_{cst}*jpn_c$			(0.002)									
				0.2337								
$fvaxsh_{cst}*khm_c$				(0.229)								
					0.0890							
$fvaxsh_{cst}*kor_c$					(0.371)							
						-0.1586*						
$fvaxsh_{cst}*lao_c$						(0.051)						
							-0.1352**					
$fvaxsh_{cst}*mys_c$							(0.041)					
								-0.2227				
$fvaxsh_{cst}*phl_c$								(0.315)				
									0.0133			

$fvaxsh_{cst}$*sgp_c								(0.858)				
									-0.2717***			
$fvaxsh_{cst}$*tha_c									(0.000)			
										-1.3256***		
$fvaxsh_{cst}$*vnm_c										(0.000)		
											0.0369	
constant											(0.598)	
	-0.0418	-0.0403	-0.0413	-0.0429	-0.0416	-0.0417	-0.0454	-0.0397	-0.0416	-0.0635	-0.0403	-0.0411
	(0.568)	(0.583)	(0.573)	(0.562)	(0.570)	(0.569)	(0.540)	(0.595)	(0.570)	(0.371)	(0.582)	(0.576)
Observations	773	773	773	773	773	773	773	773	773	773	773	773
R-squared	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.62	0.60	0.60
F-test of joint sign[a]	0.0087	0.0005	0.0091	0.0784	0.0079	0.1486	0.0501	0.2499	0.0329	0.0000	0.0011	0.0001

FVAXSH = foreign value added in exports as a percentage of exports, SHS = share of skilled labour in compensation.

Notes:

1. p*<0.1, p**<0.05, p***<0.01 (p-values in parentheses).
2. All regressions include country-sector, sector-year, and country-year fixed effects.

[a] F-test of joint significance between $fvaxsh_{cst}$ and $fvaxsh_{cst}$ *$ctry_c$ (Prob > F).

Sources: Calì et al. (2016) and World Bank (2015).

Appendix 4: FVAXSH and SHS in Manufacturing, by Country

Dependent variable: S^{HS}_{cst}	(1) **chn**	(2) **hkg**	(3)	(4) **idn**	(5) **jpn**	(6) **khm**	(7) **kor**	(8) **lao**	(9) **mys**	(10) **phl**	(11) **sgp**	(12) **tha**	**vnm**
$\ln Y_{cst}$	0.0060***			0.0060***	0.0060***		0.0060***		0.0060***	0.0060***		0.0059***	0.0060***
		0.0060***		0.0060***	0.0060***		0.0060***						
$fvaxsh_{cst}$	(0.002)	(0.002)		(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
	0.0184**	0.0184**		0.0185**	0.0185**	0.0184**	0.0185**	0.0187**	0.0189**	0.0186**	0.0185**	0.0185**	0.0186**
$fvaxsh_{cst}*chn_c$	(0.029)	(0.030)		(0.030)	(0.030)	(0.029)	(0.029)	(0.028)	(0.028)	(0.030)	(0.030)	(0.029)	(0.029)
	-0.0160												
$fvaxsh_{cst}*hkg_c$	(0.246)												
		-0.0010											
$fvaxsh_{cst}*idn_c$		(0.935)											
			-0.0052										
$fvaxsh_{cst}*jpn_c$			(0.722)										
				-0.0087									
$fvaxsh_{cst}*khm_c$				(0.460)									
					-0.0081								
$fvaxsh_{cst}*kor_c$					(0.514)								
						-0.0123							
$fvaxsh_{cst}*lao_c$						(0.285)							
							-0.0214						
$fvaxsh_{cst}*mys_c$							(0.642)						
								-0.0258**					
$fvaxsh_{cst}*phl_c$								(0.034)					
									-0.0114				
$fvaxsh_{cst}*sgp_c$									(0.253)				

*fvaxsh$_{cst}$*tha$_c$*									-0.0049			
									(0.651)			
*fvaxsh$_{cst}$*vnm$_c$*										-0.0165		
										(0.121)		
constant											-0.0301***	
											(0.009)	
	0.1258***		0.1258***	0.1258***		0.1258***		0.1258***	0.1258***		0.1260***	0.1255***
		0.1258***	0.1258***	0.1258***		0.1258***						
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	5,370	5,370	5,370	5,370	5,370	5,370	5,370	5,370	5,370	5,370	5,370	5,370
R-squared	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16
F-test of joint sign[a]	0.0929	0.0528	0.0564	0.0724	0.0673	0.0921	0.0875	0.0693	0.0664	0.0311	0.0911	0.0319

FVAXSH = foreign value added in exports as a percentage of exports, SHS = share of skilled labour in compensation.

Notes:

1. p*<0.1, p**<0.05, p***<0.01 (p-values in parentheses).
2. All regressions include country-sector, sector-year, and country-year fixed effects.

[a] F-test of joint significance between *fvaxsh$_{cst}$* and *fvaxsh$_{cst}$ *ctry$_c$* (Prob > F).

Sources: Calì et al. (2016) and World Bank (2015).

Appendix 5: FVAXSH and SHS, Mediating Role of Labour Market Flexibility, by Country

Dependent variable: S^{HS}_{cst}	(1) **chn**	(2) **hkg**	(3)	(4) **idn**	(5) **jpn**	(6) **khm**	(7) **kor**	(8) **lao**	(9) **mys**	(10) **phl**	(11) **sgp**	(12) **tha**	**vnm**
$\ln Y_{cst}$	0.0031**	0.0031**		0.0031**	0.0031**	0.0031**	0.0031**	0.0031**	0.0031**	0.0031**	0.0031**	0.0031**	0.0030**
	(0.024)	(0.024)		(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.023)	(0.024)	(0.023)	(0.024)	(0.024)
$fvaxsh_{cst}$	-0.0252	-0.0265		-0.0254	-0.0254	-0.0252	-0.0251	-0.0252	-0.0257	-0.0249	-0.0322	-0.0254	-0.0199
	(0.337)	(0.325)		(0.333)	(0.335)	(0.337)	(0.338)	(0.337)	(0.328)	(0.344)	(0.252)	(0.333)	(0.448)
$fvaxsh_{cst}*lmf_c$	0.0105	0.0109		0.0106	0.0106	0.0106	0.0105	0.0105	0.0108	0.0105	0.0125	0.0106	0.0085
	(0.158)	(0.155)		(0.155)	(0.157)	(0.158)	(0.158)	(0.158)	(0.150)	(0.161)	(0.119)	(0.155)	(0.248)
$fvaxsh_{cst}*lmf_c*chn_c$	0.0006												
	(0.912)												
$fvaxsh_{cst}*lmf_c*hkg_c$		-0.0046											
		(0.185)											
$fvaxsh_{cst}*lmf_c*idn_c$			-0.0055*										
			(0.063)										
$fvaxsh_{cst}*lmf_c*jpn_c$				0.0020									
				(0.573)									
$fvaxsh_{cst}*lmf_c*khm_c$					-0.0025								
					(0.391)								
$fvaxsh_{cst}*lmf_c*kor_c$						-0.0017							
						(0.561)							
$fvaxsh_{cst}*lmf_c*lao_c$							0.0000						
							(.)						
$fvaxsh_{cst}*lmf_c*mys_c$								-0.0061***					
								(0.003)					
$fvaxsh_{cst}*lmf_c*phl_c$									-0.0020				

								(0.397)				
$fvaxsh_{cst}*lmf_c*sgp_c$									-0.0090**			
									(0.024)			
$fvaxsh_{cst}*lmf_c*tha_c$										-0.0056		
										(0.191)		
$fvaxsh_{cst}*lmf_c*vnm_c$											0.0424	
											(0.295)	
constant	0.2080***		0.2081***	0.2080***		0.2080***		0.2080***	0.2080***		0.2080***	0.2077***
		0.2080***	0.2079***	0.2080***		0.2078***						
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	9,303	9,303	9,303	9,303	9,303	9,303	9,303	9,303	9,303	9,303	9,303	9,303
R-squared	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.15
F-test of joint sign[a]	0.0257	0.0252	0.0249	0.0259	0.0253	0.0253	0.0251	0.0236	0.0254	0.0228	0.0247	0.0492
F-test of joint sign[b]	0.0475	0.0566	0.0575	0.0363	0.0484	0.0588	0.0251	0.0174	0.0556	0.0389	0.0547	0.0580

FVAXSH = foreign value added in exports as a percentage of exports, SHS = share of skilled labour in compensation.

Notes:

1. p*<0.1, p**<0.05, p***<0.01 (p-values in parentheses).
2. All regressions include country-sector, sector-year, and country-year fixed effects.

[a] F-test of joint significance between $fvaxsh_{cst}$ and $fvaxsh_{cst}*lmf_c$ (Prob > F).

[b] F-test of joint significance between $fvaxsh_{cst}$ and $fvaxsh_{cst}*lmf_c$ and $fvaxsh_{cst}*lmf_c*ctry_c$ (Prob > F).

Sources: Calì et al. (2016); WEF (2018); and World Bank (2015).

Appendix 6: FVAXSH and SHS, Mediating Role of Expenditure on Tertiary Education, by Country

Dependent variable: S^{HS}_{cst}	(1) **chn**	(2) **hkg**	(3)	(4) **idn**	(5) **jpn**	(6) **khm**	(7) **kor**	(8) **lao**	(9) **mys**	(10) **phl**	(11) **sgp**	(12) **tha**	**vnm**	
$\ln Y_{cst}$	0.0035**	0.0035**		0.0035**	0.0035**	0.0035**	0.0035**	0.0035**	0.0035**	0.0035**	0.0035**	0.0035**	0.0035**	
	(0.011)	(0.011)		(0.011)	(0.011)	(0.011)	(0.011)	(0.012)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	
$fvaxsh_{cst}$	0.0661***			0.0665***	0.0671***		0.0662***		0.0669***	0.0667***		0.0677***	0.0669***	
		0.0676***		0.0662***	0.0663***		0.0571**							
$fvaxsh_{cst}*ter_c$	(0.005)	(0.005)		(0.005)	(0.005)	(0.005)	(0.005)	(0.004)	(0.006)	(0.005)	(0.006)	(0.005)	(0.013)	
	-0.0023**			-0.0024**	-0.0024**	-0.0024**	-0.0024**	-0.0024**	-0.0024**	-0.0024**	-0.0024**		-0.0024**	-
$fvaxsh_{cst}*ter_c*chn_c$	0.0023**	-0.0021**												
	(0.013)	(0.013)		(0.012)	(0.013)	(0.013)	(0.013)	(0.011)	(0.017)	(0.013)	(0.017)	(0.013)	(0.029)	
$fvaxsh_{cst}*ter_c*hkg_c$	0.0000													
	(.)													
$fvaxsh_{cst}*ter_c*idn_c$		0.0006												
		(0.218)												
$fvaxsh_{cst}*ter_c*jpn_c$		-0.0030**												
		(0.012)												
$fvaxsh_{cst}*ter_c*khm_c$				-0.0006										
				(0.428)										
$fvaxsh_{cst}*ter_c*kor_c$					-0.0077**									
					(0.025)									
$fvaxsh_{cst}*ter_c*lao_c$						-0.0020*								
						(0.057)								
$fvaxsh_{cst}*ter_c*mys_c$							-0.0035**							
							(0.025)							
$fvaxsh_{cst}*ter_c*phl_c$								0.0003						

							(0.486)					
$fvaxsh_{cst}*ter_c*sgp_c$								-0.0027**				
								(0.015)				
$fvaxsh_{cst}*ter_c*tha_c$									0.0001			
									(0.892)			
$fvaxsh_{cst}*ter_c*vnm_c$										-0.0011		
										(0.186)		
constant											0.0108	
											(0.310)	
	0.2070***		0.2068***	0.2083***		0.2061***		0.2071***	0.2077***		0.2057***	0.2081***
		0.2078***	0.2060***	0.2061***		0.2087***						
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	8,752	8,752	8,752	8,752	8,752	8,752	8,752	8,752	8,752	8,752	8,752	8,752
R-squared	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.16
F-test of joint sign[a]	0.0102	0.0102	0.0098	0.0105	0.0102	0.0101	0.0081	0.0102	0.0101	0.0103	0.0100	0.0230
F-test of joint sign[b]	0.0102	0.0257	0.0236	0.0181	0.0210	0.0268	0.0084	0.0078	0.0229	0.0177	0.0239	0.0298

FVAXSH = foreign value added as a percentage of exports, SHS = share of skilled labour in compensation.

Notes:

1. p*<0.1, p**<0.05, p***<0.01 (p-values in parentheses).
2. All regressions include country-sector, sector-year, and country-year fixed effects.

[a] F-test of joint significance between $fvaxsh_{cst}$ and $fvaxsh_{cst}*ter_c$ (Prob > F).

[b] F-test of joint significance between $fvaxsh_{cst}$ and $fvaxsh_{cst}*ter_c$ and $fvaxsh_{cst}*ter_c*ctry_c$ (Prob > F).

Sources: Calì et al. (2016) and World Bank (2015, 2018a).

Appendix 7: FVAXSH and SHS, Mediating Role of Trade Facilitation, by Country

Dependent variable: S^{HS}_{cst}	(1) **chn**	(2) (3) **hkg**		(4) **idn**	(5) **jpn**	(6) **khm**	(7) **kor**	(8) **lao**	(9) **mys**	(10) **phl**	(11) **sgp**	(12) **tha**	**vnm**
$\ln Y_{cst}$	0.0035***			0.0035***	0.0035***		0.0035***		0.0035***	0.0035***		0.0035***	0.0035***
		0.0035***		0.0035***	0.0035***		0.0035***						
$fvaxsh_{cst}$	(0.008)	(0.008)		(0.009)	(0.008)	(0.008)	(0.008)	(0.009)	(0.008)	(0.008)	(0.008)	(0.008)	(0.009)
	0.0376	0.0377		0.0377	0.0377	0.0377	0.0376	0.0405	0.0372	0.0376	0.0369	0.0376	0.0360
$fvaxsh_{cst}*trd_c$	(0.160)	(0.160)		(0.160)	(0.160)	(0.160)	(0.161)	(0.139)	(0.166)	(0.160)	(0.170)	(0.160)	(0.181)
	-0.0003	-0.0003		-0.0003	-0.0003	-0.0003	-0.0003	-0.0004	-0.0003	-0.0003	-0.0003	-0.0003	-0.0003
$fvaxsh_{cst}*trd_c*chn_c$	(0.323)	(0.324)		(0.324)	(0.322)	(0.323)	(0.325)	(0.286)	(0.340)	(0.325)	(0.349)	(0.325)	(0.301)
	0.0001												
$fvaxsh_{cst}*trd_c*hkg_c$	(0.752)												
		0.0000											
$fvaxsh_{cst}*trd_c*idn_c$		(0.873)											
			-0.0003										
$fvaxsh_{cst}*trd_c*jpn_c$			(0.133)										
				0.0001									
$fvaxsh_{cst}*trd_c*khm_c$				(0.657)									
					-0.0002								
$fvaxsh_{cst}*trd_c*kor_c$					(0.386)								
						-0.0000							
$fvaxsh_{cst}*trd_c*lao_c$						(0.903)							
							-0.0015**						
$fvaxsh_{cst}*trd_c*mys_c$							(0.034)						
								-0.0002**					
$fvaxsh_{cst}*trd_c*phl_c$								(0.019)					

$fvaxsh_{cst}*trd_c*sgp_c$								-0.0001				
								(0.171)				
$fvaxsh_{cst}*trd_c*tha_c$									-0.0002			
									(0.198)			
$fvaxsh_{cst}*trd_c*vnm_c$										-0.0002		
										(0.355)		
constant											0.0027	
											(0.282)	
	0.2075***		0.2069***	0.2051***		0.2049***		0.2074***	0.2063***		0.2071***	0.2055***
		0.2052***	0.2086***	0.2068***		0.2004***						
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	9,599	9,599	9,599	9,599	9,599	9,599	9,599	9,599	9,599	9,599	9,599	9,599
R-squared	0.13	0.13	0.13	0.13	0.13	0.13	0.14	0.13	0.13	0.13	0.13	0.15
F-test of joint sign[a]	0.0154	0.0152	0.0148	0.0156	0.0151	0.0150	0.0128	0.0133	0.0153	0.0129	0.0146	0.0180
F-test of joint sign[b]	0.0323	0.0368	0.0358	0.0271	0.0301	0.0384	0.0129	0.0071	0.0328	0.0221	0.0331	0.0239

FVAXSH = foreign value added in exports as a percentage of exports, SHS = share of skilled labour in compensation.

Notes:

1. p*<0.1, p**<0.05, p***<0.01 (p-values in parentheses).
2. All regressions include country-sector, sector-year, and country-year fixed effects.

[a] F-test of joint significance between $fvaxsh_{cst}$ and $fvaxsh_{cst}*trd_c$ (Prob > F).

[b] F-test of joint significance between $fvaxsh_{cst}$ and $fvaxsh_{cst}*trd_c$ and $fvaxsh_{cst}*trd_c*ctry_c$ (Prob > F).

Sources: Calì et al. (2016) and World Bank (2015, 2018b).

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