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The impact of global value chain integration on wages: evidence from matched worker-industry data in Thailand

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ABSTRACT

Using a two-stage estimation of matched worker-industry data from 2000 to 2011, this study investigates the impact of global value chain (GVC) integration on wages and the skill premium in the 32 industries in Thailand, a country with recent heavy involvement in GVCs. This study employs foreign value added in both final and intermediate goods exports as a proxy for the degree of industry integration in GVCs and applies a panel fixed effects estimation on constructed panel data to investigate its relationship with wages. The main finding indicates that a higher level of industry integration with GVCs leads to higher wages and a higher skill premium, confirming the positive effect of GVC involvement on wages and the complementary effect of high demand for skilled workers in GVC-oriented industries in Thailand. Workers in industries with downstream position will earn a higher wage than those working in the upstream position.

KEYWORDS

Global value chains; foreign value added; wages; skill premium; wage inequality; Thailand

JEL CLASSIFICATION CODE

F14; F16; J31

1. Introduction

Global value chains (GVCs) have become a main driver in international trade and investment in the global economy. United Nations Conference on Trade and Development (UNCTAD 2013) provides cross-country evidence showing a positive relationship between a country's involvement in GVCs and economic growth rates, indicating the high contribution of GVCs to developing countries' growth (around 30% of gross domestic product, GDP). However, the recent study by Kummritz et al. (2017) states that even though many counties encourage GVCs as a new track to achieve high economic growth and industrialization, the evidence shows that not all countries benefit from GVCs; country-specific characteristics such as national policy play a significant role in effective economic enhancement through GVCs.

Most existing studies focus mainly on developed countries such as the United States (Ebenstein et al. 2014), the UK (Geishecker and Görg 2013) and Germany (Baumgarten, Geishecker, and Görg 2013), and show clear evidence of the effect of GVC integration on the labor market. However, empirical studies in developing countries are just starting to appear (Farole 2016). Haskel (2000) insists that, in

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theory, involvement in GVCs improves employment and wages in developing countries. However, few studies investigate the effect of GVCs on employment and wages in developing countries such as India (Banga 2016), Vietnam (Kabeer and Mahmud 2004) and Kenya (McCulloch and Ota 2002). These studies find that these countries benefited more from integration with GVCs. Shepherd (2013) states that although the effect of GVCs on the labor market in developing countries is predominantly positive, much of the effect is country specific. Furthermore, the country's position in the GVC also affects the magnitude, composition and wages of labor engaged in GVC activities (UNCTAD 2013).

Thailand is a developing country in Southeast Asia with high engagement in the international economy since its trade liberalization policy in the 1990s. The government's aim is not only to integrate Thailand's economy into global economy, but also to have the country serve as the regional trade and investment hub of Southeast Asia. Thus, the country signed several free trade agreements, both bilateral and multilateral, which led to a significant reduction in tariffs and altered the patterns of exports and imports. This trade liberalization allows for a freer flow of intermediate goods and capital, leading to a high degree of involvement in GVCs that in turn increase wage inequality between high and low skilled workers both across and within industries (Goldberg and Pavcnik 2007).

Currently, Thailand is one of the top ten countries in Asia and the Pacific region in terms of international trade flow, particularly global GVC intermediate import flows (The United Nations Economic and Social Commission for Asia and the Pacific, UNESCAP 2015). Baldwin (2014) suggests that Thailand's development in the late 1980s taught the country how to industrialize its economy through GVCs. The Organization for Economic Co-operation and Development (OECD 2016a) highlights the characteristics of countries in the Southeast Asia region participating in GVCs, specifically that they activate overall economic activity by depending on high-value foreign value added (FVA). FVA is one of the most significant factors driving growth in Thailand's domestic value added in exports across all production activities in the agriculture, manufacturing and services sectors. Thus, imported inputs from abroad complement domestic value added in exports instead of substituting them. This clearly describes the country and its strong involvement in GVCs.

The recent factsheet on trade-in-value-added (TiVA) and GVCs by the World Trade Organization (WTO 2015) states that the annual percentage change in Thailand's total GVC participation 1995–2011 is 11.3%, and the GVC participation index in 2011 (measured by % share in total gross exports) is 54.3, which is higher than in other developing economies (48.6) and developed economies (48.0). Furthermore, Thailand on average has backward GVC participation (39.0 measured by the % share in the total foreign content of exports) at the higher level than forward GVC participation (15.4 measured by % share in total exports of domestic inputs sent to third countries).

The top three industries engaged in backward GVC participation are computers and electronics, motor vehicles and machinery and equipment; while Japan, China and the United States are top foreign input providers. The top three industries engaged in forward GVC participation are wholesale and retail trade, agriculture and

chemical products; while China, Malaysia and Japan are top exporters of inputs via GVC to Thailand. This implies that during 1995–2011, Thailand gradually and continuously developed to engage in GVCs.

This significant level of Thailand's involvement in GVC activities definitely affects the Thai labor market. GVC activities affect not only the overall wage of workers in the relevant industries but also the relative wages of skilled and unskilled workers, the so called *'skill premium'*. Goldberg and Pavcnik (2007) state that GVCs complement demand for skilled workers, leading to an increase in the skill premium in a country, which is one measurement of wage inequality between skilled and unskilled workers due to globalization.

This study investigates the impact of GVC integration on wages and the skill premium in 32 industries in Thailand using a unique dataset that matches worker- and industry-level data for 2000, 2005, 2009, 2010 and 2011. In particular, this study focuses on the wage response (in both average wages and the wage differential between skilled and unskilled workers) to an increase in an industry's dependency on FVA, which serves as the proxy for the degree of industry involvement in GVCs. To the best of the author's knowledge, there are no empirical studies on the impact of GVC involvement on the labor market in Thailand, despite its importance to the domestic labor market.

This study contributes to the existing literature as the first to use an individual-level dataset from the Thai Labor Force Survey (LFS) to quantify the impact of GVC integration on wages and the skill premium explicitly during the 2000s, which is a recent period of industrial development in Thailand. Furthermore, in addition to investigating the impact of overall GVC involvement, this study examines industry positions in the value chain by applying an indicator called the international backward and forward multipliers to determine the position of each industry in the value chain.

The main result shows that a higher level of integration leads to higher wages and a higher skill premium confirming the positive effect of GVC involvement on wages and the complementary effect on skilled workers. Moreover, workers in industries with positions close to the end of the value chain (downstream position) will earn a higher wage than those working in the upstream position. The robustness check uses the time lag of FVA and the vertical specialization index (VSI) as the dependent variable and the estimates are robust across different specifications, confirming the positive impact of GVC integration on wages and the skill premium. Thus, this study's main findings have several potential policy implications, mainly that the government should not only attempt to increase industry involvement in GVCs overall but should also aim to upgrade industries to higher positions in the value chain to gain the most benefit for Thai workers.

The article proceeds as follows. Section 2 reviews the literature on the impact of GVC integration on wages and the skill premium. Section 3 describes the data and methodology for the estimation. Section 4 provides the results and Section 5 concludes.

2. Literature review

The relationship between GVC integration and the labor market received recent research attention. Shingal (2015) provides a complete literature review of the impact

of GVC integration on labor markets in both developed and developing countries, and shows that GVC integration affects the labor market by leading to higher employment, increasing wages and improving working conditions. The World Bank (2012) states that GVCs allow an international re-allocation of tasks, which is a shift of labor-intensive work from developed countries to developing countries, particularly in East Asia, while Grossman and Rossi-Hansberg (2008) argue for a domestic re-allocation of tasks across different jobs.

The OECD (2013) clearly states that GVCs will definitely alter the labor force composition of skilled workers in the country, while Jiang and Milberg (2013) state that this compositional change will put pressure on both the wages and bargaining power of workers. Javorcik (2004) finds that one benefit of participation in a value chain is technology transfer from MNEs to domestic suppliers. Gereffi (2006) confirms that when a developing country engages in GVC activities, it increases employment, improves specialization, increases production scale, creates an efficient allocation of activities and increases the diversification of intermediate goods.

Several empirical studies show that workers in GVC-oriented industries benefit from higher wages compared to those working in other industries. Baldwin and Yan (2014) use propensity-score matching and difference-in-difference to estimate the GVC integration of a firm in manufacturing sector in Canada from 2002 to 2006 and find that workers in these firms earn higher wages. Shepherd (2013) argues that for GVC-oriented firms involved with high technology that requires highly skilled workers, GVC integration will lead to higher relative wages of skilled workers compared to unskilled workers, which widens the wage inequality between these two types of workers.

Farole (2016) clearly classifies the different effects of GVCs in developed and developing economies. Developed countries focus on the impact of offshoring and outsourcing on labor market adjustments, particularly related to skills-biased technical change, while developing economies experience a jobs and wage effect from the flow of foreign direct investment. Dean (2013) observes that despite the abundant evidence on some developing countries' involvement in GVCs, such as China and East Asian countries, few studies investigate GVC involvement in other developing countries.

Recent studies investigate the relationship between GVC integration and wages using country-specific case studies with both industry- and worker-level data (Shingal 2015). Existing studies in developed countries examine the impact of offshoring and outsourcing on wages overall, as well as the effect on high/low skilled wages, such as in the United States (Autor 2014), the UK (Geishecker and Görg 2013), the EU (Parteka and Wolszczak-Derlacz 2015), Denmark (Hummels et al. 2014) and Germany (Baumgarten, Geishecker, and Görg 2013). Goldberg and Pavcnik (2007) conclude that most empirical evidence comes from studies focusing on developed countries in their roles in offshoring and outsourcing rather than focusing on developing economies.

Existing studies of developing countries find that workers employed in traded sectors tend to received higher wages than those working in non-traded sectors, such as in Bangladesh (Kabeer and Mahmud 2004), Vietnam (Kabeer and Tran 2003), Kenya (McCulloch and Ota 2002), South Africa (Roberts and Thoburn 2004) and India

(Banga 2016). These studies also interestingly specify that the position of the firm in the value chain leads to different outcomes. Muradov (2017) clearly states that the relative position of an industry in a GVC can shift over time; that is, it could move up or down. However, utilizing the 2015 edition of the OECD Inter-Country Input-Output (ICIO) tables, he finds that in positions in 34 industries for 2000–2011 were quite stable over time. Shingal (2015, 10) concludes that workers in 'higher ends of the value-chain' benefit more than those in the lower-end of export chain' do. For example, McCulloch and Ota (2002) studies the horticulture export industry in Kenya, and finds that workers closer to the end of the chain, such as in packaging, have higher wages than those who work on farms. However, these works focus on specific industry case studies, especially GVC-oriented industries, which may only partially represent the overall impact.

Prior studies measure the degree of GVC involvement using variables related to offshoring and outsourcing as the main proxy. However, Shingal (2015) states that recent databases, such as the OECD's TiVA (2011) and the World Input-Output Database (Timmer et al. 2012), allow for various empirical work on the impact of GVC integration on employment and wages. Several studies apply a variable to measure vertical specialization to represent the level of GVC integration in each industry.

The vertical specialization chain could be defined as the specialization of a country that uses an imported intermediate input from other countries in the value chain to process its exporting goods (Hummels, Ishii, and Yi 2001). Thus, the vertical specialization index could be an indicator to measure the degree of an industry's involvement in the GVCs. Then, Koopman, Wang, and Wei (2014) further develop this vertical specialization chain by decomposing the vertical specialization value in a country's exports into three main categories: (1) foreign value-added in final goods exports, (2) foreign value-added in intermediate goods exports and (3) double counted intermediate exports produced abroad. Mattoo, Wang, and Wei (2013) suggest that FVA could be a proxy for the level of industry involvement in GVCs.

Kuroiwa (2017, 1) further suggests that the overall level of GVC integration alone is insufficient to analyze a country's welfare, and therefore, states that 'industrial deepening' such as backward links that show the position of a local supplier to foreign firms, requires further investigation. Farole (2016, 8) interestingly raises the question, 'Is it the level of participation that matters or the nature (e.g. position in the value chain)?'

Several studies discuss how to 'move up' in the value chain, such as by improving property rights (Antras 2005), research and development investment (Yue and Evenett 2010), increasing productivity through a concreate spillover effect from engaging in the chain via learning by doing (Dean 2013). Lamy (2010) finds that to benefit most from a GVC, each participating country in the chain should specialize in the area in which it has a comparative advantage.

While many studies of GVCs exist, studies of the GVC in Thailand are very rare. Rarer still are studies of the impact of GVCs on wages, despite prior works citing Thailand as a case that the 'traditional model of GVCs' explains (Farole 2016). In this model, a country succeeds by gradually engaging in a GVC by first focusing on low-skilled activities and later moving on to high-skilled activities.

Sessomboon (2015) seems to provide the only study, which computes the level of GVC integration for 32 industries from 2000 to 2011 in Thailand and uses the VSI to rank industries in Thailand with high engagement in GVCs. Furthermore, to determine the position of an industry in a GVCs of 32 industries in Thailand, Sessomboon (2015) also computes the international forward multiplier (IFM) and backward multipliers (IBM).

No studies examine the impact of GVC integration on wages and the skill premium in Thailand directly. The closest study is that by Jayanthakumaran, Sangkaew, and O'Brien (2013), who investigate the impact of trade liberalization on wages in Thailand. The remaining works study the impact of foreign direct investment (FDI) on wages. Velde and Morrissey (2004) study the impact of FDI on wage inequality between skilled and unskilled workers and Paweenawat (2019) studies wage spillover from the existence of multinational enterprises (MNEs) in the industry to local firms, for example.

As there is no prior work on this area, a study on the impact of GVC integration on wages and the skill premium in Thailand is intriguing because it can not only provide another case study of its impact on one main developing and middle-income country with recent high engagement in GVCs, but also provide the first empirical evidence of whether participating in a GVC has a positive or negative impact on wages and the skill premium.

3. Data and methodology

3.1. Data

This study first uses worker-level datasets from the LFS conducted by the National Statistical Office of Thailand (NSO), Statistical Forecasting Bureau, Thailand and constructs comparable measures of GVC integration using industry-level datasets from the OECD's ICIO released in 2005. Then, this study uses a unique dataset created by matching worker-level with industry-level data for 2000, 2005, 2009, 2010 and 2011.

More specifically, this study combines worker-level data on wages and individual characteristics with industry-level data on the degree of GVC integration. For the worker-level data, the sample consists of full time workers (working more than 30 h/week) aged 19–60 years 32 industries based on 2-digit International Standard Industrial Classification (ISIC) codes. This study examines 32 manufacturing and service industries in Thailand listed in the ICIO. This study follows the matching method in Baumgarten, Geishecker, and Görg (2013), who match worker-level data on wages with industry-specific measures of GVC involvement.

The main dependent variable in the estimation is the real hourly wages drawn from the LFS survey. Note that wages are deflated by the Thailand Consumer Price Index (CPI) (2002 as a base year). The CPI data are directly drawn from the Bureau of Trade and Economic Indices, Ministry of Commerce, Thailand. The LFS also provides individual characteristics, including age, gender, educational attainment, marital status and regions, which serve as control variables in the standard Mincerian wage equation. Furthermore, this study controls for the share of skilled to total workers, share of employment in each industry to total employment, exports per worker and

intermediate input imports per worker. While the employment ratio and share of skilled worker are constructed from the LFS, import and export data are extracted from the basic statistics of the OECD.

Next, to quantify the impact of GVC integration on the skill premium, the authors construct a dummy variable for skill workers using education level as the main criteria. Skilled workers include those graduating with post-secondary, vocational and university degrees, while the other educational levels make up the population of unskilled workers. Given the availability of educational attainment data, this study measures the skill premium directly using the relative wages of skilled and unskilled workers, as defined previously need not use the wages of white collar and blue collar workers, as in other studies that faced data limitations.

The main independent variable used as a proxy for the level of GVC integration for each industry is the FVA of gross exports, following Mattoo, Wang, and Wei (2013). FVA is the share of 'the part of the value of final output of an industry that is contributed by industries in other countries' (Amador and di Mauro 2015, 37). FVA here includes FVA for both final and intermediate goods exports and expressed as percentage of gross exports. A higher FVA means a higher dependency on foreign content and a higher degree of GVC integration.

This study adopts the FVA variables representing the degree of GVC involvement from Sessomboon (2015, 7) defined as 'the value-added of foreign country which embodied in exported product, such as, returns from foreign labor and capital'. Using the recent OECD ICIO Tables (2015) with Koopman, Wang, and Wei (2014) method and applying the codes from Wang, Wei, and Zhu (2013) in the R statistical program, Sessomboon (2015) decomposes the value of Thailand's gross exports into three parts: domestic value added, FVA and purely double counted.

In addition to FVA, the study will also use the IBM and IFM in the analysis to indicate the impact of the position of each industry in the supply chain. Sessomboon (2015) computes these two indicators by applying the matrix algebra steps in the OECD ICIO Tables in 2015 and finds that a high IBM indicates that the industry has a position near the end of the chain, while a high IFM indicates that the industry has position near the beginning of the chain.

Table 1 provides the basic summary statistics for the sample. There are 195,281 individual observations for 32 industries (Appendix provides the industry list). The average amount of Domestic Value Added (76.26), is higher than the Foreign Value Added (20.93). The vertical specification ranges from 2 to 68, with an average value of 23.66. The mean value log hourly wage is around 2.05, ranging from 1.31 to 2.86. The average working hours are 47 per week, while the average education is 10 years and the share of women is around 48%.

3.2. Methodology

This study first determines the impact of GVC integration on wages, and then, its impact on the skill premium. Both stages of the estimation will be applied in both parts.

Table 1. Summary statistics of sample (individual level).

Variables	(1) *N*	(2) Mean	(3) *SD*	(4) Min	(5) Max
Working hour	195,281	47.59	10.69	30	97
Industry	195,281	13.10	7.724	1	32
Domestic value added	195,281	76.26	13.23	32	98
Foreign value added	195,281	20.93	11.32	2	48
Vertical specialization	195,281	23.66	13.24	2	68
International forward	195,281	3.961	9.664	0.0001	64
International backward	195,281	0.538	0.326	0.0473	1.829
Relative employment	195,281	0.0903	0.0889	0.000204	0.329
Export per worker	195,281	0.562	2.896	0	92.25
Import per worker	195,281	−0.575	2.656	−58.22	−0.00104
Relative skilled worker	195,281	0.274	0.239	0.00813	0.864
Ln wage	195,281	2.047	0.343	1.310	2.860
Year of education	195,281	10.04	4.993	0	23
Female	195,281	0.475	0.499	0	1
Year	195,281	2007	3.818	2000	2011
Number of industry	32	32	32	32	32

3.2.1. Wages

This study adopts the augmented Mincerian regression (Mincer 1974) for individual worker data to find the ln wages of workers for each industry in each year, after controlling for the different individual characteristics, with the following specification:

$$\ln W_{ijt} = \sum_{i=1}^{N} \beta_i X_{ijt} + \sum_{j=1}^{N} \delta_{jt} D_j + \varepsilon_{ijt}, \tag{1}$$

where W_{ijt} is the hourly wage of worker i in industry j at time t; X_{ijt} is a vector of individual characteristics including age, age squared, gender, marital status, years of schooling and region; D_j is the industry dummy variable; and ε_{ijt} is the error term.

The coefficient of the industry dummy variable $(or\ \delta_{jt})$ indicates the average ln of the wages of workers who share the same characteristics but work in different industries in different periods. This coefficient of the industry dummy variable from Equation (1) will then become the dependent variable in Equation (2) to determine the relationship between the industry's degree of GVC involvement and wages. Intuitively, this study adopts this approach to determine whether workers with the same characteristics but in industries with differing degrees of GVC involvement could explain the wage difference among workers.

The following specification is adapted from Geishecker and Görg (2010), who determine the impact of outsourcing on wages using matched worker-industry datasets, and Jayanthakumaran, Sangkaew, and O'Brien (2013), who study the effect of trade liberalization on workers' wage premiums in Thailand. Furthermore, the additional control variable related to industry characteristics will be imposed in the estimation, as Goldberg and Pavcnik (2005) suggest.

$$\delta_{jt} = \beta_1 ln\mathrm{FVA}_{jt} + \beta_2 \mathrm{Skill}_{jt} + \beta_3 \mathrm{Employ}_{jt} + \beta_4 \mathrm{Export}_{jt} + \beta_5 \mathrm{Import}_{jt} + \sum_{j=1}^{N} \tau_j D_j + \varepsilon_{jt}, \tag{2}$$

where δ_{jt} is average of ln wage of industry j at time t and FVA_{jt} is FVA for both final and intermediate goods exports. The estimated coefficients of FVA (β_1) present the relationship between the degree of GVC involvement and the average wage overall.

For the other control variables related to industry characteristics, (1) Skill_{jt} is the share of skilled workers to total workers, (2) Employ_{jt} is the share of employment in each industry to total employment and (3) Export_{jt} is exports per worker; (4) Import_{jt} is intermediate-input imports per worker. ε_{jt} is the error terms.

These variables control for different industry characteristics for several reasons. First, the share of employment controls for the size of the industry, so a high number of workers in the industry will not lead to higher wages. Second, the share of skilled workers is included because in most developing countries, as the wage of skilled workers was affected by skills-biased technological change due to globalization, which occurred in Argentina and Brazil (Goldberg and Pavcnik 2007).

Finally, the export and import variables follow Jayanthakumaran, Sangkaew, and O'Brien (2013), who explain why these variables should be included in Equation (1). Exporting firms, which tend to be GVC-oriented industry, tend to produce high-quality products and have high margins. This type of firm definitely needs highly skilled workers in the production process and tends to pay higher wages and show a high skill premium compared to other industries (Jonsson and Subramanian 2001); and (2) a firm in an industry with high engagement in GVC activities has a larger amount of intermediate-input imports and pay higher wages (Martin 2009).

Equation (2) also includes the industry and year fixed effect to control for the unobservable heterogeneity across industries as well as to reduce the endogeneity arising from measurement errors and omitted variables bias. The Hausman Test specifies that the fixed-effect model is the suitable method for the estimation.

However, another interesting question is whether the wage response to the degree of GVC involvement varies according to the position of the industry in the GVC. To further investigate whether the industry position in the supply chain affects wages or not, this study also adds the IBM and IFM to Equations (3) and (4). The estimated coefficients of FVA (β_1) indicate the impact of industry position in the supply chain on wages.

$$\delta_{jt} = \beta_1 ln\text{FVA}_{jt} + \beta_2 \text{IBM}_{jt} + \beta_3 \text{Skill}_{jt} + \beta_4 \text{Employ}_{jt} + \beta_5 \text{Export}_{jt} + \beta_6 \text{Import}_{jt} + \sum_{j=1}^{N} \tau_j D_j + \varepsilon_{jt} \tag{3}$$

$$\delta_{jt} = \beta_1 ln\text{FVA}_{jt} + \beta_2 \text{IFM}_{jt} + \beta_3 \text{Skill}_{jt} + \beta_4 \text{Employ}_{jt} + \beta_5 \text{Export}_{jt} + \beta_6 \text{Import}_{jt} + \sum_{j=1}^{N} \tau_j D_j + \varepsilon_{jt} \tag{4}$$

3.2.2. Skill premium

In addition to exploring the wages according to the degree of GVC involvement, this section examines the skill premium reflecting the wage inequality between skilled and

unskilled workers. The first stage is the worker-level regression to determine the ln of the relative wages of skilled workers to unskilled workers (or the skill premium) after controlling for different individual characteristics. Equation (5) is a version of Equation (1) that includes the interaction term between the dummy of skilled workers (D_k) and the dummy of industry (D_j).

$$\ln W_{ij} = \sum_{i=1}^{N} \beta_i X_{it} + \sum_{j=1}^{N} \delta_j D_j + \sum_{j=1}^{N} \gamma_j (D_j * D_k) + \varepsilon_{ij}. \tag{5}$$

The estimated coefficient (γ_j) on the interaction term between the dummy variable of skilled workers (D_k) and the dummy variable of industry (D_j) represents the skill premium, which will become the dependent variable in the second stage estimation, which is the industry-level regression. Equation (6) includes the industry and year fixed effect and the estimated coefficients of FVA (β_1), which represents the relationship between the degree of GVC involvement and the skill premium.

$$\gamma_{jt} = \beta_1 ln\mathrm{FVA}_{jt} + \beta_2 \mathrm{Skill}_{jt} + \beta_3 \mathrm{Employ}_{jt} + \beta_4 \mathrm{Export}_{jt} + \beta_5 \mathrm{Import}_{jt} + \sum_{j=1}^{N} \theta_j D_j + \varepsilon_{jt}. \tag{6}$$

The estimated coefficients of FVA (β_1) represent the impact of the industry's position in the supply chain on the skill premium. Note that the estimated coefficients of Skill (β_2) present the relationship between the relative employment of skilled workers and the relative wages of skilled workers to unskilled workers, for which Katz and Murphy (1992) suggest a negative sign. As before, the Equations (7) and (8) will then include the IBM and the IFM.

$$\gamma_{jt} = \beta_1 ln\mathrm{FVA}_{jt} + \beta_2 \mathrm{IBM}_{jt} + \beta_3 \mathrm{Skill}_{jt} + \beta_4 \mathrm{Employ}_{jt} + \beta_5 \mathrm{Export}_{jt} + \beta_6 \mathrm{Import}_{jt} + \sum_{j=1}^{N} \theta_j D_j + \varepsilon_{jt} \tag{7}$$

$$\gamma_{jt} = \beta_1 ln\mathrm{FVA}_{jt} + \beta_2 \mathrm{IFM}_{jt} + \beta_3 \mathrm{Skill}_{jt} + \beta_4 \mathrm{Employ}_{jt} + \beta_5 \mathrm{Export}_{jt} + \beta_6 \mathrm{Import}_{jt} + \sum_{j=1}^{N} \theta_j D_j + \varepsilon_{jt} \tag{8}$$

Note that in the estimation of the impact of GVC integration on wages and the skill premium, this study employs a two-stage regression in the estimation. The dependent variable in the second stage regression (the industry-level regression) is generated by the first stage regression (the worker-level regression), which means they are subject to error (or have some measurement error). This study, therefore, also uses the bootstrap method as the resampling technique to approximate standard errors for the estimated parameters. Thus, the bootstrapped standard errors with constructed panel data are reported in the estimated results.

4. Results

4.1. Wages

The first stage estimation provides the estimates from the Augmented Mincerian Regression (Equation (1)) on individual workers in each year (2000, 2005, 2009, 2010 and 2011), controlling for individual characteristics. The estimate coefficients from the Ordinary Least Squares (OLS) regression on worker-level data have the signs and magnitudes expected from the standard wage equation. The estimates are all statistically significant and have positive coefficients on the years of education. This specifies that an increase in years of education will lead to an increase in wages.

Next, there is a positive coefficient on age, but a negative coefficient on age squared. This means that wages increase with age, but increase at a diminishing rate. These results are consistent with Warunsiri and McNown (2010), who estimate the rate of returns to education in Thailand. For the other variables, male workers have higher wages than female workers do, while married workers have higher wages than unmarried workers do.

Thus, this first stage mainly aims to find the average wage of each industry in each year when controlling for other individual characteristics that could affect wages. This average wage for each industry can be obtained from the coefficients on the industry dummy variable. The results show high average wages in the following industries: Chemicals and chemical products (ISIC24); Post and telecommunication (ISIC64); Computers, electronics and optical equipment (ISIC33); Transport and storage (ISIC 60-64); and Wood and products of wood and cork (ISIC20), and low average wages in the Food products, beverages and tobacco (ISIC15-16); Fabricated metal products (ISIC28); Education (ISIC-80); and Hotels and restaurants (ISIC-55) industries.

Note that the average wage results show that higher wages are concentrated in industries in manufacturing sectors, and these industries tend to be in the trading sector and potentially highly engaged in GVC activities, while the lower wages are in service sector industries that potentially have a lower degree of GVC integration. For example, Sessomboon (2015) also reports that the computers, electronics and optical equipment industry shows a high level of GVC involvement, and the basic computed average wage herein shows that these industries have higher wages compare to others. Thus, the expected relationship between the degree of industry involvement and wages should be positive in Thailand.

Next, this study employs panel data constructed using the industry-year dimension, which consists of 155 observations. The panel fixed-effect regression is applied in the second stage to control for the differences across industries (Equation (2)). The estimates in Table 2 indicate a positive effect of FVA on average wages, or more specifically, workers in industries with higher GVC engagement tend to have higher wages. The coefficients on FVA are statistically significant and range from 0.799 to 0.964 (Columns (1) and (2)). These results are consistent with most existing studies showing that high engagement in GVCs will drive wages higher in many countries (Farole 2016).

In Thailand's context, industries with high involvement in GVCs are the most productive and focus on exports, such as chemicals and chemical products, and

Table 2. The impact of FVA on wages.

Variables	(1) Fixed effect (without control)	(2) Fixed effect (with control)	(3) Fixed effect (with control)	(4) Fixed effect (with control)
Ln FVA	0.964***	0.799***	0.495**	0.799***
	(0.243)	(0.178)	(0.200)	(0.178)
International backward			0.765**	
			(0.320)	
International forward				0.00353***
				(0.000610)
Relative employment		−0.363	−0.494	−0.407
		(1.344)	(1.153)	(1.250)
Relative skilled worker		0.968***	0.893***	0.929***
		(0.182)	(0.167)	(0.188)
Export per worker		0.00176	0.00242	0.000166
		(0.0135)	(0.0158)	(0.0153)
Import per worker		−0.00187	0.00169	−0.000723
		(0.0116)	(0.0116)	(0.0127)
Constant	−0.863	−0.619	−0.204	−0.622
	(0.794)	(0.568)	(0.485)	(0.572)
Observations	155	155	155	155
R-squared	0.186	0.369	0.399	0.394
Number of industry	32	32	32	32
Industry and year FE	YES	YES	YES	YES

Robust standard errors in parentheses.
***$p < .01$, **$p < .05$, *$p < .1$.

computers, electronics and optical equipment. The Board of Investment of Thailand (BOI 2015, 2) states that 'The electrical and electronics industry has not merely played an important role in Thailand's economy as a main growth driver, but has also made Thailand Southeast Asia's electrical and electronics manufacturing hub'. Thus, these industries require skilled workers, who have high wages.

This evidence reflects that found for exporting firms in Chile and India, in which exporting firms within a GVC network tend to pay higher wages compared to local firms focusing on the local market do (World Bank 2017). Kowalski et al. (2015) also find that greater GVC participation, which is normally measured using the foreign content of intermediate imports, tends to yield a positive outcomes in a country. Furthermore, this finding confirms the existence of an industry wage premium in Thailand due to trade liberalization, as in Jayanthakumaran, Sangkaew, and O'Brien (2013). However, this finding contradicts Ebenstein et al. (2014), who indicates that the industry exposure to globalization has no critical impact on wage effect, but occupation does.

However, another interesting question is whether there is a wage response to the position of the industry in the value chain. Kowalski et al. (2015) mention that the level of industrial development and its structure affect the potential gains from GVC participation. The OECD (2016) even provides suggestions for developing countries to gain from participating in GVCs. In addition to increasing the share of value added in goods produced, a country should attempt to progress into higher value-added activities.

When including IBM and IFM in Equations (3) and (4), the coefficients on FVA are still statistically significant, and range from 0.495 to 0.799. Furthermore, the

coefficients on IBM and IFM are also positive and statistically significant, though the magnitude of the coefficient of IBM (Column (3), 0.765) is much larger than that of IFM (Column (4), 0.00353). This result indicates that IBM has a much larger impact on wages than IFM does.

Intuitively, in industries positioned closer to the end of a value chain, workers will tend to have higher wages compared to those in industries near the beginning of the chain. This result supports Shingal's (2015) conclusion from a review of similar evidence in several developing countries, such as Kenya and Vietnam, and the OECD's (2013) conclusion that the industry gains from GVC involvement differ across different stages of production. It depends on the industry's position in the chain, in which industries engaged in higher value-added activities gain higher benefits, such as higher wages and employment. However, this finding contradicts the OECD's (2016a) conclusion that the advantages of GVC involvement do not depend on the form of activities.

Based on Sessomboon's (2015) computation, the computers, electronics and optical equipment industry in Thailand has a high IBM, indicating a production process highly engaged in the GVC. Note that Errighi and Bodwell (2017) report that the electrical and electronics industry in Thailand is the largest of the ASEAN countries, which contributes 15% of GDP, promotes export revenues and has around 750,000 workers and is currently the main assembly base of ASEAN.

The remaining control variables related to industry characteristics are not statistically significant, except for skilled workers. This result shows that the share of skilled workers in an industry is a significant factor contributing to higher wages, while relative employment, exports per worker and imports per worker have no effect on average wages.

4.2. Skill premium

This section applies the same two step estimation as in Subsection 3.1 to determine the different skill premiums across the different degrees of GVC involvement. The first stage reports the estimated results of the OLS regression on the worker-level data to first find the relative wage of skilled workers of each industry in each year when controlling for different individual characteristics. The relative wages of skilled workers for each industry can be obtained from the coefficients on the interaction term between the dummy variable of skilled workers and the dummy variable of industry.

The results show that Computer and related activities (ISIC72), Wood and products of wood and cork (ISIC20) and Chemicals and chemical products (ISIC24) show high relative wages among skilled workers; while Food products, beverages and tobacco (ISIC15-16); Construction (ISIC-45); and Agriculture, hunting, forestry and fishing (ISIC 01-03) shows low relative wages among skilled workers. The high relative wages of skilled workers also implies high wage inequality between skilled and unskilled workers in the industry.

These computed relative wages for skilled workers is consistent with the average wage classified by occupation reported by the Bank of Thailand (2018) in the second

Table 3. The impact of FVA on skill premium.

Variables	(1) Fixed effect (without control)	(2) Fixed effect (without control)	(3) Fixed effect (with control)	(4) Fixed effect (with control)
Ln FVA	0.450***	0.382***	0.353*	0.382***
	(0.107)	(0.142)	(0.202)	(0.140)
International backward			0.0741	
			(0.190)	
International forward				0.000740
				(0.000541)
Relative employment		–0.900**	–0.912**	–0.903**
		(0.413)	(0.464)	(0.460)
Relative skilled worker		0.287*	0.281*	0.281*
		(0.162)	(0.148)	(0.160)
Export per worker		0.00127	0.00129	0.000720
		(0.00492)	(0.00529)	(0.00489)
Import per worker		0.00352**	0.00384***	0.00362***
		(0.00496)	(0.00470)	(0.00466)
Constant	–1.139***	–0.972**	–0.932*	–0.974**
	(0.327)	(0.407)	(0.486)	(0.403)
Observations	154	154	154	154
R-squared	0.189	0.296	0.298	0.301
Number of Industry	32	32	32	32
Industry and year FE	YES	YES	YES	YES

Robust standard errors in parentheses.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

quarter of 2018. Wages for skilled workers in the agricultural and fishery sectors are around 5785 baht compared to plant and machine operators and assemblers (=10,952 baht) and craftspersons and related trades workers (=10,684 baht). This gap clearly indicates that skilled workers will receive higher pay in industries related to the trading sector, as the high demand for skilled workers in these industries leads to high wage inequality.

The estimated results for the constructed panel data to analyze the effect of GVC integration on the skill premium from Equation (6) are reported in Table 3, and indicate a positive effect of FVA on the skill premium. The coefficients on FVA are statistically significant and range from 0.382 to 0.450 (Columns (1) and (2)). This result is consistent with Goldberg and Pavcnik (2007), who find that over the past 20 years, most developing countries experienced increasing wage inequality between skilled and unskilled workers as a result of globalization. More specifically, Taglioni and Winkler (2016) report that high GVC involvement will increase demand for skilled workers and that workers with this skill will have higher wages (or the demand effects).

In other words, high engagement in GVCs among industries in Thailand during the study period led to a higher skill premium; activities in a GVC-oriented industry could boost productivity in Thailand, leading to higher wages for skilled workers and an increase in the wage inequality between skilled and unskilled workers. Errighi and Bodwell (2017, 19) clearly state that in Thailand, 'skills shortages translate into a high turnover among skilled professionals, who face a substantial salary premium in the Thai labour market: hourly wages of graduates with a master's degree are four times those of upper secondary graduates'.

The OECD (2013) states that GVC participation alters the composition of the labor force, with low-skilled workers suffering the most negative effect. Goldberg and Pavcnik (2007) provide several reasons why globalization could lead to an increase in demand for skilled workers and document several case studies of developing countries experiencing wage inequality. Shingal (2015) concludes that several studies in both developing and developed countries find that participating in a GVC significantly affects wage inequality, leading to a discussion of the long term impact.

This finding is consistent with that of Jayanthakumaran, Sangkaew, and O'Brien (2013), who find that a tariff reduction increases the relative wages of skilled to unskilled workers. Increasing trade liberalization favors skilled workers. In the GVC context, a GVC-oriented industry tends to use high technology that requires skilled workers, thus supporting Velde and Morrissey's (2004) finding that higher FDI leads to higher wage inequality in Thailand. In other words, since the 1990s, the relative demand for high skilled workers in Thailand increased and widened the wage gap between skilled and unskilled workers in terms of GVC engagement, which is consistent with the impact of offshoring on wage inequality in Feenstra and Hanson's (1996, 1997, 1999) findings that that low-skilled workers received a lower wage due to offshoring, which decreases the demand for unskilled workers in developed countries, despite different institutional settings among countries.

Overall, this study provides empirical evidence in Thailand that an increase in GVC involvement will not only affect wage across industries overall, but also affect wages between skilled and unskilled workers within the industry due to an increase in demand for highly skilled workers in GVC-oriented industries. Thus, being more engaged in the GVC induces higher wage inequality in the country.

Errighi and Bodwell (2017) interestingly raise the issue of the skill gap among workers in one of the main exporting industries in Thailand. For example, in 2015, the electronics and electrical industry (E&E), which could reflect the main characteristics of the manufacturing and exporting industries in Thailand, mostly employ low-skilled workers (around 80% of total workers) and most industries faced a shortage of skilled workers. Furthermore, Errighi and Bodwell (2017, 18) also mention that 'skills shortages and mismatches limit the ability of E&E manufacturing facilities in Thailand to increase their productivity and are considered an obstacle to gains from spillovers associated with FDI'.

The coefficient on the variable representing the ratio of skilled workers to unskilled workers is positively statistically significant (=0.28), which contradicts the overall prediction of Katz and Murphy (1992) and is inconsistent with the finding of Velde and Morrissey (2004), who indicate a negative relation in Thailand during 1985–1998. The positive relation herein, which uses data for the 2000s, could represent the updated situation of skilled workers in Thailand, the higher number of skilled workers and the industry adjustment to higher GVC involvement, such as producing high quality products with higher prices, leading to higher pay. This could show that even as the number of skilled workers increases, the relative wages of skilled workers increases as well.

As in the first section, the IBM and IFM were added to Equations (7) and (8). Unlike the impact on wages, the IBM and IFM do not show statistically significant

effects on the skill premium (Columns (3) and (4)), indicating that industry's position in the chain does not affect the relative wages of skilled workers. This finding contradicts González et al. (2015), indicating that 'a higher degree of backward participation in GVCs have lower levels of wage inequality'.

However, the coefficient on relative employment are negatively statistically significant (=–0.90), indicating that the higher the relative employment is, the lower skill premium is. The share of skilled workers is positively and statistically significant according to the magnitude of the coefficient, of around 0.28 across all specifications (Columns (2)–(4)). This confirms the positive relationship between the share of skilled workers and the skill premium. This result clearly confirms that a high level of GVC involvement has a positive impact on the Thai labor market, particularly for skilled workers who earn a skill premium due to the increasing demand for skilled workers in GVC-oriented industries. This indicates that the recent development of GVC integration in Thailand shows that such industries have a demand for highly skill workers.

Finally, the intermediate inputs import per worker is positive and statistically significant, with a magnitude of (=0.003) across the specifications. Intuitively, an industry with high-value intermediate input imports induces a high skill premium for workers. This is consistent with Ge et al. (2019), who find that intermediate input imports positively correlate with the skill premium.

4.3. Robustness check

According to Mattoo, Wang, and Wei (2013), research on measuring and defining the degree of industrial involvement in GVCs has been quite progressive and changing over time, and involves several definitions and terms. Thus, to prove the robustness of our results. We replace the independent variable to measure the degree of involvement from current FVA with the lag term of FVA and the VSI.

4.3.1. Lag term

As GVC involvement requires time to affect wages through the wage adjustment process, the equation should include the FVA variable as a lag term. This study adopts this argument from Ebenstein et al. (2014), who analyze the impact of globalization with a focus on the effect of offshoring on wages and notes that the equation should use lagged measurements for two main reasons: (1) trading activities, such as offshoring, requires time to implement and wages do not adjust spontaneously, so offshoring would not affect wages in only a single year; and (2) if considering only one year, the two main variables of offshoring and wage might be influenced by contemporaneous shocks.

To check this argument, this study adds the lag of FVA, lag of IBM and lag of IFM as new independent variables. The estimates for the lagged variables do not differ much in terms of both the signs and magnitudes of the coefficients (Table 4). This indicates that in terms of the effect of GVCs on wages, the time dimension might not have a considerable impact and/or significantly alter the outcomes.

Table 4. The impact of FVA lag on wages.

Variables	(1) Fixed effect (without control)	(2) Fixed effect (with control)	(3) Fixed effect (with control)	(4) Fixed effect (with control)
Ln FAV = L,	0.859***	0.975***	0.517***	0.816***
	(0.299)	(0.332)	(0.635)	(0.273)
International backward = L,			1.265**	
			(0.568)	
International forward = L,				0.00825***
				(0.00104)
Relative employment		0.439	0.251	−0.159
		(1.869)	(2.011)	(1.550)
Relative skilled worker		0.940***	0.936***	0.781***
		(0.148)	(0.150)	(0.104)
Export per worker		0.00355	0.000661	0.0113***
		(0.0179)	(0.0193)	(0.00924)
Import per worker		0.00512	0.00415	0.00735*
		(0.0118)	(0.0150)	(0.00867)
Constant	−0.434	−1.045**	−0.520	−0.595**
	(0.890)	(1.001)	(1.556)	(0.817)
Observations	123	123	123	123
R-squared	0.178	0.366	0.466	0.584
Number of industry	32	32	32	32
Industry and year FE	YES	YES	YES	YES

Robust standard errors in parentheses.
***$p < .01$, **$p < .05$, *$p < .1$.

Table 5. The impact of VSI on wages.

Variables	(1) Fixed effect (without control)	(2) Fixed effect (with control)	(3) Fixed effect (with control)	(4) Fixed effect (with control)
Ln VSI	0.952***	0.793***	0.444*	0.792***
	(0.256)	(0.191)	(0.237)	(0.192)
International backward			0.797**	
			(0.335)	
International forward				0.00351***
				(0.000638)
Relative employment		−0.445	−0.576	−0.490
		(1.258)	(1.192)	(1.248)
Relative skilled worker		0.984***	0.904***	0.945***
		(0.185)	(0.173)	(0.202)
Export per worker		0.00228	0.00270	0.000695
		(0.0158)	(0.0153)	(0.0153)
Import per worker		−0.000678	0.00245	0.000458
		(0.0119)	(0.0117)	(0.00936)
Constant	−1.010	−0.753	−0.158	−0.754
	(0.886)	(0.643)	(0.619)	(0.645)
Observations	155	155	155	155
R-squared	0.171	0.360	0.390	0.385
Number of industry	32	32	32	32
Industry and year FE	YES	YES	YES	YES

Robust standard errors in parentheses.
***$p < .01$, **$p < .05$, *$p < .1$.

Table 6. The impact of FVA on wages (only Bangkok Metropolitan Region).

Variables	(1) Fixed effect (without control)	(2) Fixed effect (with control)	(3) Fixed effect (with control)	(4) Fixed effect (with control)
Ln FVA	1.134***	0.993***	0.446*	0.995***
	(0.332)	(0.241)	(0.224)	(0.244)
International backward			1.510***	
			(0.350)	
International forward				0.00100
				(0.000813)
Relative employment		0.0998	–0.0592	0.0980
		(1.077)	(0.962)	(1.076)
Relative skilled worker		0.965***	0.816***	0.952***
		(0.281)	(0.257)	(0.283)
Export per worker		–0.00982	–0.00985*	–0.00996
		(0.00674)	(0.00528)	(0.00666)
Import per worker		–0.00245	0.00235	–0.00220
		(0.00567)	(0.00328)	(0.00562)
Constant	–1.651	–1.460**	–0.801	–1.466*
	(1.103)	(0.714)	(0.538)	(0.721)
Observations	155	155	155	155
R-squared	0.186	0.369	0.399	0.394
Number of industry	32	32	32	32
Industry and year FE	YES	YES	YES	YES

Robust standard errors in parentheses.
***$p < .01$, **$p < .05$, *$p < .1$.

4.3.2. Vertical specialization index

To check the basic estimation results further, this study uses the VSI as another dimension of GVC involvement in the estimation. This VSI indicates the degree of imported content included in exports and presents the degree of the industrial link to GVCs, as proposed by Hummels, Ishii, and Yi (2001) and Koopman, Wang, and Wei (2014). In Thailand, Sessomboon (2015) computed VSI, which is composed of FVA and the value of double-counted intermediate exports produced abroad divided by gross exports.

VSI could provide a rough and simple measurement that indicates the degree of industrial link to the GVC. The weakness of using VSI as the main variable is that it includes the value of double-counted intermediate exports produced abroad; thus, this index may not be appropriate for use in the estimation or may not represent the actual degree of involvement and distort the estimated impacts. However, given the high correlation between FVA and VSI, the estimated results are robust across all specifications and show no difference in signs and values (Table 5).

4.3.3. Bangkok Metropolitan Region

This study performs another robustness check by limiting the worker sample to cover only those who work in the regions with a high concentration of GVC-intensive sectors, which is the Bangkok Metropolitan Region (BMR) (Bangkok, Nakhon Pathom, Nonthaburi, Pathum Thani, Samut Prakan and Samut Sakhon). The results (Table 6) do not differ much in terms of the signs, but the magnitudes of the coefficients on

FVA and IBM are much larger than in the overall sample. This indicates that GVC-intensive areas have higher demand for skilled workers, leading to a much higher impact on wages compared to the other areas. Furthermore, the magnitude of the coefficients on IBM is double that of the overall sample. However, the coefficient of IFM loses statistical significance, indicating that in these regions, the IFM has no impact on wages.

5. Conclusion

The Thai economy has gradually integrated into global trade and investment through its trade liberalization policy since the 1990s, which led some industries, especially in the manufacturing sector, to become active participants in GVCs. This increasing significant and complex international trade network definitely affects the Thai labor market, and presents challenges for the Thai government to handle and exploit the benefit from this integration.

This study investigates the impact of GVC integration on wages and the skill premium using matched worker-industry data from 2000 to 2011. This study fills a gap in the existing literature by being the first study to provide explicit empirical evidence of this GVC-wage link in Thailand. In the two-stage estimation, the first stage is the worker-level regression to determine the average wage for each industry in which the workers share similar characteristics, while the second stage industry-level regression presents the wage differences across industries and the skill premium for the different degrees of GVC involvement.

The main finding shows the positive link between the degree of an industry's GVC integration and wages in Thailand. Industries with higher engagement in GVCs have higher wages for workers working in that industry. Furthermore, skilled workers in GVC-oriented industries benefit from high involvement in GVCs, as their skill premium shows. Thus, the different degree of GVC involvement of the industry increases not only wage inequality across industries but also the wage inequality between skilled and unskilled workers within that industry.

The results are consistent with findings from prior studies in developing economies, which show that GVC integration significantly contributed to wages and the skill premium in Thailand overall during the 2000s. Furthermore, the evidence is consistent with Goldberg and Pavcnik's (2007) conclusion that in developing countries, more involvement in global production sharing led to more trade liberalization, allowing for a freer flow of all types of factors of production, both intermediate goods and capital, which eventually induces wage inequality in the country.

This study further shows that the industry's position in the value chain matters for wages. Workers in industries positioned closer to the end of value chain (downstream position) tend to receive higher wages compared to industries in an upstream position. This result has significant policy implications in the context of GVC-led development strategies for the Thai government. Farole (2016) suggests that governments should attempt to lift their industries to higher value-added positions. In other words, the Thai government should try to move industries, especially those involved in GVCs, toward the end of the value chain to benefit more from GVC participation.

Furthermore, one economic mechanisms from GVC participation is the enhancement of productivity growth in the country, which could come from the positive spillover effect from new technology, knowledge and innovation for domestic firms in the industry. In addition to the industry level, the government should also focus on the both firm and worker levels. At the firm level, the government should try to help workers upgrade their skills, facilitate trade, implement international standards and focus on technology transfer and innovation in addition to adopting a policy encouraging domestic firms to invest in neighboring countries to enhance GVC participation. This will also enhance exports and construct a global network with foreign firms in the value chain. At the worker-level, the Thai government could play a significant role in encouraging workers to benefit from higher involvement in GVCs not only in terms of wages but also by improving their skills, facilitating worker mobility across firms and industries and assisting in the matching process between employees and employers.

Additionally, Thailand has many local small and medium enterprises (SMEs) that might have a limited capacity to integrate with a GVC. The Thai government should have a policy to help reduce such disadvantages by connecting these firms to GVCs as well as enhancing their advantages in the sector or of being part of a GVC. This could be done by aiming to exploit GVCs using technology and knowledge transfers from workers in GVC-engaged firms to improve the capacity and productivity of other domestic firms. GVC participation could be an opportunity for SMEs to become involved in the global production process and progress to higher value-added activities.

Finally, in order to encourage effective and high participation in GVCs, Gereffi, Humphrey, and Sturgeon (2005) states that the entire economy must contribute, including the country, firms and workers, in all stages. To achieve long-term economic development and the desirable economic benefits of GVCs, sustaining GVC participation requires economic upgrades at the industry, firm and worker levels. Thus, for the success of the country, the government should adopt a leading role, but all stakeholders in the Thai economy also need to cooperate other to drive the Thai economy overall.

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Data availability statement

The data that use in this study are available from the National Statistical Office of Thailand (NSO), Statistical Forecasting Bureau, Thailand, but restrictions apply to the availability of these data, which were used only for this study, and so are not publicly available.

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Appendix: Industry list

Groupindustry

001 Real estate activities ISIC 70xx-74xx
002 Financial intermediation ISIC 65xx-67xx
003 Education ISIC 80xx
004 Wholesale & retail trade and repairs ISIC 50xx-52xx
005 Post and telecommunication ISIC 64xx
006 Mining and quarrying ISIC 10xx-14xx
007 Renting of machinery and equipment 71xx, 4550
008 Computer and related activities ISIC 72xx
009 Agriculture, hunting, forestry and fishing ISIC 01xx-03xx
010 Hotels and restaurants ISIC 55xx
011 Wood and products of wood and cork ISIC 20xx
012 Food products, beverages and tobacco ISIC 15xx-16xx
013 R&D and other business activities ISIC 73xx-74xx
014 Textiles, textile products, leather and footwear ISIC 17xx-19xx
015 Other community, social and personal services ISIC 90xx-99xx
016 Health and social work ISIC 85xx
017 Transport and storage ISIC 60xx-64xx
018 Electricity, gas and water supply ISIC 40xx-41xx, 1120
019 Rubber and plastics products ISIC 25xx, 2413
020 Other non-metallic mineral products ISIC 26xx
021 Chemicals and chemical products 24xx
022 Pulp, paper, paper products, printing and publishing ISIC 21xx-22xx
023 Construction ISIC 45xx
024 Other transport equipment ISIC 35xx
025 Manufacturing and recycling ISIC 36xx-37xx
026 Electrical machinery and apparatus ISIC 31xx-32xx
027 Machinery and equipment ISIC 29xx-30xx
028 Motor vehicles, trailers and semi-trailers ISIC 34xx 5020
029 Coke, refined petroleum products and nuclear fuel ISIC 23xx, 1030, 1110
030 Fabricated metal products ISIC 28xx
031 Basic metals 27xx
032 Computer, electronic and optical equipment ISIC 33xx
Source: http://www.oecd.org/industry/business-stats/1936170.htm