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Does GVC participation improve firm productivity? A study of three developing Asian countries

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ADB Working Paper Series

**DOES GVC PARTICIPATION
IMPROVE FIRM PRODUCTIVITY?
A STUDY OF THREE DEVELOPING
ASIAN COUNTRIES**

Shujiro Urata and Youngmin Baek

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Abstract

This paper examines the impact of local firms' participation in global value chains (GVCs) on productivity by considering three different patterns of GVC participation. We conducted a DID-PSM estimation involving three countries, Indonesia, the Philippines, and Viet Nam, and 17 manufacturing sectors in 2009 and 2015. We found an endogenous relationship between firm productivity and GVC participation: firms that enter GVCs have high productivity before participating in the GVCs (selection effect), and only Indonesian firms which entered GVCs had a high productivity growth after joining GVCs (learning effect). These two effects were only found for firms which both import intermediate goods and export output, and not for firms which only either import or export. We also found that indirect exporting does not improve a local firm's productivity. Several recommendations are made to help firms and governments facilitate the participation of firms in GVCs.

Keywords: global value chains, productivity

JEL Classification: D24, F14, L11

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1. INTRODUCTION

The expansion of global value chains (GVCs) has been a prominent feature of globalization since the turn of the century. GVCs were constructed by multinational corporations (MNCs), as they fragmented production processes into various tasks and located these tasks in various countries/locations where a particular task could be conducted most efficiently, in order to achieve an efficient production system, through foreign direct investment (FDI). Specifically, a task that requires labor-intensive operation is located in a low-wage country, while a task that requires high-skilled labor is located in a country where high-skilled labor is abundantly available (Urata and Baek 2020). A key driver of the expansion of GVCs is a decline in the cost of conducting trade and FDI, which in turn is mainly due to the liberalization of trade and FDI policies, as well as technological progress and deregulation in the transportation and communication services.

In Asia, GVCs began to be constructed by Japanese MNCs in the latter half of the 1980s, when they were faced with a decline in the competitiveness of production in Japan due to a sharp appreciation of the Japanese yen. Japanese MNCs actively moved their production bases to Southeast Asian countries such as Thailand, where production costs were significantly lower than in Japan. MNCs in emerging economies such as the Republic of Korea; Hong Kong, China; Singapore; and Taipei, China followed suit in the late 1990s, when their currencies appreciated. As a consequence, Asia, and particularly East Asia, became one of the most developed regions of GVCs in the world.

Firms in developing countries participate in GVCs through international trade, importing foreign intermediate goods and exporting products. Import and export take both direct and indirect forms. In indirect import, a firm may purchase intermediate goods from local suppliers, who produced them using foreign materials. In indirect export, a firm may produce items that are used in the goods exported by other firms. Direct export is difficult for local firms, especially for small and medium-sized enterprises (SMEs), because it entails substantial fixed costs for finding importers and/or setting up distribution networks in foreign countries. As such, indirect export, which requires lower costs, is an easier way to participate in GVCs.

GVCs have grown rapidly because they bring various benefits for firms, both MNCs and local firms, which are involved in GVCs. As discussed above, MNCs benefit from GVCs, as GVCs enable MNCs to produce efficiently, and thereby increase their profits. Local firms also benefit from their engagement in GVCs, through improved productivity or competitiveness. This is because GVCs enable them to use high-quality foreign intermediate goods and engage in export activities. GVCs have given local firms, even local SMEs, an opportunity to export products, as local firms can participate in GVCs by performing a single task.

Realizing the various benefits that GVCs may bring, governments and firms in developing countries have become interested in getting involved with GVCs, mainly by attracting FDI. Various policies have been adopted by a number of governments to establish an attractive business environment for MNCs. These policies include setting up special economic zones and providing preferential tax treatment for MNCs. Some governments have enacted free trade agreements (FTAs) with like-minded countries to lower trade and FDI costs, with the objective of facilitating the construction of GVCs by MNCs.

In light of the expansion of GVCs and their possible benefits to the GVC-participating firms, this paper examines the effects of GVCs on GVC-participating local firms in developing countries. Specifically, we examine whether GVC participation increased the productivity of GVC-participating local firms in Indonesia, the Philippines, and Viet Nam using data obtained from the World Bank Enterprise Surveys. We use the propensity score matching (PSM) method, in order to identify the selection effect, that is, whether high productivity firms can participate in GVCs; and the learning effect, that is, whether participation in GVCs increases productivity. A number of studies have considered this issue, as we explain in Section 3, but many suffer from not identifying these two effects. The countries were chosen based on data availability, as the PSM method requires at least two data points for the sample firms.

The remainder of the paper is organized as follows. Section 2 presents information on the pattern of GVC participation at country levels for selected Asian countries. Section 3 reviews studies on the effect of GVC participation on productivity. Sections 4 and 5 provide descriptive analyses of the sample firms concerning the status of GVC participation and the impact of a firm's GVC participation on productivity, respectively. Section 6 discusses the methodology and data for the analysis. Section 7 presents the estimation results and discussions. Section 8 concludes the paper.

2. GVC PARTICIPATION BY DEVELOPING ASIAN COUNTRIES

This section examines the level and pattern of GVC participation for our sample countries, Indonesia, the Philippines, and Viet Nam, and some selected developing Asian countries. Figure 1 shows two indicators, FVA and DVX as a proportion of exports, which are frequently used to measure the extent of GVC participation for a country¹. FVA indicates the foreign value added, embodied in the country's gross exports, and DVX indicates domestic value added, embodied in the gross exports of foreign countries. As such, FVA and DVX represent backward and forward participation, respectively.

The level of GVC participation (sum of FVA and DVX) increased for Indonesia and Viet Nam from 1990 to 2015, and declined slightly for the Philippines². The direction of the changes in the level of GVC participation for the other countries is also mixed, as it increased for six countries (Brunei Darussalam, the People's Republic of China (PRC), India, Malaysia, Myanmar, and Thailand) and declined for three countries (Cambodia, the Lao PDR, and Singapore).

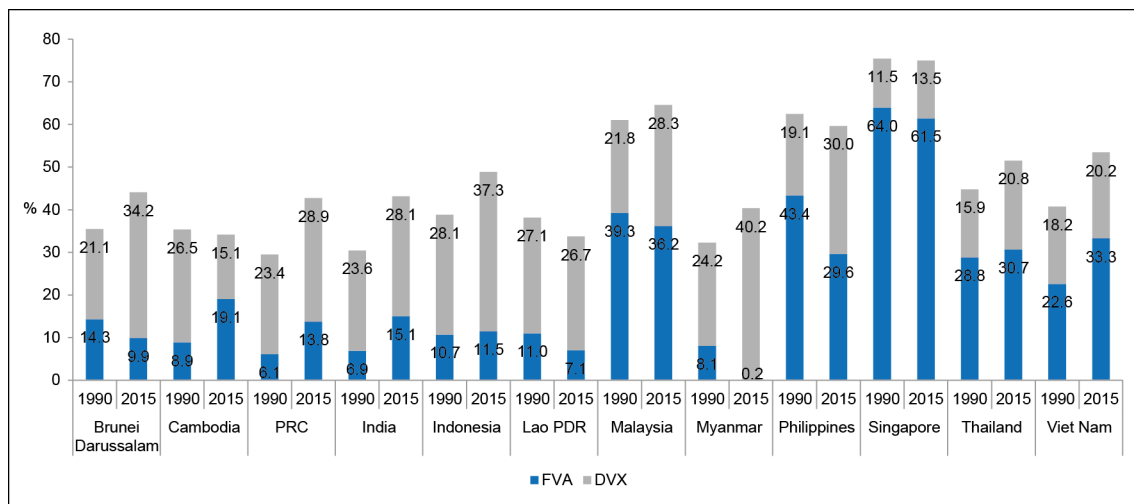
In 2015, the Philippines registered the highest level of GVC participation at 60%, followed by Viet Nam at 54%. Indonesia had the lowest level at 49%. Among the countries listed in the figure, Singapore has the highest level at 75%, and the Lao PDR the lowest at 34%. The countries in the figure can be divided into two groups, one less than 50% GVC participation, and the other with more than 50%. The former group includes the Lao PDR, Cambodia, Myanmar, the PRC, India, Brunei Darussalam, and Indonesia, while the latter includes Thailand, Viet Nam, the Philippines, Malaysia, and Singapore. The countries in the former group, that is, those with lower levels

¹ These indicators are understood to capture the pattern and level of GVC participation correctly, as these indicators take into account direct as well as indirect (inter-industry) relationships. See Aslam, Novta, and Rodrigues-Bastos (2017) for an explanation of these indicators.

² The data is presented for 1990 and 2015, rather than 2009 and 2015, the period of our analysis below, to provide the trend over a longer time period.

of GVC participation, tend to be less developed (the Lao PDR, Cambodia, and Myanmar), less industrialized (Brunei Darussalam), or large in size (the PRC, India, and Indonesia), while those in the latter group, that is, those with higher levels of GVC participation, including the Philippines and Viet Nam, tend to be of rather limited size and/or more industrialized. Opportunities for GVC participation are limited for less-industrialized or less-developed countries, and the need to rely on foreign countries through GVC participation is rather small for large countries as they are generally more self-sufficient.

Figure 1: Level of GVC Participation
(%)



Source: UNCTAD-Eora Global Value Chain Database.

A comparison of FVA and DVX for countries reveals the way the country is involved in GVCs. A low (high) ratio between FVA and DVX indicates that a country is more actively engaged in upstream (downstream) tasks in GVCs. Developing countries tend to be more focused on supplying primary products or natural resource-intensive and low-value added activities. With this observation in mind, let us examine how the sample countries are involved in GVCs. Among the sample countries, Indonesia is heavily involved in upstream activities, with the FVA/DVX ratio at 0.31 (2015 figure), while Viet Nam is involved heavily in downstream activities with the corresponding ratio at 1.65. The Philippines is located between these two countries, with the ratio at 0.99. Countries in the figure may be classified into two groups by using the cutoff value at 1: countries more heavily engaged in upstream activities (Myanmar, the Lao PDR, Indonesia, the PRC, India, and the Philippines in the ascending order of the ratios), and downstream activities (Cambodia, Malaysia, Thailand, Viet Nam, and Singapore).

3. LITERATURE REVIEW

This section provides a brief review of empirical studies regarding the effects of GVC participation on productivity. Empirical analyses have been performed using sector-level and firm-level data. We review the studies using sector-level data first, and then turn to those using firm-level data.

Empirical studies of the effects of GVCs on productivity at sector-level have mainly used trade in value added data, and measured the extent of GVC participation by employing two indicators, the foreign value added (FVA) in gross exports, and domestic value added (DVX) absorbed in foreign countries' exports to third countries. FVA and DVX indicate backward and forward linkages, respectively. Kordalska, Parteka, and Wolszczak-Derlacz (2016) and Constantinescu, Mattoo, and Ruta (2017) found that FVA had positive effects on productivity in their studies of 20 sectors and 40 countries covering 1995–2011, and 13 sectors and 40 countries covering 1990–2014, respectively, while Kummritz (2016) found that DVX had positive effects on productivity in his study of 20 industries and 54 countries covering 1995, 2000, 2005, and 2008–2011³. Urata and Baek (2020) found that both FVA and DVX had positive effects on total factor productivity (TFP) growth in their study of 13 sectors and 47 countries covering 1995–2011. These studies found that productivity enhanced the effect of GVC participation.

Using firm-level data, Baldwin and Yan (2014) examined the impact of a firm's GVC participation on labor productivity using Canada's Annual Survey of Manufactures data for the 2002–2006 period. They defined GVC participation as a firm's participation in importing and exporting, and found that a firm's GVC participation improved productivity in the short and long term. Defining GVC firms as two-way (export and import) traders with an internationally recognized quality certification, Del Prete, Giovannetti, and Marvasi (2017) investigated whether, and to what extent, GVC participation boosted the competitiveness of local firms through increased TFP and labor productivity using World Bank Enterprise Surveys data for two North African countries, Egypt and Morocco, in 2004 and 2007. Their analysis found that firms which enter GVCs perform better ex-ante (selection effect), and register additional productivity gain ex-post (learning effect).

Lu, Sun, and Chen (2016) measured GVC participation through the ratio of foreign value added to total exports, using the Chinese Industrial Firm Database and China Customs Import and Export Database from 2000 to 2006, and analyzed the impact of a firm's GVC participation on TFP. They found an inverted U-shaped non-linear relationship between GVC participation and the productivity of Chinese firms. Defining GVC participation similarly to Lu, Sun and Chen, Ge et al. (2018) used the survey database of Chinese industrial firms from the National Bureau of Statistics (NBS) of China and Chinese customs transaction-level trade data from 2000 to 2007, to investigate the effect of a firm's GVC participation on a firm's TFP. They confirmed that manufacturing enterprises in the PRC experience significant productivity improvement effects from GVC participation.

Benkovskis et al. (2020) examined the effect of those exports that are highly relevant in the context of GVCs, such as exports of intermediate goods, re-exports, and service exports, on a firm's productivity using data on financial statements and the international trade of Latvian firms over the 2006–2014 period, and Estonian firms for the 1995–2014 period. They found that exports related to GVCs increased a firm's productivity.

Although not explicitly analyzing the effect of GVC participation on productivity, a number of studies have examined the effects of exporting and importing on firm productivity. Since these two types of analyses, one on GVC participation and the other on trade participation, are closely related, we briefly review major studies on the effect

³ For the measurement of productivity, Kordalska, Parteka, and Wolszczak-Derlacz (2016) use total factor productivity (TFP), and Constantinescu, Mattoo, and Ruta (2017) and Kummritz (2016) used labor productivity.

of trade on productivity. Bernard and Jensen (1999) found robust evidence of a self-selection effect for US exporters, although the learning impact was less clear. Alvarez and Lopez (2005) found supporting evidence for both the self-selection and learning-by-exporting hypotheses amongst Chilean firms. Using the data from Slovenia, De Loecker (2013) showed that substantial productivity gains were associated with export entry.

Increased imports of intermediate goods can also contribute to the improved productivity of importing firms, as they enable importing firms to use high-quality intermediate goods, especially in developing countries. This effect was observed by Amiti and Konings (2007), who showed that input tariff reduction increased productivity in Indonesia.

The studies we reviewed found that a firm's GVC participation increases its productivity and competitiveness. One of the shortcomings of these studies is their lack of recognition of various patterns of GVC participation, as they define GVC participation as engagement in both importing and exporting. We consider different patterns of GVC participation, that is, partial participation in the form of either exporting, or importing. We also consider indirect exporting in addition to direct exporting. Such an analysis provides a closer examination of the way that GVCs affect a GVC firm's productivity.

4. GVC PARTICIPATION BY FIRMS

We consider three different patterns of GVC participation in order to analyze the productivity improvement effect for a firm participating in GVC, and denote them GVC1, GVC2, and GVC3 (Table 1). GVC1 indicates a pattern where a firm imports intermediate goods, and exports directly. GVC2 indicates a pattern where a firm imports intermediate goods but does not export directly. GVC3 indicates a pattern where a firm exports directly, but does not import intermediate goods.

In the analysis of a firm's GVC participation, 'export' usually refers to direct export. We also consider indirect export, which takes the following form: a firm is considered to be engaged in indirect export when its output is used as input for the products that are produced and exported by other firms. Firms, particularly small and medium-sized enterprises (SMEs), with limited resources conduct indirect export, which requires fewer resources than direct export. We consider such case and denote it indirect GVC participation. World Bank Enterprise Survey, which we use for the analysis, has information on indirect export, in addition to direct export.

Table 1: Types of GVC Participation by Firms

	Non-GVC	GVC			Indirect GVC
		GVC1	GVC2	GVC3	
Import	×	✓	✓	×	✓
Direct Export	×	✓	×	✓	×
Indirect Export	×	–	–	–	✓

Note: ✓ indicates included, × indicates not included, – indicates may or may not be included.

Source: Authors' own elaborations.

Table 2 shows the status of the GVC participation of firms between 2009 and 2015 for the sample countries, Indonesia, the Philippines, and Viet Nam. In order to examine the effects of GVC participation on a firm's productivity, we selected non-GVC firms in 2009 as sample firms and then compared the productivity of the firms that became GVC firms, and those that remained non-GVC firms. As shown in Table 2, all firms were non-GVC firms in 2009, and in 2015, firms are either non-GVC firms or GVC firms (GVC1, GVC2, and GVC3 firms based on the classification in Table 1). Non-GVC firms in 2015 are the control group, and GVC firms are the treatment group.

Among our sample firms, 18.18% were non-GVC firms in 2009, and became GVC firms in 2015⁴. GVC1 firms that export directly and import accounted for the smallest proportion of GVC firms, with 2.8%, while GVC2 firms that only imported accounted for the largest proportion of GVC firms, with 10.49%. GVC3 firms that only export directly account for 4.9%. Indirect GVC firms included in GVC2 accounted for only 0.7%. The pattern of GVC participation varied from country to country. According to the GVC participation rate in 2015, the Philippines was the highest at 28.57%, followed by Viet Nam at 23.33%, and Indonesia was the lowest at 14.13%. GVC3 firms accounted for the largest proportion with 6.52% in Indonesia in 2015, and GVC2 firms accounted for the largest proportion in the Philippines and Viet Nam, at 19.05% and 20%, respectively.

Table 2: Different Patterns of GVC Participation by Firms

2009 (# of firms)		2015 (# of firms)		2009 (%)		2015 (%)	
NonGVC (Total Sample)	143	NonGVC (control group)	117	NonGVC (Total Sample)	100	NonGVC (control group)	81.82
			GVC1 4			GVC1	2.80
			GVC2 15			GVC2	10.49
			(Indirect GVC) (1)			(Indirect GVC)	(0.70)
			GVC3 7			GVC3	4.90
			TOTAL 26			TOTAL	18.18
NonGVC (Indonesia)	92	NonGVC (control group)	79	NonGVC (Indonesia)	100	NonGVC (control group)	85.87
			GVC1 2			GVC1	2.17
			GVC2 5			GVC2	5.43
			(Indirect GVC) (0)			(Indirect GVC)	(0.00)
			GVC3 6			GVC3	6.52
			TOTAL 13			TOTAL	14.13
NonGVC (Philippines)	21	NonGVC (control group)	15	NonGVC (Philippines)	100	NonGVC (control group)	71.43
			GVC1 1			GVC1	4.76
			GVC2 4			GVC2	19.05
			(Indirect GVC) (0)			(Indirect GVC)	(0.00)
			GVC3 1			GVC3	4.76
			TOTAL 6			TOTAL	28.57
NonGVC (Viet Nam)	30	NonGVC (control group)	23	NonGVC (Viet Nam)	100	NonGVC (control group)	76.67
			GVC1 1			GVC1	3.33
			GVC2 6			GVC2	20.00
			(Indirect GVC) (1)			(Indirect GVC)	(3.33)
			GVC3 0			GVC3	0.00
			TOTAL 7			TOTAL	23.33

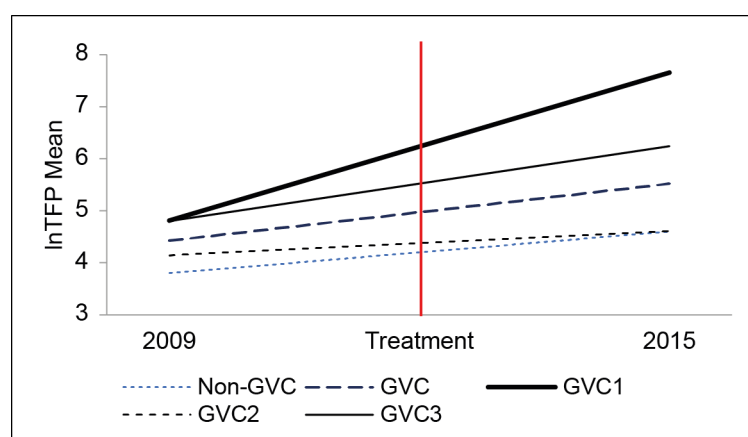
Source: World Bank, Enterprise Surveys.

⁴ Our sample firms are those for which the data necessary for the estimation of total factor productivity (TFP) was available in the World Bank Enterprise Survey. The method of estimating TFP is presented in Appendix 1. The estimation results of the production function, basic statistics of TFP, and the correlation between different TFP measures are presented in Appendix Tables 1.1, 1.2, and 1.3, respectively.

5. GVC PARTICIPATION AND FIRM PRODUCTIVITY

Figure 2 shows the mean of productivity (logarithm of total factor productivity)⁵ for the five groups. In 2009, when all groups were non-GVC, the average TFP of firms participating in GVC in 2015 was higher than that of firms not participating in GVC. GVC1 and GVC3 firms that export directly have the highest TFP among GVC firms, followed by GVC2 firms that only import. Non-GVC firms have the lowest TFP level. These observations imply the presence of fixed costs for GVC participation. They also indicate that the initial fixed cost of exporting is greater than that of importing. The TFP of all firms increased in 2015 compared to 2009, however, there are differences in the rates of increased productivity among different types of GVC firms. GVC1 firms register the largest increase in TFP, followed by GVC3 firms. The increase in the TFP of GVC2 firms is lower than those with GVC1 or GVC3, and comparable to that of non-GVC firms. These group-specific productivity differences suggest that the productivity gains from GVC1 outweigh those from GVC2 or GVC3.

Figure 2: GVC Participation and Firm Productivity



Note: lnTFP = logarithm of total factor productivity.

Source: Computed by the authors.

6. THE METHODOLOGY AND DATA

We investigate the effect that the GVC participation of local firms in developing countries has on their productivity. GVC participation is likely to be driven by a firm's ex-ante characteristics. Melitz (2003) shows that an exporting firm needs to be productive in order to deal with the fixed costs associated with exporting, such as setting up a distribution system and being exposed to exchange rate risks. A similar argument may be made for importing. For instance, firms with large scale, high productivity, and close relationships with foreign firms are more likely to participate in GVCs because they are more likely to import and export than those that do not. Estimation without overcoming these self-selection issues will therefore lead to inconsistent estimates.

⁵ Total factor productivity (TFP) is defined as the portion of growth in output that cannot be accounted for by growth in the input of labor and capital used in production. TFP is generally interpreted as technological change or technical efficiency.

To address these issues, Rosenbaum and Rubin (1983, 1985) devised the propensity score matching (PSM) method, and Heckman, Ichimura, and Todd (1997) extended it by employing propensity score matching jointly with the differences-in-differences estimator (DID-PSM). In PSM estimation, each GVC firm is matched with a non-GVC firm that has similar characteristics to a corresponding counterfactual GVC firm. In other words, a non-GVC firm matched with a counterfactual GVC firm has a similar probability of GVC participation as the counterfactual GVC firm. Since the counterfactual of each firm cannot be observed, we focus on the average treatment effect on the treated (ATT), rather than on its individual effect. The PSM estimates for ATT are shown in Equation (1).

$$PSM = \frac{1}{N} \sum_{i \in GVC_1} \left(Y_{i,t+s}(1) - \sum_{j \in GVC_0} W(P(X_{i,t-1}), P(X_{j,t-1})) Y_{j,t+s}(0) \right) \quad (1)$$

where GVC_1 and GVC_0 represent a group of GVC firms and a matched control group (non-GVC firms), respectively. N is the number of firms participating in GVCs, $Y_{i,t+s}(1)$ is the productivity when firm i participates in GVCs, and $Y_{j,t+s}(0)$ is the productivity when firm j does not participate in GVCs⁶. $P(X)$ is the probability of participation in GVCs, which is determined by relying on a firm's characteristics X prior to participating in GVCs, and W is the weight determined by the difference between the probability of participation between the GVC firms and the matched non-GVC firms. If panel data is available, an estimate of the DID-PSM of ATT proposed by Heckman, Ichimura, and Todd (1997) may be used. Estimation for DID-PSM is as shown in Equation (2). While PSM can only eliminate observable factors, DID-PSM has the advantage of eliminating time-independent fixed effects⁷.

$$DID - PSM = \frac{1}{N} \sum_{i \in GVC_1} \left(\Delta Y_{i,t+s}(1) - \sum_{j \in GVC_0} W(P(X_{i,t-1}), P(X_{j,t-1})) \Delta Y_{j,t+s}(0) \right) \quad (2)$$

The procedure for obtaining DID-PSM estimates is as follows. First, we estimate the conditional probability of changing GVC status from the probit model⁸ (Equation 3), and calculate a propensity score, that is the probability of a firm becoming GVC firm, for each firm.

$$\Pr(GVC_{it} = 1) = \Phi(\alpha + \beta X_{i,t-1} + \gamma_c + \gamma_s) \quad (3)$$

where i is firm, c is country, and s is sector, and $X_{i,t-1}$ includes productivity, scale, age, foreign ownership, and quality certification, which affect a firm's GVC participation. Firms will be involved in GVCs in 2015 according to their characteristics ($X_{i,t-1}$) as observed in 2009. The GVC firms in our sample are matched with the non-GVC firms with the closest propensity score sharing a common support region⁹, and these

⁶ Since $Y_{j,t+s}(0)$ is not observed, ATT (average treatment effect on the treated) is often estimated when evaluating impact.

⁷ Heckman, Ichimura, and Todd (1997) and Smith and Todd (2005) show that DID-PSM estimate is more efficient than the simple PSM estimate without DID.

⁸ The results of probit estimation show that TFP and scale have statistically positive effects on a firm's GVC participation. For detailed results, see Appendix Table 2.

⁹ GVC firms are matched with non-GVC firms based on the estimated propensity score using the kernel matching (Gaussian kernel), and one to one nearest neighbor matching.

matched firms are used in the DID regression. We ensure the quality of matching through balancing testing¹⁰. The DID estimation can be written as follows:

$$Y_i = \alpha + \beta_1 GVC_i * Post_i + \beta_2 GVC_i + \beta_3 Post_i + \gamma_c + \gamma_s + \varepsilon_i \quad (4)$$

where Y_i is a firm's productivity (lnTFP), GVC_i is a GVC dummy variable (1 for treated group: GVC firms, 0 for control group: Non-GVC firms), $Post_i$ is a dummy equal to 1 in 2015 and zero in 2009. γ_c and γ_s denote country and sector dummies, respectively. In Equation (4), the coefficient we are interested in is β_1 , because it represents the effect of GVC participation.

We use a panel dataset of three countries in the analysis, Indonesia, the Philippines, and Viet Nam, from the World Bank Enterprise Surveys. All local currency units obtained from the World Bank Enterprise Surveys, are converted to USD using the official exchange rate (LCU per US\$, period average), and then deflated to the 2015 baseline year by GDP deflator of the US. The official exchange rates and GDP deflator are obtained from the World Bank World Development Indicators (WDI).

7. ESTIMATION RESULTS

We estimated Equation (4) using the World Bank Enterprise Surveys data¹¹ covering 17 sectors¹² and three countries, Indonesia, the Philippines, and Viet Nam. The estimation results, which show the effect of firm's GVC participation on TFP, are presented in Tables 3, 4, and 5¹³.

The results of two types of estimation are presented in Table 3, one using the original sample and the other using data obtained from kernel matching. The results of the two types of estimation are similar, but we discuss those obtained using kernel matching. The effect of GVC participation ($GVC \times Post$) is positive and statistically significant only for GVC1 (columns 2 and 6), and the effect is mixed and not statistically significant for the other forms of GVC participation. These findings indicate that a firm can improve productivity when it is involved in GVC by importing intermediate goods and exporting output directly. A firm cannot improve productivity when it is involved in GVC by only importing intermediate goods or only exporting output. In other words, a firm can expect to gain in terms of productivity improvement when it becomes deeply involved in GVC through backward and forward linkages. Our findings are consistent with the findings of earlier studies, which are discussed in Section 2.

The estimated coefficients of GVC are positive and statistically significant for GVC total and GVC3, indicating that GVC firms tend to have high TFP levels compared to non-GVC firms. The estimated results for Post indicate that TFP levels for all types of GVC firms were higher in 2015 compared to 2009, consistent with the findings shown in Figure 2.

¹⁰ A t-test of equality of means for each variable between the control and treatment groups is used for the balancing test. The results of the balancing test for kernel matching and the one to one nearest neighbor matching are presented in Appendix Tables 3.1 and 3.2, respectively. In both matchings, covariates are not balanced before matching but are balanced after matching.

¹¹ See Appendix Tables 4 and 5 for basic statistics and correlation coefficients.

¹² See Appendix Table 6 for the sector classification.

¹³ We also estimated Equation (4) using DID with one to one nearest neighbor matching for the robustness check, and the results were similar to those in Table 3, 4, and 6. See Appendix Table 7 for more details.

Table 3: Productivity (TFP) and GVC Participation, Baseline Estimations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	DID with Original Sample				DID with Kernel Matching			
GVC Type	GVC Total	GVC1	GVC2	GVC3	GVC Total	GVC1	GVC2	GVC3
Dep.	ln(TFP)				ln(TFP)			
GVC × Post	0.294 (0.473)	2.050* (1.098)	−0.434 (0.611)	0.616 (0.849)	0.244 (0.492)	2.057* (1.117)	−0.569 (0.642)	0.621 (0.864)
GVC	0.797** (0.345)	1.277 (0.808)	0.274 (0.450)	1.205** (0.611)	0.821** (0.355)	1.274 (0.821)	0.341 (0.465)	1.203* (0.622)
Post	0.801*** (0.202)	0.797*** (0.184)	0.900*** (0.198)	0.824*** (0.188)	0.806*** (0.213)	0.790*** (0.194)	0.912*** (0.208)	0.820*** (0.198)
Constant	3.679*** (0.280)	3.893*** (0.271)	3.799*** (0.286)	3.762*** (0.276)	3.676*** (0.286)	3.896*** (0.277)	3.792*** (0.292)	3.764*** (0.281)
Observations	286	286	286	286	266	266	266	266
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.171	0.184	0.128	0.165	0.158	0.172	0.115	0.152

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

Table 4: Productivity (TFP) and GVC Participation, Including Controls

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	DID with Original Sample				DID with Kernel Matching			
GVC Type	GVC Total	GVC1	GVC2	GVC3	GVC Total	GVC1	GVC2	GVC3
Dep.	ln(TFP)				ln(TFP)			
GVC × Post	−0.0258 (0.437)	2.030** (0.997)	−0.627 (0.550)	−0.0612 (0.775)	−0.00132 (0.448)	2.025** (1.007)	−0.582 (0.570)	−0.108 (0.784)
GVC	0.437 (0.323)	0.383 (0.747)	0.103 (0.405)	0.918 (0.562)	0.402 (0.329)	0.349 (0.754)	0.0673 (0.416)	0.923 (0.568)
Post	0.755*** (0.190)	0.696*** (0.173)	0.818*** (0.182)	0.764*** (0.176)	0.749*** (0.199)	0.690*** (0.180)	0.813*** (0.190)	0.765*** (0.184)
Scale	0.315*** (0.0816)	0.303*** (0.0802)	0.351*** (0.0793)	0.312*** (0.0809)	0.318*** (0.0838)	0.305*** (0.0823)	0.354*** (0.0814)	0.314*** (0.0831)
Age	0.00675 (0.00770)	0.00653 (0.00758)	0.00529 (0.00774)	0.00487 (0.00767)	0.00731 (0.00780)	0.00711 (0.00768)	0.00587 (0.00785)	0.00548 (0.00777)
Foreign Ownership	0.00746 (0.00643)	0.00649 (0.00631)	0.00883 (0.00645)	0.00798 (0.00636)	0.00940 (0.00684)	0.00839 (0.00673)	0.0104 (0.00684)	0.0101 (0.00679)
Quality Certification	1.495*** (0.342)	1.547*** (0.335)	1.592*** (0.343)	1.558*** (0.340)	1.611*** (0.355)	1.663*** (0.348)	1.700*** (0.356)	1.681*** (0.353)
Constant	2.550*** (0.382)	2.720*** (0.380)	2.562*** (0.387)	2.640*** (0.382)	2.526*** (0.391)	2.695*** (0.388)	2.535*** (0.395)	2.614*** (0.391)
Observations	286	286	286	286	266	266	266	266
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.319	0.338	0.316	0.323	0.319	0.338	0.316	0.324

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

The estimation results presented in Table 4 include additional controls to the baseline estimations shown in Table 3. The results are similar to the baseline results, indicating the robustness of the finding on the positive effects of GVC1 on TFP. Estimation with additional controls increased the R-square and statistical significance of some estimated coefficients. Among the controls, scale and quality certification are positive and statistically significant. These results indicate that economies of scale and technological development are important factors in improving productivity. It should be

noted that coupled with our finding on the importance of high productivity to participate in GVC, shown in Appendix Table 2, the findings from Tables 3 and 4 support those of Del Prete, Giovannetti, and Marvasi (2017), that firms which enter GVCs have high productivity before participating in GVC (selection effect), and achieve additional productivity gains after joining GVC (learning effect).

We are interested to understand whether a firm can improve productivity by participating in GVC through exporting indirectly, because many SMEs cannot export directly due to their limited resources, and thus export indirectly. The results of the estimation are shown in Table 5. The estimated coefficients on (GVC x Post) are positive but not statistically significant, indicating that no productivity improvement effect was detected from indirect export.

Table 5: Productivity (TFP) and GVC Participation, Indirect GVC

GVC Type	(1)	(2)	(3)	(4)
	DID with Original Sample		DID with Kernel Matching	
	Indirect GVC		Indirect GVC	
Dep.	ln(TFP)		ln(TFP)	
GVC × Post	0.0111 (2.242)	0.157 (2.010)	0.0129 (2.280)	0.156 (2.027)
GVC	−1.305 (1.606)	−0.717 (1.446)	−1.306 (1.633)	−0.695 (1.459)
Post	0.854*** (0.188)	0.747*** (0.174)	0.852*** (0.198)	0.745*** (0.182)
Scale		0.346*** (0.0800)		0.347*** (0.0821)
Age		0.00631 (0.00776)		0.00693 (0.00786)
Foreign Ownership		0.00769 (0.00641)		0.00978 (0.00685)
Quality Certification		1.551*** (0.341)		1.670*** (0.354)
Constant	3.822*** (0.280)	2.548*** (0.382)	3.823*** (0.285)	2.520*** (0.391)
Observations	286	286	266	266
Country FE	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes
R-squared	0.130	0.312	0.116	0.313

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

So far, we have analyzed the data from three sample countries, Indonesia, the Philippines, and Viet Nam, together. We now examine whether the results differ between the countries. Table 6 shows the results of the estimations conducted for the three countries separately, which show that a productivity improving effect, or learning through GVC effect, is observed only for Indonesia, and not for the Philippines or Viet Nam. We attempted to identify possible factors that may explain these different results, such as economies of scale or technological capability, but could not find meaningful results. It should be noted that our analysis is affected by small sample size, which is constrained by the availability of data from the World Bank Enterprise Survey. Only one GVC1 case each was identified for the Philippines and Viet Nam, making it difficult to obtain reliable results.

Table 6: Productivity (TFP) and GVC Participation, by Country

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
DID with Original Samples								
GVC Type	Indonesia				Philippines			
	GVC Total	GVC1	GVC2	GVC3	GVC Total	GVC1	GVC2	GVC3
Dep.	lnTFP				lnTFP			
GVC × Post	0.812 (0.703)	4.146** (1.667)	−0.869 (1.150)	0.903 (1.041)	−0.633 (0.661)	−0.291 (1.464)	−0.652 (0.761)	−0.342 (1.465)
GVC	1.466*** (0.514)	2.614** (1.291)	1.392* (0.832)	1.003 (0.750)	−0.176 (0.478)	−0.0828 (1.248)	−0.267 (0.552)	0.00136 (1.248)
Post	0.655** (0.264)	0.680*** (0.246)	0.817*** (0.268)	0.711*** (0.266)	0.905** (0.354)	0.738** (0.320)	0.848** (0.332)	0.740** (0.320)
Constant	3.722*** (0.369)	4.022*** (0.358)	3.873*** (0.388)	3.885*** (0.383)	2.814*** (0.360)	2.799*** (0.357)	2.863*** (0.357)	2.798*** (0.357)
Observations	184	184	184	184	42	42	42	42
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.241	0.251	0.139	0.163	0.500	0.456	0.500	0.456
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
DID with Original Samples					DID with Kernel Matching			
GVC Type	Viet Nam				Indonesia			
	GVC Total	GVC1	GVC2	GVC3	GVC Total	GVC1	GVC2	GVC3
Dep.	lnTFP				lnTFP			
GVC × Post	−0.126 (0.642)	0.0906 (1.524)	−0.159 (0.680)		0.873 (0.709)	4.194** (1.663)	−0.841 (1.160)	0.949 (1.049)
GVC	−0.293 (0.491)	−0.440 (1.193)	−0.269 (0.531)		1.435*** (0.515)	2.589** (1.286)	1.378 (0.838)	0.980 (0.754)
Post	1.232*** (0.310)	1.200*** (0.278)	1.235*** (0.304)	1.203*** (0.269)	0.594** (0.286)	0.631** (0.263)	0.788*** (0.290)	0.665** (0.287)
Constant	4.506*** (0.443)	4.344*** (0.400)	4.501*** (0.451)	4.343*** (0.392)	3.753*** (0.372)	4.046*** (0.360)	3.888*** (0.394)	3.908*** (0.387)
Observations	60	60	60	60	160	160	160	160
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.375	0.365	0.373	0.363	0.243	0.254	0.127	0.154
	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
DID with Kernel Matching								
GVC Type	Philippines				Viet Nam			
	GVC Total	GVC1	GVC2	GVC3	GVC Total	GVC1	GVC2	GVC3
Dep.	lnTFP				lnTFP			
GVC × Post	−0.212 (0.890)	−	−0.212 (0.890)	−	−0.148 (0.753)	0.190 (1.524)	−0.230 (0.819)	
GVC	−0.00388 (0.639)	−	−0.00388 (0.639)	−	0.161 (0.561)	−0.0583 (1.301)	0.212 (0.610)	
Post	0.967** (0.412)	0.922** (0.349)	0.967** (0.412)	0.922** (0.349)	1.141*** (0.351)	1.101*** (0.318)	1.149*** (0.341)	1.109*** (0.303)
Constant	2.707*** (0.380)	2.707*** (0.340)	2.707*** (0.380)	2.707*** (0.340)	4.330*** (0.461)	4.394*** (0.405)	4.322*** (0.468)	4.390*** (0.394)
Observations	28	28	28	28	46	46	46	46
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.550	0.547	0.550	0.547	0.320	0.319	0.321	0.318

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

Note: In models 18 and 19, GVC × post and GVC are omitted because of collinearity.

8. CONCLUSIONS

This paper examined the effect that local firms participating in GVC in developing countries has on productivity. We performed a DID-PSM estimation for the manufacturing sectors in Indonesia, the Philippines, and Viet Nam using data for 2009 and 2015, which we obtained from the World Bank Enterprise Surveys. Unlike earlier studies which examined one form of GVC participation, that is importing intermediate goods and exporting output, we examined three different forms of GVC participation; (1) importing intermediate goods and exporting output, (2) importing intermediate goods only, and (3) exporting output only. We also analyzed the effects of indirect exports on productivity.

We found that a local firm's GVC participation in developing countries improves their productivity when they are engaged in both importing intermediate goods and exporting output, as in the previous studies. However, a local firm's productivity does not increase when they are engaged in either importing intermediates only, or exporting output only. We also found that indirect exporting does not improve a local firm's productivity. Our analysis of the determinants of GVC participation by firms, which was conducted as a step in undertaking DID-PSM estimation, showed that high productivity is an important determinant. These findings indicate the presence of a circular or endogenous relationship between firm productivity and GVC participation; firms that enter GVCs have high productivity before participating in GVCs (selection effect), and achieve additional productivity gain after joining GVCs (learning effect).

Our findings have important implications for both firms and governments. Improving productivity is very important for the success of firms. Achieving high productivity enables them to participate in GVCs, and their participation in GVCs in turn increases their productivity, possibly resulting in increased sales and profits. A number of strategies may be considered for achieving high productivity by firms. One very important strategy is to upgrade the capability of workers through effective training and education. Another important strategy may be to improve organizational and managerial structures to realize efficient production/sales. To achieve these objectives, firms may learn not only from their own experiences but also from those of other firms, in various ways, including active interaction. In addition to these strategies, which may be applicable to all firms that are eager to improve productivity, conducting business with foreign firms and acquiring technology from them would not only improve the productivity of local firms but also facilitate them to participate in GVCs. Obtaining international quality certificates would also contribute to a firm's participation in GVCs.

For governments, the provision of technical training for potential workers is important in order to improve their technical capability, which in turn contributes to improving productivity of the firms. The provision of technical training is especially important for workers employed by SMEs, which have limited financial and human resources. Recognizing that not all firms with high productivity participate in GVCs, it is important for governments to implement measures/policies to promote GVC participation by firms. Governments should establish a policy environment to facilitate the participation of firms in international trade. Specifically, reducing tariff rates or eliminating tariffs through trade liberalization facilitates firms to import intermediate goods. Enacting free trade agreements is a specific policy that may achieve tariff reduction/elimination, and it also enables firms to participate in export, as tariffs on their products will be lowered or removed by FTA partner countries. In addition to implementing trade policies, governments may assist firms to participate in international trade by providing the necessary information on export markets through various means, including

hosting trade fairs. Finally, it is important for governments to communicate with firms/businesses in the process of formulating and implementing policies.

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APPENDIX 1: MEASURING TOTAL FACTOR PRODUCTIVITY

Total factor productivity (TFP) is obtained by estimating the Cobb–Douglas production function shown in Equation (A1) using World Bank Enterprise Surveys data. Since there are limited number of observations and limited availability of necessary price deflators for the estimation at sector level, we estimate Equation (A1) at country level to obtain TFP.

$$\ln Y_{it} = \alpha_L \ln L_{it} + \alpha_K \ln K_{it} + \ln TFP_{it} + \gamma_s + \gamma_t \quad (\text{A1})$$

where Y_{it} is the value added of firm i at time t . Value added is calculated by subtracting the intermediate input and energy costs (electricity and fuel) from sales. L_{it} and K_{it} are labor and capital, respectively. The former used the total number of permanent full-time employees, and the latter used the net book value of machinery, vehicles, and equipment, as a proxy variable.

The endogeneity problem is one of several issues concerning TFP estimation. Olley and Pakes (1996)¹ proposed a two-step procedure aimed at overcoming endogeneity by using a firm's investment level as a proxy variable for capital stock. Their approach was improved by Levinson and Petrin (2003), Wooldridge (2009), and Akerberg, Caves, and Frazer (2015).

We calculated TFP using different estimation methods² and adopted the TFP estimated by Wooldridge (2009), who proposed a novel estimation method and showed how to perform a consistent estimation in a single-step system GMM econometric framework. Olley and Pakes (1996), Levinsohn and Petrin (2003), and Akerberg, Caves, and Frazer (2015) use two-step estimators. According to Wooldridge (2009), the two-step estimators are inefficient for two reasons: (i) they ignore the contemporaneous correlation in the errors across two equations; and (ii) they do not efficiently account for serial correlation or heteroskedasticity in the errors.

Appendix Table 1.1 shows the estimation results of the production function. The coefficients of labor and capital are positive and highly significant in the results, except for Akerberg, Caves, and Frazer (2015), which does not have enough observations because the previous year's variables were used as instrumental variables. In Indonesia, the estimated coefficients of labor are not statistically significant under Levinson and Petrin (2003) and Wooldridge (2009), but the estimated coefficients of capital are positive and statistically significant. These observations indicate that capital has a positive effect on production, but labor does not, in the case of Indonesia.

Appendix Tables 1.2 and 1.3 show the basic statistics and correlation coefficients between different TFP measures, respectively. We found high correlations between the TFP variables calculated in various methods. In particular, the correlation coefficient between the methods of Levinson and Petrin (2003) and Wooldridge (2009) is greater than 0.9.

¹ We do not estimate Olley and Pakes' (1996) method because there are many missing values for investment variables in the World Bank Enterprise Surveys.

² Simple OLS, LSDV (least squares dummy variable estimator) with sector and time fixed effects, Levinsohn and Petrin (2003), Akerberg, Caves, and Frazer (2015), and Wooldridge (2009).

Appendix Table 1.1: The Results of Production Function

	OLS with No Fixed Effect			OLS with Fixed Effect (Sector and Year)		
	Indonesia	Philippines	Viet Nam	Indonesia	Philippines	Viet Nam
	lnVA	lnVA	lnVA	lnVA	lnVA	lnVA
lnK	0.291*** (0.0359)	0.388*** (0.0413)	0.213*** (0.0357)	0.304*** (0.0367)	0.309*** (0.0427)	0.192*** (0.0346)
lnL	0.991*** (0.0648)	0.884*** (0.0780)	0.634*** (0.0542)	0.969*** (0.0666)	0.886*** (0.0778)	0.710*** (0.0570)
Observations	518	300	330	518	300	330
	Levinsohn and Petrin (2003)			Akerberg, Caves and Franzer (2015)		
	Indonesia	Philippines	Viet Nam	Indonesia	Philippines	Viet Nam
	lnVA	lnVA	lnVA	lnVA	lnVA	lnVA
lnK	0.567*** (0.0988)	0.565*** (0.122)	0.460*** (0.0561)	0.149 (0.110)	-0.141 (0.573)	0.191* (0.100)
lnL	0.0965 (0.121)	0.599*** (0.211)	0.218* (0.120)	1.274*** (0.319)	2.243 (1.637)	0.635 (0.458)
Observations	488	248	283	251	110	115
	Woodridge (2009)					
	Indonesia	Philippines	Viet Nam			
	lnVA	lnVA	lnVA			
lnK	0.567*** (0.0727)	0.460*** (0.0331)	0.460*** (0.0331)			
lnL	0.0974 (0.0691)	0.219** (0.0967)	0.219** (0.0967)			
Observations	488	283	283			

Appendix Table 1.2: Basic Statistics of TFP

Variable	Obs	Mean	Std. Dev.	Min	Max
OLS	286	-5.51E-02	1.462203	-5.75381	8.441624
OLSF	286	-1.98E-02	1.411761	-5.25196	6.694509
lnLP_TFP	286	4.025088	1.838258	-3.22353	12.59218
lnACF_TFP	270	0.650531	0.879839	-5.12280	2.250091
lnWRDG_TFP	286	4.340244	1.630632	-0.20291	12.59174

Source: Computed by the authors.

Appendix Table 1.3: Correlation between Different TFP Measures

	OLS_TFP	OLSF_TFP	lnLP_TFP	lnACF_TFP	lnWRDG_TFP
OLS	1				
OLSF	0.9442	1			
lnLP_TFP	0.7360	0.7129	1		
lnACF_TFP	0.5033	0.4881	0.5443	1	
lnWRDG_TFP	0.8157	0.7766	0.9018	0.5072	1

Source: Computed by the authors.

Appendix Table 2: Determinants of a Firm's GVC Participation

Variables	GVC
lnTFP	0.284** (0.133)
Scale	0.228* (0.138)
Age	-0.00851 (0.0133)
Foreign Ownership	-0.00317 (0.00985)
Quality Certification	0.0809 (0.502)
Constant	-2.505*** (0.704)
Country FE	Yes
Sector FE	Yes
Observations	138

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

Appendix Table 3: Balancing Testing**Appendix Table 3.1: Kernel Matching (Gaussian Kernel)**

Variable	Unmatched	Mean		t-test	
	Matched	Treated	Control	t	p> t
lnTFP	U	4.5519	3.7999	3.12	0.002
	M	4.5941	4.7594	0.43	0.669
Scale	U	3.7488	2.9795	3.12	0.002
	M	3.7604	3.8998	0.38	0.707
Age	U	21.581	22.504	0.4	0.693
	M	21.9	23.713	0.62	0.54
Foreign Ownership	U	2.3226	2.9829	0.22	0.83
	M	2.4	0.94834	0.61	0.544
Quality Certification	U	0.16129	0.05983	1.85	0.066
	M	0.16667	0.32726	1.44	0.154

Source: Computed by the authors.

Appendix Table 3.2: Nearest Neighbor Matching (1:1)

Variable	Unmatched	Mean		t-test	
	Matched	Treated	Control	t	p> t
lnTFP	U	4.5519	3.7999	3.12	0.002
	M	4.5941	4.2954	0.9	0.373
Scale	U	3.7488	2.9795	3.12	0.002
	M	3.7604	3.5502	0.65	0.518
Age	U	21.581	22.504	0.4	0.693
	M	21.9	25.533	1.2	0.236
Foreign Ownership	U	2.3226	2.9829	0.22	0.83
	M	2.4	3.3333	0.25	0.803
Quality Certification	U	0.16129	0.05983	1.85	0.066
	M	0.16667	0.13333	0.36	0.723

Source: Computed by the authors.

Appendix Table 4: Basic Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
InTFP	286	4.3402	1.6306	−0.2029	12.5917
GVC × Post	286	0.0909	0.2880	0	1
GVC1 × Post	286	0.0140	0.1176	0	1
GVC2 × Post	286	0.0524	0.2233	0	1
GVC3 × Post	286	0.0245	0.1548	0	1
Indirect GVC × Post	286	0.0035	0.0591	0	1
Scale	286	3.1736	1.2514	0.6931	7.0901
Age	286	25.3636	11.9959	6	81
Foreign Ownership	286	3.2587	15.8212	0	100
Quality Certification	286	0.0839	0.2777	0	1

Source: Computed by the authors.

Appendix Table 5: Correlation Coefficients

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) InTFP	1									
(2) GVC × Post	0.2287	1								
(3) GVC1 × Post	0.2427	0.3766	1							
(4) GVC2 × Post	0.0389	0.744	−0.028	1						
(5) GVC3 × Post	0.1850	0.5009	−0.019	−0.037	1					
(6) Indirect GVC × Post	−0.0110	0.1873	−0.007	0.2518	−0.009	1				
(7) Scale	0.3897	0.2143	0.1664	0.0674	0.175	−0.033	1			
(8) Age	0.1474	0.0625	0.0312	−0.006	0.101	0.0526	0.1476	1		
(9) Foreign Ownership	0.0729	0.1427	0.0697	0.1501	−0.004	−0.012	0.1149	−0.077	1	
(10) Quality Certification	0.3608	0.2114	0.0713	0.1551	0.1153	−0.018	0.3811	0.0414	0.1332	1

Source: Computed by the authors.

Appendix Table 6: Sector Classification

N	Code	Sector Description
1	15	Food
2	17	Textiles
3	18	Garments
4	19	Leather
5	20	Wood
6	21	Paper
7	22	Publishing, printing, and recorded media
8	24	Chemicals
9	25	Plastics and rubber
10	26	Non-metallic mineral products
11	27	Basic metals
12	28	Fabricated metal products
13	29	Machinery and equipment
14	31	Electronics
15	33	Precision instruments
16	35	Transport machines
17	36	Furniture

Source: World Bank, Enterprise Surveys.

Appendix Table 7: Results of DID with Nearest Neighbor Matching (1:1)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	DID with Nearest Neighbor Matching (1:1)									
GVC Type	GVC Total	GVC1	GVC2	GVC3	GVC Total	GVC1	GVC2	GVC3	Indirect GVC	
Dep.	ln(TFP)				ln(TFP)				ln(TFP)	
GVC × Post	0.786 (0.639)	2.399** (1.187)	−0.375 (0.743)	0.937 (0.954)	0.409 (0.530)	2.394** (0.979)	−0.355 (0.609)	0.0631 (0.797)	0.247 (2.418)	0.432 (1.990)
GVC	0.187 (0.463)	0.567 (0.897)	−0.164 (0.555)	0.538 (0.710)	0.202 (0.385)	−0.240 (0.762)	0.0199 (0.463)	0.704 (0.590)	−1.762 (1.840)	0.220 (1.558)
Post	0.265 (0.431)	0.448 (0.320)	0.718* (0.375)	0.503 (0.340)	0.310 (0.364)	0.333 (0.275)	0.607* (0.318)	0.516* (0.292)	0.618* (0.326)	0.502* (0.280)
Scale					0.254** (0.123)	0.218* (0.123)	0.268** (0.125)	0.247** (0.124)		0.285** (0.127)
Age					0.00253 (0.0126)	0.00166 (0.0122)	−0.00158 (0.0129)	−0.00232 (0.0125)		−0.000902 (0.0127)
Foreign Ownership					0.0170** (0.00824)	0.0162** (0.00799)	0.0176** (0.00832)	0.0175** (0.00822)		0.0180** (0.00848)
Quality Certification					2.186*** (0.448)	2.227*** (0.434)	2.220*** (0.452)	2.219*** (0.450)		2.227*** (0.454)
Constant	4.575*** (0.461)	4.737*** (0.405)	4.690*** (0.449)	4.557*** (0.426)	3.420*** (0.645)	3.735*** (0.609)	3.547*** (0.671)	3.542*** (0.624)	4.588*** (0.425)	3.484*** (0.629)
Observations	110	110	110	110	110	110	110	110	110	110
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.182	0.232	0.152	0.183	0.467	0.499	0.455	0.468	0.455	0.468

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.