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Does Participation in Global Value Chains Increase Productivity? An Analysis of Trade in Value Added Data

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Abstract: *This paper examines the impact of global value chain (GVC) participation on productivity by considering both backward and forward participation. Conducting a panel estimation covering 47 countries and 13 manufacturing sectors for 1995–2011, we found that both backward and forward GVC participation contributes to an increase in the productivity of the countries involved in GVCs. In particular, benefits in the form of improved productivity are larger in cases where developing countries procure intermediate goods from developed countries, or backward participation. Our analysis indicates the importance of GVC participation for improving productivity. We argue that, in order for a country to increase GVC participation, an open, free, and transparent trade and foreign direct investment environment (which is provided by regional trade agreements); well-developed soft infrastructure (e.g. educational and legal systems); hard infrastructure (e.g. transportation and communication systems); and the availability of capable human resources are important.*

Keywords: global value chains, backward linkage, forward linkage, total factor productivity growth
JEL Classification: F14, F15, F63, O4

1. Introduction

One of the most dramatic developments in international trade in recent decades has been the rapid and remarkable expansion of trade in parts and components, which have been traded under global value chains (GVCs) or production networks. GVCs have been developed mainly by foreign firms, which have fragmented production processes into a several different sub-processes located in the country or region where each particular sub-process can be conducted at the lowest cost. The final products are assembled through the active trading of parts and components within the framework of the GVCs. GVCs have been developed in industries such as machinery and textiles, which require a large number of sub-processes for the manufacturing of the final products. The development of GVCs can be attributed to various factors. The development of information and communication technology has facilitated the transfer of knowledge, which is necessary to develop and manage value chains, from a foreign firm's parent firm to its overseas affiliates. The liberalisation of trade and investment policies has also contributed to the expansion of GVCs, as they reduce trade and investment costs.

In light of these observations, this paper attempts to examine the impacts of GVC participation on the countries involved, with a focus on productivity. For example, it has been argued that GVCs contribute to the economic growth of the countries involved in them. In addition to increased economic activities resulting from their engagement in GVCs, these countries may be able to obtain technology and management know-how, which would play an important role in increasing productivity, and thus achieving economic growth. We examine the impacts of GVC participation from two perspectives: backward participation and forward participation. Backward participation is the sourcing of foreign inputs for a country's own export production, while forward participation is the providing of inputs to foreign partners for their export production. Technology spillover can be expected from both backward and forward participation. Backward participation enables a country to use inputs containing high-quality technology, while forward participation enables a country to acquire useful information about technology and management know-how from its export destination or partner. One of the contributions of this paper is that we divide trading partners into high-income and low- and middle-income countries (hereafter, low-income countries), and examine whether the impacts of backward and forward participation differ between these two groups of trading partners in terms of their impacts on productivity.

2. Previous Studies on the Relationship between Global Value Chain Participation and Productivity

Studies on GVCs have been drawing attention since the 2000s. One of the most frequently examined issues concerning GVCs is their impacts on productivity, as productivity is an important factor influencing economic growth. A large number of studies on GVCs with a focus on internationally fragmented production has been conducted by examining the relationship between offshoring, which is the business practice of basing a business or part of a business in a different country, and productivity (Feenstra and Hanson, 1996; Egger and Egger, 2006; Amiti and Wei, 2009; Winkler, 2010). It has been theoretically and empirically shown that firms that engage in offshoring have higher productivity, and that offshoring tends to increase the productivity of offshoring firms as it enables the firms to specialise in sub-processes with their comparative advantage. Additionally, offshoring results in increased access to new input varieties for offshoring firms, improving their competitiveness. These discussions in terms of firms may be also framed in terms of countries. Countries can improve productivity by engaging in offshoring, as this enables them to specialise in the production of products with comparative advantage (Mitra and Ranjan, 2007; Grossman and Rossi-Hansberg, 2007; Criscuolo, Timmis, and Jonestone, 2016). In short, the countries involved in GVCs through offshoring firms are likely to be able to improve productivity.

So far we have discussed studies examining the impacts of GVCs on developed countries, or countries with offshoring firms. Let us now turn to discussions of the impacts of GVCs on developing countries, which are involved in GVCs by hosting firms from developed countries. Theoretically, developing countries' participation in GVCs can promote economic growth by improving productivity. The impact of production fragmentation on productivity and economic growth in developing countries can be explained through trade-focused endogenous growth models. These models determine long-term growth. The most important endogenous factor driving economic growth is knowledge, such as technology and management know-how, and human capital. Developing countries may be able to obtain technology and management know-how through various channels, including technology licensing and the importation of capital and intermediate goods embodying technology. Amongst these channels, hosting foreign firms and engaging in offshoring or GVCs is one of the most effective ways to acquire technology and management know-how, not only directly from being involved in the management of these firms and trading with them, but also indirectly from technology spillover in the firms, such as through the demonstration effect.

Some recent theoretical studies have considered the impact of participation in GVCs by examining the links between developed countries (North) and developing countries (South) in GVCs. For instance, Li and Liu (2014) show that the South can improve productivity through learning by doing, while the North becomes more productive by specialising in tasks in which it has a strong advantage. In the Baldwin and Robert-Nicoud (2014) model, the North and South compete in producing final goods by combining a set of tasks as inputs. Participation in GVCs allows the North to combine its superior technology with low wages in the South through offshoring. This decreases average production costs, leading to an increase in wages and output in the North. In contrast, the final goods output of the South decreases since the South experiences a decline in resources used for final goods production at the expense of increased parts and components production, which are used for final production in the North. However, both regions can increase productivity and value added when there are knowledge transfers or spillovers from the North to the South. Consequently, participation in GVCs gives both developed and developing countries opportunities to increase productivity.

Table 1 shows empirical studies analysing the relationship between GVC participation and productivity using trade in value added data. The proxy variables for GVC participation include the foreign value added (FVA) component of gross exports, indicating backward linkages, and domestic value added (DVA) in home country exports that are absorbed in foreign countries' exports, indicating forward linkages. Turning to productivity measures, due to the lack of data, earlier studies (excluding Kordalska, Wolszczak-Derlacz, and Parteka [2016]) used labour productivity rather than total factor productivity (TFP) as the dependent variable. One study (Kummritz, 2016) examined the impact of backward and forward linkages, but the other studies only looked at backward linkages. These studies (except for that of Kummritz [2016]) found that backward participation in GVCs contributed to improving productivity, while Kummritz (2016) showed that forward participation in GVCs resulted in improving productivity.

Table 1: Selected Previous Studies

	Kowalski et al.(2015)	Kordalska et al. (2016)	Kummritz (2016)	Constantinescu et al. (2017)
	log of per capita domestic value added in exports	multi factor productivity growth TFP growth	labour productivity	labour productivity
Capital(K)		+***		+***
Labour(L)		+***		
Imports	+			+***
Exports				+***
Imports of final goods				+ / —
Imports of intermediates				+***
Exports of final goods				+*
Exports of intermediates				+
Imports of intermediates embodied in domestically－asorbed output				+***
FVA(Foreign value added embodied in exports)	+**	+***	+	+***
DVA(domestic value added in foreign exports)			+***	
	152 countries 15 years	40 countries and 20 industries 1995–2011	54 countries and 20 industries 1995, 2000, 2005, and 2008 to 2011	40 countries and 13 industries 1990-2014
	OLS	IV	OLS, IV	OLS, IV

IV = instrumental variable, OLS = ordinary least squares.
Notes: + and – indicate the signs of estimated coefficients. '*', '**', and '***' indicate the statistical level of significance at 10, 5, and 1%, respectively.
Source: Authors' compilation.

In this study, we examine the impacts of both forward and backward participation in GVCs on TFP. We divide the countries into high-income countries and low-income countries, and examine whether there are any differences in the impacts resulting from GVC participation with high-income versus low-income countries. Our expectation is that a developing (low-income) country may improve productivity by participating in GVCs with high-income countries but not with low-income countries, because technology and management know-how obtained from high-income countries is likely to be of higher quality relative to that from low-income countries.

3. Methodology and Hypotheses

3.1 The Model

This section specifies our empirical framework to examine how GVC participation by a country affects the country's productivity, as measured by TFP growth. Following Kummiritz (2016), we use a simple reduced-form model with the following specification – equation (1) – to investigate the impact of GVCs on TFP growth.

$$TFPgrowth_{ijt} = \alpha + \beta_1 \ln(GVC_{ijt}) + FE_{it} + FE_{jt} + FE_{ij} + e_{ijt} \quad (1)$$

where $TFPgrowth_{ijt}$ denotes the growth rate of TFP in sector j of country i in year t.[1] The growth rate of TFP depends on the GVC. FE_{it}, FE_{jt}, and FE_{ij} present three types of fixed effects: country-year, sector-year, and country-sector fixed effects, respectively. Unobserved determinants (which vary depending on the countries and sectors) such as

[1] For the method of estimating TFP growth, see Appendix 1.

labour market reforms, global technology shocks, and time-invariant technology are captured by the three fixed effects. e_{ijt} is an error term with the usual properties.

In the estimation, we divide GVC into two types, FVA and DVA.[2] FVA indicates backward participation and DVA indicates forward participation in the GVC. We estimate the following equations (2) and (3).

$$TFPgrowth_{ijt} = \alpha + \beta_1 lnFVA_{ijt} + FE_{it} + FE_{jt} + FE_{ij} + e_{ijt} \quad (2)$$

$$TFPgrowth_{ijt} = \alpha + \beta_1 lnDVA_{ijt} + FE_{it} + FE_{jt} + FE_{ij} + e_{ijt} \quad (3)$$

Furthermore, we compare the effects of FVA from high-income countries (HFVA) and FVA from low-income countries (LFVA) in a GVC, as well as the effects of DVA to high-income countries (HDVA) and DVA to low-income countries (LDVA) in a GVC. Using these notations, we estimate equations (4) and (5).

$$TFPgrowth_{ijt} = \alpha + \beta_1 lnHFVA_{ijt} + \beta_2 lnLFVA_{ijt} + FE_{it} + FE_{jt} + FE_{ij} + e_{ijt} \quad (4)$$

$$TFPgrowth_{ijt} = \alpha + \beta_1 lnHDVA_{ijt} + \beta_2 lnLDVA_{ijt} + FE_{it} + FE_{jt} + FE_{ij} + e_{ijt} \quad (5)$$

We realise that the estimation model may suffer from endogeneity bias due to the possibility of a reverse causal relationship (that is to say, a country with high productivity growth is likely to be engaged in GVCs). To deal with this problem, we adopt an instrumental variable method of estimation. To construct the necessary instruments, we

[2] For the method of calculating FVA and DVA, see Appendix 2.

follow a methodology based on Constantinescu, Mattoo, and Ruta (2017) and Giovanni and Levchenko (2009), and construct the sector-level instruments (FVA and DVA) for GVCs by estimating a gravity-type regression,[3] as in equation (6).

$$
\begin{aligned}
lnFVA(DVA)_{ijklt} &= \alpha + \beta_1 lnSectorSize_{ikt} + \beta_2 lnSectorSize_{jlt} + \beta_3 lnDist_{ij} \\
&\quad + \beta_4 Contig_{ij} \\
&\quad + \beta_5 Comlang_{off_{ij}} + \beta_6 Colony_{ij} + \beta_7 Comcur_{ij} + \beta_8 RTA_{ijt} \\
&\quad + FE + e \ , \qquad (6)
\end{aligned}
$$

where $SectorSize_{ikt}$ $(lnSectorSize_{jlt})$ is the real output of sector k (l) of country i (j) at time *t*; $Dist_{ij}$ is the distance between country i and country *j*; $Contig_{ij}$ represents a dummy variable of contiguity that takes unity if countries i and *j* have a common border, zero if otherwise; $Comlan_{ij}$ is a binary variable that takes unity if countries i and *j* have a common language, zero if otherwise; $Colony_{ij}$ is a binary variable that takes unity if countries *i* and *j* have a colonial relationship, zero if otherwise; $Comcur_{ij}$ is a binary variable that takes unity if countries *i* and *j* have a common currency, zero if otherwise; and RTA_{ij} is a binary variable that takes unity if countries i and *j* belong to the same regional trade agreement (RTA) at time *t*.

Generally, technology is transmitted from developed countries with a high technological level to developing countries with a low technological level. Accordingly, we hypothesise that HFVA has a greater positive impact on productivity than LFVA. As for exporting, exporting to high-income countries requires intermediate goods of high quality compared

[3] See Table A1.3 for the results of the gravity regression.

to exporting to low-income countries. As such, HDVA is hypothesised to have a greater positive impact on productivity than LDVA. Based on these discussions, we establish the following four hypotheses:

Hypothesis 1: The higher the FVA, the higher the productivity growth rate.

Hypothesis 2: The higher the DVA, the higher the productivity growth rate.

Hypothesis 3: HFVA has a greater impact on productivity than LFVA.

Hypothesis 4: HDVA has a greater impact on productivity than LDVA.

4. Total Factor Productivity Growth and Global Value Chain Participation

This section presents a brief discussion of the two key variables for the analysis – TFP growth and GVC participation – for the sample countries. Figure 1 shows the average TFP growth rates from 1995 to 2011 for the manufacturing sector for 47 countries.[4] Wide variations in TFP growth rates can be observed amongst the sample countries. Five East European countries (the Slovak Republic, Lithuania, Czechia, Estonia, and Latvia) recorded high TFP growth rates of around 5%–8% over this period.[5] These five countries joined the European Union (EU) in May 2004. It should also be noted that their TFP levels were likely to be quite low at the beginning of the sample period, leaving ample room for improvement. In contrast to these five countries, Bulgaria and Romania, which are also

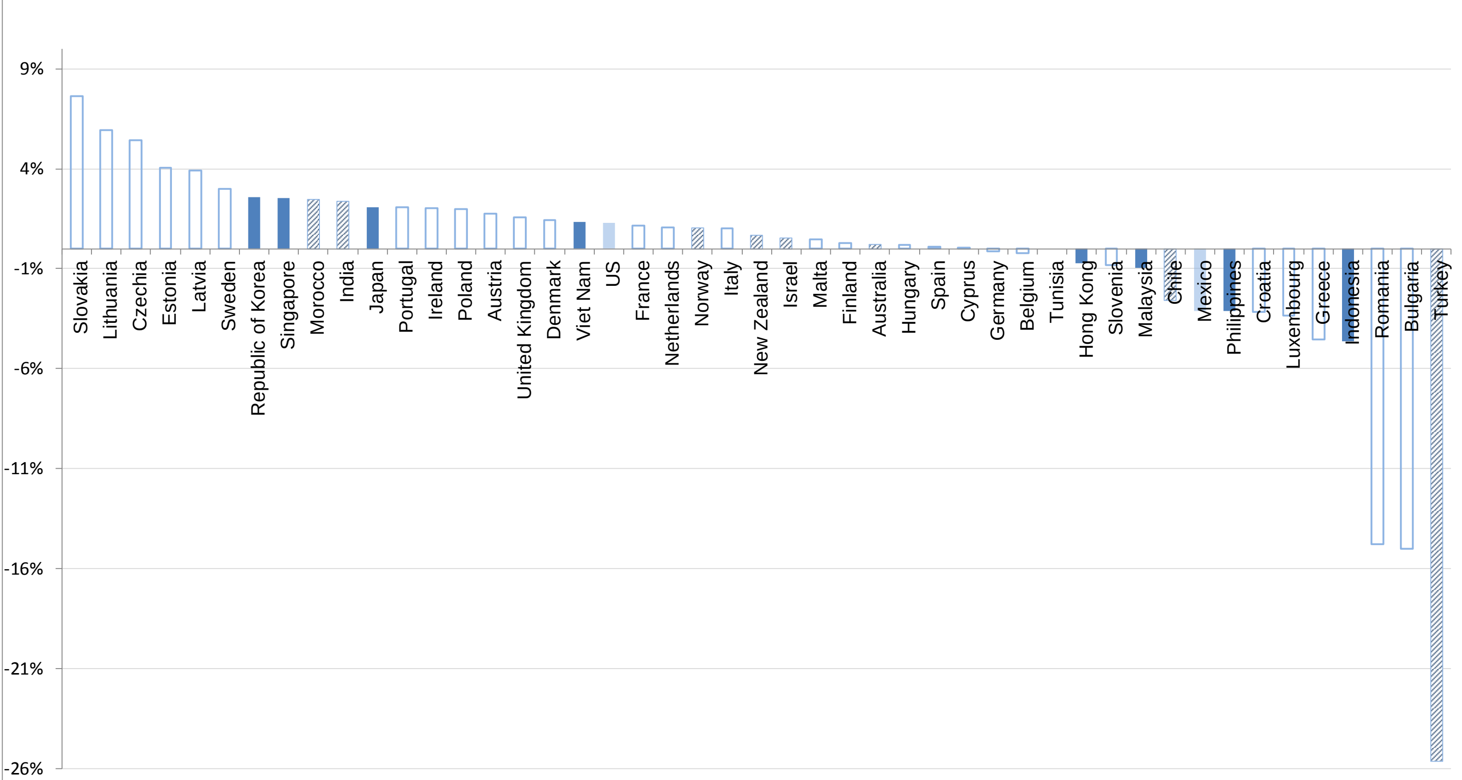
[4] The methodology used to compute TFP growth rates is explained in Appendix 1. Computed TFP growth rates are shown in Table A1.1. A lack of necessary data for the estimation of TFP growth resulted in the exclusion of some important countries such as China and Canada in the analysis.

[5] There are several different approaches used to classify East European countries. We adopt a broad definition, which includes the Baltic countries.

East European countries as well as EU members, registered huge negative TFP growth rates of around minus 15%–16%. It may be worth pointing out that they entered the EU in 2007, 3 years after the five countries listed above. Amongst the sample countries, Turkey registered the worst TFP growth rate, at minus 26%.

Figure 1 Average Total Factor Productivity Growth Rates for the Manufacturing Sector (1995–2011)

(%)



US = United States.

Source: Authors' own calculation using data from the United Nations Industrial Development Organization Industrial Statistics Database 2. https://stat.unido.org/content/dataset_description/indstat-2-2018%252c-isic-revision-3# (accessed 28 February 2018).

Similar to the pattern observed in the sample East European countries, East Asian countries can be divided into two groups: high- and low-TFP growth countries. The Republic of Korea (henceforth, Korea), Singapore, Japan, and Viet Nam are classified as high-TFP growth countries, as their TFP growth rates range from 1.3% to 2.6%; and the Philippines and Indonesia are classified as low-TFP growth countries, registering TPF growth rates of minus 3%–5%. The variations in TFP growth rates for the remaining countries are rather small, with rates ranging from 3 to minus 5%.

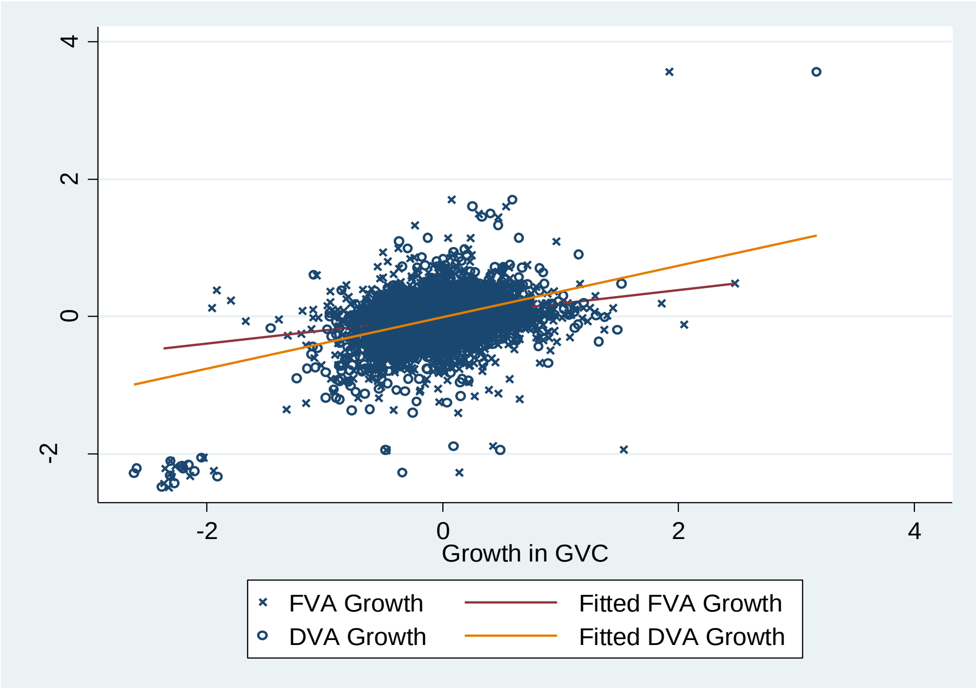
Turning to GVC participation, which is measured by FVA and DVA, we find that many of the sample countries expanded their participation in GVCs (notably, from 1995 to 2011), as shown by notable increases in FVA and DVA.[1] A casual observation shows that low-income countries experienced high growth in both FVA and DVA compared to high-income countries. This observation is not surprising because many developing countries with low wages have successfully engaged in GVCs by hosting offshoring firms from developed counties. Of the countries that have been highly successful in increasing GVC participation, Viet Nam experienced the highest rate of growth in both FVA and DVA during 1995–2011. Besides Viet Nam, several East European countries including Poland, Czech Republic, Latvia, Slovakia, Hungary, Lithuania, Romania, and Estonia registered high growth in FVA and DVA. It is clear that accession to the EU helped these countries participate in GVCs.

In contrast to the countries registering a remarkable increase in GVC participation, Hong Kong has decreased its participation in GVCs in terms of both FVA and DVA, while Malta experienced a decline in FVA. The decline in GVC participation by Hong Kong seems to be due to the fact that China has begun to trade directly with the rest of the world without transshipment through Hong Kong. In many high-income countries, including those in Western Europe and the United States, relatively low rates of increase in GVC participation are observed. That said, countries with large economies, such as the United States and Germany, are heavily involved in GVCs in terms of absolute magnitude. It may also be noted that FVA for Korea is very large in terms of absolute magnitude, while DVA for Japan is quite large. These contrasting patterns reflect the fact that Korea relies heavily on foreign inputs for its exports, while many countries rely on inputs from Japan for their export production.

A scatter diagram (Figure 2) shows a positive relationship between the rate of increase in GVC (FVA and DVA) and the TFP growth rate. The growth rate of FVA is shown to have greater slope compared to the growth rate of DVA. In the next section we investigate the relationship between GVCs and TFP growth more rigorously.

[1] The method for computing FVA and DVA is explained in Appendix 2. The computed values for FVA and DVA are in Tables A1.2A– A1.2C.

Figure 2: Change in Global Value Chain Participation and Total Factor Productivity Growth Rates



DVA = domestic value added, FVA = foreign value added, GVC = global value chain, TFP = total factor productivity.
Source: Authors' own calculation using data from the Organisation for Economic Cooperation and Development-Inter-Country Input–Output Tables https://www.oecd.org/sti/ind/inter-country-input-output-tables.htm (accessed 10 October 2018); and the United Nations Industrial Development Organization Industrial Statistics Database 2. https://stat.unido.org/content/dataset_description/indstat-2-2018%252c-isic-revision-3# (accessed 28 February 2018).

5. The Results

We estimated equations (2)–(5) by applying the ordinary least squares and two-stage least squares (2SLS) methods using the data covering 47 countries for the period 1995–2011.[2] The estimation results are presented in Tables 2 and 3. In Table 2 FVA and DVA are used as explanatory variables, while in Table 3 both FVA and DVA are divided into HFVA and LFVA, and HDVA and LDVA, respectively, in order to compare the impacts of GVC participation with high-income and low-income countries on TPF growth.

[2] See Table A1.3 for the results of the gravity regression (equation [6]), which is used to construct instruments.

Table 2: Estimation Results: Dependent Variable = Total Factor Productivity Growth Rates (1995–2011)

	All Countries				Developed Countries				Developing Countries			
	OLS		IV		OLS		IV		OLS		IV	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
VARIABLES	TFPgrowth	TFPgrowth	TFPgrowth	TFPgrowth	TFPgrowth	TFPgrowth	TFPgrowth	TFPgrowth	TFPgrowth	TFPgrowth	TFPgrowth	TFPgrowth
lnFVA	0.0216		0.109***		0.0289		0.0999***		0.0118		0.187***	
	(0.0171)		(0.0295)		(0.0224)		(0.0339)		(0.0157)		(0.0660)	
lnDVA		0.0771***		0.116***		0.0939***		0.116***		0.0542***		0.130***
		(0.0220)		(0.0295)		(0.0290)		(0.0355)		(0.0182)		(0.0396)
Constant	-0.118	-0.670***	-0.852***	-0.679***	-0.181	-0.822***	-0.893***	-0.824***	-0.753***	-1.132***	-1.421***	-0.769***
	(0.179)	(0.223)	(0.202)	(0.149)	(0.234)	(0.293)	(0.312)	(0.262)	(0.169)	(0.175)	(0.452)	(0.197)
Country-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7,807	7,807	7,807	7,807	5,920	5,920	5,920	5,920	1,887	1,887	1,887	1,887
Durbin-Wu-Hausman Test			65.003	12.214			55.751	4.009			9.223	3.964
			(p = 0.0000)	(p = 0.0005)			(p = 0.0000)	(p = 0.0453)			(p = 0.0024)	(p = 0.0465)
Cragg-Donald Wald F statistics			2430.51	2872.47			3021.5	3055.3			91.7327	242.597
R-squared	0.576	0.581	0.566	0.579	0.378	0.389	0.369	0.388	0.772	0.773	0.755	0.771

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

DVA = domestic value added, FE = fixed effects, FVA = foreign value added, IV = instrumental variables, OLS = ordinary least squares, TFP = total factor productivity.

Source: Authors' own estimation.

Table 3: Estimation Results: Dependent Variable = Total Factor Productivity Growth Rates (1995–2011)

	All Countries							
	OLS				IV			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	TFPgrowth	TFPgrowth	TFPgrowth	TFPgrowth	TFPgrowth	TFPgrowth	TFPgrowth	TFPgrowth
lnHFVA	0.0235				0.111***			
	(0.0170)				(0.0293)			
lnLFVA		0.0146				0.103***		
		(0.0152)				(0.0289)		
lnHDVA			0.0725***				0.115***	
			(0.0218)				(0.0295)	
lnLDVA				0.0548***				0.116***
				(0.0155)				(0.0307)
Constant	-0.132	-0.0278	-0.600***	-0.366***	-0.798***	-0.739***	-0.638***	-0.529***
	(0.173)	(0.141)	(0.214)	(0.136)	(0.184)	(0.178)	(0.140)	(0.118)
Country-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7,807	7,807	7,807	7,807	7,807	7,807	7,807	7,807
Durbin-Wu-Hausman Test					62.0754	72.6553	14.7115	26.4778
					(p = 0.0000)	(p = 0.0000)	(p = 0.0001)	(p = 0.0000)
Cragg-Donald Wald F statistics					2344.67	2221.68	2798.03	1841.69
R-squared	0.576	0.575	0.580	0.579	0.566	0.564	0.578	0.574

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

	Developed Countries							
	OLS				IV			
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
VARIABLES	TFPgrowth	TFPgrowth	TFPgrowth	TFPgrowth	TFPgrowth	TFPgrowth	TFPgrowth	TFPgrowth
lnHFVA	0.0310				0.101***			
	(0.0223)				(0.0336)			
lnLFVA		0.0204				0.0953***		
		(0.0193)				(0.0334)		
lnHDVA			0.0871***				0.114***	
			(0.0288)				(0.0354)	
lnLDVA				0.0656***				0.118***
				(0.0204)				(0.0373)
Constant	-0.194	-0.0668	-0.725**	-0.448**	-0.888***	-0.668***	-0.794***	-0.625***
	(0.227)	(0.178)	(0.282)	(0.180)	(0.305)	(0.245)	(0.256)	(0.207)
Country-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5,920	5,920	5,920	5,920	5,920	5,920	5,920	5,920
Durbin-Wu-Hausman Test					52.6815	63.9818	6.20332	18.4087
					(p = 0.0000)	(p = 0.0000)	(p = 0.0128)	(p = 0.0000)
Cragg-Donald Wald F statistics					2947.2	2527.13	2999.7	1695.15
R-squared	0.378	0.377	0.387	0.385	0.369	0.364	0.386	0.380

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

	Developing Countries							
	OLS				IV			
	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
VARIABLES	TFPgrowth	TFPgrowth	TFPgrowth	TFPgrowth	TFPgrowth	TFPgrowth	TFPgrowth	TFPgrowth
lnHFVA	0.0142				0.193***			
	(0.0156)				(0.0691)			
lnLFVA		0.00689				0.174***		
		(0.0165)				(0.0601)		
lnHDVA			0.0525***				0.140***	
			(0.0181)				(0.0422)	
lnLDVA				0.0379**				0.108***
				(0.0148)				(0.0337)
Constant	-0.777***	-0.689***	-1.118***	-0.884***	-1.346***	-1.204***	-0.775***	-0.506***
	(0.166)	(0.149)	(0.174)	(0.110)	(0.432)	(0.370)	(0.196)	(0.127)
Country-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,887	1,887	1,887	1,887	1,887	1,887	1,887	1,887
Durbin-Wu-Hausman Test					8.9764	9.70697	4.45486	4.89055
					(p = 0.0027)	(p = 0.0018)	(p = 0.0348)	(p = 0.0270)
Cragg-Donald Wald F statistics					85.5126	94.9368	207.346	246.839
R-squared	0.772	0.772	0.773	0.773	0.754	0.755	0.770	0.770

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

FE = fixed effects, HDVA = domestic value added from high-income countries, HFVA = foreign value added from high-income countries, IV = instrumental variables, LDVA = domestic value added from low-income countries, LFVA = foreign value added from low-income countries, OLS = ordinary least squares, TFP = total factor productivity.

Source: Authors' own estimation.

Between the ordinary least squares and 2SLS results, we adopt the 2SLS results, as the test statistics from the Durbin-Wu-Hausman test indicate the presence of endogeneity between TFP growth and GVC variables. We find the appropriateness of the instruments for the 2SLS (instrumental variable) estimation, because the weak identification test statistic based on the Cragg-Donald Wald F statistics exceeds the Stock and Yogo (2005) critical values in all cases.

The estimated results for FVA and DVA for all countries are positive and statistically significant for the case of instrumental variable estimation. These results are consistent with our expectation that countries with greater participation in GVCs tend to achieve high TFP growth. More specifically, the countries that use a large amount of FVA in their production of exports and those countries whose value added is used in a large amount by foreign countries are found to achieve high TFP growth.

The positive impacts of GVC participation on TFP growth are found for both developed and developing countries. A comparison of the estimated coefficients on FVA and DVA show that the impacts are greater for developing countries than for developed countries. These findings indicate that developing countries can assimilate technology and management know-how more than developed countries from participation in GVCs because developing countries have more room to catch up in terms of upgrading technology and management know-how compared to developed countries.

Table 3 shows the results of the estimation, which differentiates HFVA and LFVA, and HDVA and LDVA. According to the results from the instrumental variable estimation, all of the estimated coefficients on HFVA, LFVA, HDVA, and LDVA are positive and statistically significant for all three cases: all countries, developed countries, and developing countries. These findings show that the countries, regardless of their level of economic development, can achieve high TFP growth by engaging, not only with developed countries, but also with developing countries through GVCs. For developed countries, the magnitude of the impacts of GVC participation on TFP growth appears similar regardless of the country type (i.e. developed and developing countries) engaged with. However, this relationship is quite different in the case of developing countries. Developing countries are shown to be capable of acquiring technology and management know-how, etc., which contributes to improve TFP, by engaging with developed countries, more so than is possible through engagement with developing countries. These observations appear reasonable, considering that the level of technology and management know-how is higher in developed countries than in developing countries.

6. Conclusions

We examined the impacts of GVC participation on TFP growth by using data from the manufacturing sector in 47 countries in 1995–2011. Our analysis found that GVC-related trade increases the TFP of the countries involved in GVCs. Both FVA (backward linkages) and DVA (forward linkages) are shown to have positive impacts on productivity. We then divided trading partners into high-income and low-income countries, and examined whether the impacts differ depending on the level of economic development of the countries involved in the GVCs. We conducted the analysis for three country groups: all countries, high-income (developed) countries, and low-income (developing) countries. We found that only in the case of developing countries are the benefits (in the form of improved TFP) larger for backward linkages relative to forward linkages, and for linkages with developed countries relative to developing countries. These findings indicate that GVC participation is beneficial for all countries, but especially for developing countries. Furthermore, purchasing intermediate goods from developed countries tends to impart larger benefits.

Our analysis showed the importance of GVC participation for all countries, especially developing countries. It is thus important for countries to be able to participate in GVCs to promote economic growth. A detailed analysis of the factors that would enable countries to participate in GVCs is needed. Our tentative findings from the first stage estimation for the construction of instruments, whose results are shown in Table A3, indicate that openness in trade (RTAs) is an important factor. Indeed, GVC participation increased tremendously for several East European countries as a result of their accession to the EU. In addition to an open, free, and transparent trade and foreign direct investment environment (which is provided by RTAs), well-developed soft infrastructure (e.g. educational and legal systems), hard infrastructure (e.g. transportation and communication systems), and the availability of capable human resources are important for a country to participate in GVCs.

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Appendix 1: Estimation of Total Factor Productivity Growth

Total factor productivity (TFP) growth is calculated by using the data from the United Nations Industrial Development Organization database. To calculate the capital stock, we adopt the perpetual inventory method as in equation (A1.1):

$$K_t = (1-\delta)K_{t-1} + I_t \,, \quad \text{(A1.1)}$$

where I is investment, δ the depreciation rate (5%), and K refers to the capital stock. The initial capital stock is computed using the method used by Fuente and Domenech (2000), as in equation (A1.2):

$$initial\ K = \frac{I}{gk+\delta} \cong \frac{I}{gI+\delta} \qquad \text{(A1.2)}$$

where g is the growth rate of investment, and we use the growth rate of investment over the initial 10 years. TFP growth is computed as the Solow residual by adopting equation (A1.3):

$$TFPgrowth_{ijt} = \Delta lnY_{ijt} - \left(\hat{\alpha} + \hat{\beta}_1 \Delta lnK_{ijt} + \hat{\beta}_2 \Delta lnL_{ijt}\right) \quad \text{(A1.3)}$$

where Y_{ijt} is the value added of sector j in country i at time t, which is produced with labour (L_{ijt}) and capital (K_{ijt}).

Table A1: Total Factor Productivity Growth Rates (1995–2011)

		Manufacturing industry	Textiles, textile products, leather and footwear	Machinery and equipment, nec	Computer, electronic and optical equipment	Electrical machinery and apparatus, nec	Transport equipment
EAST ASIA	Republic of Korea	2.6	3.1	1.4	3.4	2.8	3.3
	Singapore	2.5	4.1	3.4	3.2	2.0	3.0
	Japan	2.1	1.7	0.8	2.8	2.7	2.7
	Viet Nam	1.3	-3.0	4.2	3.4	0.5	6.7
	Hong Kong	-0.2	3.2	0.0	0.0	0.0	2.6
	Malaysia	-0.8	-1.0	-3.7	-1.7	-2.9	-0.1
	Philippines	-3.2	-4.6	-2.2	2.5	-3.3	-4.3
	Indonesia	-4.9	-6.5	-6.0	-3.2	5.1	-3.9
EU 28	Slovakia	7.7	0.0	9.9	11.7	7.2	10.0
	Lithuania	6.0	4.5	8.6	3.3	8.0	1.9
	Czechia	5.5	5.5	5.2	5.9	5.7	7.9
	Estonia	4.0	2.3	4.7	6.5	7.3	4.8
	Latvia	4.0	2.1	3.5	10.4	4.2	2.3
	Sweden	2.9	2.8	2.1	8.8	2.6	2.5
	Poland	2.2	1.2	3.1	1.2	2.7	5.1
	Portugal	2.1	0.0	1.2	0.0	1.6	-0.1
	Ireland	1.9	4.3	2.3	1.5	-1.2	6.2
	Austria	1.8	0.0	2.0	1.4	3.0	2.1
	United Kingdom	1.6	2.3	2.2	0.5	1.5	3.0
	Denmark	1.4	0.0	1.3	2.5	1.3	0.3
	France	1.1	3.0	1.2	0.5	0.5	1.3
	Netherlands	1.1	2.6	2.3	0.0	1.0	2.4
	Italy	1.0	2.0	1.3	0.3	1.1	1.3
	Malta	0.5	3.3	-0.7	-2.1	5.6	2.2
	Finland	0.3	1.9	1.1	-10.5	2.2	0.3
	Hungary	0.3	-0.4	3.9	4.0	0.0	-2.1
	Spain	0.1	1.5	0.3	-1.7	-0.4	0.5
	Cyprus	-0.1	-2.1	0.5	0.0	1.7	-2.7
	Germany	-0.1	0.9	-0.1	-0.1	-0.3	1.8
	Belgium	-0.2	-0.4	0.2	-1.0	-0.2	-0.5
	Slovenia	-0.9	-2.0	-1.1	-3.0	-0.7	0.3
	Croatia	-1.4	1.1	2.0	-19.2	-15.4	-5.0
	Luxembourg	-3.3	0.0	-0.8	0.0	0.0	0.0
	Greece	-4.6	-4.0	-2.6	-7.1	-1.3	-11.0
	Bulgaria	-15.0	-22.7	-17.4	-8.3	-18.5	-20.9
	Romania	-16.9	0.0	-20.3	0.0	-4.0	-16.2
NAFTA	United States of America	1.4	1.2	-0.6	-0.7	-1.4	1.5
	Mexico	-3.0	0.8	-0.5	-8.6	-4.3	-6.9
Rest of World	Morocco	2.6	1.9	1.8	-0.1	-0.8	3.4
	India	2.4	3.4	2.7	-0.2	-1.4	3.3
	Norway	1.0	3.0	2.8	1.4	0.5	1.9
	New Zealand	0.7	0.0	1.5	0.0	0.0	-0.2
	Israel	0.5	1.5	0.0	0.0	-0.8	1.7
	Australia	0.5	-1.2	2.7	0.2	-3.8	-1.9
	Tunisia	-0.3	1.1	0.0	0.0	0.0	0.0
	Chile	-2.6	0.0	-2.1	0.0	-4.8	0.0
	Turkey	-25.6	-24.8	-27.0	-27.5	-24.6	-24.7

EU = European Union, NAFTA = North American Free Trade Agreement, nec = not elsewhere classified.

Source: Authors' own calculation using data from the United Nations Industrial Development Organization Industrial Statistics Database 2. https://stat.unido.org/content/dataset_description/indstat-2-2018%252c-isic-revision-3# (accessed 28 February 2018).

Appendix 2: Estimation of Foreign Value Added and Domestic Value Added

We calculate foreign value added (FVA) and domestic value added (DVA) by using the Inter-Country Input–Output (ICIO) Tables of the Organisation for Economic Cooperation and Development (OECD). The ICIO Tables contain information on 34 industries in 35 OECD countries, 28 non-OECD economies, and the rest of world from 1995 to 2011. Table A1.8 shows the basic structure of the ICIO Tables, where X is the gross output, T is the intermediate demand, and F is the final demand. As shown in equation (A2.1), X is the sum of T and F.

Table A2.1: Structure of the Inter-Country Input–Output Tables

	Intermediate use country 1 x industry 1 ··· country 64 x industry 64	Final demand country1 ··· country 64	Gross output
country 1 x industry 1 country 1 x industry 2 ⋮ country 64 x industry 1 ⋮ country 64 x industry 34	*(T)*	*(F)*	*(X)*
Value added	*(V)*		
Gross output	*(X)*		

Source: Authors' compilation based on the Organisation for Economic Cooperation and Development-Inter-Country Input–Output Tables. https://www.oecd.org/sti/ind/inter-country-input-output-tables.htm (accessed 10 October 2018).

$$X = T + F \qquad \text{(A2.1)}$$

In the equations (A2.2) and (A2.3), A obtained by dividing T by X is the matrix of input–output coefficients. Equation (A2.4) is obtained by modifying equation (A2.3). Equation (A2.5) can be derived by solving for X in equation (A2.4) and using the Leontief inverse matrix (L), which is defined as $(\mathrm{I} - \mathrm{A})^{-1}$. In equations (A2.4) and (A2.5), I indicates the identity matrix.

$$X = AX + F \qquad \text{(A2.2)}$$
$$X - AX = F \qquad \text{(A2.3)}$$
$$(I - A)X = F \qquad \text{(A2.4)}$$
$$X = (I - A)^{-1}F = LF \qquad \text{(A2.5)}$$

The matrix of value-added trade ($\mathrm{T_v}$) can be obtained by multiplying the matrix of value-added shares ($\hat{v}$) with L and the matrix of gross export (E) as shown in equation (A2.6). The matrix of value-added shares ($\hat{v}$) is obtained by dividing value added (V) by X as shown in the equation (A2.7).

$$T_v = \hat{v}LE \qquad \text{(A2.6)}$$
$$\hat{v} = V/X \qquad \text{(A2.7)}$$

If we suppose that there are N countries, linear equation (A2.6) can be represented in matrix as shown in equation (A2.8). Furthermore, T_v matrix can be displayed in Table A2.3. The diagonal elements of T_v matrix are DVA embodied in gross exports. FVA can be calculated by summing up all the elements in the corresponding column and subtracting the diagonal elements. In the same way, DVA can be calculated by summing up all of the elements in the corresponding row and subtracting the diagonal elements. By using this method, we calculate FVA and DVA at the country-industry level.

$$\begin{pmatrix} \widehat{v^1} & 0 & 0 \\ 0 & \ddots & 0 \\ 0 & 0 & \widehat{v^n} \end{pmatrix} \begin{pmatrix} L^{11} & \cdots & L^{1n} \\ \vdots & \ddots & \vdots \\ L^{n1} & \cdots & L^{nn} \end{pmatrix} \begin{pmatrix} e^1 & 0 & 0 \\ 0 & \ddots & 0 \\ 0 & 0 & e^n \end{pmatrix} = \begin{pmatrix} \widehat{V^1}L^{11}e^1 & \cdots & \widehat{V^1}L^{1n}e^n \\ \vdots & \ddots & \vdots \\ \widehat{V^n}L^{n1}e^1 & \cdots & \widehat{V^n}L^{nn}e^n \end{pmatrix}$$
$$= \begin{pmatrix} T_v^{11} & \cdots & T_v^{1n} \\ \vdots & \ddots & \vdots \\ T_v^{n1} & \cdots & T_v^{nn} \end{pmatrix}, \qquad \text{(A2.8)}$$

Table A2.2: Matrix of the Value-Added Content of Trade

DVA (row of Country 1, excluding diagonal); FVA (column of Country 1, excluding diagonal)

	Country 1	Country 2	Country 3	…	Country k	…	Country N
Country 1	T_v^{11}	T_v^{12}	T_v^{13}	…	T_v^{1k}	…	T_v^{1N}
Country 2	T_v^{21}	T_v^{22}	T_v^{23}	…	T_v^{2k}	…	T_v^{2N}
Country 3	T_v^{31}	T_v^{32}	T_v^{33}	…	T_v^{3k}	…	T_v^{3N}
…	…	…	…	…	…	…	…
Country k	T_v^{k1}	T_v^{k2}	T_v^{k3}	…	T_v^{kk}	…	T_v^{kN}
…	…	…	…	…	…	…	…
Country N	T_v^{N1}	T_v^{N2}	T_v^{N3}	…	T_v^{Nk}	…	T_v^{NN}

DVA = domestic value added, FVA = foreign value added.
Source: United Nations Conference on Trade and Development (2013), *Global Value Chains and Development: Investment and Value Added Trade in the Global Economy.* Geneva: United Nations Conference on Trade and Development. p.29.

Table A2.3A: Foreign Value Added and Domestic Value Added in Total Manufactures

Country	FVA 1995	FVA 2011	Change	Country	DVA 1995	DVA 2011	Change
Viet Nam	793	22,591	2748%	Viet Nam	142	2,995	2006%
India	1,710	30,331	1674%	Romania	513	6,065	1083%
Turkey	1,852	28,949	1463%	Lithuania	79	899	1031%
Poland	3,226	47,806	1382%	India	1,364	13,590	896%
Czechia	4,799	54,375	1033%	Latvia	72	609	751%
Latvia	177	1,933	990%	Estonia	83	663	698%
Slovakia	2,044	21,893	971%	Bulgaria	215	1,645	664%
Hungary	4,003	39,930	897%	Chile	1,655	12,295	643%
Lithuania	275	2,214	705%	Slovakia	812	6,021	641%
Romania	1,119	8,353	647%	Hungary	926	6,680	621%
Korea	25,399	164,028	546%	Czechia	1,797	12,891	618%
Estonia	431	2,710	530%	Poland	2,125	14,690	591%
Chile	1,590	9,528	499%	Indonesia	2,036	11,479	464%
Bulgaria	1,183	6,829	477%	Korea	10,105	56,294	457%
Malaysia	14,559	73,891	408%	Morocco	312	1,737	456%
Morocco	1,137	5,568	390%	Philippines	1,202	6,568	446%
Mexico	18,416	85,930	367%	Turkey	1,568	7,937	406%
Japan	20,298	90,059	344%	Israel	1,170	5,365	359%
Germany	64,764	266,470	311%	Mexico	3,976	17,136	331%
Spain	17,624	65,613	272%	Singapore	3,476	14,655	322%
Indonesia	4,442	15,189	242%	Tunisia	239	924	286%
Israel	2,798	9,103	225%	Ireland	3,340	12,585	277%
Italy	33,601	105,555	214%	Spain	6,941	25,027	261%
Tunisia	1,377	4,254	209%	Slovenia	689	2,341	240%
Australia	4,411	13,352	203%	Malaysia	3,945	13,164	234%
Ireland	15,469	42,724	176%	Greece	679	2,105	210%
New Zealand	1,635	4,460	173%	Austria	5,268	16,114	206%
Austria	11,737	31,842	171%	New Zealand	489	1,418	190%
France	43,453	115,496	166%	Norway	2,447	7,034	187%
Slovenia	2,576	6,803	164%	Cyprus	25	71	184%
Finland	9,109	22,971	152%	Germany	51,922	139,777	169%
USA	67,001	165,767	147%	Italy	17,258	46,237	168%
Norway	5,165	12,659	145%	Australia	3,303	8,774	166%
England	40,367	95,583	137%	Portugal	1,560	3,964	154%
Portugal	6,688	15,599	133%	Japan	45,590	108,051	137%
Croatia	517	1,190	130%	Croatia	235	553	135%
Greece	1,894	4,220	123%	USA	58,505	133,837	129%
Sweden	20,448	42,595	108%	Sweden	8,182	16,805	105%
Luxembourg	2,951	6,116	107%	Netherlands	9,825	19,841	102%
Singapore	21,828	41,520	90%	Denmark	3,229	6,198	92%
Netherlands	31,975	59,252	85%	France	21,132	40,306	91%
Denmark	7,848	14,315	82%	England	21,606	37,622	74%
Philippines	5,165	9,418	82%	Luxembourg	737	1,249	69%
Belgium	28,120	36,420	30%	Finland	4,613	7,778	69%
Cyprus	229	293	28%	Malta	79	126	59%
Hong Kong	4,885	3,622	-26%	Belgium	8,406	13,068	55%
Malta	1,053	170	-84%	Hong Kong	732	473	-35%

DVA = domestic value added, FVA = foreign value added, US = United States.
Source: Authors' own calculation using data from the Organisation for Economic Cooperation and Development-Inter-Country Input–Output Tables. https://www.oecd.org/sti/ind/inter-country-input-output-tables.htm (accessed 10 October 2018).

Table A2.3B: Foreign Value Added from High-Income Countries and Foreign Value Added from Low-Income Countries in Total Manufactures

Country	HFVA 1995	HFVA 2011	Change	Country	LFVA 1995	LFVA 2011	Change
Viet Nam	657	12,680	1829%	Viet Nam	136	9,911	7190%
India	1,355	19,483	1338%	India	355	10,848	2960%
Turkey	1,471	18,723	1172%	Poland	393	11,780	2894%
Poland	2,832	36,026	1172%	Turkey	380	10,227	2589%
Latvia	122	1,501	1128%	Mexico	1,017	22,415	2105%
Czechia	4,106	40,585	888%	Czechia	693	13,790	1890%
Slovakia	1,663	15,542	835%	Hungary	527	9,167	1638%
Hungary	3,476	30,763	785%	Slovakia	381	6,350	1567%
Romania	811	6,264	672%	Korea	4,179	59,881	1333%
Lithuania	198	1,307	559%	Malaysia	1,887	24,930	1221%
Estonia	345	2,116	514%	Israel	181	2,270	1156%
Korea	21,220	104,147	391%	Lithuania	77	908	1083%
Morocco	966	3,988	313%	Bulgaria	293	3,324	1034%
Bulgaria	890	3,505	294%	Chile	507	5,432	972%
Malaysia	12,672	48,961	286%	Indonesia	567	5,690	903%
Chile	1,083	4,096	278%	Spain	1,572	15,729	901%
Mexico	17,399	63,514	265%	Morocco	171	1,580	823%
Germany	57,992	207,604	258%	Germany	6,772	58,866	769%
Japan	15,490	50,326	225%	Australia	687	5,787	742%
Spain	16,052	49,884	211%	Japan	4,808	39,732	726%
Ireland	14,690	39,142	166%	Sweden	858	7,080	725%
Italy	29,000	76,982	165%	Tunisia	125	1,015	712%
Israel	2,617	6,833	161%	Latvia	55	432	684%
Tunisia	1,252	3,239	159%	Croatia	42	327	677%
Indonesia	3,875	9,499	145%	Austria	638	4,829	657%
Austria	11,099	27,013	143%	Luxembourg	102	747	632%
France	39,809	91,557	130%	New Zealand	188	1,336	611%
Slovenia	2,289	5,177	126%	Estonia	86	594	593%
New Zealand	1,447	3,124	116%	Romania	308	2,089	579%
Portugal	6,259	13,331	113%	Finland	994	6,749	579%
Norway	4,765	9,996	110%	Norway	400	2,663	565%
England	36,592	76,146	108%	France	3,644	23,939	557%
Australia	3,724	7,565	103%	Italy	4,602	28,573	521%
Finland	8,115	16,222	100%	Slovenia	287	1,626	467%
Luxembourg	2,849	5,369	88%	Portugal	429	2,268	428%
USA	53,865	99,507	85%	Greece	259	1,365	427%
Croatia	475	863	82%	England	3,775	19,437	415%
Sweden	19,589	35,515	81%	Philippines	596	3,060	413%
Greece	1,636	2,855	75%	USA	13,136	66,260	404%
Denmark	7,253	12,115	67%	Ireland	778	3,582	360%
Singapore	17,645	28,415	61%	Netherlands	2,810	12,516	345%
Netherlands	29,166	46,735	60%	Denmark	595	2,201	270%
Philippines	4,569	6,358	39%	Belgium	1,863	6,194	232%
Cyprus	199	240	20%	Singapore	4,182	13,105	213%
Belgium	26,256	30,226	15%	Cyprus	30	53	76%
Hong Kong	3,342	1,982	-41%	Hong Kong	1,543	1,640	6%
Malta	1,008	139	-86%	Malta	45	31	-31%

HFVA = foreign value added from high-income countries, LFVA = foreign value added from low-income countries, US = United States.
Source: Authors' own calculation using data from the Organisation for Economic Cooperation and Development-Inter-Country Input–Output Tables. https://www.oecd.org/sti/ind/inter-country-input-output-tables.htm (accessed 10 October 2018).

Table A2.3C: Domestic Value Added from High-Income Countries and Domestic Value Added from Low-Income Countries in Total Manufactures

Country	HDVA 1995	HDVA 2011	Change	Country	LDVA 1995	LDVA 2011	Change
Viet Nam	105	1,744	1565%	Viet Nam	37	1,250	3239%
Lithuania	63	769	1113%	Philippines	147	3,695	2410%
Romania	436	4,892	1022%	Chile	268	4,728	1664%
Latvia	54	512	840%	India	279	4,489	1506%
India	1,085	9,101	739%	Malaysia	464	7,386	1491%
Estonia	71	563	691%	Romania	77	1,173	1425%
Bulgaria	173	1,238	616%	Korea	2,497	33,224	1231%
Slovakia	749	5,282	605%	Indonesia	440	5,483	1147%
Czechia	1,650	11,261	583%	Slovakia	63	740	1075%
Poland	1,897	12,792	574%	Hungary	100	1,140	1037%
Hungary	826	5,540	571%	Czechia	147	1,630	1011%
Chile	1,387	7,567	445%	Malta	4	39	923%
Turkey	1,316	6,386	385%	Israel	150	1,494	896%
Morocco	256	1,212	374%	Bulgaria	42	407	858%
Mexico	3,734	14,824	297%	Mexico	242	2,312	855%
Israel	1,020	3,871	280%	Morocco	57	525	827%
Indonesia	1,597	5,996	276%	Ireland	204	1,730	746%
Tunisia	223	824	269%	Estonia	12	100	735%
Ireland	3,136	10,854	246%	Poland	228	1,897	732%
Slovenia	582	1,980	240%	Portugal	62	500	711%
Spain	6,342	20,658	226%	Lithuania	16	129	705%
Korea	7,609	23,071	203%	Singapore	988	7,831	693%
Austria	4,896	13,705	180%	Norway	134	1,057	689%
Cyprus	20	55	175%	Spain	599	4,370	629%
Singapore	2,488	6,824	174%	Germany	4,628	30,894	568%
Greece	589	1,612	174%	Austria	372	2,409	547%
Philippines	1,055	2,873	172%	Tunisia	16	100	526%
Norway	2,313	5,977	158%	Turkey	252	1,551	515%
New Zealand	400	993	149%	Latvia	17	97	468%
Italy	15,359	36,408	137%	Japan	9,693	54,642	464%
Portugal	1,498	3,464	131%	Greece	89	493	452%
Germany	47,294	108,882	130%	Italy	1,899	9,829	418%
Croatia	217	480	121%	Australia	810	4,102	406%
Netherlands	9,231	17,415	89%	Luxembourg	27	133	385%
Australia	2,493	4,672	87%	Sweden	638	3,045	378%
Sweden	7,545	13,760	82%	New Zealand	90	424	373%
USA	44,996	79,390	76%	Denmark	203	889	338%
Denmark	3,026	5,309	75%	France	1,752	7,522	329%
France	19,379	32,784	69%	Croatia	17	73	318%
Malaysia	3,481	5,778	66%	Netherlands	594	2,426	309%
Luxembourg	710	1,116	57%	USA	13,509	54,446	303%
England	19,872	30,760	55%	England	1,733	6,862	296%
Japan	35,897	53,409	49%	Belgium	486	1,691	248%
Finland	4,056	5,980	47%	Slovenia	107	361	239%
Belgium	7,920	11,377	44%	Finland	557	1,799	223%
Malta	75	87	15%	Cyprus	5	15	221%
Hong Kong	470	233	-51%	Hong Kong	261	240	-8%

HDVA = domestic value added from high-income countries, LDVA = domestic value added from low-income countries, US = United States.

Source: Authors' own calculation using data from the Organisation for Economic Cooperation and Development-Inter-Country Input–Output Tables. https://www.oecd.org/sti/ind/inter-country-input-output-tables.htm (accessed 10 October 2018).

Table A3: Results of Gravity Regression for Instrumental Variables

VARIABLES	(1) lnFVA	(2) lnDVA
lnReporter_Sectorsize	1.007***	0.946***
	(0.000359)	(0.000413)
lnPartner_sectorsize	0.861***	0.853***
	(0.000331)	(0.000380)
lnDIST	-0.976***	-0.997***
	(0.000554)	(0.000638)
contig	0.379***	0.299***
	(0.00177)	(0.00202)
comlang_off	0.226***	0.259***
	(0.00131)	(0.00151)
colony	0.356***	0.393***
	(0.00182)	(0.00209)
comcur	-0.285***	-0.243***
	(0.00164)	(0.00187)
fta_wto	0.0428***	0.0561***
	(0.00101)	(0.00116)
Constant	-14.67***	-16.14***
	(0.00848)	(0.00976)
Reporter FE	Yes	Yes
Partner FE	Yes	Yes
Reporter sector FE	Yes	Yes
Partner sector FE	Yes	Yes
Year FE	Yes	Yes
Observations	20,534,475	20,185,087
R-squared	0.861	0.838

Standard errors in parentheses

DVA = domestic value added, FVA = foreign value added, FE = fixed effects.
Source: Authors' own estimation.

Table A4: Basic Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
TFPgrowth	7,807	-4.12E-12	0.212671	-2.48898	3.562214
lnFVA1	7,807	6.216315	1.978956	-4.5706	11.24841
lnHFVA1	7,807	5.969777	1.998497	-4.68362	11.05227
lnLFVA1	7,807	4.507337	2.0082	-6.80671	9.743081
lnFVA2	7,807	6.216315	1.978956	-4.5706	11.24841
lnHFVA2	7,807	5.969777	1.998497	-4.68362	11.05227
lnLFVA2	7,807	4.507337	2.0082	-6.80671	9.743081
lnivFVA	7,807	5.979525	2.035241	-1.90103	11.53021
lnivHFVA	7,807	5.812453	2.060275	-2.09342	11.45707
lnivLFVA	7,807	3.824725	1.971285	-3.95846	9.922116
lnDVA1	7,807	5.447414	1.979449	-2.55211	10.42475
lnHDVA1	7,807	5.203085	1.969275	-2.62068	9.868663
lnLDVA1	7,807	3.598223	2.167287	-5.2661	9.891907
lnDVA2	7,807	5.447414	1.979449	-2.55211	10.42475
lnHDVA2	7,807	5.203085	1.969275	-2.62068	9.868663
lnLDVA2	7,807	3.598223	2.167287	-5.2661	9.891907
lnivDVA	7,807	4.908738	2.06986	-2.68408	10.03172
lnivHDVA	7,807	4.693943	2.092125	-2.83233	9.959278
lnivLDVA	7,807	2.866839	2.093287	-4.91108	8.467633

Max = maximum, Min = minimum, Obs = observations, Std Dev = standard deviation.
Source: Authors' own calculation.

Table A5: Correlation Coefficients

	TFPgro~h	lnFVA1	lnHFVA1	lnLFVA1	lnFVA2	lnHFVA2	lnLFVA2	lnivFVA	lnivHFVA	lnivLFVA	lnDVA1	lnHDVA1	lnLDVA1	lnDVA2	lnHDVA2	lnLDVA2	lnivDVA	lnivHDVA	lnivLDVA
TFPgrowth	1																		
lnFVA1	-0.0048	1																	
lnHFVA1	-0.0027	0.9966	1																
lnLFVA1	-0.0167	0.9615	0.9386	1															
lnFVA2	-0.0048	1	0.9966	0.9615	1														
lnHFVA2	-0.0027	0.9966	1	0.9386	0.9966	1													
lnLFVA2	-0.0167	0.9615	0.9386	1	0.9615	0.9386	1												
lnivFVA	0.0141	0.9514	0.9519	0.9053	0.9514	0.9519	0.9053	1											
lnivHFVA	0.0158	0.9457	0.9486	0.8912	0.9457	0.9486	0.8912	0.9979	1										
lnivLFVA	-0.0018	0.9211	0.9092	0.9246	0.9211	0.9092	0.9246	0.9428	0.9207	1									
lnDVA1	0.0032	0.9003	0.8954	0.875	0.9003	0.8954	0.875	0.9034	0.8966	0.8891	1								
lnHDVA1	0.0058	0.8999	0.8991	0.8593	0.8999	0.8991	0.8593	0.9062	0.9048	0.8656	0.994	1							
lnLDVA1	-0.0135	0.8291	0.812	0.8563	0.8291	0.812	0.8563	0.8289	0.8081	0.8909	0.9465	0.9097	1						
lnDVA2	0.0032	0.9003	0.8954	0.875	0.9003	0.8954	0.875	0.9034	0.8966	0.8891	1	0.994	0.9465	1					
lnHDVA2	0.0058	0.8999	0.8991	0.8593	0.8999	0.8991	0.8593	0.9062	0.9048	0.8656	0.994	1	0.9097	0.994	1				
lnLDVA2	-0.0135	0.8291	0.812	0.8563	0.8291	0.812	0.8563	0.8289	0.8081	0.8909	0.9465	0.9097	1	0.9465	0.9097	1			
lnivDVA	0.0083	0.8614	0.8581	0.8325	0.8614	0.8581	0.8325	0.908	0.902	0.8791	0.9638	0.9587	0.9171	0.9638	0.9587	0.9171	1		
lnivHDVA	0.0105	0.8572	0.8572	0.8156	0.8572	0.8572	0.8156	0.909	0.9098	0.8494	0.9571	0.9613	0.8869	0.9571	0.9613	0.8869	0.9938	1	
lnivLDVA	-0.0118	0.7957	0.7799	0.8192	0.7957	0.7799	0.8192	0.8135	0.7867	0.903	0.9155	0.8817	0.9539	0.9155	0.8817	0.9539	0.9357	0.8955	1

Source: Authors' own calculation.

Table A6: Correspondence between International Standard Industrial Classification Revision 3 (United Nations Industrial Development Organization Industrial Statistics Database 2) and the Organization for Economic Cooperation and Development-Inter-Country Input–Output Tables

No	ISIC(UNIDO)	ISIC_Description(UNIDO)	Sectors(ICIO)	Sectors_Description(ICIO)
1	15	Food and beverages	C15T16	Food products, beverages and tobacco
	16	Tobacco products	C15T16	Food products, beverages and tobacco
2	17	Textiles	C17T19	Textiles, textile products, leather and footwear
	18	Wearing apparel, fur	C17T19	Textiles, textile products, leather and footwear
	19	Leather, leather products and footwear	C17T19	Textiles, textile products, leather and footwear
3	20	Wood products (excl. furniture)	C20	Wood and products of wood and cork
4	21	Paper and paper products	C21T22	Pulp, paper, paper products, printing and publishing
	22	Printing and publishing	C21T22	Pulp, paper, paper products, printing and publishing
5	24	Chemicals and chemical products	C24	Chemicals and chemical products
6	25	Rubber and plastics products	C25	Rubber and plastics products
7	26	Non-metallic mineral products	C26	Other non-metallic mineral products
8	27	Basic metals	C27	Basic metals
9	28	Fabricated metal products	C28	Fabricated metal products
10	29	Machinery and equipment n.e.c.	C29	Machinery and equipment, nec
11	30	Office, accounting and computing machinery	C30T33X	Computer, electronic and optical equipment
	32	Radio,television and communication equipment	C30T33X	Computer, electronic and optical equipment
	33	Medical, precision and optical instruments	C30T33X	Computer, electronic and optical equipment
12	31	Electrical machinery and apparatus	C31	Electrical machinery and apparatus, nec
13	34	Motor vehicles, trailers, semi-trailers	C34T35	Transport equipment
	35	Other transport equipment	C34T35	Transport equipment

excl. = excluding, ICIO = Inter-Country Input–Output Tables, ISIC = International Standard Industrial Classification, nec = not elsewhere classified, UNIDO = United Nations Industrial Development Organization.
Source: Authors' compilation.

Table A7: Sample Countries

34 High-income countries (Developed countries)						13 Low- and middle-income countries (Developing countries)	
Country name	ISO3	Country name	ISO3	Country name	ISO3	Country name	ISO3
Australia	AUS	Ireland	IRL	Republic of Korea	KOR	Bulgaria	BGR
Austria	AUT	Israel	ISR	Singapore	SGP	Chile	CHL
Belgium	BEL	Italy	ITA	Slovakia	SVK	Croatia	HRV
Hong Kong	HKG	Japan	JPN	Slovenia	SVN	India	IND
Cyprus	CYP	Latvia	LVA	Spain	ESP	Indonesia	IDN
Czechia	CZE	Lithuania	LTU	Sweden	SWE	Malaysia	MYS
Denmark	DNK	Luxembourg	LUX	United Kingdom	GBR	Mexico	MEX
Estonia	EST	Malta	MLT	United States	USA	Morocco	MAR
Finland	FIN	Netherlands	NLD			Philippines	PHL
France	FRA	New Zealand	NZL			Romania	ROU
Germany	DEU	Norway	NOR			Tunisia	TUN
Greece	GRC	Poland	POL			Turkey	TUR
Hungary	HUN	Portugal	PRT			Viet Nam	VNM

GNI = gross national income.
Source: Authors’ compilation.

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