



The Impact of the Outward and Inward FDI on Global Value Chains

Hang Su, Yao Fu*

College of International Economics and Trade, Dongbei University of Finance and Economics, Dalian, China.

*Email: fyilinda9441@163.com

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ABSTRACT

What kind of trade agreements should a country choose? Regional trade agreements, multilateral trade agreements, or both? What's the role of a country's outward foreign direct investment (OFDI) and foreign direct investment (FDI) in its participation and position in global value chains (GVCs)? Is a country's research and development spending conducive to breaking the "low-end locking" of FDI? Based on the World Input-Output Tables (WIOTs) released in 2016, this paper computes the indicators of GVC participation and position and identifies the feature of the production division, providing a reference for promoting regional and multilateral trade agreements. This paper uses feasible generalized least squares (FGLS) and system generalized method of moments (SYS-GMM) to examine the impact of a country's outward and inward FDI on its GVC participation and position. The empirical results imply that a country's OFDI promotes its GVC participation and fosters its upgrading within industries in GVCs, while FDI inhibits the upgrading of GVCs, though it promotes a country's GVC participation. In addition, a country's research and development spending can be conducive to breaking the "low-end locking" effect of FDI.

Keywords: Outward Foreign Direct Investment, Inward Foreign Direct Investment, Global Value Chains, World Input-Output Tables, Feasible Generalized Least Squares

JEL Classifications: C33, F21

1. INTRODUCTION

Global value chains (GVCs) are a powerful driver of productivity growth, job creation, and increased living standards. GVCs give an impetus to development and growth (Humphrey and Schmitz, 2002). How countries engage with GVCs determines how much they benefit from them. With GVC-driven development, countries generate growth by moving to higher-value-added tasks and by embedding more technology and know-how in all their agriculture, manufacturing, and services production. In order to benefit from value chain participation, countries are also supposed to put in place the right kind of trade and investment policies and seize the opportunity to leap-frog their development process.

The GVC position and participation of countries are increasingly linked to the ability to conduct more and better outward foreign direct investment (OFDI) and attract higher quality foreign direct

investment (FDI) (Amendolagine et al., 2019; Martínez-Galán et al., 2019). Given the booming of integrated production systems spanning several countries and the application of advanced technology and sophisticated skills in international production, it is important for countries to conduct OFDI and attract high quality FDI, which contributes to the optimal allocation of production factors in global markets and the upgrading of GVCs.

In fostering the upgrading of global value chains, FDI plays a positive role, while it can also play a negative role due to its "low-end locking" effect. This paper examines the effect of FDI on global value chains and introduces the interaction between FDI and research and development spending to figure out whether a country's research and development spending is conducive to breaking the "low-end locking" effect of FDI and raising a country's position in the global value chains. This paper also examines the effect of OFDI on global value chains and sheds

lights on the ways a country promotes its global value chain participation and fosters its upgrading within industries in global value chains.

The remaining part of the study is structured as follows: Section 2 presents a review of the literature. The analytical framework and data sources are discussed in Section 3. Section 4 presents results and discussion, and the final Section 5 concludes.

2. LITERATURE REVIEW

There is considerable literature on the impact of a country's OFDI on its industrial upgrading, and some suggest that as one of the determinants of OFDI, the technology-seeking objective enables enterprises conducting OFDI to seek the advanced technologies and strategic resources which can not be obtained in their domestic markets (Deng, 2007), thus enhancing their technological strength and further promoting the domestic industrial upgrading (Neven et al., 1996; Wu and Huang, 1997), while some analyze the reverse technology spillover effect of OFDI (Branstetter, 2000; Pottelsberghe and Lichtenberg, 2001; Zhao and Liu, 2008).

The notion of reverse technology spillovers of OFDI put forward by Kogut and Chang (1991) is different from the technology-seeking effect illustrated above, as reverse technology spillover emphasizes the potential and intangible influence of countries with technological advantages on the technology transfer in the investment, during which process the enterprises conducting OFDI often do not have to pay the cost of technology learning. Kogut and Chang put forward this notion by studying Japanese companies' investments in the United States. It argues that the reverse technology spillover effect of OFDI can also increase the total factor productivity, promote exports, improve the innovation of enterprises, and contribute to their technological progress (Mao and Xu, 2014).

Focusing on the role of direct investment in the upgrading of global value chains which can be quantified based on non-competitive input-output tables¹, Li and Zhang (2017), and Yang and Li (2018) measure the GVCs and find that there is a positive effect of direct investment on a country's position in the global value chains. Compared with the export complexity index and the vertical specialization share (VSS), the KPWW² based on non-competitive input-output tables further divides a country's domestic value-added into additional components that reveal the destination of a country's exported value added, including its own value-added that returns home in its imports.

However, OFDI also has a "crowding-out effect," causing a decrease in the domestic investment and having a negative impact on domestic technological progress brought about by investments.

- 1 Different from the competitive input-output table, the intermediate products of the non-competitive input-output tables are distinguished according to the source (export and domestic production).
- 2 Koopman, R., Powers, W., Wang, Z. (2010), Give Credit Where Credit Is Due-Tracing Value Added in Global Production Chains. National Bureau of Economic Research. The KPWW method is named using the capital letter of the authors' names of the above mentioned paper.

In addition, the technology gap between enterprises in some cases is too large to make a reverse technology spillover play a part. For these two reasons, the effect of the reverse technology spillover of OFDI on technology upgrading may not be obvious or significant. FDI can raise the position of a country's manufacturing industry in global value chain by increasing the inflow of foreign intermediate products, but FDI may also hinder the upgrading of manufacturing in global value chain through the competitive effect of imported intermediate products and the low-end locking effect (Tang and Zhang, 2017).

Based on the literature above, the role of the outward and inward FDI in the upgrading of GVCs is a mixed one, and the evidence is not adequate on the impact of outward and inward FDI on the global value chain participation. This paper examines the effect of outward and inward FDI on global value chains and also presents whether a country's research and development spending is conducive to breaking the "low-end locking" effect of FDI and raising a country's position in the global value chains.

3. DATA AND METHODOLOGY

3.1. GVC Indicators

Based on the decomposition of gross exports, Koopman et al. (2010) constructs indicators that imply a country's global value chain participation and position, namely the GVC participation index and the GVC position index. The GVC participation index is defined as follows:

$$Gvc_participation = (IV+FV)/E \quad (1)$$

Where $Gvc_participation$ denotes a country's participation in global value chain production networks. IV is the indirect domestic value added, FV is the foreign value added, and E denotes total exports. The indirect domestic value added in a country's total exports can be defined as (I) in the Table 1.

$$Gvc_position = \ln(1+IV/E) - \ln(1+FV/E) \quad (2)$$

Where $Gvc_position$ denotes a country's position in global value chain production networks. The GVC position index indicates the gap between a country's indirect value-added exports and foreign value-added exports. The higher the index, the more intermediate goods the country exports to the rest of the world, indicating that the country is likely to be in the upstream of the global value chain.

It can be noted that the GVC indicators computed above imply a country's position and participation in GVCs, but they can't tell whether the GVCs the countries participate in tend to be "regional" or "global." The index constructed by Los et al. (2015) indicates whether the value chain is featured by the regional production division or the global production division, based on which it can be implied that whether a country should promote regional or multilateral trade agreements in order to increase its welfare. If the value chain is dominated by the regional production division, regional trade agreements are a better choice to help improve welfare under the value chain trade. If the value chain is dominated by a global one, a multilateral trade

Table 1: Gross exports decomposition

Gross exports (E)					
Domestic value-added			Foreign value-added (FV)		
Domestic value-added embodied in exports of final goods and services absorbed by the direct importer	Domestic value-added embodied in intermediate inputs used by the direct importer to produce its domestically needed products	Domestic value-added embodied in intermediate exports used by the direct importer to produce goods for third countries (I)	Domestic value-added embodied in intermediate exports used by the direct importer to produce goods shipped back to source	Value-added from foreign countries embodied in exports of final goods	Value-added from foreign countries embodied intermediate in exports

This table presents the gross exports decomposition. The decomposition method by Koopman et al. (2010) and Wang et al. (2015) is employed

agreement is a better choice to help improve the welfare (Los et al., 2015). Los et al. (2015) expand the method of Feenstra and Gordon (1999) and the multinational division of production, and further examine the feature of a country’s participation in the value chain based on the distribution of final product value-added among countries participated in the global production network which is represented typically by the Asia Factory, the North America Factory, and the Europe Factory (Baldwin and Lopez-Gonzales, 2013).

The function is set as follows:

$$FINO(i, j) = \sum_k VA(k)(i, j) \tag{3}$$

Where FINO(i,j) denotes the final output value of product (i,j), and VA(k)(i,j) denotes the value added by country k in its production.

$$FVA(i, j) = \sum_{k \neq j} VA(k)(i, j) = FINO(i, j) - \sum_k VA(j)(i, j) \tag{4}$$

Where FVA(i,j) is defined as all value added outside the country-of-completion of product (i,j).

$$FVAS(i, j) = FVA(i, j) / FINO(i, j) \tag{5}$$

The importance of foreign value added is expressed as a share of all value added in production of (i,j), presented by FVAS(i,j). It should also be noted that FVA can be decomposed into regional foreign value added (RFVA) and global foreign value added (GFVA).

$$RFVA(i, j) = \sum_{k \in \text{region of } j} VA(K)(i, j) - VA(j)(i, j) \tag{6}$$

Where RFVA(i,j) in the value of product i with country j as country-of-completion is defined as the value added contribution of the region to which country j belongs minus the contribution of the country itself.

The share of RFVA in the value chain of (i,j) is defined as:

$$RFVAS(i, j) = RFVA(i, j) / FINO(i, j) \tag{7}$$

The global value added is defined as the value added contribution of all countries outside the region of country j:

$$GFVA(i, j) = \sum_{k \in \text{outsideregion of } j} VA(K)(i, j) \tag{8}$$

The share of GFVA in the value chain of (i,j) is defined by:

$$GFVAS(i, j) = GFVA(i, j) / FINO(i, j) \tag{9}$$

3.2. Research Model

$$GVC_POS_{it} = \beta_0 + \beta_1 OFDI_{it} + \gamma X_{it} + \alpha_i + \lambda_t + \epsilon_{it} \tag{10}$$

Where the subscript i denotes country and t denotes year. Dependent variable GVC_POS_{it} represents global value chain position. OFDI (OFDI_{it}) is employed as independent variable. X_{it} represents control variables, including FDI (FDI_{it}) market size (GDP_{it}), natural resource abundance (RES_{it}), institutional quality (INS_{it}), technology and innovation capacity (TEC_{it}), and human resource endowment (HR_{it}). α_i is the fixed effect of the country, λ_t controls the time trend, and ε_{it} is the random error term.

In order to examine the impact of OFDI technology reverse spillover and FDI technology spillover on the participation and the position of global value chains, this paper introduces interaction (ODTEC_{it}) between OFDI (OFDI_{it}) and technology and innovation capacity (TEC_{it}) on the basis of formula (10) and interaction (FDTEC_{it}) between FDI (FDI_{it}) and technology and innovation capacity (TEC_{it}) on the basis of formula (10):

$$GVC_POS_{it} = \beta_0 + \beta_1 \ln OFDI_{it} + \beta_1 \ln ODTEC_{it} + \gamma X_{it} + \alpha_i + \lambda_t + \epsilon_{it} \tag{11}$$

$$GVC_POS_{it} = \beta_0 + \beta_1 \ln OFDI_{it} + \beta_1 \ln FDTEC_{it} + \gamma X_{it} + \alpha_i + \lambda_t + \epsilon_{it} \tag{12}$$

To examine the impact of OFDI on the global value chain participation, GVC_PAR_{it} is adopted to represent the dependent variable:

$$GVC_PAR_{it} = \beta_0 + \beta_1 \ln OFDI_{it} + \gamma X_{it} + \alpha_i + \lambda_t + \epsilon_{it} \tag{13}$$

To examine the impact of OFDI technology reverse spillover and FDI technology spillover on the participation of global value chains, this paper introduces interaction item (ODTEC_{it}) between

OFDI ($OFDI_{it}$) and technology and innovation capacity (TEC_{it}) on the basis of formula (13) and interaction item ($FDTEC_{it}$) between FDI (FDI_{it}) and technology and innovation capacity (TEC_{it}) on the basis of formula (13):

$$GVC_PAR_{it} = \beta_0 + \beta_1 \cdot \ln OFDI_{it} + \beta_2 \cdot \ln ODTEC_{it} + \gamma \cdot X_{it} + \alpha_i + \lambda_t + \varepsilon_{it} \tag{14}$$

$$GVC_PAR_{it} = \beta_0 + \beta_1 \cdot \ln OFDI_{it} + \beta_2 \cdot \ln FDTEC_{it} + \gamma \cdot X_{it} + \alpha_i + \lambda_t + \varepsilon_{it} \tag{15}$$

3.3. Variables

(1) Global value chain position (POS) and global value chain participation (PAR): Based on the gross export decomposition (Koopman et al., 2010), and the methods of Cen (2015) and Wang et al. (2015), this paper calculates the GVC participation and position indices, which are adopted to represent a country’s global value chain participation and global value chain position, respectively.

(2) Outward foreign direct investment (OFDI): OFDI can be conducted to obtain strategic resources, break the “low-end locking,” and thus foster the upgrading of the value chain (Li et al., 2017). Strategic resources tend to be featured by the incompleteness of the external market, so alliance learning becomes the main way to obtain this resource (Barney, 1991). Compared to FDI, OFDI enables investors to have better access to strategic resources. This paper selects the stock of OFDI to measure OFDI, according to Liu et al. (2017).

(3) Foreign direct investment (FDI): FDI can raise the position of a country’s manufacturing industry in global value chain by increasing the inflow of foreign intermediate products, but FDI may also hinder the upgrading of manufacturing in global value chain through the competitive effect of imported intermediate products and the low-end locking effect (Tang and Zhang, 2017). This paper takes the stock of foreign direct investment in various countries as the sample.

(4) Market size (GDP): This paper selects a country’s GDP level as an indicator to measure the country’s market size, according to Wheeler et al. (1992). This paper uses the GDP based on the constant dollar price in 2015.

(5) Human resource endowment (HR): This paper uses the secondary school enrollment rate as a measure of human resource endowment with reference to Li et al. (2018).

(6) Natural resource endowment (RES): This paper measures a country’s natural resource endowment using the share of host country ore, fossil fuel and metal exports in total exports, according to Buckley et al. (2007).

(7) Technology and innovation capacity (TEC): This paper uses the share of R & D costs in GDP of home country as a measure of a country’s technology and innovation capacity with reference to Chen et al. (2014).

(8) Institution quality (INS): This paper uses global governance indicators including Voice and accountability (VA), Political stability and absence of violence (PV), Government effectiveness (GE), Regulatory quality (RQ), Rule of law (RL), and Control of corruption (CC) to measure institution quality on a weighted average basis (Kaufmann et al., 2012).

3.4. Data

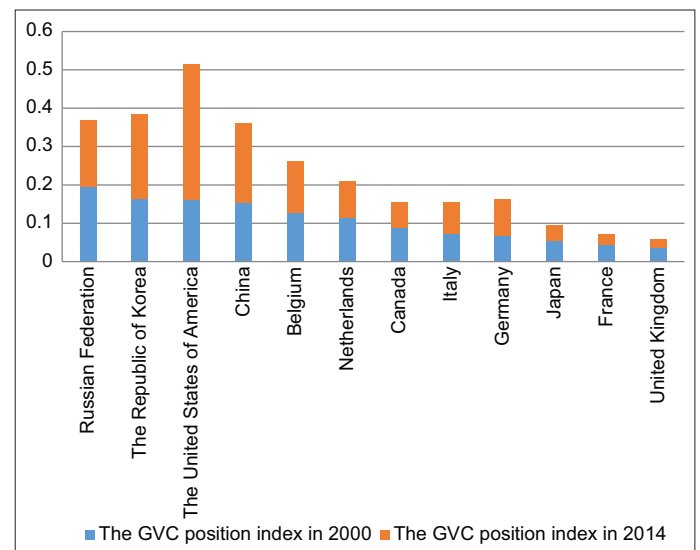
Global value chain participation and position indicators are computed based on the World Input-Output Tables (WIOTs) released in 2016. The newly released WIOTs in 2016 covers data from 56 industries in 43 economies from 2000 to 2014. The database provides data on the world’s major economies and is adopted in studies of global value chains and trade value added. The data of OFDI and FDI are collected from the United Nations Conference on Trade and Development Stat (UNCTAD). Market size (GDP) is collected from the United Nations Stats (UN). Natural resource endowment (RES) is collected from the World Bank Databank (WB). Technology and innovation capacity (TEC) and human resource endowment (HR) are collected from the UNESCO Institute for Statistics (UIS). Institution quality (INS) is calculated based on the Worldwide Governance Indicators (WGI). Voice and accountability (VA), Political stability and absence of violence (PV), Government effectiveness (GE), Regulatory quality (RQ), Rule of law (RL) and Control of corruption (CC) are collected from the Worldwide Governance Indicators (WGI).

4. RESULTS AND DISCUSSION

4.1. GVC Indicators

Figure 1 presents the GVC position index in the year 2000 and 2014. In the year 2000, Russia stands top in the GVC position

Figure 1: The GVC position index



The GVC position index is calculated based on the World Input-Output Tables database (WIOTs) in 2000 and 2014. In this section, the ranking of twelve major exporting countries is presented. The twelve major exporting countries listed are collected based on the ranking in gross exports in 2013 from the United Nations Conference on Trade and Development (UNCTAD) database

index, followed by South Korea³, the United States, and China. It should be noted that, compared with other countries, the United States has witnessed a sharp increase in the GVC position index in 2014, making it stand at the top in the rankings in 2014. The top to low ranking of countries in GVC position index in 2000 is as follows (Figure 1): Russia, South Korea, the United States, China, Belgium, Netherlands, Canada, Italy, Germany, Japan, France, and United Kingdom.

Table 2 presents the changes in the ranking of countries in GVC position index over the period 2000-2014. Countries such as China, Germany, and Netherlands have seen an increase in their GVC position indices, indicating that these countries have gained a higher GVC position in the global production network. The GVC position index of Japan, France, United Kingdom, and other countries are relatively stable, while countries including Russia, Italy, Belgium and Canada have seen declines in the GVC position. The top to low ranking of countries in GVC position index in 2014 is as follows (Table 2): Russia, South Korea, the United States, China, Belgium, Netherlands, Canada, Italy, Germany, Japan, France, and United Kingdom.

The GVC indicators computed above imply a country's position and participation in GVCs, but they can't tell whether the GVCs the countries participate in are regionally or globally fragmenting. Table 3 shows that Belgium, Italy, China, Japan, South Korea, and Canada have seen an increase in their regional foreign value added shares in 2014, which means that the value chains of these countries are regionally fragmenting. While United Kingdom, Germany, France, Netherlands, and the United States have witnessed a decrease in their regional foreign value added shares.

It should also be noted that Belgium, United Kingdom, Germany, France, Netherlands, China, Japan, Germany, and the United States have had an increasing global share of foreign added value, which means that the value chains of these countries are globally fragmenting. This trend indicates that the shares of some countries such as Belgium, China, Japan, and Germany are increasing in two ways, at both regional and global level, suggesting that it can be more complicated for these countries to decide whether to promote regional or multilateral trade agreements so as to increase their welfare. However, this feature of the GVCs of these countries can also mean that they have more opportunities and options to benefit from the production division network, although they have to take more factors into account.

4.2. Empirical Results

This section discusses the empirical results. After computing GVC indicators, this paper proceeds to examine the impact of outward and inward FDI on the GVCs. Table 4 presents the description, sources of data, and descriptive statistics of the key variables employed.

As the data collected in this paper is long-panel data, the two-way fixed effect model is applied according to the long-panel data model assumption. In this paper, dummy variables are introduced to control individual effects and time trends. The basic regression

Table 2: The GVC position index

Year	2000	2010	2014
Belgium	0.1287 (5)	0.1343 (5)	0.1288 (6)
Canada	0.0889 (7)	0.0663 (9)	0.0799 (8)
China	0.1531 (4)	0.2071 (3)	0.2240 (3)
France	0.0421 (11)	0.0286 (11)	0.0318 (11)
Germany	0.0681 (9)	0.0948 (7)	0.0918 (7)
Italy	0.0724 (8)	0.0815 (8)	0.0716 (9)
Japan	0.0558 (10)	0.0397 (10)	0.0392 (10)
Netherlands	0.1140 (6)	0.0951 (6)	0.1467 (5)
The Republic of Korea	0.1641 (2)	0.2196 (2)	0.2287 (2)
Russian Federation	0.1955 (1)	0.1723 (4)	0.1675 (4)
United Kingdom	0.0371 (12)	0.0212 (12)	0.0295 (12)
The United States of America	0.1613 (3)	0.3518 (1)	0.3601 (1)

The GVC position index is calculated based on the World Input-Output Tables database (WIODs) over the period 2000-2014. The figures in the parentheses are the ranking of countries in the GVC position

is estimated using feasible generalized least squares (FGLS). To solve auto-correlation of error terms, heteroskedasticity, and cross-sectional correlation problems, standard errors corrected by panels are used.

Table 5a reports results for model (10), (11), and (12). In model (10), (11), and (12), the effects of OFDI and FDI on GVC positions (POS) are investigated. The results presented in columns (1), (2), and (3) show that the coefficients of OFDI are positive and statistically significant, indicating that the impact of OFDI is positive. This is in line with the expectations in theories, in which OFDI can be conducted to obtain strategic resources, break the "low-end locking," and thus foster the upgrading of the value chain (Li and Zhang, 2017). The coefficients of FDI are statistically significant and negative, indicating the negative impact of FDI. FDI can hinder the upgrading of manufacturing in global value chain through the competitive effect of imported intermediate products as well as the low-end locking effect, although it may also raise the position of a country's manufacturing industry in global value chain by increasing the inflow of foreign intermediate products (Tang and Zhang, 2017).

The results presented in Table 5a also show that the coefficient of the interaction (ODTEC) between OFDI and TEC is positive and statistically significant, indicating that the reverse technology spillover effect of OFDI is positive. Column (3) shows that the coefficient of the interaction (FDTEC) between FDI and TEC is positive, which implies that a country's high-tech innovation can be conducive to breaking the "low-end locking" effect of FDI, and raise a country's global value chain position. However, this mediating effect of TEC is offset by the negative effect of FDI.

The coefficients of the control variables in Table 5a are in line with expectations in theories. The impact of a country's market size (GDP) is positive. With the expansion of a country's economic scale, foreign exchange reserves increase, which attracts more foreign direct investment, and thus is conducive to fostering the upgrading of a country's global value chain. The impact of natural resource endowment (RES) is positive. A country with natural resource endowment has sufficient resource to promote

³ The Republic of Korea.

Table 3: Regional and global shares of FVAS (%)

Year	Belgium		Canada		China		France		Germany		Italy	
	2000	2014	2000	2014	2000	2014	2000	2014	2000	2014	2000	2014
FVAS	46	54.4	52.4	50.6	52.2	55.4	46.7	46.1	48.2	50.7	48.7	50.5
RFVAS	24	28.2	27.8	28.3	25.3	26.8	27.1	20.1	25.5	21.8	23.8	27.2
GFVAS	22	26.2	24.6	22.3	26.9	28.6	19.6	26.1	22.7	28.9	24.9	23.3
Year	Japan		Netherlands		United Kingdom		The United States of America		South Korea			
	2000	2014	2000	2014	2000	2014	2000	2014	2000	2014		
FVAS	46.7	48.8	52.2	57	47.6	45.3	44	43	53.8	57.6		
RFVAS	24.1	25.7	28.8	27.6	27.8	22.1	25.3	23.2	25.7	29.3		
GFVAS	22.6	23.1	23.4	29.4	19.8	23.2	18.7	19.8	28.1	28.3		

The index is calculated based on the World Input-Output Tables database (WIOTs) in 2000 and 2014

Table 4: Description, sources of data, and descriptive statistics

Variable	Description	Source	Mean	S.D.	Min	Max
PAR	Global value chain participation	WIOTs	0.7921	0.2408	0.6942	0.8457
POS	Global value chain position	WIOTs	0.1354	0.1082	0.1109	0.3728
OFDI	OFDI	UNCTAD	14.0987	1.3126	8.7918	15.7489
FDI	FDI	UNCTAD	12.8978	1.0891	10.0984	16.9732
GDP	Market size	UN	17.3524	1.0972	14.9321	18.6140
RES	Natural resource endowment	WB	13.6446	16.9873	1.7631	32.1879
TEC	Technology and innovation capacity	UIS	1.9821	0.6932	0.6137	3.9786
HR	Human resource endowment	UIS	1.7872	1.8318	0.4213	3.7341
INS	Institution quality	WGI	0.6933	0.2571	0.5324	0.8907
VA	Voice and accountability	WGI	0.7781	0.2141	0.5229	0.9842
PV	Political stability and absence of violence	WGI	0.6382	0.1627	0.4772	0.8760
GE	Government effectiveness	WGI	0.7973	0.3214	0.3017	0.9971
RQ	Regulatory quality	WGI	0.7991	0.2179	0.5152	0.9816
RL	Rule of law	WGI	0.7980	0.1057	0.4931	0.9074
CC	Corruption control	WGI	0.6701	0.1844	0.5122	0.9891

The data are collected from the World Input-Output Tables (WIOTs), the United Nations Conference on Trade and Development Stat (UNCTAD), the United Nations Stats (UN), the World Bank Databank (WB), the UNESCO Institute for Statistics (UIS), and the Worldwide Governance Indicators (WGI)

Table 5a: Basic regression results

Variables	(1)	(2)	(3)
	POS	POS	POS
OFDI	0.105*** (3.94)	0.107*** (4.41)	0.106*** (4.12)
FDI	-0.124*** (-4.71)	-0.122*** (-4.95)	-0.131*** (-4.92)
GDP	0.296*** (5.81)	0.301*** (4.52)	0.270*** (5.77)
RES	0.314*** (5.98)	0.320*** (5.73)	0.311*** (5.78)
TEC	0.231*** (3.62)	0.219*** (2.76)	0.240*** (2.51)
INS	-0.113*** (-9.76)	-0.108*** (-9.87)	-0.117*** (-10.12)
HR	-0.041 (-2.01)	-0.029 (-1.96)	-0.031 (-1.83)
ODTEC		0.067*** (2.26)	
FDTEC			0.082*** (3.16)
_cons	17.101*** (8.17)	16.291*** (7.90)	17.210*** (8.20)
N	210	210	210

t statistics in parentheses. * P<0.05,**P<0.01,***P<0.001

Table 5b: Basic regression results

Variables	(4)	(5)	(6)
	PAR	PAR	PAR
OFDI	0.098*** (2.16)	0.091*** (1.97)	0.092*** (2.01)
FDI	0.081*** (2.24)	0.079*** (2.31)	0.083*** (2.27)
GDP	-0.063*** (-2.51)	-0.065*** (-2.47)	-0.064*** (-2.53)
RES	-0.030*** (-1.74)	-0.027*** (-1.81)	-0.029*** (-1.70)
TEC	0.014*** (1.34)	0.016*** (2.02)	0.013*** (1.41)
INS	0.020 (1.03)	0.032 (1.42)	0.021 (1.06)
HR	-0.042 (-2.03)	-0.038 (-1.96)	-0.041 (-2.10)
ODTEC		0.023*** (2.26)	
FDTEC			0.031*** (1.91)
_cons	2.327*** (11.57)	2.218*** (11.41)	2.384*** (12.31)
N	210	210	210

t statistics in parentheses. * P<0.05,**P<0.01,***P<0.001

industrial development, which gives industrial development more opportunities to focus on the advancement of technology, and aim at technology rather than resources when conducting OFDI.

This is conducive to raising the position in global value chains. The impact of a country's ability of high-tech innovation (TEC) is positive. The improvement of technology and innovation can

Table 6a: Robustness test results

Variables	(1)	(2)	(3)
	POS	POS	POS
L.POS	0.812*** (5.32)	0.811*** (4.97)	0.814*** (5.96)
OFDI	0.072*** (1.88)	0.078*** (2.21)	0.074*** (2.03)
FDI	-0.083*** (-1.93)	-0.084*** (-1.81)	-0.079*** (-2.72)
GDP	0.086*** (2.26)	0.081*** (1.52)	0.085*** (1.81)
RES	0.051*** (1.23)	0.053*** (1.31)	0.046*** (1.21)
TEC	0.060*** (1.54)	0.055*** (1.47)	0.059*** (1.50)
INS	-0.026*** (-1.12)	-0.021*** (-1.01)	-0.024*** (-1.03)
HR	-0.027 (-1.21)	-0.022 (-1.32)	-0.034 (-1.47)
ODTEC		0.057*** (1.71)	
FDTEC			0.062*** (1.83)
AR (2) test p values	0.281	0.279	0.296
Sargan test p values	0.116	0.121	0.113
cons _	3.247 (1.17)	3.441 (1.61)	3.423 (1.58)
N	180	180	180

t statistics in parentheses. * P<0.05,**P<0.01,***P<0.001

Table 6b: Robustness test results

Variables	(4)	(5)	(6)
	PAR	PAR	PAR
L.PAR	0.863*** (5.58)	0.858*** (5.47)	0.861*** (5.63)
OFDI	0.077*** (1.57)	0.081*** (1.72)	0.073*** (1.24)
FDI	0.080*** (1.84)	0.086*** (1.91)	0.095*** (2.02)
GDP	-0.053*** (-1.31)	-0.051*** (-2.01)	-0.063*** (-2.16)
RES	-0.061*** (-1.73)	-0.072*** (-1.81)	-0.069*** (-1.65)
TEC	0.044*** (1.33)	0.050*** (1.53)	0.047*** (1.51)
INS	0.014*** (1.01)	0.012*** (1.44)	0.015*** (1.74)
HR	-0.103 (-1.28)	-0.051 (-1.06)	-0.070 (-1.12)
ODTEC		0.096*** (1.82)	
FDTEC			0.089*** (1.74)
AR (2) test p values	0.173	0.178	0.165
Sargan test p values	0.216	0.232	0.224
_cons	1.782 (1.58)	1.931 (1.72)	2.109 (2.98)
N	180	180	180

t statistics in parentheses. * P<0.05,**P<0.01,***P<0.001

increase the value added of its export products, and foster the upgrading of global value chains.

In Table 5b, columns (4), (5), and (6) report the results of the effects of OFDI and FDI on GVC participation (PAR). The results

presented in Table 5b show that the coefficients of OFDI and FDI are both significant and positive, which is in line with Li et al. (2017). In columns (5) and (6), the coefficients of the interaction are significant and positive, which implies that the ability of technology and innovation of a country has a positive mediating effect on a country's embedding in global value chain. It can be noted that the coefficient signs of the core variables remain the same when introducing control variables.

4.3. Robustness test

System generalized method of moments (SYS-GMM) is applied to test the robustness which can be used to solve endogeneity. The AR(1) and AR(2) test and Sargan test results all imply that the SYS-GMM is effective. Based on the basic regression model, the lagged variables are introduced. Table 6a presents the results which imply that the coefficients of the core variables basically remain the same.

Table 6a reports robustness test results for model (1), (2), and (3), in which the effects of OFDI and FDI on GVC positions (POS) are investigated. The results presented in Table 6a show that the coefficients of OFDI and FDI are statistically significant, indicating that the impact of OFDI is positive, while the impact of FDI is negative. The results presented in Table 6a also show that the coefficients of ODTEC and FDTEC are positive and statistically significant, indicating that the reverse technology spillover effect of OFDI and FDI is positive, which implies that a country's high-tech innovation can be conducive to raising a country's global value chain position.

In Table 6b, columns (4), (5), and (6) report the results of the effects of OFDI and FDI on GVC participation (PAR), which indicate that the coefficients of OFDI and FDI are both significant and positive. It can be noted that the coefficients of ODTEC and FDTEC are significant and positive, indicating that the mediating effect of the ability of technology and innovation of a country is positive.

5. CONCLUSION

A country's OFDI not only promotes its global value chain participation but also fosters its upgrading within industries in global value chains, while FDI inhibits the upgrading of global value chains, although FDI can promote a country's participation in the international fragmentation of production. The coefficient of interaction between a country's FDI and its technology and innovation capacity is positive, which indicates that a country's technology and innovation capacity has a positive mediating effect which is conducive to breaking the "low-end locking" effect of FDI and can raise a country's position in the global value chains. The shares of FVAS of some countries such as Belgium, China, Japan, and Germany are increasing in two ways, at both regional and global level, suggesting that it can be more complicated for these countries to decide whether to promote regional or multilateral trade agreements so as to increase their welfare. However, this feature of the GVCs of these countries can also mean that they have more opportunities and options to benefit from the production division network, although they have to take more factors into account.

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