

The impact of forward and backward GVC participation on China's OFDI in ASEAN*

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Abstract

This paper mainly studies the impact of forward and backward participation in ASEAN global value chains on China's investment in ASEAN. The results show that forward participation in global value chains is negatively correlated with China's investment in ASEAN, while backward participation is positively correlated. The technological advancement of ASEAN, the expansion of the number of highly educated labor force, the increase of consumer market consumption potential, the improvement of infrastructure, and the degree of openness of the market will attract and expand China's investment in ASEAN. This means that in addition to investment in ASEAN manufacturing, China can also promote investment in education, technology research and development, infrastructure construction, and tertiary industries in ASEAN countries. The labor cost of ASEAN countries is positively correlated with China's investment in ASEAN, while natural resources are negatively correlated. It is recommended

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that Chinese companies make full use of the abundant labor resources of ASEAN countries, reduce production costs, and appropriately develop markets according to local consumption habits as well as preferences, stimulate household consumption, and increase corporate profits. ASEAN countries need to strengthen opening up, improve infrastructure construction, attach importance to the training of high-tech talents, and attract more foreign investment, including China.

Key words: forward and backward GVC participation, OFDI, China, ASEAN

I. Introduction

1. China's OFDI and ASEAN

With the development of the global value chain (GVC), Adam Smith's view of "division of labor can improve efficiency" has been extended to the world. From the perspective of company productivity, the size of companies participating in global value chains (GVC) is more than twice that of companies participating in standard transactions.¹⁾ From the perspective of national income created, for every 1% increase in GVC participation rate, national income will be increased by more than 1%, while the growth rate of standard trade is only 0.2%. The World Development Index (WDI) data released by the World Bank shows that when countries participate in the global value chain of the primary manufacturing stage, the per capita GDP growth rate is the fastest.²⁾ The participation of manufacturing-based

1) Smith, A. (1937). *The wealth of nations* [1776] (Vol. 11937). na.

global value chains has increased China's total foreign trade by more than 37 times compared with the 1980s.³⁾

This paper chooses ASEAN as the research object of foreign investment, and focuses on the impact of the forward and backward participation of countries in the global value chain on China's foreign investment. The reasons for choosing ASEAN are as follows. First of all, ASEAN is an important global production base and emerging consumer market. By the end of 2019, the population was 660 million and the total economy was US\$3 trillion. Secondly, more than 90% of the commodities in the China-ASEAN Free Trade Area have achieved zero tariffs on both sides. In 2020, the total value of ASEAN's imports and exports to China reached 740.6 billion U.S. dollars, making it China's largest trading partner. As of 2017, the proportion of total value added at home and abroad in the region has increased from 49.23% in 2000 to 75.55%. This shows that the regional value chains of China and ASEAN manufacturing are internalized.⁴⁾ Third, at the level of GVC participation, ASEAN has a comparative advantage that China is losing in terms of labor, and surrounding production factors have reduced transportation costs. According to the theory of marginal industrial transfer, the upgrading of global value chains requires China to increase investment in ASEAN.⁵⁾

2) World Development Report 2020 : Trading for Development in the Age of Global Value Chains

3) The total value of China's trade imports and exports has increased from US\$20.6 billion in 1978 to US\$769.2 billion in 2020

4) The values are derived from table 1 in Zhang Yan's (2019) paper, "Changes in the proportion of trade added value within and outside China and ASEAN"

5) "ASEAN" refers to 10 countries: Malaysia, Philippines, Singapore, Indonesia, Thailand,

According to the United Nations Conference on Trade and Development's "World Investment Report 2020", global foreign direct investment (OFDI) reached US\$131 billion in 2019, and the stock of foreign direct investment was US\$34.57 trillion. In the past 20 years, China's foreign direct investment flow peaked in 2016, with an average growth rate of 26%.⁶⁾ In 2017, China's stock of foreign direct investment in ASEAN surpassed the EU for the first time, becoming China's (except Hong Kong) largest direct investment economy. At the end of 2019, China has also become the third largest source of foreign direct investment in ASEAN. In the past 15 years, the investment structure of China's foreign direct investment in ASEAN has been upgraded from the initial infrastructure investment to a manufacturing-based development model. In the process of investment transformation, from 2012 to 2015, China temporarily increased its investment in ASEAN leasing and business service industries. In 2015, leasing and business services became the first place in China's OFDI industry, accounting for 45.7% of OFDI flows and 25.7% of OFDI stock, followed by manufacturing, which accounted for 14.9% of OFDI. Subsequently, the focus of China's foreign direct investment shifted to manufacturing. In 2016, the manufacturing industry officially became the most important industry for China's direct investment in ASEAN. In 2018, China's investment in ASEAN manufacturing increased by 41.7% year-on-year, with an average growth rate of 22.9% in the past four years. At the end of

Brunei, Vietnam, Laos, Myanmar, Cambodia.

6) The flow of OFDI in China rose rapidly from US\$2.85 billion in 2003 to US\$196.2 billion in 2016, followed by a downward trend. In 2019, OFDI was US\$117.1 billion.

2019, China's stock of foreign direct investment in ASEAN manufacturing was US\$26.599 billion, accounting for 24.2% of ASEAN's stock of foreign direct investment and 43.5% of its foreign direct investment flow.

It can be seen from <Figure 1> that China's OFDI stock to ASEAN countries has shown a steady upward trend. However, China's massive investment in leasing and business services in 2015 made Singapore's growth trend significantly higher than other ASEAN countries. In addition, Indonesia is the largest economy in ASEAN, and the growth trend of China's foreign direct investment stock in Indonesia is significantly higher than that of other ASEAN countries. The Philippines, which is prone to frequent natural disasters, and Brunei, which is highly dependent on the oil and gas industry, has always had a low stock of foreign direct investment, and there has been no obvious growth trend in the past 15 years. In addition, China's OFDI flow to ASEAN exhibits irregular fluctuations. In 2015, China's investment in ASEAN leasing and business services was US\$674 million, a year-on-year increase of 438.6%, which was the most volatile among them. As China's main investment target, Singapore's OFDI has increased by 3.7 times compared with the past. Subsequently, China's foreign direct investment in ASEAN turned to manufacturing. The relative weakness of Singapore's manufacturing industry resulted in a 69.7% drop in investment compared to the previous year. In the same year, Malaysia, Vietnam and Thailand all achieved rapid growth due to foreign direct investment in manufacturing.

2. The concept of forward and backward GVC participation

The concept of global value chain (GVC) refers to the personnel, roles and activities involved in the production and supply, distribution and after-sales activities of goods and services. These activities must be coordinated across regions. GVC is similar to the value chain at the industry level, but includes operations at the global level. The value chain has been used to analyze international trade in the global value chain, which includes the product from its concept, design, procurement of raw materials and intermediate inputs, marketing, distribution, and its support to end consumers.⁷⁾

Koopman (2010) proposed the KWW method⁸⁾ and Zhi Wang (2015) continued to expand the total trade flow to bilateral and multilateral countries as well as industry levels, namely the WWW method⁹⁾, which greatly improved the accuracy of trade value added calculations. Backward GVC participation refers to the ratio of the “Foreign value added content of exports”(FVA)¹⁰⁾ to the economy's total gross exports. This is the “buyer” perspective or sourcing side in GVCs, where an economy imports intermediates to produce its

7) https://en.wikipedia.org/wiki/Global_value_chain

8) The export value-added decomposition method proposed by Koopman et al. in 2010. Koopman, R., Powers, W., Wang, Z., & Wei, S. J. (2010). Give credit where credit is due: Tracing value added in global production chains (No. w16426). National Bureau of Economic Research.

9) zhi Wang et al. (2015) used the method of decomposition of added value proposed by Koopman et al. (2010) to expand the total trade volume to bilateral and multilateral countries and the industry level to calculate the added value of product exports.

10) Foreign value-added content of exports corresponds to the value added of inputs that were imported in order to produce intermediate or final goods/services to be exported.

exports. Forward GVC participation corresponds to the ratio of the “Domestic value added sent to third economies”(DVA)¹¹⁾ to the economy's total gross exports. It captures the domestic value added contained in inputs sent to third economies for further processing and export through value chains. This is the “seller” perspective or supply side in GVC participation.¹²⁾

If a country is located upstream in the global value chain, it can participate by providing raw materials or manufactured intermediate products to other countries. For such a country, the share of its indirect value-added exports (IV) in total exports will be higher than its share of foreign value added (FV). In contrast, if a country is located downstream in the global value chain, it will use a large part of the intermediates from other countries to produce final products for export, and its FV share will be higher than its IV share. ¹³⁾¹⁴⁾ Koopman (2010) proposed the indicator GVC_Position to measure whether a country is located upstream or downstream in the value chain. GVC_participation is used to weigh a country's participation in the value chain.

11) Domestic value added re-imported in the economy refers to the domestic value added of exported intermediates, or inputs, that is sent back to the economy of origin as embodied in other intermediates and used to produce exports. Such a value added round-trip between two (or more) economies highlights the domestic value added content present in an economy's imports.

12) Source: OECD TiVA Database

13) Koopman, R., Powers, W., Wang, Z., & Wei, S. J. (2010). Give credit where credit is due: Tracing value added in global production chains (No. w16426). National Bureau of Economic Research.

14) Wang Zhi, Wei Shangjin, & Zhu Kunfu. (2015). Total Trade Accounting: Official Trade Statistics and Measurement of Global Value Chains. Chinese Social Sciences, 9, 108-127.

$$GVC_{forward\ participation} = \frac{IV_{ir}}{E_{ir}}$$

$$GVC_{backward\ participation} = \frac{FV_{ir}}{E_{ir}}$$

In the formula, IV_{ir} represents the domestic value-added part of r industry exports in country i ; IV_{ir}/E_{ir} represents forward participation, which measures the proportion of a country's intermediate products in total exports; FV_{ir} represents the foreign value-added part of r industry exports in country i . FV_{ir}/E_{ir} represents backward participation, which measures the proportion of intermediate goods imported from abroad in a country's exports. Generally, if a country's forward participation is greater than backward participation, it means that the country mainly provides raw materials or intermediate products abroad, which means that the country is located relatively upstream of the GVC. If forward participation is less than backward participation, it means that the country's supply chain is highly dependent on foreign intermediate products.¹⁵⁾

Many ASEAN countries' exports have created added value for the country and accounted for a large part of the gross domestic product. However, part of the exports also contributed to foreign countries. It can be seen from figure 2 that the average contribution rate of the ten ASEAN countries in 2018 was only about 33%, and only Thailand, Singapore, Malaysia and Brunei were above the average.

15) Li Yuan, Li Mengjia, & Feng Rongkai. (2020). Research on the embedded effect of OFDI on China's global value chain. *Journal of Shenyang University of Technology (Social Science Edition)*, 13(2), 119-124.

The domestic value added of the ten ASEAN countries is generally higher than that of foreign value added. In fact, higher foreign value added may lead to higher economic growth rates. In 1990, 38% of ASEAN's exports were added value created by foreign countries. In the past 20 years, ASEAN countries have used a large amount of foreign investment in their exports. Moreover, the domestic value-added part of exports occupies a large proportion of the ten ASEAN countries. This trend has not declined significantly in the past 20 years. More domestic trade value-added means that the competitiveness of the ASEAN region has been improved (as shown in figure 2).

From the perspective of the proportion of trade value added in the global value chain, the domestic value added of the ten ASEAN countries is generally higher than the foreign value added, which shows that most of the domestic value added of the ten ASEAN countries are exported to third countries as intermediate products. The foreign added value of the 10 ASEAN countries is generally less than 50%, which shows that the ASEAN supply chain is highly dependent on foreign intermediate products. In addition, the forward participation and backward participation of the ten ASEAN countries are not high. The forward participation level of countries is relatively concentrated, and the backward participation level shows a certain degree of differentiation. And the country with the highest participation rate reached 44.5%, while the country with the low participation rate was only 3.15% (as shown in figure 3 & 4).

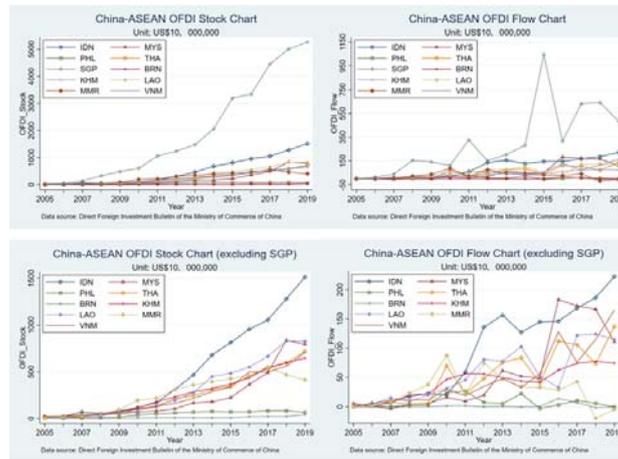


Fig.1 China-ASEAN OFDI¹⁶⁾

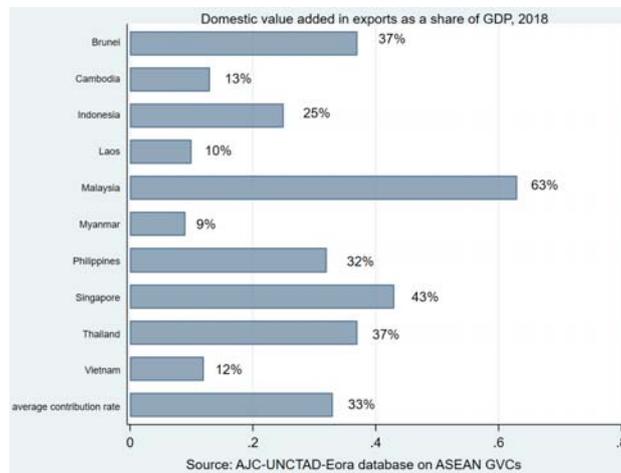


Fig.2 DVA in exports as a share of GDP, 2018

16) data source: Foreign Direct Investment of the Ministry of Commerce of China.
<http://www.mofcom.gov.cn/article/tongjiziliao/dgz/>

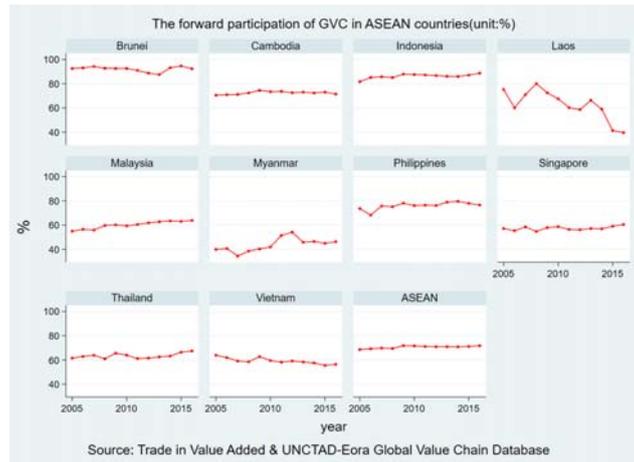


Fig.3 The forward participation of GVC in ASEAN

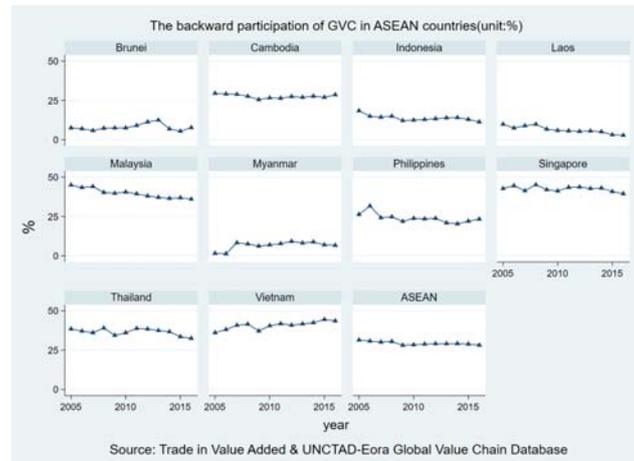


Fig.4 The backward participation of GVC in ASEAN

II. Literature review

There are many previous studies on China's outward direct

investment in the ten ASEAN countries and the analysis of the ten ASEAN countries' participation in global value chains. This research mainly reviews previous studies from two perspectives: the factors influencing China's foreign direct investment in the ten ASEAN countries and the status of ASEAN's participation in global value chains.

Research on the Factors Influencing the Location Choice of OFDI in China are as follows. Based on the cross-country panel data of the 20 oil resource countries along the "Belt and Road" from 2000 to 2016, Hui Ning(2018) analyzed the factors affecting the investment of Chinese oil companies from the perspectives of the home country and host country. China's economic environment, domestic oil supply, and oil prices have a significant impact on China's foreign oil investment cooperation, while the industrial environment and domestic oil demand have no significant impact on Chinese oil companies' foreign investment. The petroleum resource endowment and infrastructure of the host country are significantly related to the location selection of Chinese oil companies for foreign direct investment, and the distance cost is significantly negatively correlated, and political stability has no significant impact on the investment of Chinese oil companies. Jingjing Wang(Wang 2017) mainly research the influence of location choice of China's agricultural foreign direct investment factors and the decision-making process and results of reasonable location selection. The results show that the international environment is the most basic aspect; the investment country factors that affect the location of China's agricultural foreign direct investment include policy factors and the level of agricultural

economic development; host country factors include agricultural natural resources, labor force quantity and quality, infrastructure, and stability. Economic cooperation relationship, social and cultural “distance”, corporate investment motivation, competitive advantage, scale and overseas investment experience, industry selection and entry methods, etc. Based on China's panel data of countries and regions along the “Belt and Road” from 2007 to 2017, Anqi Zhai(Zhai 2019) adopted a random effects model for regression analysis. The empirical results show that China and the host country's gross domestic product, total import and export volume, host country's infrastructure and the level of the rule of law have promoted China's direct investment in countries along the “Belt and Road” and non-“Belt and Road” countries. Yuanfei kang(kang et al., 2012) investigated the factors determining foreign direct investment (FDI) location choices of Chinese multinational firms and developed a conceptual framework that synthesizes traditional economic factors and institutional perspective. The empirical results showed that the FDI location choices of Chinese firms have a dynamic nature, as statistical evidence indicates a heterogeneous response of Chinese FDI towards different economic groups and during different time periods. Based on the driving model and the division of labor, Pei Yu(Yu et al., 2020) analyzed how China's foreign direct investment affected the development of the host country's manufacturing GVC. The results of panel data analysis of 26 EU member states and 13 manufacturing sub-sectors from 2003 to 2014 showed that high-tech level, human capital, and huge market potential are important factors that affect the location of China's foreign direct investment. Higher levels of

vertical specialization and the host country's manufacturing GVC status sub-industries have attracted the inflow of Chinese investment. Wenbin Sun(Sun 2019) selected four aspects of economics, politics and law, infrastructure and environment as the empirical analysis index data, and analyzed the investment status and related data of 29 countries in the African region and the 6 countries with the most investment from China from 2006 to 2017. The results show that China tends to invest in countries with large market scale and high degree of opening to the outside world. It also attaches great importance to the rule of law and political stability of African countries. In addition, China also shows a certain tendency of resource preference when investing in African countries.

In terms of the participation of GVCs in the ten ASEAN countries, Yamaguchi Ayako(Ayako 2018) analyzed the participation of the ten ASEAN countries in the global value chain based on the statistical data of value-added trade. The result shows that in ASEAN, the traditional vertical transformation is that Japan exports high value-added parts, while ASEAN countries assemble these parts into finished products. But in addition to traditional vertical specialization, In order to enjoy the benefits of centralized production scale, ASEAN has joined an increasingly complex global value chain by dividing the production process including parts and intermediate products, and mutual export and import in various ways and in various countries. Siew Yean Tham(Tham et al., 2016) examined upgrading in the information and communications technology (ICT) value chain through changes in the product quality of parts and components (PNC) exports from ASEAN to China and the influence of these

changes on their ICT trade with China. The main findings indicated that there is little or no product upgrading in the most important SITC 776 sub-component of the PNC exports from the four major ASEAN economies (ASEAN-4) to China after 2005. It was also found that improvements in product quality were more apparent for SITC 772 but this product group constituted a small share in total manufactured exports from the ASEAN-4 to China. Javier López-González(2017) identified how SMEs in ASEAN economies participated in GVCs by combining firm level data with the Trade in Value Added (TiVA) database. The main findings indicated that SMEs tended to export intermediate products directly to global value chains through intermediate products sold to larger domestic or multinational companies. Policies that seek to integrate SMEs into global value chains needed to address import restrictions by continuing unilateral or regional liberalization or continuing support for trade facilitation and connectivity. Small and medium-sized enterprises took advantage of their relative advantages when producing intermediate products and services, and integrated directly or indirectly into regional and global value chains. Chunlai Chen(Chen 2018) analyzed the impact of China's OFDI on economic growth by using provincial panel data sets and applying fixed effects and instrumental variable regression techniques. The positive impact of OFDI on provincial economic growth may be the result of reverse knowledge spillovers from OFDI to the domestic provincial economy through demonstration and imitation, labor mobility, and backward and forward industrial linkages, thereby increasing the productivity of local companies and enterprises and promote the growth of the family economy.

All in all, in most of the literature, the main factors affecting China's investment in ASEAN are technology, human capital and potential markets. The development of GVC in the ten ASEAN countries is more inclined to forward participation, which means that ASEAN mainly provides raw materials or intermediate products to foreign countries and is relatively upstream of GVC. The purpose of this paper is to analyze the impact of the forward and backward participation of the ten ASEAN countries on China's foreign direct investment in ASEAN, so as to predict the trend of China's investment in ASEAN and how to adopt better investment strategies to achieve bilateral benefits. This paper mainly conducts research from three aspects. The first is to analyze the current status of China's foreign direct investment in the ten ASEAN countries, including the flow and stock, and the characteristics of investment in each country. The second is to study the trends and models of the ten ASEAN countries participating in the global value chain. Finally, it analyzes the influencing factors of the forward and backward participation of GVCs in the ten ASEAN countries on China's investment in ASEAN.

Ⅲ. Model and hypothesis

1. Model setting

In order to study the impact of the forward and backward participation of the ten ASEAN countries on China's outward direct investment in ASEAN, the model of this paper is established based

on the model of Yu, P., & Chen, Q. Q. (2020).¹⁷⁾

$$\begin{aligned}
 OFDI_{flow(it)} &= \beta_0 + \beta_1 forward_{it} + \beta_2 backward_{it} + \beta_3 tech_{it} + \\
 &\quad \beta_4 hum_{it} + \beta_5 mp_{it} + \beta_6 cost_{it} + \beta_7 X_{it} + \varepsilon_{it} \dots\dots\dots(1) \\
 OFDI_{stock(it)} &= \beta_0 + \beta_1 forward_{it} + \beta_2 backward_{it} + \beta_3 tech_{it} + \\
 &\quad \beta_4 hum_{it} + \beta_5 mp_{it} + \beta_6 cost_{it} + \beta_7 X_{it} + \varepsilon_{it} \dots\dots\dots(2)
 \end{aligned}$$

The explained variables *OFDI_flow* and *OFDI_stock*, as well as the core explanatory variables *hum*, *mp*, *cost*, *Geodist* in the control variables were taken logarithms respectively, and then regression analysis was performed. Among them, because *OFDI_flow* has negative values in some countries in some years, the method used by Busse, M., & Hefeker, C. (2007) is used to process the negative values and then take the logarithm. The specific calculation formula is as follows:¹⁸⁾

$$Y = (x + \sqrt{x^2 + 1})$$

2. Description of variables and data

17) Yu, P., & Chen, Q. Q. (2020). Research on China's OFDI Location Strategy in EU from the Perspective of Host Country Manufacturing Industry GVC Evolution. *American Journal of Industrial and Business Management*, 10, 315-326. <https://doi.org/10.4236/ajibm.2020.102020>

18) Busse, M., & Hefeker, C. (2007). Political risk, institutions and foreign direct investment. *European journal of political economy*, 23(2), 397-415.

<Table 1> The meaning and specification of each independent variable in the model

Description of variables and data				
Explained variable	<i>OFDI</i>	The stock and flow of China's OFDI investment in ASEAN member countries		Data source: People's Republic of China Ministry of Commerce (http://www.mofcom.gov.cn/article/tongjiziliao/dgzz/)
	variable name	meaning	expected result	data sources
core Explanatory variables	<i>tech</i>	technology(Measured by the ratio of R&D expenditure to GDP)	+	World Bank Database
	<i>hum</i>	human capital(Measured by the host country's higher education labor force)	+	World Bank Database
	<i>mp</i>	market potential ¹⁹⁾²⁰⁾	+	World Bank Database (WDI)
	<i>forward</i>	forward participation in GVC	+	trade in value added database; http://www.oecd.org/industry/ind/measuring-trade-in-value-added.htm#country-notes UNCTAD-Eora Global Value Chain Database: https://www.worldmrio.com/unctadgvc/
	<i>backward</i>	backward participation in GVC	+	
	<i>cost</i>	labor cost(GDP per capita)	-	World Bank Database
Control variable (Xit represents control variables, including infra, openness, sources)	<i>infra</i>	Number of Internet users per 100 people	+	World Bank Database
	<i>openness</i>	Open level of foreign investment(Measured by the ratio of foreign direct investment stock to GDP)	+	WTO/ WOID
	<i>sources</i>	Natural resources (measured by the host country exports minerals, metals and fuels as a percentage of total merchandise exports.)	+	World Development Indicators Database WDI published by the World Bank

3. Hypothesis

Technology is the primary productive force. The development of

19) this paper calculate market potential based on previous method (Ma & Liu, 2016),

$$mp_{it} = \sum_{j \neq i} \frac{1}{d_{ij}} GDP_{jt}$$

where mp_{it} is the market potential of host country i in year t , d_{ij} is the geographical distance between host country i and host country j , and GDP_{jt} is the GDP of host country j in year t .

20) Ma, S. Z., & Liu, M. H. (2016). Research on the Third Country Effect of OFDI in China along the "One Belt and One Road": Based on Spatial Econometric Method. *International Trade Issues*, 7, 72-83.

science and technology has promoted the progress of society and the development of mankind. Three technological revolutions have improved human production and lifestyle. The use of technological means to innovate products is conducive to the development of enterprises.

Hypothesis 1: The technological advancement of the ten ASEAN countries will increase China's investment in ASEAN.

Human capital is an important strategic asset of an organization, and even the primary resource for gaining competitive advantage. Speeding up the cultivation of high-end specialized skills talents is conducive to enterprise technology and product innovation, thereby reducing production costs and labor costs.

Hypothesis 2: The more highly educated talents in the ten ASEAN countries, the more attractive China's investment in ASEAN.

The broad market potential is conducive to the rational allocation of investment or existing resources. Decision makers can allocate resources based on the total market potential of various products, rather than relying solely on sales levels. And the promising market potential is conducive to determining the stages of the product life cycle, helping to determine different product goals and marketing strategies.

Hypothesis 3: The greater the market potential of the ten ASEAN countries, the more they can promote China's investment in ASEAN.

Generally speaking, if a country's forward participation is greater than backward participation, it means that the country mainly provides raw materials or intermediate products abroad, which means that the

country is located relatively upstream in the global value chain. If forward participation is less than backward participation, it means that the country's supply chain is highly dependent on foreign intermediate products. If a country is located in the upper reaches of the global value chain, it can participate by providing raw materials to other countries or by providing manufactured intermediate products or both. For such a country, the share of indirect value added exports (IVA) in total exports will be higher than its share of foreign value added (FVA). Conversely, if a country is located downstream in the global value chain, it will use a large portion of intermediates from other countries to produce the final product for export, and its FVA share will be higher than its IVA share. Therefore, in the participation of a country in the global value chain, the higher the forward and backward participation, the more it can stimulate and attract foreign investment in the country.

Hypothesis 4: The greater the forward participation of GVCs in the ten ASEAN countries, the more they can stimulate China's investment in ASEAN.

Hypothesis 5: The more backward GVC participation in the ten ASEAN countries, the more it will promote China's investment in ASEAN.

The higher the labor cost means the higher the cost that the enterprise needs to pay for the input of production factors, and the higher the cost the enterprise pays to its employees. In the production process, companies will try to reduce production costs and labor costs to maximize profits. Therefore, the higher the labor cost, the more unfavorable the development of the enterprise.

Hypothesis 6: The higher the labor cost of the ten ASEAN countries, the

more it will hinder China's investment in ASEAN.

IV. Empirical Analysis Results

<Table 2> Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
<i>year</i>	120	2010.5	3.467	2005	2016
<i>OFDI flow</i>	120	52512.575	110571.25	-3282	1045248
<i>OFDI stock</i>	120	253876.25	499531.16	190	3344564
<i>forward participation</i>	120	.674	.145	.345	.946
<i>backward participation</i>	120	.246	.144	.013	.452
<i>tech</i>	120	.432	.642	.028	2.597
<i>hum</i>	120	29618620	33618546	176832	1.260e+08
<i>mp</i>	120	50565271	47169779	984013.93	1.783e+08
<i>cost</i>	120	10651.942	16364.27	244.882	57562.531
<i>infra</i>	120	4.91	7.143	0	27.383
<i>openness</i>	120	5.654	5.735	-1.321	26.327
<i>sources</i>	120	20.991	27.23	0	97.815

This paper collected a total of 120 sample observations. From the perspective of descriptive statistics, China's investment in the ten ASEAN countries has increased year by year from 2005 to 2016. The maximum value of investment flow is 1045248, and the minimum value is -3282, which reflects that China's investment in the ten ASEAN countries has a focus and there is a certain gap in the intensity of investment in different countries. The maximum value of investment stock is 3344564, the minimum value is 190, and the average value is 253876.25, which indicates that China's cumulative investment in the ten ASEAN countries is generally on the rise and there are few withdrawals after investment in the ten ASEAN countries. The maximum value of GVC forward participation in the

ten ASEAN countries is 0.946, and the minimum value is only 0.345. The maximum value of GVC backward participation is 0.452 and the minimum value is 0.013, which indicates that the ten ASEAN countries are not highly involved in the global value chain, and there is a certain gap in GVC participation among countries. In addition, the forward participation of the ten ASEAN countries is generally higher than the backward participation(as shown in table 2).

<Table 3> Pearson correlation analysis

	OFDI flow	OFDI stock	forward participation	backward participation	tech	hum	mp
<i>OFDI flow</i>	1						
<i>OFDI stock</i>	0.601***	1					
<i>forward parti-on</i>	-0.269***	-0.419***	1				
<i>backward pa-on</i>	0.129	0.298***	-0.275***	1			
<i>tech</i>	0.257***	0.423***	-0.328***	0.623***	1		
<i>hum</i>	0.247***	0.394***	-0.251***	0.263***	-0.135	1	
<i>mp</i>	0.193**	0.446***	-0.0880	0.533***	0.354***	0.696***	1
<i>cost</i>	0.0710	0.0230	0.261***	0.267***	0.628***	-0.547***	0.211**
<i>infra</i>	0.227**	0.395***	-0.164*	0.545***	0.916***	-0.279***	0.309***
<i>openness</i>	0.281***	0.430***	-0.276***	0.426***	0.674***	-0.245***	-0.0500
<i>sources</i>	-0.320***	-0.491***	0.439***	-0.438***	-0.145	-0.599***	-0.276***
		cost	infra	openness	sources		
<i>cost</i>		1					
<i>infra</i>		0.763***	1				
<i>openness</i>		0.325***	0.671***	1			
<i>sources</i>		0.493***	0.0350	-0.219**	1		

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
 Correlation coefficient 0.8-1.0 very strong correlation, 0.6-0.8 strong correlation, 0.4-0.6 moderate correlation, 0.2-0.4 weak correlation, 0.0-0.2 very weak correlation or no correlation

The Pearson correlation coefficient (as shown in table 3) is used to measure the degree of correlation between variables. It can be seen from the table that the forward participation of the global value chain

is negatively correlated with China's investment in the ten ASEAN countries, which is inconsistent with the hypothesis 4. This is because from the perspective of investment industries, before 2014, China's foreign direct investment in ASEAN focused on related primary production factors such as electricity, heat, gas and water production and supply, and reached its peak in 2012, accounting for 18.1% of the total direct investment stock. At this time, China was still playing the role of "world processing factory" in the global value chain. After 2015, the focus of China's foreign direct investment has shifted from primary production factors to leasing business services and manufacturing. The global value chain participation of the ten ASEAN countries is mainly focused on forward participation in the provision of raw materials and primary products. Therefore, the forward participation of the ten ASEAN countries cannot attract Chinese investment. The backward participation of the ten ASEAN countries is positively correlated with China's investment in ASEAN, which is consistent with the hypothesis 5. Because after 2015, China's investment in ASEAN is mainly concentrated in manufacturing, and the backward participation of the ten ASEAN countries is also mainly in manufacturing. Therefore, the backward participation of the ten ASEAN countries in the global value chain promotes Chinese investment.

<Table 4> ADF test results

variable	Lag period	ADF value	1% critical value	5% critical value	10% critical value	P value	Stationarity test
<i>OFDI_flow</i>	3	-4.740	-4.035	-3.448	-3.148	0.0006	1% stable
<i>OFDI_stock</i>	3	-5.787	-4.035	-3.448	-3.148	0.0000	1% stable

Through the ADF unit root test of the variables, it can be seen from the results in table 4 that OFDI_flow and OFDI_stock with the third-order lag reject the null hypothesis of “there is a unit root” at the 1% level. Therefore, the variables OFDI_flow and OFDI_stock do not contain unit roots.

<Table 5> Fixed effects and random effects analysis results

variables	OFDI-flow	OFDI-flow	OFDI-stock	OFDI-stock
	FE	RE	FE	RE
<i>forward-participation</i>	-2.6820*** (5.9441)	-3.5395** (2.8706)	-0.4406*** (0.3971)	-2.2269*** (0.4554)
<i>backward-participation</i>	0.1779** (14.5179)	7.1327** (3.0264)	0.3486*** (0.9698)	2.4823*** (0.4801)
<i>tech</i>	3.6562* (2.7086)	1.2763* (1.4139)	0.1201*** (0.1809)	0.8561*** (0.2243)
<i>hum</i>	66.3096** (38.2878)	9.9727** (3.7948)	5.4158*** (2.5576)	2.7909*** (0.6020)
<i>mp</i>	101.0621** (62.5489)	9.0549** (4.0054)	22.9152*** (4.1783)	2.2175*** (0.6354)
<i>cost</i>	105.2362* (63.4712)	7.5899* (3.9069)	-21.2625*** (4.2399)	-2.7752*** (0.6198)
<i>infra</i>	0.2433* (0.2050)	0.3100* (0.1326)	0.0048** (0.0137)	0.0790*** (0.0210)
<i>openness</i>	0.0266 (0.1264)	0.0321 (0.0863)	0.0017 (0.0084)	0.0359** (0.0137)
<i>sources</i>	0.0651* (0.0764)	-0.0300* (0.0189)	-0.0057* (0.0051)	-0.0162*** (0.0030)
<i>_cons</i>	-93.2146** (110.0521)	-17.1836** (11.0665)	-50.6279*** (7.3515)	-6.1542*** (1.7555)
<i>N</i>	120	120	120	120
<i>r2</i>	0.2076		0.9109	
<i>F</i>	2.9405		114.7716	
<i>p</i>	0.0039	0.0000	0.0000	0.0000

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

<Table 6> 2SLS estimation results (solving endogenous problems)

VARIABLES	OFDI_flow	OFDI_stock
<i>Forward_participation</i>	-8.517*** (3.265)	-2.996*** (0.518)
<i>Backward_participation</i>	6.995** (2.937)	2.461*** (0.466)
<i>tech</i>	2.432* (1.428)	1.035*** (0.226)
<i>hum</i>	12.509*** (3.783)	3.183*** (0.600)
<i>mp</i>	11.661*** (3.988)	2.620*** (0.632)
<i>cost</i>	11.010*** (3.968)	3.304*** (0.629)
<i>infra</i>	0.312** (0.129)	0.079*** (0.020)
<i>openness</i>	0.023 (0.084)	0.034*** (0.013)
<i>sources</i>	-0.035* (0.018)	-0.017*** (0.003)
<i>Constant</i>	-24.070** (10.994)	-7.218*** (1.743)
<i>Observations</i>	120	120
<i>R-squared</i>	0.280	0.687
<i>Hausman</i>	8.050	7.638
<i>p-value</i>	0.00455	0.00572

Standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Hausman test is used to determine whether to establish a fixed-effects model or a random-effects model. The test results show that both fixed effects and random effects are significant. Considering the robustness of the model, the fixed effects model is adopted. Considering that there is a reverse causal relationship between explanatory variables and explained variables, this paper sought to find instrumental variables to solve the problem of endogeneity. By

finding the exogenous variables that affect the endogenous variables, and regression together with other existing exogenous variables, the estimated value of the endogenous variables is obtained, which is used as IV and put into the original regression equation for regression. The test results of the two stage least squares (2SLS) estimator are shown in table 6. The forward participation of the global value chain is negatively correlated with China's investment in the ten ASEAN countries, which is inconsistent with the hypothesis 4. This is caused by the inconsistency between China's outward direct investment in ASEAN and the participation of the ten ASEAN countries in the global value chain. At that time, the participation in the global value chain of the ten ASEAN countries was mainly focused on the forward participation in the supply of raw materials and primary products. The backward participation of the ten ASEAN countries is positively correlated with China's investment in ASEAN, which is consistent with the hypothesis 5. In addition, from the results of the two-stage least squares estimation, factors such as technology, human capital, market potential, infrastructure, and openness of the ten ASEAN countries have played a positive role in promoting China's investment in the ten ASEAN countries. In ASEAN, the main reason why labor costs are positively correlated with China's investment in ASEAN is that labor costs in the ten ASEAN countries are generally low. And the sample time is from 2005 to 2016. During this period, China takes into account the cheap labor factor in ASEAN, and increasing investment will increase the profits and income of enterprises. Therefore, from this perspective, ASEAN's low labor costs have attracted Chinese investment. The main reason for the negative

correlation between natural resources and China's investment in ASEAN is that China's investment in the ten ASEAN countries is not because the ten ASEAN countries are rich in natural resources, but more attention is paid to ASEAN's market potential, labor costs, and geographical location.

V. Conclusions and Limitation

This paper mainly studies the impact of forward participation and backward participation in the ASEAN global value chain division of labor on China's investment in ASEAN. First, the KWW method mentioned by Koopman (2010) is used to calculate the forward and backward participation of the ten ASEAN countries in the global value chain. Then select the data of 10 ASEAN countries from 2005 to 2016 to establish a measurement model to test the impact of ASEAN countries' participation in global value chains on China's investment in ASEAN. The main research conclusions are as follows:

First, the stock of China's investment in ASEAN has shown a steady upward trend overall. In 2016, individual countries began to show a downward trend, such as Malaysia, Laos, and Myanmar. This is due to the fact that the focus of China's diversified value chain investment strategy has shifted to manufacturing, and the manufacturing industries of these countries do not have comparative advantages and other factors. The flow of China's direct investment in ASEAN shows an irregular upward and downward trend, which depends on the transformation of China's industrial investment

strategy. This is because China's foreign investment has shifted from primary resource investment to leasing and business services to manufacturing. Second, the forward participation in global value chains is negatively correlated with China's investment in the ten ASEAN countries, which is not in line with Hypothesis 4. Mainly because before 2014, China's outward direct investment in ASEAN was mainly concentrated on the production and supply of related primary production factors such as electricity, heat, gas, and water. After 2015, the focus of China's foreign direct investment has shifted from major production factors to leasing commercial services and manufacturing. The participation in the global value chain of the ten ASEAN countries is mainly focused on the forward participation in the supply of raw materials and primary products. Therefore, the active participation of the ten ASEAN countries cannot attract Chinese investment. The backward participation of the ten ASEAN countries is positively correlated with China's investment in ASEAN. This is consistent with Hypothesis 5. Third, factors such as technology, human capital, market potential, infrastructure, and openness of the ten ASEAN countries have a positive effect on China's investment in the ten ASEAN countries. This is consistent with Hypothesis 1, 2, and 3. The results suggest that technological progress in the ten ASEAN countries, the increase in the number of highly educated labor, the expansion of consumer market consumption potential, the improvement of infrastructure, and the increase in market openness will attract Chinese investment. The main reason why the labor cost of the ten ASEAN countries is positively correlated with China's investment in ASEAN is that the low labor

costs of the ten ASEAN countries have attracted Chinese investment. The main reason for the negative correlation between natural resources and China's investment in ASEAN is that China's investment in the ten ASEAN countries is not because the ten ASEAN countries are rich in natural resources, but more attention is paid to factors such as ASEAN's market potential, labor costs and geographical location.

With the development of globalization, the increasing foreign investment of ASEAN countries and the cooperation between ASEAN and developed countries have promoted the development of ASEAN countries, and ASEAN has become a potential market for attracting foreign investment. This is of positive significance for strengthening China's investment in ASEAN, realizing bilateral interests, and promoting the friendly development of China and ASEAN countries. Based on the research conclusions, the following recommendations are put forward: On the one hand, Chinese companies make full use of the rich labor resources of ASEAN countries, reduce production costs, and increase Chinese companies' investment in ASEAN. On the other hand, ASEAN is located in Southeast Asia and has huge market potential. Chinese foreign-funded enterprises can appropriately explore the market in accordance with local consumption habits and preferences to stimulate residents' consumption and increase corporate profits. In addition to investment in ASEAN manufacturing, China can also increase investment in education, technology research and development, infrastructure construction, and tertiary industry in ASEAN countries to consolidate China's investment position in ASEAN and realize bilateral benefits. Last but not least, ASEAN

countries should expand openness, improve infrastructure construction, vigorously develop education, and cultivate higher education talents with professional skills. Improve independent innovation capabilities, increase investment in innovative research and development, attach importance to the training of high-tech talents, attract more foreign investment including China, actively promote national development, and enhance its status in global value chain participation.

This paper draws on the KWW method of Koopman (2010), and uses the data provided by the TiVA database and the UNCTAD-Eora Global Value Chain Database to measure the GVC forward participation and backward participation of the ten ASEAN countries. Since the database only provides data up to 2016, the trend from 2017 to 2020 has not been empirically studied.

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<국문요약>

GVC의 전방 및 후방 참여가 ASEAN에서 중국의 OFDI에 미치는 영향

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본 논문은 주로 ASEAN 글로벌 가치 사슬(GVC, global value chains)에 대한 전방 참여와 후방 참여가 중국의 아세안 투자에 미치는 영향을 연구한다. 연구 결과에 따르면 ASEAN 국가들의 GVC 전방 참여는 중국의 아세안 10개국 투자에 부정적인 영향을 미치는 반면 후방 참여는 긍정적인 영향을 미치는 것으로 나타났다. 아세안의 기술 발전, 고학력 노동력의 확대, 소비자 시장 소비 잠재력의 증가, 인프라 개선 및 시장 개방도는 중국의 아세안 투자를 유치하고 확대할 것이다. 이는 중국이 ASEAN 제조에 대한 투자 외에도 ASEAN 국가의 교육, 기술 연구 및 개발, 기반 시설 건설 및 3차 산업에 대한 투자를 촉진할 수 있음을 의미한다. 아세안 국가의 인건비는 아세안에 대한 중국의 투자와 긍정적인 상관관계가 있는 반면 천연자원은 부정적인 상관관계가 있다. 중국 기업은 아세안 국가의 풍부한 노동력을 최대한 활용하여 생산 비용을 절감하고 현지 소비 습관 및 선호도에 따라 시장을 적절하게 개발하여 가계 소비를 촉진하고 기업 이윤을 높일 것을 권장한다. 아세안 국가는 개방을 강화하고 인프라 건설을 개선하며 첨단 기술 인재 양성을 중시하고 중국을 포함한 더 많은 외국인 투자를 유치해야 한다.

주제어: 전방 및 후방 GVC 참여, OFDI, 중국, ASEAN

