An Analysis of Agglomeration Effects and the Determinants of Location Choice of Japanese Manufacturing Firms in Vietnam

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Abstract

This paper formally investigates how Supplier Access (SA) and Market Access (MA) affect the location choice byJapanesemanufacturing firms in Vietnam. We use province level dataset of Vietnam's 47 provinces.Conditional logit analysis of the location choice by 117 Japanese manufacturing firms in Vietnam during the period 2001-2007 confirms a major impact of SA.The results imply that forward linkage effect within province isquite important for Japanese firms in Vietnam. Additionally, itand the trade data imply that there is arelationshipbetween Japan and Vietnam in international division of labor.

Ⅰ. Introduction

In recent years, international trade is characterized byclose relationship between international trade (both productand service) and international division of labor (fragmentation of production process). Thus, the role of firmsis of growing importance in international trade. In addition,an analysis of firm's behavior is essential for understanding recent international trade.

In this situation, an analysis of the determinants of location of firms is one of the most important issuesfor understanding international division of labor in East Asia[i]. In this paper, we use New Economic Geography (NEG) model to analyze the determinants of location choice of Japanese manufacturing firms in Vietnam during the period 2001-2007. Additionally, we use the term agglomeration effects as market access (MA) and supplier access (SA).

The paper is organized as follows. In the next section we review some of early studies which analyze an important relationship between location choice and agglomeration effects. Section 3 shows FDI trends in Vietnam. Section 4 expounds the model which is used in this paper. Section 5 conducts conditional logit analysis. Section 6 presents empirical results and Section 7 concludes.

Ⅱ. Early studies

Location choice is one of key issue for multinational firms when they go abroad via FDI. Firms determine the location after considering the regional characteristics. If regional characteristicsare profitable for firms, they locate there and vice versa. In fact, Vietnam's FDI inflows from Japan and other countries differ between provinces. We consider that an analysis of its FDI from Japan is notable because we can investigate the determinants of location of Japanese firms in Vietnam by observing the differences.

New economic theories on location choice of firms emphasize a tension among production costs and access to large final goods market and input suppliers.
There are many early studies which analyze determinants of location choice in the U.S and Europe.

Head,Ries,Swenson (1995) use data on 751Japanese manufacturing firms established from 1980 to 1992 in order to estimate the determinants of location choice. They have shown that Japanese manufacturing firms tend to choice the location that Japanese manufacturing firms already locate. In addition, their analysis confirms the important relationship between *keiretsu* specific agglomeration effect and location choice by Japanese firms in automobile industry.

Urata and Kawai (2000), Belderbos and Carree (2002), and Inui, Matsuura, Poncet (2008) analyze the relationships among agglomeration, firm heterogeneity, and location decision.

Urata and Kawai (2000) investigate main determinants of location of

Japanese firms by using the data on its FDI in China. They conclude that both demand side and supply side factor, in terms of agglomeration, is important for their location choices. Furthermore, empirical results indicate that the determinants of location are differ between large firms and small and medium-sized firms.

Belderbos and Carree (2002) conduct an analysis of the determinants of Japanese manufacturing firms in China during the period 1990-1995. They classify agglomeration into agglomeration, Japanese firm-agglomeration, and keiretu-agglomeration in the paper. The results illustrate that both distance from Japan and local Japanese firm-agglomeration are more important for small and medium-sized firms than large firms (over 500 employees). Additionally, they indicate that both local keiretu-agglomeration and infrastructure are important for exporting firms and market size is important for local-market-oriented-firms. Inui, Matsuura, Poncet (2008) investigate the location choice of Japanese firms by using firm-level micro data. In their paper, they conduct nested logit analysis the determinants of Japanese firms. The results indicate that agglomeration and spillover between local firms are important factors for Japanese firms. The point is that important factors differ depending on the firm's characteristics.

Milner, Reed, Talerngsri (2006), Maeno (2008), and Wakasugi (2008) investigate the determinants of location of Japanese firms and international division of labor in East Asia.

Milner,Reed,Talerngsri (2006) investigate the relationship between intra-industry transaction and inter-industry transaction in Thailand.In their analysis, they make a classification of transaction of intermediate productsinto intra-industry transaction (intra-industry linkage) and inter-industry transaction (inter-industry linkage). They assume that there are two types (1 and 2) of firms operating in industry A in Japan. Type 1 firms are large assembling firms, and they use intermediate products partly supplied by type 2 firms. They assume that each of type 1 and 2 firms produce a differentiated products. They conclude that many Japanese firms move into Thailand for supply intermediate

goods to local firms which moved from Japan. Additionally, it implies that Japanese firms agglomerate in particular regions and form the production network in the regions.

Maeno (2008) analyze the determinants of location of Japanese firms in China and the role of FDI in the international fragmentation of production. The results indicate that market access, firm agglomeration, and infrastructure have positive effect on location choice of Japanese firms.

Wakasugi (2008) investigate the determinants of Japanese manufacturing firms in China by using firm-level micro data. The results of conditional logit analysis illustrate that agglomeration, infrastructure, institution, human resources have positive effect and wage has negative effect on location choice probability of Japanese firms in China.

Amiti and Javorcik (2008) and Ijiri (2010) analyze the relationship between agglomeration effects and location decision of multinational firms.

Amiti and Javorcik (2008) investigate the determinants of location of multinational firms in China by using the province level 515 industrial data during the period 1998-2001. They stress the impacts of agglomeration effects, supplier access and market access, on location decision of multinational firms in China. The results indicate that supplier access and market access have positive effect on location decision of multinational firms. Additionally, inner provincial agglomeration effects have more impacts on the location decision of them than inter provincial agglomeration effects.

Ijiri (2010) conduct the comparative analysis of location choice of multinational firms in China and those in Vietnam by using panel data during the period 2000-2007. His empirical results illustrate that supplier access, foreign supplier access, and foreign market access have positive effects on the location choice of multinational firms in Vietnam.

Nguyan and Nguyan (2007) investigate determinants of location of FDI in Vietnam by using province level data during the period 1988-2005. Empirical results show that local market, quality of labor, and infrastructures have the

positive effects on the determinants of location of FDI in Vietnam.

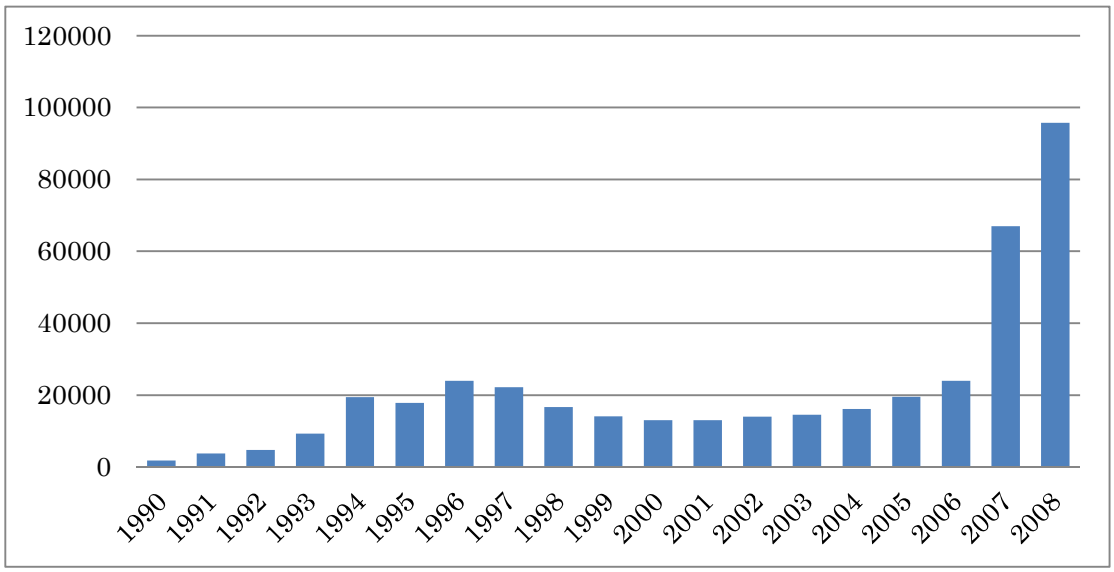
Unfortunately, there are a small number of studies which investigate the determinants of location of firms in Vietnam. In the next chapter, we review the trends of Vietnam's FDI.

Ⅲ. Inward FDI in Vietnam

In this chapter, we outline major trends in Vietnam's inward FDI.

There is no data that shows the location of foreign firms in Vietnam. Therefore, we use *Kaigaishinshutsukigyousouran* that includes locational information of Japanese firms. In addition, we see the distribution of Japanese FDI in Vietnam.[ii] In this paper, we develop conditional logit analysis of the determinants of location choice of Japanese manufacturing firms in Vietnam by using FDI data of Japanese manufacturing firms which was expanding into Vietnam during the period 2001-2007.

Figure 1　Vietnam's inward FDI from the world

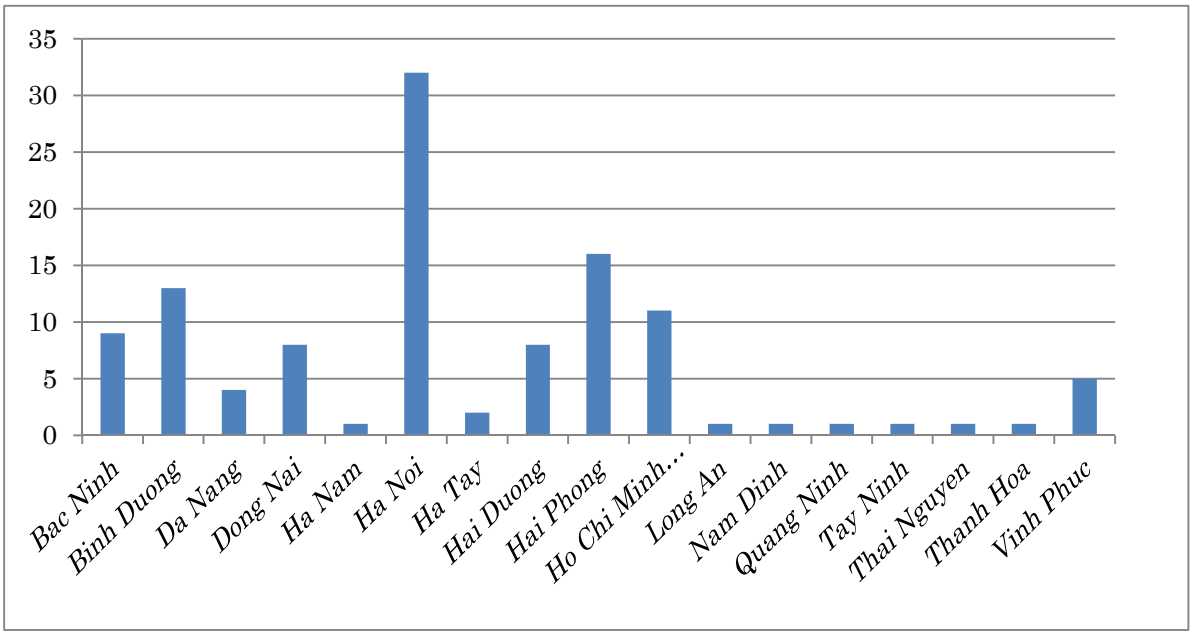


Unit: Hundred thousand dollars

Source: World Develop Indicators,World Bank

Figure 1 represents the value of inward FDI of Vietnam during the period of 1990-2008. There were two FDI booms in Vietnam in 1996 and 2007. We employ the data during the period 2001-2007, which remove the influences of Asian currency crisis.

Figure2 Vietnam's inward FDI from Japan



Unit: Projects

Source: *Kaigaishinsyutsukigyousouran2008, Toyokeizaishimposha*

Figure 2 depicts the number of Japan's FDI projects in Vietnam during the period of 2001-2007. It shows that inward FDI differ between provinces in Vietnam.[iii]

If we assume that rational choice of firm is to choice the province which can maximize its profit, we can recognize that the province which attracts more inward FDI than other provinces has economic characteristics that are important for the firm's profits. In the next chapter, we review the model which is used in this paper.

Ⅳ. Theory

1. Production activities of local firms

In this paper, we employ analytical framework of Wakasugi (2008).[iv] We suppose that Japanese firms establish local firm in Vietnam and conduct local production. Production function of local firm is given by

$$q_{ij} = a_0 A_j^{\beta_1} S_j^{\beta_2} (a_j L_{ij})^{\alpha_1} K_{ij}^{\alpha_2} R_{ij}^{\gamma} \qquad (1)$$

At this time, q_{ij} is defined as production output (quantity of production) of local firm i in province j where price of goods and inputs is given. Local firms select optimal combination of inputs: Labor, L_{ij}, capital stock, K_{ij}, technical knowledge stock, R_{ij}. Then, agglomeration, A_j, social capital stock, S_j, and quality of labor, a_j, represent the characteristics of province j. Therefore, these characteristics are common for local firms in province j. In addition, $\beta_i (i = 1,2)$ is defined as effects of the characteristics of province $j$on the production of local firms. We assume that $\beta_i > 0$, which means that productivity of local firmsimproves with increase in agglomeration and social capital. Additionally, we assume that rent of capital goods is common in all provinces. On the contrary, wage and quality of labor are different in each province. Furthermore, local firms do not carry out R&D activities and use R_{ij} which is transferred from headquarters to local firms as inputs.

2. Profit maximization

Given economiccharacteristics and price of goods and inputs, firm $i$determines the quantity of output, technical knowledge stock, and factor input. Then, profit maximization equation of local firms in province$j$ can be written as

$$\max_{L_{ij}, K_{ij}, R_{ij}} \pi_{ij} = pq_{ij} - (w_j L_{ij} + rK_{ij}) - T(R_{ij}) \qquad (2)$$

$$s.t.\ q_{ij} = a_0 A_j^{\beta_1} S_j^{\beta_2} (a_j L_{ij})^{\alpha_1} K_{ij}^{\alpha_2} R_{ij}^{\gamma}$$

At this time, p is price of goods, w_j is wage in province *j*, and r is rent of capital. By using equation (1), optimal output and maximum profit of firm *i* in province *j* can be written as

$$q_{ij} = \left[a_0 A_j^{\beta_1} S_j^{\beta_2} p^{1-\rho} \alpha_1^{\alpha_1} \alpha_2^{\alpha_2} \left(\frac{a_j}{w_j} \right)^{\alpha_1} \left(\frac{1}{r} \right)^{\alpha_2} \left[\frac{\gamma}{\delta_0} \right]^{\frac{\gamma}{2}} h_j^{\frac{\eta \cdot \gamma}{2}} \right]^{\frac{1}{\rho}} \quad (3)$$

$$\pi_{ij} = \rho p^{\frac{1}{\rho}} \left[a_0 A_j^{\beta_1} S_j^{\beta_2} \alpha_1^{\alpha_1} \alpha_2^{\alpha_2} \left(\frac{a_j}{w_j} \right)^{\alpha_1} \left(\frac{1}{r} \right)^{\alpha_2} \left[\frac{\gamma}{\delta_0} \right]^{\frac{\gamma}{2}} h_j^{\frac{\eta \cdot \gamma}{2}} \right]^{\frac{1}{\rho}} \quad (4)$$

Propositions of this model are as follows.

In this model, if there are differences in economic characteristics among provinces in Vietnam, the higher level of agglomeration, social capital stock, human resources, and the lower level of wage have positive effects on local firm's profit. Therefore, the provinces which have the characteristics that can increase local firm's profit attract inward FDI.

3. Conditional logit analysis

In this paper, we assume that Japanese firms choose one location from 64 provinces in Vietnam, and that all local firms are identical. Each province has different characteristics, so profits of local firms depend where local firms locate. Then, Japanese firms shouldchoose the province that they can achieve profit maximization. In other words, it would appear that the province which is chosen by Japanese firms has the characteristics that can generate profits of local firms. Therefore, estimated profit of local firm can be written as

$$\ln \pi_{ij} = \hat{c}_0 + \hat{c}_1 \ln A_j + \hat{c}_2 \ln S_j + \hat{c}_3 \ln\left(\frac{w_j}{a_j}\right) + \hat{c}_4 \ln h_j + \varepsilon_{ij} \quad (5)$$

At this point, $\hat{c}_i (i = 1,...,5)$ represent each parameter which is estimated in

this analysis and ε_{ij} is the error term. Estimated profit function is consist of agglomeration, social capital stock, wage, quality of labor, human resources, h_j, and error term.As is the case with Train (2003), we assume that ε_{ij} complies with[v]

$$P(\varepsilon_{ij} < x) = \exp(-\exp(-x)) \tag{6}$$

At this time, according to Mcfadden(1974), the probability that firm i chooses j province from J provinces can be written as

$$\Pr(Y_i = j) = \frac{\exp(c_0 + c_1 \ln A_{ij} + c_2 \ln S_{ij} + c_3 \ln(\frac{w_{ij}}{\alpha_{ij}}) + c_4 \ln h_{ij})}{\sum_{j \in J} \exp(c_0 + c_1 \ln A_{ij} + c_2 \ln S_{ij} + c_3 \ln(\frac{w_{ij}}{\alpha_{ij}}) + c_4 \ln h_{ij})} \tag{7}$$

Then, $\Pr(Y_i = j)$ representslogit type function which is the probability that firm i chooses j province from J provinces. The right-hand side of this equation is the proportion of the profit of firm i locatedin province j to the profits of the total profits of firm $i$located in province other than j.This exponent function represents the location choice probability that firm i chooses province j.If sign condition of estimated parameters is positive, the characteristics have positive impacts on the location choice probability of them. On the other hand, negative sigh means that the characteristics have negative effects on those of them. Then,

the location choice probabilities that firm i chooses each province can be written as likelihood function,

$$L = \prod_{j=1}^{J} (\Pr(Y_i = j))^{n_j} \tag{8}$$

$$\ln L = \sum_{j=1}^{J} n_j \ln \Pr(Y_i = j) \tag{9}$$

At this time, $N = \sum_{j=1}^{J} n_j$ means that each firm chooses only one province to locate.

Besides, each parameter is estimated by maximum-likelihood method by using equation (9).[vi]

Ⅴ. Data and measurement

1. Data

(1)Kaigaishinsyutsukigyousouran

*Kaigaishinsyutsukigyousouran*hasbeen collected by the *Toyokeizaishinposha* at the Japanese firm level.

(2)Statistics Office of Vietnam, Statistical Data.

The data coverspopulation, GDP, the number of employees, FDI, and infrastructure by city.

2. Measurement

Table 1 illustrates the definition of independent variables.

Independent Variable	Expected Sign	Definition
Agglomeration	+	Employed population of province j in time t-1
SA1	+	$\frac{IndstrialOutput_{jt-1}}{IndstrialOutput_{Vt-1}} * D_{jj}^{-1}$,where $D_{jj} = \sqrt{\frac{Area_j}{\pi}}$
SA2	+	$\sum_{j=1}^{n} \frac{\frac{IndstrialOutput_{kt-1}}{IndstrialOutput_{Vt-1}}}{DISTANCE_{jk}} \quad (j \neq k)$
MA1	+	$(\frac{Income_{jt-1}}{Income_{Vt-1}} + \frac{RetailSale_{jt-1}}{RetailSale_{Vt-1}}) * D_{jj}^{-1}$,where $D_{jj} = \sqrt{\frac{Area_j}{\pi}}$
MA2	+	$\sum_{j=1}^{n} \frac{(\frac{Income_{kt-1}}{Income_{Vt-1}} + \frac{RetailSale_{kt-1}}{RetailSale_{Vt-1}})}{DISTANCE_{jk}} \quad (j \neq k)$
Volume_Freight	+	Volume of freight of province j in time t-1
Wage	−	Average income per employee of province j in time t-1.
Skila	+	Number of students in Universities and Colleges of province j in time t-1.

Table-1 Definition of independent variables

(1)Agglomeration

Agglomeration is increasing function of profit of local firms. Thus, agglomeration has positive effects on the location choice probability of Japanese firms.

$Agglomeration$ ：Employed population of province j in time t -1

(2) Supplier access

We employ calculation methods of Leamer (1997) and Hariss (1954) to calculate SA1 and SA5.[vii] SA1 represents supplier access within the province and SA5 illustrate supplier access to all markets in Vietnam. The increase in both SA1 and SA5 has positive effects on location choice of Japanese firms. However, SA5 has the diversion effects on inward FDI when transaction cost is too high in the province.

$$SA1 = \frac{IndstrialOutput_{jt-1}}{IndstrialOutput_{Vt-1}} * D_{ii}^{-1} \quad \text{, where} \quad D_{ii} = \sqrt{\frac{Area_i}{\pi}} \ (j \neq k)$$

$$SA5 = \sum_{j=1}^{n} \frac{\dfrac{IndstrialOutput_{kt-1}}{IndstrialOutput_{Vt-1}}}{DISTANCE_{jk}}$$

$IndustrialOutput_{jt-1}$: Industrial output of province j in time t -1

$IndustrialOutput_{Vt-1}$ ：Industrial output of Vietnam in time t -1

$D_{ii} = \sqrt{\frac{Area_i}{\pi}}$ ： The radius of province j

$DISTANCE_{jk}$ ：Distance between province j and k

(3) Market Access

The increase in MA1 and MA5 has positive effects on inward FDI. Yet, MA5 has diversion effect on it when the cost of access to local market is too high in the province.

$$MA1 = (\frac{Income_{jt-1}}{Income_{Vt-1}} + \frac{RETAILSALE_{jt-1}}{RETAILSALE_{Vt-1}}) * D_{ii}^{-1} \quad , \text{where} \quad D_{ii} = \sqrt{\frac{Area_i}{\pi}} \ (j \neq k)$$

$$MA5 = \sum_{j=1}^{n} \frac{(\frac{Income_{kt-1}}{Income_{Vt-1}} + \frac{RETAILSALE_{kt-1}}{RETAILSALE_{Vt-1}})}{DISTANCE_{jk}}$$

$Income_{jt-1}$: Average income per employee of province j in time t-1

$Income_{Vt-1}$: Average income per employee of Vietnam in time t-1

$RETAILSALE_{jt-1}$: Retail sales of province j in time t-1

$RETAILSALE_{Vt-1}$: Retail sales of Vietnam in time t-1

(4) Social capital stock

The increase in volume of freight of province j means that infrastructure is developed in province j. Therefore, the increase in social capital stock attracts inward FDI.

$Volue\_Freight$: Volume of freight of province j in time t-1

(5) Wage

There is s strong relationship between profit maximization of firms and wage. Therefore, the decrease in wage rate is positive effects on inward FDI.

$Wage$: Average income per employee of province j in time t-1

(6) Human resources

Human resource is increasing function of profit of local firms in this paper. Hence, the increase in human resource has positive impacts on location choice by Japanese firms.

$Slila$: The number of students in universities and colleges of province j in time t-1

As is case with early studies, we use each data with time lag.[viii]We can remove the problem of simultaneity by using this approach.[ix]

Ⅵ. Empiricalresults

In this analysis, if sigh condition of estimated parameter is positive, it bolsters profit of firms.Thus the characteristics has positive effects on the probabilities of location choice of them while negative sigh imply that the characteristics has negative effects on those of them. Table 2 illustrates the empirical results of conditional logit analysis.

Table-2 Empirical results

Variables	(1)	(2)	(3)	(4)	(5)	(7)	(6)
Agg	1.355	0.255	-0.251	-0.628	0.058		2.888
	(1.99)*	(0.45)	(0.66)	(1.69)	(0.09)		(6.72)**
SA1	1.56	1.157		1.232		1.149	1.034
	(5.07)**	(6.65)**		(4.98)**		(6.57)**	(10.29)**
MA1	-1.742	-1.518			-0.997	-1.311	-2.12
	(2.24)*	(2.49)*			(1.65)	(3.27)**	(6.16)**
SA5	-3.968		-3.284	-0.206			
	(4.19)**		(4.40)**	(0.77)			
MA5	4.809		5.074		1.339		
	(4.33)**		(5.35)**		(5.11)**		
Volume_freight	0.57	1.544	1.66	1.219	1.969	1.596	
	(1.67)	(5.32)**	(5.81)**	(3.73)**	(6.56)**	(6.00)**	
Wage	3.251	-2.099	0.999	-4.115	-2.67	-2.399	
	(1.72)	(1.66)	(0.83)	(4.06)**	(2.33)*	(2.22)*	
SkiLa	0.109	0.298	0.423	0.064	0.632	0.301	
	(0.65)	(2.44)*	(3.57)**	(0.46)	(4.61)**	(2.46)*	
Observations	4712	5568	5176	4712	5063	5568	6301

Absolute value of z statistics in parentheses

* significant at 5%; ** significant at 1%

We summarize the findings of this analysis.

There are four findings in the results. First, agglomeration has positive or negative effects on location choice by Japanese firms, which means that results

are mixed. Second, SA1 has significant and positive effects while SA5 has significant and negative effects on inward FDI. Third, social capital stock and human resource have significant and positive effects on location choice of them. Finally, wage has significant and negative effects on those of them.

Ⅶ. Conclusion

In this paper, we investigate the relationship between agglomeration effects and the determinants of location of Japanese manufacturing firms in Vietnam. We conduct conditional logit analysis by using locational data of Japanese firms during the period 2001-2007.

The results indicate that SA1, MA5, infrastructure, and human resource have positive effects and that wage has negative effects on the location choice of Japanese firms in Vietnam. However,the impacts of agglomeration effects on the location choice of them are still mixed.

SA1 has positive effects on location choice of Japanese manufacturing firms while SA5 has negative effects on location choice of them. That is to say, access to suppliers of parts and components within a province is important for Japanese manufacturing firms when they determine the location in Vietnam.This implies that there is the relationship between Japan and Vietnam in international division of labor. In addition, parts and components goods trade between Japan and Vietnam has grown during the period 1990-2007.[x]The fact also supports the early studies of international division of labor in East Asia.

MA1 has negative effects on location choice of Japanese manufacturing firms while MA5 has positive effects on them.This mean access to all market is significant for location decision of them in Vietnam.Fukunaga (2010) indicates that Japanese firms have shifted the purpose of FDI from producing manufacturing products locally to sellingthose to local markets in Vietnam. However, Vietnam's GDP per capita is $2,520 while that of Japan is $34,760 in 2007. Therefore, we recognize that the number of market oriented FDI by

Japanese firms is still small.

We have four problems which should be improved in the next analysis. First, we need the comparison between Vietnam and other countries, especially China. Second, calculation methods of agglomerationand agglomeration effects need to be improved. This is because Japanese firm-agglomeration has positive effects on the location decision of Japanese firms. We do not classify the agglomeration into local firm-agglomeration and Japanese firm-agglomeration. Third, it is better to incorporate the idea of Economic Development Area into this analysis. Wakasugi (2008) includes this idea into the model which is used in his paper. Finally, it is important for this paper to investigate trade structures in detail for the understanding of relationship between Japan and Vietnam in international division of labor.

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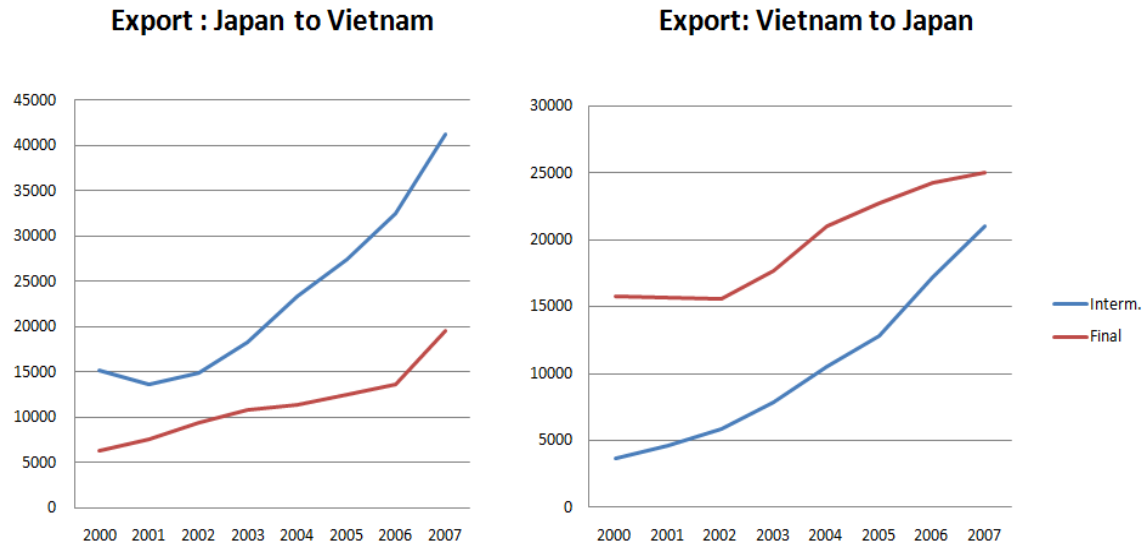
Statistical Data

・Toyokeizaishimposha,『*Kaigaishinshutsukigyousouran*(2008)』
・Statistics Office of Vietnam, Statistical Data 2010.
・World Bank, World Development Indicators 2009.

Appendix A　Vietnam's map

Appendix B　Intermediate and final goods trade (HS96, BEC)



Unit: Hundred thousand dollars

Source: *UN Comtrade*, HS96

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[i]We assume that East Asia consist of ASEAN10, Japan, Korea, and China.
[ii]AppendixA illustrates Vietnam's map.
[iii]Ha Noi（27.8%）,Hai Phong(13.9%),Binh Duong(11.3%),Ho Chi Minh（9.5%）,Bac Ninh（7.8%）.
[iv]See Wakasugi(2008) pp.61-65.
[v]Train (2003) pp.36-50.
[vi]Equation (9) is log of equation (8).
[vii]As is case with Leamer (1997), we assume that each province is circular.
[viii]We employ 1 year time lag method.
[ix]Wakasugi(2008) p.69.
[x]See AppendixB.

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