

# Agglomeration Economies and Location Choice of Inward Foreign Direct Investments in Korea\*

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**Abstracts:** Employing the micro data for 1996–2005, we analyze the role of the both horizontal and vertical agglomeration economies in the location choice of inward foreign direct investments in Korea. From the estimation results for the overall industry, the nested logit estimation results confirm that not only industry-specific foreign-firm agglomeration economies but also Korean domestic firm agglomeration economies play an important role in the location choice of foreign manufacturing firms in Korea. On the vertical agglomeration variables, while the effect of forward linkage agglomeration is positive and significant as we expect, the effect of backward is negative and insignificant. This explains that the spatial availability of intermediate good shows statistically significant positive relationship with the location choice for the inward FDI within Korea.

*Keywords:* location decision, horizontal agglomeration, vertical agglomeration, nested logit

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## I . Introduction

Recently, one of the main issues in urban and international economics is about the role of economic concentration and firm's location choice in a regional economic growth. Many theoretical and empirical research papers have supported the idea that regional economic concentration gives the chance of residential firms to increase their productivity and save costs. Futhermore, this chance raises the probability of firms location choice in an economically concentrated region. In this article, we analyze empirically the role of the regional agglomeration in the location choice of foreign direct investments in Korea from 1996 to 2005.

While the influx of FDI made a slow progress before the foreign currency crisis in Korea, the positive role of FDI in regional economic growth is reemphasized and it expands rapidly in size after 2000. For example, while the size of FDI was 0.8 billion dollars at 1990, its size is up to 11.2 billion dollars at 2006 which is 14 times larger than that of 1990. Even though we have experienced the rapid increase of FDI influx into Korea, there are no enough researches about the location decision process of FDI in view of agglomeration, especially, at firm's micro data level.

As Krugman (1991) suggests, since the spatial concepts are not regarded as important in the traditional economics especially in international trade, the problem of location choice itself paid little attention to most of economists in international trade. From the viewpoint of this background, the researches about the inward FDI into Korea focus only on analyzing the impact of inward FDI on economic growth and employment or explaining the incentives of inward FDI. Therefore, the location choice problem of inward FDI still has not been studied enough.

And a few empirical studies about location decisions of FDI are limited to only analyze the gravity equation model with geographical and economic variables or simply estimate the coefficients of the exogenous location determinants such as market accessibility, availability of production factors, etc. So it is needed to develop the explanation for the endogenous mechanism of agglomeration economies which shows where the inward FDI

firms locate and how much it affects. Since the inward FDI into Korea has increased rapidly during the period from 1995 to 2005, it provides a good sample for us to identify the effects of agglomeration economies on the location choice of foreign investors in Korea. This paper focuses on the following factors to investigate the location choice, which are somewhat different from the previous literature.

First, we specify the different types of agglomerations and estimate the effect of each type of agglomeration on location decision. Especially, we introduce the forward/backward linkage agglomeration into the location decision. We expect that this will explain the role of intermediate good availability or market accessibility in location decision in detail by considering the industrial input-output relationship to each other. We classify the agglomeration types into four groups; i) the agglomeration comes from the concentration of foreign direct investment in a region ii) the region-industry specific endowment driven agglomeration, iii) forward linkage agglomeration, and iv) backward linkage agglomeration. And we investigate whether agglomeration economies are relevant for location choices of foreign investor in the Korea and which types of agglomeration economies are important.

Second, we include the analysis of location decision by industry group. Each industry has different characteristics in terms of factor intensity, the degree of linkage between related industries, technological basis and so on, therefore, these would affect the location decision patterns. In this sense, following the classification of Bank of Korea, we categorize industries into three industry groups and investigate location decisions using conditional logit model for each industry group.

Third, using an extensive firm-level dataset on inward FDI in Korea, we employ nested logit model of discrete choice to examine the factors determining the locational choices of FDI from abroad. Normally, lots of previous researches about the location choice depend on the conditional logit model(Head et al. 1995; Woodward, 1992; Hilber and Voicu, 2006). But the conditional logit model requires error terms that are independent across locations. This raises the argument about the independence of irrelevant

alternatives problems. To avoid this IIA problems, nested logit model is recommended. For example, like Korea, the metropolitan area of Seoul(the capital city) and other regions outside the border of this metropolitan area show big differences in the concentration of companies and business environments. Therefore, the selection of location within the metropolitan region and over that region must be treated differently. So we take a generalization approach that permits hierarchical decision process like the nested logit model. Furthermore, to our knowledge, there is no existing study of location choice of inward FDI in Korea using nested logit model.

Our paper proceeds as follows. Section 2 summarizes the theoretical background of this paper and review the existing literature. Section 3 presents the nested logit setup in more detail. In section 4, we describe the data and discuss the variables that are expected to explain the location of FDI. Section 5 then presents empirical results. Section 6 provides concluding remarks.

## **II. Background and Literature Survey**

Firms in the same industry tend to agglomerate in particular regions. According to the traditional regional economics, the spatial concentration of companies in the same industry can create positive externalities in view of region, which can not be perceived as a good one to each companies in that region though (so called MAR externalities). Marshall(1920) suggests the following three as the source of externalities; i) economies of labor pooling coming from the spatial concentration of workers with specific skills ii) the economies of non-tradable industry specific intermediate goods and service concentration iii) technology spillover.

Even though localization(agglomeration) economies work on both foreign firms as well as domestic ones, the location decisions of foreign firms can be somewhat different from those of domestic ones. For example, many foreign firms would be confronted with trade barriers such as institution, culture, language, etc., which are not barriers to domestic ones. In fact, as Caves(1996)

pointed out, the search costs are much higher for foreign compared to domestic firms due to the uncertainty with regard to locational quality and subsequent information. Meanwhile, the business relationship or communication network among same nationality, which can be added as a different form of localized externalities, would be very important for foreign start-ups, which less for domestic firms. Above discussion implies that the analysis for the location decision of foreign companies should be done with different location factors from domestic ones (e.g. Glickman and Woodward, 1988).

The empirical literature on the location decision for the foreign companies is very broad. Head et al. (1995) analyze the location choice decisions of Japanese firms in the US with conditional logit model. Based on the estimation results, they argue that a location theory about agglomeration-externalities explains the Japanese firms' behavior better than the traditional location theories with the resource endowment differences among states. Belderbos and Carree (2002) also investigate the Japanese firms' location decision. They suggest that the Japanese FDI (Foreign Direct Investment) in China tends to have high incentives of locating the place where Japanese firms concentrate, especially when the business relation firm within *keiretsu* is small-medium size.

Meanwhile, regional resource endowments is another important factor which lead localization. Traditional Heckscher-Ohlin theory in international trade predicts that the location choice of firm depends on the regional differences of production factors and raw material endowments. Even within one country border, because each region is heterogenous individual firm will choose the location which is suitable for the firm among several heterogenous regions in view of resource endowments. Then it is likely that the companies in the same industry gather together in a same region (endowment-driven theory). This suggests that we need to control the effect of regional resource endowment difference in the study of agglomeration economies.

Recently, Du et al. (2007) focus on the role of vertical agglomeration. Vertical agglomeration explains the type of spatial agglomeration of companies which have backward or forward linkages to the other companies in the same region. Forward linkages agglomeration is the agglomeration of

companies which provide the upstream parts. Then, the region with the concentration of upstream manufacturers is attractive to the FDI which is the downstream of them because of the easy availability to intermediate goods. This will generate positive externality to the FDI. In Head and Ries(1996), they find the significant positive effect of the existence of intermediate good suppliers on the location choice.

Those goods can be used as intermediate goods or final goods for other companies which are in the downstream of production process, too. The backward linkage agglomeration focus on such situation as the above. That is, the backward linkage agglomeration shows how much FDI considers the demanders in its location choice. As Du et al.(2007) suggests, forward linkage shows the importance of intermediate goods accessibility in FDI location choice and backward linkage does the importance of market accessibility in the location choice. Generally producers typically like to choose locations that have good access to large markets and to suppliers of intermediate inputs.

With regard to empirical study for linkage effects, Head and Ries(1996), Komoritani and Tsukata(2003) indicate that the agglomeration of potential intermediate goods producers has the positive effect on the location choice of FDI in China. Head and Mayor(2004) pay attention to the market potential that is demand side agglomeration. They focus on the location decision of Japanese FDI in EU and find that the market potential also is one of the important factors for FDI to decide the location.

### **III. Methodology**

Let's think about the location choice of a foreign investor in an specific industry. Alternatives of the firm is the 7 metropolitan cities and 9 provinces in this research. Since the firm tries to maximize its profit, it choose the location where it can achieve the highest profit. If  $\pi_j$  is a profit when a typical firm chooses its location at  $j$  region,

$$\pi_j = \boldsymbol{\beta}' \mathbf{x}_j + \epsilon_j, \quad j = 1, 2, \dots, J \quad (1)$$

Here,  $\mathbf{x}_j$  is the vector of attributes in  $j$  region,  $\boldsymbol{\beta}'$  is the vector of estimated coefficients and  $\epsilon_j$  is the unobserved region specific or company specific characteristics. We model the location choice of inward FDI firms in Korea with a nested multinomial logit frame. In this model, the dependent variable is the region chosen by each investor.

In our setting, we make a two tier choice process. First, the company chooses the two subgroups of the metropolitan area of Seoul (Seoul, Incheon and Gyeonggido; two metropolitan city and one province) and other regions(all other provinces and metropolitan cities). And then the company chooses an alternative within the subgroup. The NL approach allows dividing the choice set a prior into mutually exclusive subgroups(here 2 groups), where the Independence of Irrelevant Alternative(IIA) assumption is assumed to hold within the subgroup but not across subgroups. Therefore, we re-write the equation (1) as follows;

$$\pi_{jl} = \boldsymbol{\beta}' \mathbf{x}_{jl} + \boldsymbol{\gamma}' \mathbf{z}_l + \epsilon_j, \quad j = 1, 2, \dots, J \quad (2)$$

where  $\mathbf{x}_{jl}$  is the attributes of an alternative  $j$  which is in the subgroup  $l$  ( $l=1$  means metropolitan area of Seoul,  $l=2$  is others).  $\mathbf{z}_l$  is the vector of the attributes of  $l$ .

And when we assume that the error term is distributed as extreme value distribution, the probability of a company choosing  $j$  alternative in  $l$  region is

$$P_{jl} = P_{j|l} \cdot P_l = \frac{\exp(\boldsymbol{\beta}' \mathbf{x}_{jl} + \boldsymbol{\gamma}' \mathbf{z}_l + \tau_j I_j)}{\left( \sum_l \exp(\boldsymbol{\gamma}' \mathbf{z}_l + \tau_j I_j) \right) \left( \sum_j \exp(\boldsymbol{\beta}' \mathbf{x}_{jl}) \right)}, \quad (3)$$

$$I_j = \ln \left( \sum_m \exp(\boldsymbol{\beta}' \mathbf{x}_{jn}) \right), \quad (4)$$

where  $I_j$  is the inclusive value<sup>1)</sup>. If  $\tau_j$  is 1, then the nested logit model is

same to the conditional logit model. This nested logit model is estimated with full-information maximum likelihood method.

In the data section below, we provide the explanation of variables in detail which we use in this empirical work. However, we need to discuss briefly about the meaning of important variables which are directly related to the identification of the agglomeration effects. To identify the effects of agglomeration, we need to discern the effects of agglomeration which come from the cumulative process of the inward FDI firms from the effect of different type of agglomeration coming from the size of region-industry specific resource endowment in the location.

If we do not specify these two effects with each other, then it is likely that the estimation parameter is mixed. Since, as Head et al. (1995) discuss, the region-industry specific endowment driven agglomeration can be mixed with the cumulative agglomeration of the inward FDI firms at the location, the estimator of cumulative establishment variables could not be identified if there is no explicit specification of endowment driven agglomeration in the model. So, it needs to specify the region-industry specific endowment driven agglomeration with the variables which can be used as proxies for those effects in the model. As Head et al. (1995) suggest in their model, we include the two industry specific agglomeration variables; the count of inward FDI firms and the count of domestic Korean firms in the same industry to the investor. By doing so, we try to reduce the estimation bias which comes from the unknown correlation with error terms as possible as we can.

That is, since the domestic firms have more information about the location quality in a region of Korea than the foreign firms, the geographic concentration of the Korean domestic firms provides a good proxy for representing the endowment conditions of a region which are related to the specific industry endowment requirements. Since the introduction of the count of the Korean domestic firms in the same industry and region in the

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1) We estimate the model using STATA(v.7.0). In STATA, the estimated parameter  $\tau$  for the inclusive value is the inverse of  $(1-\rho)$ , here  $\rho$  is the correlation of alternatives within the subgroup.



model can control the endowment driven agglomeration effects, the count of the inward FDI firms in the same industry and region can capture the agglomeration effects coming from the concentration of foreign firms in the location decision of inward FDI firms precisely.

#### IV. Variables and Data

In this section, we explain the variables. Especially we focus our explanation on the agglomeration variables which affect location choice of firms. We introduce four different types of variables to capture the agglomeration economies; two horizontal agglomerations and two vertical agglomerations.

First type of variable is the log of the number of foreign participants in the same industry as the investor. This variable captures industry-specific foreign agglomeration economies, a form of localization economies. As traditional regional studies suggests, the agglomeration of the same industry concentration brings about the externality of labor-pooling, knowledge spillover and industry specific market formation for intermediate goods and services, etc.

Add to these traditional externalities of industry-specific foreign agglomeration, foreign firms can get the substantial reductions in the information and search costs associated with foreign investors' high uncertainty about the local environment. Therefore, foreign manufacturing firms may be attracted to regions with previously concentrated region of foreign-owned firms in the same industry due to externalities.

Relating data can be found in the Oversea Direct Investment Information Network of Korea Ministry of Finance and Economy. They provide the information of the inward FDI in detail such as the name of local subsidiary, the region where the FDI is established, the industrial classification of the FDI, and the date when the FDI is established, etc. Among them, we focus on 1,961 inward FDIs from 1996 to 2005 which are adequate to the industry classification.

The cumulative number of inward FDI firms is a proxy for the measure of agglomeration. As Head et al.(1995) suggests, agglomeration is measured as one plus the previous year's number of inward FDI firms in the establishments' industry to avoid log of zero problem in variable calculation.

The second agglomeration measure is the log of the number of the Korean domestic establishments in the same industry to the investor. As noted earlier, this variable is used to identify the region-industry specific endowment driven agglomeration effects depending on the geographical distribution of production related factor endowments. This approach is suggested by Head et al. (1995).

The data of the domestic companies are collected from the current mining and manufacturing survey from 1992 to 2005. The current mining and manufacturing survey announces Economic Census Survey every year and we can find the number of establishments, value of shipments, paid employees and annual payroll data of individual firm level by region and by KSIC 3 digit class in the survey.

Next, we explain about forward and backward linkage which represent the production relationship among industries. A vertical agglomeration is an index which shows the relationship between the agglomeration of domestic companies and the location choice of FDI. That is, FDI chooses the place where domestic companies which have upstream or downstream relationship in the production/consumption process with its products gather together.

As we explain, forward linkage agglomeration is the agglomeration of domestic companies which have upstream relationship with FDI's products. Head and Ries(1996) uses regional manufacturing products as a proxy for forward linkage agglomeration. However, the region which shows high production quantities is not chosen as FDI's location if the agglomeration of companies in the region do not have any relevance to the products of the FDI. Therefore, manufacturing production in region must be considered with an appropriate weights, for which here we use input coefficients in Input-Output table.

Suppose that  $x_{ij}$  is the real output of industry  $i$  in region  $j$ ,  $a_{io}$  is the input coefficient reflecting the inputs from the upstream industry  $i$  required

for one unit of product of industry  $o^2$ ) (here,  $o$  is the industry including a FDI's production). Forward linkage related agglomeration at  $j$  region ( $IPU_{oj}$ ) is defined as follows;

$$IPU_{oj} = \sum_{i=1}^I a_{io} x_{ij} \quad (5)$$

It is probable that the region with high production amounts will produce more various intermediate goods. Thus, in view of FDI, since the availability of intermediate goods will be high in the region with highly developed supporting industry, the region as its production site is highly attractive. Following this logic, we expect (+) sign of  $IPU_{oj}$  in the location decision estimation.

Here, instead of the count of companies in the region, we use production amounts as an index for the forward linkage agglomeration, which can be weighted with input coefficients. And since  $IPU_{oj}$  has a high correlation with total production amounts, we scaled it with regional real manufacturing output.

Meanwhile, backward linkage agglomeration is the agglomeration of domestic companies or final consumers which are regarded as downstream agents in the production process of FDI's products. A backward linkage agglomeration ( $IPD_{oj}$ ) is defined as follows;

$$IPD_{oj} = \left( \sum_{i=1}^I b_{oi} x_{ij} \right) + b_{oY_j} Y_j, \quad (6)$$

where  $b_{oi}$  is the input coefficients which show FDI products are used as an

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2) Each industry input coefficient is the ratio of intermediate input amounts with total input amounts in the transaction table at producers goods and service. Here, we need to match the industry classification in I/O table with KSIC 3 digit classification. We use code-match table which is provided by ISTANS at KIET(Korea Institute for Industrial Economics and Trade). Since I/O table is announced every 5 years and supplement table is announced third year within each 5 year periods, the input coefficient in the missing year is assumed to be same to the previous input coefficient which is based on the data.

intermediated or final goods for industry  $i$  and  $x_{ij}$  is the real production output of industry  $i$  in region  $j$ . These two terms, especially expressed in the first term in the righthand side of equation (6), represent the potential intermediate demand for the products of FDI in  $j$  region.

In the second term in the righthand side of equation (6),  $b_o Y_j$  is the marginal propensity expenditure to the  $o$  industry in region  $j$  and  $Y_j$  is the regional real income in  $j$ . This represents the potential demand of final consumer for the products of FDI.<sup>3)</sup> Therefore,  $IPD_{oj}$  is the sum of the final goods demand and the intermediate goods demand which induces a direct effect on the production. As we scale the  $IPU_{oj}$ , we calculate  $IPD_{oj}$  with scaled regional real manufacturing production amounts. The region with highly developed downstream industries/final consumer can be attractive to FDI. Therefore, the expected sign of that variable is (+) in the location choice estimation.

## V. Empirical Results

### 5.1. Estimation Results for Model with Choice among Regions

Table 1 presents the agglomeration coefficients generated by logit estimation of Eq. (3). These empirical results are obtained by considering the regional fixed effects. In the table, first column(named model 1) is the estimation results with nested logit setup and second is with conditional logit estimation method. The comparison of those estimates with each other can provide the idea of a degree of difference between the nested logit estimation and the conditional one.

For model specification, we test the appropriateness of grouping. As shown in table 1, test statistics of likelihood ratio is 22.40, which rejects the hypothesis that the estimated parameters of inclusive values are equal

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3) We consider the only first term of equation (6) as a backward linkage agglomeration in the estimation.

to 1. This means that the grouping is suitable for the estimation with this sample. So we focus on the results of nested logit model estimation for the interpretation.

First, we try to catch the unobserved characteristics of each location. So we include the regional dummies in the estimation. Especially, even though we do not report in the table, the 7 coefficients of all 14 regional dummies are statistically significant at 1% significance level and 12 at 10% level. This also shows that the inclusion of state dummies enhances model specifications.

From the result of nested logit estimation, we find that the two horizontal agglomeration variables, those are localization agglomeration and endowment driven agglomeration, generally display the expected signs and are important determinants for the foreign firms' location choices in Korea. This means that the location choices of foreign investors in the Korea are affected by the previously located both foreign and Korean companies in the same industry and region.

Different from the estimation result of conditional logit method, in the nested logit, the effect of foreign firms agglomeration on the location choice is larger than that of the domestic firms agglomeration variable. This suggests that the attractive effect of previous inward FDI would exceed that of the prior domestic investment.

Interestingly, the coefficients with respect to the two horizontal industry specific agglomeration variables in the nested logit are very similar to the results obtained by Hilber and Voicu(2006) or Head et al. (1995). Hilber and Voicu(2006), which investigate the location choice of FDI within Romania, argue that while the signs of two industry specific agglomeration (the agglomeration of foreign firms and that of the domestic firms) are estimated positively together, the magnitude of estimated coefficients of the foreign agglomeration is larger than that on the domestic agglomeration.

This shows that the foreign manufacturing firms do not simply follow the spatial distribution of the domestic(Korean) establishments in their industry. Rather the accumulation of foreign companies at one location spurs successive investors in the same industry to choose the same location.

Next, vertical related agglomeration estimators show interesting feature. While, as we expected, the sign of forward linkage agglomeration is positive, that of backward linkage agglomeration is negative which we do not expect. But the estimator of backward linkage agglomeration is not significant. The spatial availability of intermediate good shows statistically significant positive relationship with the location choice. As confirmed in the Head and Ries(1996) and Komoritani and Tsukata(2003), we can find the importance of spatial availability of intermediate good on location decision process in the case of inward FDI within Korea.

As we previously pointed out, the specialized intermediate suppliers are one of the important compelling reasons for spatially industrial concentration. And this immediately implies that there are forward linkages that tend to concentrate the downstream producers in a single location, where the upstream industry is located. Thus, we can show that the location choices of Korean FDI are affected by the forward linkages.

In the case of backward linkage agglomeration, different from the forward one, it does not provide meaningful information about the location choice of FDI in Korea. But this might be related to our definition of backward linkage agglomeration variable. That is, as we show in the equation (6), backward linkage agglomeration is defined with the composition of both the agglomeration of downstream companies and the agglomeration of final consumers in a region. In this estimation, however, we consider only the agglomeration of downstream companies. Therefore, the interpretation of the this estimator must be confined the effect of the downstream companies agglomeration on the location choice of FDI. We will consider the effect of final consumer agglomeration anytime soon.

## **5.2. Estimation Results by Industry Group**

Our analysis focuses on the characteristics of choices. This means that we do not take into consideration the characteristics of each industry group. In fact, if we set up the model with two error terms, that is, unobserved region industry specific error and unobserved individual industry error, then

we are going to be confronted with the integration problem over the dimension of high order, which is difficult to treat. Therefore, we classify the industries into three categories and we re-estimate our logit model for each industry group. Industries are classified into three industry groups; consumer goods industry group, assembly and processing industry group, basic material manufacturing industry group.<sup>4)</sup>

Table 2 shows the results of estimation. In this estimation, we use only the model with fixed effects. When we look at the test statistics for grouping appropriateness, only assembly and processing industry group rejects the null hypothesis. This means that in the case of other two industry groups conditional logit estimation method is suitable for the location choice estimation. Therefore, we provide the estimation result of conditional logit model for both consumer good industry group and basic good metal industry group. The estimation result of assembly and processing industry group is nested logit one.

As we expect, the result of two horizontal agglomeration variables are positive and significant. In the case of vertical agglomeration estimators, the effect of forward linkage agglomeration is positive but the degree of significance is lower than that of the estimators in the pooled data model which is nested logit model in the table 1. That is, the estimators of forward linkage agglomeration in consumer good industry group and assembly and processing industry group are significant at 10% level of significance.

Meanwhile, when we investigate the location choice of FDI by each industry group reflecting the specific characteristics of each one, the estimation results with respect to industry specific agglomeration variables exhibit different patterns across industry groups. In the following, we summarize some results.

In the case of consumer industry group, the effect of domestic firms

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4) The consumer goods industry includes food and beverage, textile and leather, paper and wood, printing, furniture and other manufactures. Assembly and processing industry group includes general machinery, electronics, precision machinery, transportation equipment. Basic material manufacturing industry group includes chemicals, petroleum, non-metallic minerals, primary metals, and metal fabricating.

agglomeration, which is proxy for the factor endowment effect on the location decision, is positive, 0.442, and significant at 1% significance level. The effect of foreign companies agglomeration is also positive however it has weak significance and the size of that one, 0.235, is lower than that of domestic agglomeration. This explains that the location choices of the foreign firms in the consumer goods industry are affected sensitively by the factor endowment distribution of the Korea.

The estimation result of forward linkage agglomeration is positive and significant at 10% of significance level. That of backward linkage is positive but not significant. Especially, the reason why the effect of backward linkage does not show significant effect might be that we do not reflect the demand of final consumption on the backward linkage agglomeration variable in the model.

Next, look at the assembly and processing industry group which accounts for 59% of the sample. The estimation size of domestic firms aggregation, 0.548, is greater than that of foreign one, which is 0.455. And the forward linkage agglomeration affects positively. It is similar pattern to that of FDI location decision in the consumer industry group. But, different from the consumer industry case, FDI in this industry group prefers clearly the region which has foreign firms agglomeration and is in the vicinity of the metropolitan area of the capital city, Seoul.

Meanwhile, the basic material manufacturing industry group shows an opposite pattern in the relative size of the effect of two horizontal agglomeration variables in both the consumer industry group and the assembly and processing industry group. It shows that the estimated coefficient size of foreign firms agglomeration is larger than that of the domestic firms agglomeration variable. This suggests that the attractive effect of previous inward FDI might exceed that of the prior domestic investment.

Foreign firms in the basic material manufacturing industries do not simply follow the spatial distribution of the Korean domestic establishments in their industry. Rather, the previous accumulation of the foreign firms in this industry group at one location spurs successive investors in the same



industry to choose the same location. Lastly, the effect of vertical related agglomeration variables does not show any significant effect on the location choice in this industry group.

## VI. Conclusion

Using the comprehensive firm-level data which covers all the inward foreign direct investments within Korea between 1996 and 2005, we estimate the impact of horizontal and vertical agglomeration economies on location choices.

From the estimation results for the overall industry, the nested logit estimation results confirm that not only industry-specific foreign-firm agglomeration economies but also Korean domestic firm agglomeration economies play an important role in the location choice of foreign manufacturing firms in Korea. However, the estimated agglomeration coefficient of foreign firms exceed that of Korean firms. This shows that the foreign manufacturing firms do not simply follow the spatial distribution of the domestic(Korean) establishments in their industry. Rather the accumulation of foreign companies at one location spurs successive investors in the same industry to choose the same location.

The estimation results on the vertical agglomeration variables, forward linkage agglomeration and backward linkage one, show different result. While the effect of forward linkage agglomeration is positive and significant as we expect, the effect of backward is negative and insignificant. This explains that the spatial availability of intermediate good shows statistically significant positive relationship with the location choice for the inward FDI within Korea.

We re-estimate the model using three sub-samples by industry group; consumer goods industry group, assembly and processing industry group, and basic material manufacturing industry group. Estimation results exhibit somewhat different patterns by each industry group reflecting the nature of each industry group.

Mostly, the FDI location decision in the case of consumer industry group and assembly and processing industry group are affected more by the foreign firms agglomeration than by the domestic firms agglomeration. And the estimators of forward linkage effect in those industry group are also positive, too. It explains that FDI in these industry group considers more important domestic endowment distributions across regions and the availability of intermediate goods in the location decision.

On the contrary, in the case of basic material industry group, it shows that the estimated coefficient size of foreign firms agglomeration is larger than that of the domestic firms agglomeration variable. This suggests that the attractive effect of previous inward FDI might exceed that of the prior domestic investment.

There has been no through statistical analysis with regard to the location decisions of inward foreign manufacturing investments in Korea. In this sense, this paper provides implications and insights to the questions about foreign firms' location behavior particularly in relation to both the horizontal and vertical agglomeration externalities. Yet, there is still need for further research on these issues. In this paper, we could not reflect the final demand agglomeration in the variable of backward linkage agglomeration. So we can not catch fully the effect of regional demand side attractiveness.

< Table 1> Logit Estimates, 1996-2005

	Model 1 (Nested logit)	Model 2 (Conditional logit)
Lower Nest		
Industry-specific foreign agglomeration	0.507*** (0.055)	0.455*** (0.050)
Industry-specific domestic agglomeration	0.403*** (0.042)	0.454*** (0.037)
forward linkage agglomeration	4.098*** (1.438)	4.632*** (1.440)
backward linkage agglomeration	-0.288 (1.381)	-0.701 (1.413)
Upper Nest		-
Metropolitan	5.076*** (1.061)	-
$\tau_1$	1.046*** (0.061)	-
$\tau_2$	1.431*** (0.150)	-
LR test ( $\lambda=1$ )	$\chi^2(2)=22.40$	-
Regional fixed effects	Yes	Yes
Log likelihood	-3,626.62	-3,637.82
Number of observations	31,376	31,376
Number of investors	1,961	1,961

Note :  $\tau_i$  are parameters for the inclusive variables of each group.

<Table 2> Logit Estimates by Industry Group, 1996-2005

	Consumer Goods	Assembly and Processing	Basic Material Manufacturing
Lower Nest			
Industry-specific foreign agglomeration	0.235* (0.142)	0.455*** (0.080)	0.484*** (0.098)
Industry-specific domestic agglomeration	0.442*** (0.079)	0.548*** (0.073)	0.221** (0.101)
forward linkage agglomeration	16.051* (9.29)	3.286* (1.962)	0.489 (4.321)
backward linkage agglomeration	3.927 (5.86)	-0.475 (1.737)	3.482 (3.868)
Upper Nest			
Metropolitan	-	4.061*** (1.513)	-
$\tau_1$	-	1.028*** (0.135)	-
$\tau_2$	-	1.307*** (0.167)	-
LR test ( $\lambda=1$ )	-	$\chi^2(2)=10.87$	-
Regional fixed effects	Yes	Yes	Yes
Log likelihood	-501.19	-2,120.19	-972.97
Number of observations	5,424	18,592	7,360
Number of investors	339	1,162	460
Estimation method	Conditional logit	Nested logit	Conditional logit

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