Agglomeration Economies and the Location Decision of Japanese Manufacturing Investments in Korea

Ki-Dong Lee† and Seok-Joon Hwang**

June 20, 2011

Abstract

Employing the micro data for 1998-2005, we investigate the location decision of Japanese manufacturing investors in Korea. For the overall industry without grouping, quality of labor, business service availability, government policies approximated by industrial complex, and horizontal agglomeration play a positive role for location choice of Japanese investors. Distinct different location patterns can be seen between two industry groups. Japanese FDIs in high-tech industry tend to concentrate nearby the capital metro region where high-skilled labor and business service firms are highly concentrated, while those in low-tech prefer major cities in each wide-ranged economic region to meet both labor cost and quality, and well-developed transportation system. Strong evidence of country-of-origin effects is found. FDIs in high-tech industry follow the location of previous Japanese or domestic firms in the same industry, while FDIs in the low-tech follow the previous US or domestic firms.

key words: Location; FDI; Conditional logit; Agglomeration economies; Country-of-origin effect

JEL Classification: F23, R38

* Department of International Commerce, Keimyung University, Kora.
** Department of Economics, Keimyung University, Kora.
† Address for Correspondence: 1000 Sindang-dong, Dalseo-Gu, Daegu, 704-701 Korea. Phone: +82-53-580-5223. Fax: +82-53-580-5483. E-mail: kdlee@kmu.ac.kr.
1. Introduction

There has been unprecedented increase of direct investment across national borders over recent decades.\(^1\) Indeed, in the Korea, though the influx of FDI made a slow progress before the Asian financial crisis, it has shown a rapid increase due to the government’s promotional measures to attract inward FDI especially after 2000. Accordingly, Korea's inward stock of FDI as a percentage of GDP has increased from 2.1% in 1990 before the Asian financial crisis in 1997 to 8.0% in 2006 after the crisis (UNCTAD, 2007).

As the positive role of FDI in the regional economic growth is emphasized, researchers have investigated its locational determinants. Large parts of these papers have explored the FDI location decision within USA (Bartik, 1985; Woodward, 1992; Head et al, 1995, 1999; Coughlin et al., 1991; Friedman et al., 1992; Nachum, 2000). Among other studies, some have done the same for the individual countries in Europe or EU as a whole. Recently, as the largest FDI recipient country, China has caught much attention in the academic literature on FDI location choice (Head and Ries, 1996; Cheng and Kwan, 1999, 2000; Amiti and Javorcki, 2005; Fung et al., 2002; Du et al., 2007).

As far as the Korea is related, there have been only a few empirical studies of the location determinants of inward FDI. Some of the papers have investigated the location choice in relation to foreign investors as a whole (Lee et al., 2008), or do the descriptive analysis using the questionnaire survey thus cannot reach the scientific results based on econometric analysis (Cha, 2004). To our knowledge, nobody has studied the determinants of location choice of foreign investors originating from a particular country. This paper, using a comprehensive firm-level data covering individual location choices for 1998 to 2005, examines the determinants of Japanese manufacturing investors at a regional level in Korea and more particularly assesses the importance of different types agglomeration economies among other determinants.

Here, we focus on FDI from Japan. Since 1962 when the direct investment was opened to foreign countries, Japan has been the largest source of Korean inbound FDI on a number of projects basis especially in the manufacturing sector. Figure 1

\(^1\) According to Shatz and Venables (2000), FDI has grown much faster (17.6% of annual growth rate for 1985-1997) than either trade (9.2% for the equivalent years) or income (7.2% for the equivalent years) at a global level, which has made the
shows the composition of inbound FDI from 1985 to 2006 by country-of-origin. At least by 1991, more than half of total FDI in Korea came from Japan. Even though the source country has been diversified therefore the share of Japan has decreased since the 90s, Japan is still the largest FDI provider in the manufacturing industry on the basis of project numbers. Despite that Japan is the first country who started major direct investment into Korea and still has the considerable share in the total inward FDI, there has been no thorough empirical analysis of Japanese FDI location within Korea. Little is known about Japanese firms’ location selection in Korea. In this sense, this study on the location decision of FDI from Japan will provide important clues in understanding the locational determinants of succeeding direct investments from major countries other than Japan.

<Figure 1> is here

This paper is of interest for several reasons. First, we pursue the consistency between the theoretical and empirical approach. We set up the theoretical model of locational determinants which combines the oligopolistic competition in the downstream sector proposed by Crozet et al. (2004) with the monopolistic competition in the upstream sector, which yields an estimable equation for the location choice of firms. This method will add the scientific basis to the analysis.

Second, we specify different types of agglomerations and estimate the effect of each type of agglomeration on location decision. Especially, we introduce two types of agglomeration variables in large, those are horizontal and vertical agglomeration variables, and investigate whether agglomeration economies are relevant for location choice of the Japanese investors and which types of agglomeration economies are more important. As far as vertical agglomerations are concerned, an important study for the approach that we take is the work of Du et al.(2007). In this paper, we also adopt the index analogous to Du et al.(2007) to investigate whether the upstream or downstream agglomerations are an important determining factors for the firms from Japan to invest in one of Korea’s region.

Third, this paper deals with the agglomeration effect by country-of-origin of investors. We investigate whether the nationality of firms do matter in the location attraction of FDI a major policy target throughout the countries.

2 If we include service industry, the above order of FDI source country changes. For the years 2000 to 2007, Japan accounts for 17.6% of the total number of inward FDI covering all the industry including service sector, which is the third largest level as a FDI source country followed by China (20.3%) and the U.S. (17.8%).
decision of Japanese direct investment. Rauch (2001) insist in his survey paper that the trans-boundary business and social networks such as Japanese Keiretsu or the co-ethnic networks comprised of immigrants can help to alleviate the informal trade barriers, therefore, create the positive externalities in trade and investment. This implies that, when firms plan to extend their business abroad, they would have incentives to cluster more with other firms from the same country. In this study, we break down the horizontal agglomeration variable into variables distinguished by firms' nationality and show that nationality of investors is an important locational determinant for the Japanese direct investment.

Fourth, we carry out the analysis of location decision by industry group. Each industry has different characteristics in terms of factor intensity, technological basis, the degree of linkages between related industries, and so on. Since these differences can affect the location decision patterns, we separate industries into two sectors of high-tech and low-tech industry, and explore how firms' industrial or technological characteristics influence firms' location decision.

Our paper proceeds as follows. Section two presents the theoretical determinants of location choice of a representative foreign investor entering the region, which yields an estimation equation for the location choice of firms. Section three explains the estimation method and the data used. And Section four presents the results of the empirical analysis. Conclusions are set in the final section.

2. Model of Location Choice

2.1. Theoretical Model

In general, main determinants of FDI location can be broadly classified into four large categories, i.e., agglomeration effects, market demand, factor costs, and infrastructure including policy measures. Here, agglomeration effects compromise both horizontal and vertical aspects: the former means the geographical concentration of the firms within the same industrial classification, while the latter reflects the concentration of domestic firms with backward or forward linkages to the firms from foreign countries.

Horizontal agglomeration generates two conflicting effects on the location of new entrants. On the one hand, it generates positive externalities called “localization economies” for nearby firms engaged in similar activities thus has the centripetal
force which attracts additional firm to enter the same region. On the other hand, a rise in the number of firms in a given region raises the competition between firms and shifts prices down in that region, which consist of centrifugal force (or dispersion force) since imperfectly competitive firms have a tendency to locate in regions with relatively few competitors. In order to incorporate above mentioned factors theoretically, we suggest the following model of locational determinants, which combines the oligopolistic competition model in the downstream sector proposed by Crozet et al. (2004) with the love of variety approach in the intermediate-good sector. As in Crozet et al. (2004), we assume Cobb-Douglas type demand function for a specific good in region $i$

$$X_i = Y_i^\gamma P_i^{-\beta},$$  \hspace{1cm} (1)

where $P$, $X$, $Y$, $\gamma$, and $\beta(>1)$ are, respectively, the price of the final good, the total quantity of demand, income of consumers, income elasticity, and price elasticity. Here, $\gamma$ and $\beta$ are industry-specific parameters, thus are not affected by the regional attributes. If firms are identical when producing in the same region, it yields $X_i = N_iX_i$ in equilibrium, where $N_i$ and $X_i$ are, respectively, the number of active firms and the representative firm’s output in region $i$. We assume that each investor has an identical Cobb-Douglas type production function with constant return to scale and external effects which individual firm regard as given. If inputs, labor and composite intermediate-good, are chosen to minimize cost, the marginal cost function can be derived from the production function as follows:

$$c_i(w_i, g_i; \xi) = \Psi w_i^\alpha g_i^{1-\alpha} \{\xi(N_i, S_i)\}^{-1}, \quad \text{where} \quad \xi = N_i^{\alpha_s} S_i^{\delta_s}. \hspace{1cm} (2)$$

In Eq. (2), $w_i$ and $g_i$ are, respectively, the ongoing wage and the price of intermediate-good in region $i$. Here, the last term, $\xi$, captures the external effects which each individual firm regards as given and is a function of $N_i$ and $S_i$: $\xi = N_i^{\alpha_s} S_i^{\delta_s}$, where $\alpha_s, \delta_s > 0$. It is assumed that the labor-market pooling and knowledge spillovers which are the principal features of localization economies are reflected in the variable $N_i$ (i.e., $\partial \xi / \partial N_i > 0$). The variable $S_i$, business service output density in a particular region, is to capture the external effects of business service availability on location decision ($\partial \xi / \partial S_i > 0$), which is especially important
for the foreign investors who have more obstacles in doing business and less initial knowledge about Korean locations than many domestic firms. Letting $t_i$ denote a corporate tax rate in region $i$, which represents promotional policies of the local government in a large sense, then a representative firm willing to produce and sell at this location earns profit

$$
\pi_i = (1 - t_i) \left\{ P_i - c_i \left( w_i, g_i, \xi_i \right) \right\} x_i.
$$

(3)

Since each firm maximizes its profit, taking the outputs of rivals as given in the Cournot competition, we obtain the following expressions for the output of each firm and market price in the equilibrium.

$$
\hat{x}_i = \frac{Y_i}{N_i^{1+\beta}} \left( \frac{N_i \beta - 1}{c_i \beta} \right)^{\beta}, \quad \text{and} \quad \hat{P}_i = \frac{N_i \beta}{N_i \beta - 1} c_i.
$$

(4)

Substituting Eqs. (4) and (2) into Eq. (3) provides the equilibrium profit function. Analogous to Crozet et al. (2004), we can simplify the profit function by assuming large value in $N_i$. Since it holds $N_i \beta - 1 = N_i \beta$ with a sufficiently large value of $N_i$ and $\beta > 1$, the equilibrium profit function of a firm can be expressed by

$$
\hat{\pi}_i = (1 - t_i) \beta^{1-\beta} Y_i^{1-\beta} w_i^{(1-\beta)\xi_i \beta} g_i^{(1-\alpha)(1-\beta)} S_i^{(\beta-1)1-\beta} N_i^{\beta \beta (\beta-1)-2}
$$

(5)

As can be seen in Eq. (5) the equilibrium profit of a representative foreign investor locating in region $i$ is positively related with $Y_i$ (income), $S_i$ (business service availability), and $(1 - t_i)$ (policy measure to promote inward FDI), and is negatively related with $w_i$ (wage), and $g_i$ (the price level of intermediate-good). The sign of $N_i$, however, now depends on the impact of the externality parameter relative to the negative impact of competition.

More importantly, of the variables above mentioned, the price level of intermediate-good in a regional level usually cannot be observed. Thus we try to represent the regional price level of intermediate-good as a function of observable variables by including the Dixit-Stiglitz type love of variety approach in the intermediate-good
sector. In order to do this, we assume that \( z_i \) is a region \( i \)'s composite index of intermediate-good varieties which are produced in a different region, and that region \( i \) imports these non-home-produced varieties from these regions adjacent to region \( i \). And if these varieties become expensive this will raise the price index of \( z_i \) accordingly.

Eq. (6) shows the CES sub-production function for \( z_i \), which is a function of separate varieties \( d_{ri}(s_r) \):

\[
z_i = \left[ \sum_{s_i=1}^{m_i} d_{ri}(s_i)^{\frac{\sigma-1}{\sigma}} + \cdots + \sum_{s_R=1}^{m_R} d_{rR}(s_R)^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}} = \left( \sum_{r=1}^{R} \sum_{s_i=1}^{m_i} d_{ri}(s_r)^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}, \quad (6)
\]

where \( \sum_{r=1}^{R} m_r = M \). \hfill (7)

In Eq. (6), \( d_{ri}(s_r) \) is the delivered volume faced by a representative Japanese investor in region \( i \) (destination) for the products from region \( r \) (origin), \( s_r \) is the index of varieties of region \( r \), \( m_r \) is the number of delivered varieties from region \( r \), and \( \sigma(>1) \) is the elasticity of substitution among varieties. We further assume that \( \sum_{r=1}^{R} m_r = M \) in Eq. (7), implying that a representative Japanese firm obtains \( M \) kinds of varieties in total from the region where it is located and other adjacent regions. Solving the cost minimizing problem subject to Eq. (6) gives \( g_i \), which is the unit cost function for \( z_i \) or can be regarded as an intermediate-good price index in region \( i \):

\[
g_i = \left( \sum_{r=1}^{R} \sum_{s_r=1}^{m_r} q_{ri}(s_r)^{1-\sigma} \right)^{1-\sigma}, \quad (8)
\]

\( q_{ri}(s_r) \) is a delivered price charged the foreign investor firms in region \( i \) (destination) for the intermediate-good of \( s_r \) variety from region \( r \).

Let us introduce iceberg type transportation costs. And if all the varieties produced in the same region have same mill price, then it holds \( q_{ri} = q_r \times \tau_{ri} \); it is the product of mill price \( q_r \) and the transportation costs \( \tau_{ri} \). Here, \( \tau_{ri} \) includes all the costs associated with moving goods across space and provincial borders.

In the discrete varieties version of Dixit-Stiglitz type production function, if the
number of available varieties is large enough, each producer will simply face a fixed elasticity of demand $\sigma$. Thus the resulting mill prices of intermediate-good producer in region $j$ are simple mark-ups over marginal cost, denoted by $\mu_r$, 

$$q_r = \frac{\sigma}{\sigma-1} \mu_r, \quad r = 1, 2, \ldots, R$$

(9)

This is called mill pricing or factory gate pricing, since it is as if the firm sets a single price at its plant or at the factory gate, and customers bear all the transportation costs. Another way of saying this is that with mill pricing, a firm’s producer price is the same for sales to all markets. For the simplification, let’s assume that the marginal costs of the intermediate-good producers are the same all over the regions ($\mu_r = \mu$). Then the intermediate-good price index in region $i$, $g_i$, will be given by

$$g_i = \left( \frac{\sigma}{\sigma-1} \mu \right) \left[ \sum_{r=1}^{R} m_i r_i^{1-\sigma} \right]^{1/(1-\sigma)}.$$  

(10)

The price level of intermediate-good in a region depends on the industry’s mark-up level ($\sigma/\sigma-1$), marginal cost ($\mu$), and the degree of concentration of domestic upstream firms weighted by transportation costs between the corresponding region and region $r$ from which the intermediate-goods are supplied ($\sum m_i r_i^{1-\sigma}$). And it is noteworthy that the mark-up level and marginal cost term in Eq. (10) are industry-specific, thus are independent with regional characteristics. Differentiating Eq. (10) with respect to $m_i$ subject to Eq. (7), we have

$$\frac{\partial g_i}{\partial m_i} = \frac{g_i}{1 - \sigma} \left( 1 + \sum_{r=1}^{R} m_i \phi_{ri} \frac{\partial}{\partial m_i} \phi_{ri} \right) < 0,$$

(11)

where $\phi_{ri} = r_i^{1-\sigma}$, which measures the freeness of trade between the regions $r$ and $i$. That is, the freeness of trade rises from $\phi_{ri} = 0$, with the infinite transportation costs between those regions, to $\phi_{ri} = 1$, with zero transportation costs.

Eq. (11) means that a higher $m_i$ lowers $g_i$ as long as $\phi_{ri} < 1$. This implies that the agglomeration of domestic upstream firms is a significant local factor to the
downstream foreign investor because the geographical proximity of the firms that are suppliers of their inputs will cause a saving in transportation costs as a pecuniary externality. Substituting Eq. (10) into (5) and rearranging, we have

$$
\ln \hat{\pi}_i = A + \ln (1-t_i) + \gamma Y_i + a(1-\beta) \ln w_i + \frac{(1-a)(1-\beta)}{1-\sigma} \ln \sum_{r=1}^{s} m_r \phi_r \\
+ \theta_S (\beta - 1) \ln S_i + \{\theta_S (\beta - 1) - 2\} \ln N_i,
$$

where $A$ is a complicated function of the parameters which are independent with regional characteristics.

Eq. (12) is the final specification that should be estimated. The sign of all the variables except $N_i$ are clearly determined. Let us remind that $\beta, \sigma > 1$ and $a < 1$. Profit of a firm in region $i$ is a decreasing function with regard to region's corporate tax rate ($t_i$), input prices ($w_i$) while an increasing function with regard to consumers' income ($Y_i$), the concentration of domestic upstream firms weighted by the market openness ($\sum_{r=1}^{s} m_r \phi_r$), and business service availability ($S_i$). Signs of the count of active firms ($N_i$) is not clear. It depends on the relative magnitude of the externality parameter compared to the negative impact of competition.

### 2.2. Econometric Model of Location Choice

We model the location decision of Japanese manufacturing plants (within Korea) as a conditional logit problem where the dependent variable is the region chosen by each investor. The conditional logit setup is widely used method to analyze how firms choose among several alternatives. It focuses on the attributes of each region in the choice set. Let's think about the location decision of a representative Japanese manufacturing investor in a specific industry. The geographical dimension used in this research is the 16 major administrative districts in Korea; those are seven major cities and nine provinces.

We define $\pi_i(a)$ to be the profit of a Japanese investor $a$ when it chooses its location in region $i$ (at time $t$). If the profit that individual firm earns from locating in any of the potential locations is determined by the attributes of that location, then we can express profit as
\[ \pi_i(a) = \beta'X_i + \varepsilon_i(a) \]  

where \( X_i \) represents the vector of attributes in region \( i \) which vary across investors, since investors differ in the date of location choice, industry and country of origin. And \( \beta \) is the vector of unknown coefficients that should be estimated and \( \varepsilon_i(a) \) is the unobserved region specific of firm specific characteristics. We assume that each firm is rational therefore chooses the location that offers the highest expected profits. Thus the probability (Pr) that a particular region \( i \) is chose by the firm \( a \) is

\[
\Pr_i(a) = \text{Prob}\{\pi_i(a) > \pi_r(a)\}, \quad \forall r \neq i
\]

\[
= \text{Prob}\{\varepsilon_i(a) < \varepsilon_i(a) + \beta'X_i(a) - \beta'X_r(a)\}
\]

As McFadden (1974) suggests if \( \varepsilon_i(a) \) follows type I extreme value (Gumbel) distribution, then it can be shown that

\[
\Pr_i(a) = \frac{\exp\left(\beta'X_i(a)\right)}{\sum_{r \in R} \exp\left(\beta'X_r(a)\right)},
\]

which leads to what is called the conditional logit model. In Eq. (14), \( R \) is the set of possible location sites and location \( i \) offers a profit \( \pi_i(a) \) to an investor \( a \). Using the maximum likelihood techniques we estimate the coefficients of the industry-specific independent variables. The expected signs and magnitudes of those coefficients are dictated by Eq. (12).

Relevant factors for the site selection decision include (but are not limited to) agglomeration variables in both horizontal and vertical terms, prices of inputs (land, labor and capital), market demand, and quality of infrastructure or the region's promotional policies. In the data section below we describe in detail the set of explanatory variables which we use in the empirical analysis.
3. Variables and Data

We consider location decisions of Japanese manufacturing investors in Korea. First, our data on Japan-invested firms in Korea comes from a broad dataset on inward FDI of Korea Ministry of Knowledge Economy. This dataset provides the information on foreign affiliates operating in Korea, which is including establishment date and address of investment, the KSIC industry classification of products and the nationality of source country. Among them, we focus on 563 Japan-affiliated manufacturing investments from 1998 to 2005 which provides obvious information as to the industry classification of products, address of investment, and firm’s establishment date etc.

<Horizontal Agglomeration Variables>

The horizontal agglomeration variable is to capture the localization economies, which comes from the geographical concentration of firms within same industrial classification in a particular region. The industry-level agglomeration variables make use of the Korean Standard Industrial Classification (KSIC) codes. And throughout the paper, we employ 3-digit KSIC level of disaggregation as an industry unit. In order to investigate that whether the country-of-origin of FDI matters in the agglomeration effects, we try to identify the 'nationality' of the horizontal agglomeration. Specifically, as Head et al.(1995) suggests, industry-specific agglomeration of $i$ country-origin firms ($AG_i$) is measured by the log of one plus the previous year’s number of plants from $i$ country in the same industry level. Here, adding one to the cumulative number of firms is to avoid log of zero problem in variable calculation.

<Vertical Agglomeration Variables>

Vertical agglomeration reflects the concentration of domestic firms with backward and forward linkages to the firms from Japan. According to the recent development of new economic geography, in addition to the externalities of agglomeration mentioned earlier, there are backward and forward linkages that tend to concentrate the upstream and downstream producers in a single location (Venables, 1996; Krugman and Venables, 1995).

Backward agglomeration is the geographical concentration of domestic upstream manufacturing firms which are suppliers of intermediate inputs to the Japanese firms located in the same region. The concentration of intermediate-good producers
in the region makes firms’ availability for those goods highly possible. Thus, Japanese investors in the downstream sector will prefer to locate nearby the domestic upstream firms in order to save transportation costs for their intermediate inputs.

Furthermore, the geographical closeness between domestic intermediate-good suppliers and foreign firms in the downstream sector enhance their interactive cooperation through the linkage relationship thus it can make production costs of foreign investors low. Head and Ries (1996) uses regional manufacturing production as a proxy for the backward (or upstream) agglomeration and shows positive relationship between the location choice of firms and the regional manufacturing production.

However, if a region with a large volume of manufacturing production has little input-output relation with the production of the foreign investors, then the probability that those investors choose the region as a location site would be low. This implies that total manufacturing production in a region as a backward agglomeration index must be adjusted using an appropriate weight based on vertical production linkage, for which we use input coefficient by industry of Input-Output Table as a weight in making vertical agglomeration index. The index of domestic backward agglomeration in region $i$ is defined as follows:

$$AIU_{oi} = \sum_{h=1}^{m} \frac{a_{ho}x_{hi}}{X_i},$$  \hspace{1cm} (16)$$

where $X_i$, $x_{hi}$, and $a_{ho}$ are, respectively, total manufacturing output (in real term) in region $i$, industry $h$’s real output in region $i$, and the input coefficient which denote industry $h$’s input required to produce one unit of industry $o$’s products.$^3$

The $AIU_{oi}$, the proportion of domestic upstream products weighted by the input-output ratio in total manufacturing output in region $i$, represents the potential availability of domestic upstream products in one region for the potential

---

$^3$ In making the index, 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 five years and supplement table is announced second or third year within each five periods, the input coefficient in the missing year is
Japanese investors entering the region. Therefore, Japanese investors belonging to downstream industry \( o \) will prefer the region with high \( AIU_{oi} \) as a production site to other regions, which might help save the transportation costs for their intermediate inputs or get the network externalities of domestic upstream suppliers. Since the region of high \( AIU_{oi} \) would be highly attractive for the Japanese investors as a production site, we expect (+) sign of \( AIU_{oi} \) in the location decision estimation. Here, instead of the count of companies in the region, we use production amounts weighted by the input-output coefficients as an index for the backward agglomeration. And since \( AIU_{oi} \) has a high correlation with total production amounts, we scaled it with regional real manufacturing output.

Some manufacturing goods that foreign investors produce are also demanded by the domestic firms as intermediate inputs. Forward agglomeration is the agglomeration of domestic firms which are regarded as downstream agents in the production process of FDI’s products. We define forward agglomeration \( (AID_{oi}) \) as follows.

\[
AID_{oi} = \sum_{k=1}^{n} \frac{b_{ok}x_{ki}}{X_i},
\]  

where \( b_{ok} \) is the input-output ratio showing the amount of input made by industry \( o \), to which the Japanese investor belongs, required to produce one unit of output of downstream industry \( k \). Therefore, the right-hand side of Eq. (17) represents the region \( i \)'s potential demand for industry \( o \)'s products as intermediate goods. Similarly in the calculation of \( AIU_{oi} \), we measure it by scaling with the region’s total manufacturing output. Since the region with highly developed downstream industries can be attractive to the foreign investors, the expected sign of that variable would be positive.

**<Input Prices>**

The variables which reflect the effect of cost-side on the location choice are the prices of production factors such as labor, capital and land. Especially, immobile production factors such as lands and location specific labors are one of the main factors causing spatial concentration of industry.

One of the largest components of variable costs is labor. Inter-province wage assumed to be the same to the previous input coefficient which is based on the data.
variations could be a significant influence on the location choice. Since the labor costs reflect the productivity, however, if Japanese investor prefers the high quality of labor then the estimated coefficient might be positive.\(^4\) This suggests that when measuring labor costs, one needs to account for the productivity of labor. To address this issue, following Coughlin and Segev (2000), Devereux and Griffith (1998), and Boudier-Bensebaa (2005), we include in our specification two variables representing labor market condition of a region. One is unit labor cost, defined by dividing the labor costs (average annual gross earnings of industry per province) by labor productivity (industrial production divided by total employment of that industry) for each province, which captures the labor cost condition of corresponding region. The other is the ratio of vocational/apprentices school per total manufacturing employment as proxies for the educational and skill levels of the local work force.

In general, higher labor costs are expected to deter inward FDI, which implies expected sign of the estimated coefficients associated with unit labor costs is negative. As for the skilled labor, we expect the sign for that variable to be positive: a usual finding in the literature (see, for example, Glickman and Woodward, 1987; Coughlin and Segev, 2000).

Land costs are another important location determinant on the cost side of profit function. But usually, it is not easy to get meaningful and absolute land price data by region in many countries. For this reason, Many earlier studies use population density as a proxy for the land cost (Bartik, 1985; Guimaraes et al. 2000). However, fortunately, we could find an appropriate proxy for the land price in Korea. Korea Industrial Complex Corporation releases the land sales price of a particular year of the national industry park, where the greater parts of FDIs are located. So we obtained the information of the land price of the national industry park in each province at 2007,\(^5\) and extended it using the housing price index\(^6\) to get time series of land price by interpolation. Capital costs are normally proxied by interest rates. However, because the interest rates vary little across potential locations and we cannot find adequate information for capital stock by province and industry, we do

---

\(^4\) In fact, empirical evidence on the effect of wage is not always consistent. For example, Bartik (1985), Coughlin et al. (1991) Friedman et al. (1992) report that higher wages make a location less attractive to foreign investors, while Woodward (1992) does not get a significant effect of wage on the choice of county for the business location.

\(^5\) Daegu and Jeju do not have a national industry park. In this case we gather the land price information of the local industry park in the same year.

\(^6\) Housing price index is announced by Kookmin Bank, one of the commercial banks in Korea. But the index is admitted as one of the official national statistics in Korea.
not include capital costs in our estimation model.

<Market Demand>
To capture the effect of final market demand on the location choice, we use regional gross domestic products (RGDP) information. However, since RGDP reflects the aggregated demand of the region, it is inadequate to capture the region's final output demand by industry level, of which information matters more than the aggregated information in the location decision of FDI firms. Here, we use the index of \( \frac{\eta_o \times RGDP}{GDP} \) instead of simple RGDP as a final good demand variable, where \( \eta_o \) is the marginal propensity to expend to industry \( o \), to which the Japanese investor belongs, in a particular region. Above index presents the proportion of the final output demand for industry \( o \)'s output by region \( i \) in the total final output demand by the whole country.

<Variables for Business Environment>
As Woodward (1992) argues, for the foreign companies the geographical availability of business service products such as accounting, law and financial services is one of the important determinants of the location decision of plants. And this geographical availability of business service is important not only for the start-up periods of new establishments but also for their successive operation periods. Regional business service availability is measured by the number of employees in this sector per square kilometer for the relevant region. As already shown in the theoretical part, the business service agglomeration provides the positive externality to the foreign direct investments in the region, thus the estimated coefficient for this variable is expected to be positive.

Transportation system is another important locational determinant for the FDI. Other things being equal, an area with a well-developed transportation system will be more attractive as a location site for the foreign investors. It is widely reported in earlier studies that regions with well developed transportation facilities are more attractive to foreign firms (Bartik, 1985; Head and Ries, 1996; Coughlin and Segev, 2000). Here, we include the log value of the total paved road length in each province as a proxy variable for the transportation system.

<Policy Measures>
In Eq. (12), \( (1-t_i) \) can be interpreted as a regional promotion policy to attract
foreign investments in region \( i \). Most studies on FDI location determinants in relation to regional policy instruments are for taxation. In case of Korea, however, the taxation level in each province is not adequate as a region's promotional policy to attract FDI. This is because the management of policy measures at the local government level with regard to inward FDI is confined by FIPA (Foreign Investment Promotion Act), the local governments have very limited discretionary authority in setting the taxation.

On the other hand, the central and local governments use the designation of Foreign Investment Zone (FIZ)\(^7\) or industrial complex for foreign companies as a means to attract foreign investments. So, as a proxy variable for the regional policy instrument to attract inward FDI, we introduce a dummy variable \( f_{complexed} \) in the regression, which helps to examine whether the incentive policies in terms of industrial complex of regional government work or not. A \( f_{complexed} \) takes value 1 if a region has ‘foreign-only’ industrial complexes and zero otherwise.

4. Empirical Results

4.1. Overall Empirical Results

For the estimation of the location choice of Japanese direct investments in Korea for 1998-2005, we first consider the case where all the samples are pooled without separating them by industry groups. However the determinants of location of foreign investors would vary depending not only on the nationality (country-of-origin) of those investments but also on the industrial characteristics of the plant located in Korea. Reflecting these factors, in the next section, we further split our samples into those referring to the location of hi-tech firms and those that correspond to low-tech ones, and investigate the locational determinants by industry group.

Table 1 displays the conditional logit estimates for the location decision of Japanese investments in Korea. In all specifications, the regressions are significant according to the chi square test at the log-likelihood and restricted log-likelihood ratios. One of our main goals is to obtain consistent estimates of the agglomeration effects by

---

\(^7\) As of December 2009, there are 12 complex type Foreign Investment Zones in the country to attract foreign direct investments and many foreign companies are already located there. Those FIZs are Daebul, Gumi, Cheonam, Pyeongdong, Jinsa,
country-of-origin, and we believe that the inclusion of agglomeration variables with same nationality along with other location factors in the econometric model is crucial for this purpose.

However, similar to the methods used in many previous empirical studies such as Head et al.(1995), Croz et al.(2004), we begin by presenting estimation results for a baseline specification. Model 1 of Table 1 gives coefficients of three horizontal agglomeration variables, i.e., industry-specific Japanese firm agglomeration (\(\ln AG'\)), domestic firm agglomeration (\(\ln AG^K\)), and foreign firm agglomeration other than Japan (\(\ln AG^F\)) along with other location factors, which gives a benchmark to which various specifications will be compared.

Here, it is noteworthy that the variable of industry-specific domestic agglomeration (\(\ln AG^K\)), as another form of localization economies, captures not only the effect of agglomeration externalities of domestic firms in the same industry but also the effects of endowment distribution on the location choice. Traditional H-O 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 heterogeneous individual firm will choose the location which is suitable for the firm among several heterogeneous regions in view of resource endowments. Then it is likely that the companies in the same industry gather together in a same region due to inter-regional difference of endowments. This suggests that we need to control the effect of regional resource endowment difference in the study of agglomeration economies. Thus the variable \(\ln AG^K\) has a role to control for endowment effects, allowing us to obtain a more precise estimate of industry-specific foreign agglomeration economies.

From the empirical results of Model 1, as expected, we find that estimated coefficients on three horizontal agglomeration variables show positive signs and are, with one exception, statistically significant at the 1 percent level, indicating that the geographical concentration of firms in the same industry (horizontal agglomeration) matters in the location decision of Japanese FDI in Korea. This specification describes location choice of Japanese investors where the country-of-origin effects in the agglomeration economies are represented in the simplest way or the case where the variable of industry-specific domestic agglomeration acts as a proxy for industry-specific endowments effects. It is noteworthy that the estimated coefficient on \(\ln AG^K\) (0.488) is much higher than that on \(\ln AG'\) (0.306), which reveals Japanese firms tend to locate in the regions where there are a relatively

Ochang, Jangan 1, Inju, Dangdong, Jisa, Jangan 2, and Osong.
large number of Korean firms in the same industry.

This can be interpreted in two ways. First, we can regard these coefficients as parameters showing the importance of positive externalities from agglomeration relative to the negative impact of competition. In this sense, the above results imply that the competition in the market faced by Japanese investor in Korea is more intense with other Japanese firms than with Korean firms or that the agglomeration economies to individual Japanese firms are much higher by locating close to Korean firms in the same industry rather than locating with other Japanese firms.

Another interpretation, which is more convincing, is to regard the variable $\ln K^A$ as a proxy for the endowment driven agglomeration. The geographical concentration of economic activities occurs not only due to the benefits of agglomeration but also by the dissimilarity in the resource endowment conditions across regions. And, as Caves (1996) pointed out, the search costs are much higher for the foreign companies compared to domestic ones due to the uncertainty with regard to regional quality and related information. This would be also true for the Japanese investors, who have less initial knowledge about regional quality across provinces in Korea than many domestic firms in the same industry. The location of previous Korean firms in the same industry would provide more information on regional quality including endowment condition than the location of Japanese affiliates or other foreign firms for a potential Japanese entrant. In this sense, the domestic agglomeration in the same industry can be a proxy variable to control the endowment driven agglomeration effects. Then the above results show that Japanese investors are more willing to follow the previous Korean firms' location choices than the choices made by other Japanese firms who have less information on regional quality than domestic firms, implying that industry-specific endowment effects matter in the location decision for the Japanese investors.

Next, let's look at the estimated coefficients with regard to vertical agglomeration and final demand agglomeration. The sign for the backward agglomeration ($AIU$) is positive and statistically significant at 10 percent level as one might expect, while those for the forward agglomeration ($AID$) and final demand are negative and not significant, which contradicts one's expectation. It is supported, thus, that the concentration of domestic upstream firms in the region attracts Japanese downstream firms: in other words, backward agglomeration of domestic firms increases the variety of intermediate inputs available for choice, and lowers the average purchasing costs of those inputs for the downstream Japanese affiliates.
On the other hand, the negative and insignificant coefficient estimates of the forward agglomeration and final demand variables suggests that the manufacturing goods produced by foreign (Japanese) firms are demanded little as intermediate inputs or final goods by domestic downstream firms or consumers in the region. It can be said that the sales linkage of Japanese affiliates to the local market where they are located is weak.

But this does not immediately imply the low sales linkage of Japan-affiliated FDI to the domestic downstream market as a whole. It is argued in the literature that the markets served by foreign investors are not confined to the region where they located especially if the market size of the region is small (Head et al., 1995; Coughlin and Segev, 2000). Thus the above estimates of forward agglomeration and final demand variables indicate that the Japanese investors in Korea do not target the market of the region where they are locating but, instead they might serve across the boundaries of the province including export to other countries.

As might be expected, both the unit labor cost and educational and skill levels of labor have expected coefficients, albeit insignificant especially for the unit labor cost.

This suggests that labor quality condition of the region matters than the labor cost of that region when the Japanese investors choose their location sites in Korea. This can be explained in two ways.

First is related to the fact that most Japanese direct investments in Korea are classified into the high-tech industries and tends to involve high level of technology, implying the labor quality matters more than the simple labor costs in the location decision. This is also consistent with the findings of Fung, Iizaka and Porter (2002) and Gao (2005) that regional labor quality significantly affects regional aggregate FDI flows from developed countries including the US or Japan.

Another interpretation of this result is related to the Japanese production system. The Japanese flexible production regime generally demands a higher degree of multi-skilling workers and involvement in all phases of manufacturing, including work teams, job rotation, and continuous quality control (Woodward 1992). The multi-skilling of Japanese workers as well as their participation in the process of quality improvement has been noted by many previous studies (Dore 1973, Aoki, 1986, 1988, Koike, 1993). If these characteristics are to be applied to the Japanese affiliates in the destination country, they may as well choose the region with higher human capital endowment as a location site than just simply searching for low cost production site. In fact, Graham and Krugman (1989) calculated in their research that Japanese investors pay higher-than-average wages compared with their
domestic and foreign counterparts in the case of U.S. The land cost variable has a coefficient which is negative as hypothesized, albeit insignificant. Among other variables, the estimate of business service shows positive sign with 1 percent level of significance, which shows that the spatial availability of business service matters in the location decision for the Japanese affiliates in Korea. As Woodward (1992) noticed for the U.S., the business service agglomeration measured by the number of employees in business service sectors per unit area (\(bizrat\)) acts as external economies in a particular industry by reducing the transaction costs of each Japanese investors locating that region.

The regional policy measures to promote FDI in terms of foreign-only industrial complex, \(fcomplex\), produce the expected positive and significant impact on Japanese firm entry. Japanese investors prefer the foreign-only industrial complex as a location site, if other things being equal. Thus, setting up industrial complex for the foreign investors would be an effective promotional policy to attract direct investments especially from Japan. In Korea, according to the field study of Cha and Jeong (2002), 25% of FDI in Korea locates its site at industrial complex, which is contrast to the fact that only 13% of domestic firms are locating there. Infrastructure level is another important factor in the location choice decision. The estimated parameter for the paved road length (\(lroad\)) is positive as expected, but statistically insignificant. Accordingly, it does not seem that transportation infrastructures provide regions with advantage in attracting foreign investors from Japan. In the regression model, the variable \(capmetro\), which takes value 1 if a region belongs to Seoul, Incheon (city), and Gyeonggi-do (province) and zero otherwise, is a dummy variable to investigate whether the capital and its vicinities are preferred as a location site to the Japanese firms. The estimated coefficient of \(capmetro\) exhibits positive and significant at 1 percent level, implying Japanese investors prefer the capital and vicinities as a location site to other regions if other things being equal.

Model 2 and 3 in Table 1 are to investigate the impacts of the major cities on the location decision of Japanese investors. In Korea, there are one special city (Seoul) and six metropolitan cities, which have autonomous urban districts with a municipal status and perform a role as a central city in each wide-ranged economic area. We added a dummy variable, \(dmetro\), to determine whether the major cities might provide an additional impetus to Japanese firms’ location decision beyond the draw of previous investments in the same industry. As can be seen in Model 2, the estimated coefficient of \(dmetro\) exhibit positive but
insignificant. With only this, however, we cannot be sure whether Japanese investors prefer the metropolitan cities in each wide-ranged economic area to other regions as a production site. Compared with the estimation results of benchmark case (Model 1), most of the estimated coefficients except bizrat (business service agglomeration) in Model 2 show little difference in the magnitude and significance. As for the bizrat, however, it is observed substantial decline in the magnitude and significance of estimation by including the variable dmetro in the regression. Considering business services are distributed mainly in the urbanized areas and provides professional services that firms may need, this implies that the two variables bizrat and dmetro are highly correlated in the positive direction. Thus, Model 3 is the estimation results obtained by dropping bizrat from the explanatory variables to add the variable dmetro.

As can be seen in Model 3, the magnitude of estimated coefficients of dmetro, lroad, and launiv, which are statistically significant at one percent level, have increased by dropping the variable bizrat in the specification. Moreover, the estimated coefficients of both dmetro and lroad have changed from insignificant value (in Model 2) to the positive and significant value (in Model 3). This reflects the fact that business service mainly locates in the metropolitan urban areas (in each wide-ranged economic area), that has well-developed transportation system and abundant human capital. And other things being equal, Japanese investors prefer to locate at the urban areas to enjoy the externalities of business service.

Model 4 is to investigate whether the nationality of firms matter in the location decision of Japanese investors. In usual, the magnitude of agglomeration economies are influenced not only by the characteristics of the industry that the firm belongs to but also by the country-of-origin of the investor. In order to specify the country-of-origin effects in the agglomeration economies, we identify the 'nationality' of agglomeration by dividing the variable lnAGF into three types of agglomeration variables by country-of-origin. Those are lnAGUS, lnAGEU, and lnAGOT, which represent industry-specific firms agglomeration from US, EU, and other foreign countries, respectively. Model 4 has five different types of horizontal agglomeration variables by source of country of firms.

Compared with the estimation results of benchmark case (Model 1), most of the estimated coefficients except horizontal agglomeration variables show little difference in the magnitude and significance. Thus the regional characteristic variables such as labor quality, business service agglomeration, regional government promotion policies in terms of industrial complex, and capital Seoul
area exhibit positive and significant influence on the location decision of Japanese investors.

In Model 4, of the five horizontal agglomeration variables by country-of-origin, three variables $\ln AG^K$, $\ln AG^J$, and $\ln AG^{US}$ generate positive and statistically significant impact on Japanese firms' entry. Furthermore, the hypothesis that the estimated coefficients of those three variables are equal to each other was rejected at one percent significance level. This suggests that the nationality of previous firms' cluster is important in location decision of Japanese investors and they tend to choose the regions where there already exists the geographical concentration of firms from Japan, US, or clustering of domestic firms in the same industry. And this reflects that agglomeration forces dominate the dispersion forces on average, and is an indicator of positive externalities that might exist among firms of those countries. These externalities can be technological spillover, network effect and resource pooling, etc.

When we look at the magnitudes of estimated coefficients, the estimation of $\ln AG^K$ is larger than those of $\ln AG^J$ or $\ln AG^{US}$, suggesting that industry-specific endowment effects still matter in the location decision of Japanese investors. However, the estimation of $\ln AG^J$ is larger than that of $\ln AG^{US}$, implying that firms from Japan cluster more with other firms from the same country-of-origin than with firms from US. Interestingly, the estimations of $\ln AG^{EU}$ and $\ln AG^{OT}$ exhibit negative signs albeit insignificant. This shows the possibility that the previous investment from EU or other foreign countries may have negative impacts on the location decision for the Japanese investors.

### 4.2. Estimation by Industry Group

In this subsection we try to check the heterogeneity of industrial location choices coming from technological difference. In order to do this, we separate the same sample into two industry groups such as high-tech foreign firms and low-tech ones. Table 2 shows the results of estimation by industry group.

First, the estimation results on the labor market condition exhibit somewhat different location patterns over each industry group. The estimated coefficients on $launiv$, a proxy which reflects the educational and skill-level of local work force, are positive and significant for both high- and low-tech industries, implying that the regional human capital does matter in attracting Japanese direct investments throughout all over the industries. When we look at the estimations of unit labor
costs, however, we find a sharp contrast over two industry groups reflecting the characteristics of the industry. While the coefficients of unit labor costs in all specifications are estimated negative and statistically significant for the low-tech industry, those for the high-tech industry are estimated positive, albeit statistically insignificant. Above results imply that the skill-level of workers rather than labor costs of a region does matter in the location decision for the high-tech firms from Japan, while, for the low-tech firms, both cost and skill-level of workers are important as a locational determinant.

In addition, there exists a distinct difference of locational patterns in terms of horizontal agglomeration by country-of-origin over the two industry groups. In the case of high-tech industry, both domestic (Korean) and same country-of-origin (Japan) agglomeration have a positive influence on the location decision process of Japanese investors. Particularly, the estimated coefficients of $\ln AG'$ range from 0.362 to 0.404 over the four specifications, which exceed the magnitude of those for the same variables in the overall industry sector in Table 1. Here, since the variable $\ln AG^K$ serves as a control for industry-specific endowment-driven agglomeration, the above results suggest that the Japanese direct investments in high-tech industry are significantly influenced by the locations of previous same country-of-origin investments in the same industry and region. There appears typical follow-the-leader pattern within the same nationality in the high-tech investments from Japan.

In case of low-tech industry, the important location factors in the horizontal variables are somewhat different from those of high-tech industry. The estimated coefficients on $\ln AG'$ exhibit still to be positive but statistically insignificant. Instead, the coefficients on both $\ln AG^K$ and $\ln AG^{US}$ are estimated positive and significant. This shows that Japanese investors in low-tech industry choose their location sites by the regional endowment condition or just follow the previous US investments in the same industry rather than replicate the location pattern of previous Japanese investments.

Low-tech firms in general produce relatively standardized products compared to high-tech of which products are highly sophisticated, thus reducing the production costs as well as maintaining the quality level is a substantial location factor for the low-tech investors from Japan entering the region. For the Japanese investors in the low-tech industry, thus, the necessity of clustering with other Japanese firms in the industry to get the information sharing or enhance interaction between firms will decrease. Rather, they can get its competitive edges by choosing its production
location following the regional endowment condition or previous US investments. There also appears a distinct difference in the preference for the metropolis as their location. In the empirical results for the high-tech FDI in Table 2, the estimated coefficients of both bizrat and capmetro are positive in all specifications and statistically significant at the 5 percent level, while those of demetro show unstable signs which are statistically insignificant. On the other hand, for the low-tech FDI, the estimated coefficients of demetro are positive as expected and significant at 5 percent level while coefficients of bizrat and capmetro are positive but show sharp decrease in the estimated values and their statistic significance compared to those for high-tech. Rather, the estimated coefficient of lroad, which showed unstable estimated signs for the high-tech, reports positive estimated values which are stable and statistically significant at 5 percent when the variable bizrat is dropped from the specification (Model 2 and 4 of low-tech industry in Table 2).

This means that Japanese direct investments in the hi-tech industry prefer the capital metro region to any other regions as their location sites where business service and skilled-labor are highly concentrated, while those in the low-tech industry show the tendency to locate at the major cities in each wide-ranged economic area as well as to choose Seoul and its vicinities. This reflects the fact that major cities in each area provide lower labor cost than capital metro region with relatively high-skilled labor.

The above results are consistent with the argument that modern (high-tech) industries tend to locate in highly urbanized and business service abundant areas (Henderson, 1988). In Korea, more than half of the economic activities including business service are concentrated in Seoul metropolitan region which comprise only 12.7 percent of the national land area, and these areas are highly urbanized than any other provinces in Korea. In this sense, the Japanese direct investments in high-tech industry tend to concentrate nearby the Capital Metro Region in order to enjoy the potential gains from urban diversity related to cross-fertilization of knowledge spill-over and/or to get the benefits of externalities of business service availability.

5. Conclusion

Employing the comprehensive micro data which covers Japanese direct investment within Korea between 1998 to 2005, we examines the determinants of Japanese
FDIs at a regional level and more particularly assesses the importance of different types of agglomeration economies among other determinants. From the analysis, we have derived several major results.

First, the conditional logit estimation results confirm strong evidence that, for the overall industry without grouping, quality of labor, business service availability, government policies approximated by industrial complex, and horizontal agglomeration play a positive role for location choice of Japanese investors. Concerning vertical agglomeration and land cost condition, we find little evidence of any positive impact. Especially, the negative and insignificant estimated coefficient on the downstream domestic firm agglomeration implies that the sales linkage of Japanese FDIs to the local market where they are located is weak.

Second, we focus on the existence, magnitude, and the identification of country-of-origin effects of agglomeration economies. Japanese manufacturing investors, on average, have a tendency to choose the regions where there already exist the concentrations of firms from Japan, US, or clustering of domestic firms in the same industry. And this reflects that agglomeration forces dominate the dispersion forces, and is an indicator of positive externalities that might exist among firms of those countries.

Furthermore, looking at the estimated results by industry group, we find that the nationality of previous firms’ cluster is important in the location decision of Japanese investors entering the region. Japanese FDIs in high-tech industry tend to follow the cluster of competitors from the same country (follow-the-leader pattern), while, in the low-tech industry, those investors choose their locations by regional endowment condition or rather follow the locational pattern of previous US investments in the same industry.

Third, besides agglomeration effects, there also exists distinct difference in the locational pattern over two industry groups. Japanese FDIs in high-tech industry tend to concentrate nearby the capital metro region where high-skilled labor and business service firms are highly concentrated, while those in low-tech prefer major cities in each wide-ranged economic region as well as capital metro region to meet the conditions of both labor cost and quality, and well-developed transportation system.

Although we have only a few analyses on the inward FDI as a whole, to my best knowledge, there is no thorough statistical analysis with regard to location decision of inward FDIs from a particular country in Korea. As already mentioned, Japan not only has been the largest source of FDI but also is the first major country which
set up the direct investments in Korea. In this sense, the focus on Japanese direct investment is germane to the analysis of location decision of foreign investors from countries other than Japan. According to Woodward (1992), unlike direct investment from other developed countries, the Japanese direct investment in the developed countries usually prefer the green-field type to M&A, which requires an explicit location decision while takeovers of existing companies almost invariably do not. Considering these, Japanese site selection conveys more information about regional quality of Korea than FDI from any other foreign countries, therefore, might influence the location decision of succeeding direct investment from other countries.
<Fig. 1> The Distribution of inward FDI by Nationality

Chart showing the distribution of inward FDI by nationality from 1985 to 2006. The chart includes categories for Other Countries, EU, China, U.S., and Japan.
Table 1. Conditional Logit Estimates: 1998-2005

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic agglomeration</td>
<td>0.488***</td>
<td>0.481***</td>
<td>0.423***</td>
<td>0.511***</td>
</tr>
<tr>
<td>(ln $AG^D$)</td>
<td>(6.92)</td>
<td>(6.64)</td>
<td>(6.61)</td>
<td>(7.27)</td>
</tr>
<tr>
<td>Agglomeration of Japan</td>
<td>0.306***</td>
<td>0.308***</td>
<td>0.305***</td>
<td>0.329***</td>
</tr>
<tr>
<td>(ln $AG^J$)</td>
<td>(2.87)</td>
<td>(2.89)</td>
<td>(2.88)</td>
<td>(3.07)</td>
</tr>
<tr>
<td>Agglomeration of foreign countries</td>
<td>0.134</td>
<td>0.138</td>
<td>0.179*</td>
<td>-</td>
</tr>
<tr>
<td>(ln $AG^F$)</td>
<td>(1.30)</td>
<td>(1.33)</td>
<td>(1.77)</td>
<td></td>
</tr>
<tr>
<td>Agglomeration of U.S.</td>
<td>-</td>
<td>-</td>
<td>0.254**</td>
<td></td>
</tr>
<tr>
<td>(ln $AG^US$)</td>
<td></td>
<td></td>
<td>(2.41)</td>
<td></td>
</tr>
<tr>
<td>Agglomeration of EU</td>
<td>-</td>
<td>-</td>
<td>-0.156</td>
<td></td>
</tr>
<tr>
<td>(ln $AG^EU$)</td>
<td></td>
<td></td>
<td>(-1.43)</td>
<td></td>
</tr>
<tr>
<td>Agglomeration of other foreign countries</td>
<td>-</td>
<td>-</td>
<td>-0.043</td>
<td></td>
</tr>
<tr>
<td>(ln $AG^OT$)</td>
<td></td>
<td></td>
<td>(-0.36)</td>
<td></td>
</tr>
<tr>
<td>Upstream agglomeration</td>
<td>4.731*</td>
<td>4.722*</td>
<td>4.774*</td>
<td>4.902*</td>
</tr>
<tr>
<td>(AIU)</td>
<td>(1.82)</td>
<td>(1.82)</td>
<td>(1.85)</td>
<td>(1.90)</td>
</tr>
<tr>
<td>Downstream agglomeration</td>
<td>-0.369</td>
<td>-0.354</td>
<td>-0.418</td>
<td>-0.551</td>
</tr>
<tr>
<td>(AID)</td>
<td>(-0.14)</td>
<td>(-0.13)</td>
<td>(-0.16)</td>
<td>(-0.21)</td>
</tr>
<tr>
<td>Final good demand</td>
<td>-0.063</td>
<td>-0.093</td>
<td>-0.168</td>
<td>-0.071</td>
</tr>
<tr>
<td>(lfdemand)</td>
<td>(-0.37)</td>
<td>(-0.50)</td>
<td>(-0.91)</td>
<td>(-0.41)</td>
</tr>
<tr>
<td>Unit labor cost</td>
<td>-1.302</td>
<td>-1.319</td>
<td>-1.473</td>
<td>-0.928</td>
</tr>
<tr>
<td>(lwage)</td>
<td>(-0.86)</td>
<td>(-0.87)</td>
<td>(-0.98)</td>
<td>(-0.60)</td>
</tr>
<tr>
<td>Skill-level of workers</td>
<td>5.180***</td>
<td>5.222***</td>
<td>5.634***</td>
<td>4.965***</td>
</tr>
<tr>
<td>(launiv)</td>
<td>(3.93)</td>
<td>(3.95)</td>
<td>(4.34)</td>
<td>(3.75)</td>
</tr>
<tr>
<td>Land cost</td>
<td>-0.255*</td>
<td>-0.282*</td>
<td>-0.215</td>
<td>-0.244*</td>
</tr>
<tr>
<td>(lrent)</td>
<td>(-1.77)</td>
<td>(-1.76)</td>
<td>(-1.42)</td>
<td>(-1.68)</td>
</tr>
<tr>
<td>Length of road</td>
<td>0.112</td>
<td>0.264</td>
<td>0.772***</td>
<td>0.114</td>
</tr>
<tr>
<td>(lroad)</td>
<td>(0.81)</td>
<td>(0.64)</td>
<td>(2.62)</td>
<td>(0.82)</td>
</tr>
<tr>
<td>Business service availability</td>
<td>0.200***</td>
<td>0.171*</td>
<td>-</td>
<td>0.205***</td>
</tr>
<tr>
<td>(bizrat)</td>
<td>(2.89)</td>
<td>(1.73)</td>
<td></td>
<td>(2.98)</td>
</tr>
<tr>
<td>Foreign-only industrial complex</td>
<td>0.889***</td>
<td>0.908***</td>
<td>0.981***</td>
<td>0.847***</td>
</tr>
<tr>
<td>(fcomplex)</td>
<td>(5.51)</td>
<td>(5.36)</td>
<td>(5.84)</td>
<td>(5.19)</td>
</tr>
<tr>
<td>Capital and its vicinity</td>
<td>0.840***</td>
<td>0.857***</td>
<td>0.799***</td>
<td>0.833***</td>
</tr>
<tr>
<td>(capmetro)</td>
<td>(3.63)</td>
<td>(3.63)</td>
<td>(3.84)</td>
<td>(3.63)</td>
</tr>
<tr>
<td>Major cities</td>
<td>-</td>
<td>0.243</td>
<td>1.033**</td>
<td>-</td>
</tr>
<tr>
<td>(dmetro)</td>
<td></td>
<td>(0.39)</td>
<td>(2.41)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>9008</td>
<td>9008</td>
<td>9008</td>
<td>9008</td>
</tr>
<tr>
<td>-------------------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>No. of obs.</td>
<td>9008</td>
<td>9008</td>
<td>9008</td>
<td>9008</td>
</tr>
<tr>
<td>No. of investors</td>
<td>563</td>
<td>563</td>
<td>563</td>
<td>563</td>
</tr>
<tr>
<td>Log-likelihood</td>
<td>-1091.84</td>
<td>-1091.76</td>
<td>-1093.23</td>
<td>-1089.36</td>
</tr>
</tbody>
</table>

Note: ( ) is the asymptotic z-statistics.

***, ** and * denote significance at 1, 5 and 10% levels, respectively.
### Table 2: Conditional Logit Estimates by Industry Group: 1998-2005

<table>
<thead>
<tr>
<th></th>
<th>High-tech Industry</th>
<th>Low-tech Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model 1</td>
<td>Model 2</td>
</tr>
<tr>
<td><strong>ln AG^X</strong></td>
<td>0.498***</td>
<td>0.515***</td>
</tr>
<tr>
<td></td>
<td>(4.47)</td>
<td>(4.40)</td>
</tr>
<tr>
<td><strong>ln AG^J</strong></td>
<td>0.362***</td>
<td>0.358***</td>
</tr>
<tr>
<td></td>
<td>(2.62)</td>
<td>(2.58)</td>
</tr>
<tr>
<td><strong>ln AG^F</strong></td>
<td>0.187</td>
<td>0.178</td>
</tr>
<tr>
<td></td>
<td>(1.30)</td>
<td>(1.22)</td>
</tr>
<tr>
<td><strong>ln AG^E</strong></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ln AG^EU</strong></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ln AG^OT</strong></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>AIU</strong></td>
<td>4.987</td>
<td>4.936</td>
</tr>
<tr>
<td></td>
<td>(1.60)</td>
<td>(1.58)</td>
</tr>
<tr>
<td><strong>AID</strong></td>
<td>0.186</td>
<td>0.240</td>
</tr>
<tr>
<td></td>
<td>(0.06)</td>
<td>(0.08)</td>
</tr>
<tr>
<td><strong>ldemand</strong></td>
<td>-0.310</td>
<td>-0.250</td>
</tr>
<tr>
<td></td>
<td>(-1.18)</td>
<td>(-0.87)</td>
</tr>
<tr>
<td><strong>uwage</strong></td>
<td>1.271</td>
<td>1.282</td>
</tr>
<tr>
<td></td>
<td>(0.69)</td>
<td>(0.69)</td>
</tr>
<tr>
<td><strong>launiv</strong></td>
<td>5.116***</td>
<td>5.017***</td>
</tr>
<tr>
<td></td>
<td>(2.88)</td>
<td>(2.81)</td>
</tr>
<tr>
<td><strong>lrent</strong></td>
<td>-0.301</td>
<td>-0.259</td>
</tr>
<tr>
<td></td>
<td>(-1.54)</td>
<td>(-1.22)</td>
</tr>
<tr>
<td><strong>lroad</strong></td>
<td>0.147</td>
<td>-0.131</td>
</tr>
<tr>
<td></td>
<td>(0.72)</td>
<td>(-0.22)</td>
</tr>
<tr>
<td><strong>bizrat</strong></td>
<td>0.206**</td>
<td>0.259*</td>
</tr>
<tr>
<td></td>
<td>(2.15)</td>
<td>(1.81)</td>
</tr>
<tr>
<td><strong>fcomplex</strong></td>
<td>0.939***</td>
<td>0.905***</td>
</tr>
<tr>
<td></td>
<td>(4.24)</td>
<td>(3.94)</td>
</tr>
<tr>
<td><strong>capmetro</strong></td>
<td>0.994***</td>
<td>0.962***</td>
</tr>
<tr>
<td></td>
<td>(3.10)</td>
<td>(2.94)</td>
</tr>
<tr>
<td>(dmetro)</td>
<td>-</td>
<td>(-0.435)</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>(0.50)</td>
<td>(1.33)</td>
<td>(2.22)</td>
</tr>
</tbody>
</table>

| No. of obs. | 5168 | 5168 | 5168 | 5168 | 3840 | 3840 | 3840 | 3840 |
| No. of investors | 323 | 323 | 323 | 323 | 240 | 240 | 240 | 240 |
| Log-likelihood | \(-628.8\) | \(-628.7\) | \(-630.3\) | \(-627.4\) | \(-457.7\) | \(-457.0\) | \(-455.7\) | \(-454.9\) |

Note: ( ) is the asymptotic z-statistics.

***, ** and * denote significance at 1, 5 and 10% levels, respectively.

31
References


Cha, Mi-Sook and Y. Jeong (2002), Locational characteristics and local industrial linkage of foreign direct investment companies in Korea, R2002-21, Korea Research Institute for Human Settlements.


