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Location Choice of Inward FDIs in Korea: The Case of Japanese FDIs with Unexpected Shock in Home

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Abstract

Sometimes, a change in investment motives, caused by an unexpected shock such as national disasters, can make the location pattern of foreign direct investments (FDIs) hosted in a neighboring country. In this paper, the location of new manufacturing FDIs of Japan in Korea from 2008 to 2015 is analyzed. The occurrence of “East Japan earthquake” in 2011 changed the location pattern of Japanese FDIs by industry group. However, general attracting factors, such as easy accessibility to service establishments, continues to be an important location factor, regardless of the industry group. Therefore, to be an effective strategy, the regional economic development strategy of the host country attracting FDIs, should be flexible to the sudden changes in the natural environment of the source country of FDIs, and focus more on the general factors which attract FDIs.

Keywords: inward foreign direct investments, location choice, East Japan earthquake, colocation

1. Introduction

The Korean government has attempted to attract foreign direct investments (FDIs) in the free economic zone (FEZ) of each region for regional economic development from the early of 2000s. The popular strategy of regional governments to attract FDIs is making their FEZs centers for a specific industry which they expect to accommodate in their respective region. The benefits of localization can reduce production cost and the chosen location can provide maximum profits for firms in the industry. The spiral accumulation process of benefits between regional concentration of firms in the industry and benefits from localization can raise the probability of FDIs' choosing a specific region as a final destination.

In view of individual FDIs, the potential profits accruing to alternative locations in the host country are the main decision factors for the location choice. In other words, industrial and regional attributes of alternative locations are the major components of the potential profits. However, the weights of these attributes on the decision on location choice can depend on the investment motives of individual FDIs. It can change the potential profits of the alternative location in the host country. Unfortunately, in the estimation process of location choice of FDI, this linkage is not directly observed and mixed together in the data. The one way to identify this linkage explicitly is using a natural experiment. For example, a natural disaster, such as an earthquake, can motivate companies in the region to change their location owing to high uncertainty in their business environments. In this case, the behavior of location choice can be different in comparison to one without the occurrence of a natural disaster.

Recently, both the frequency and magnitude of earthquakes in Japan increased¹. Even though it is not possible to forecast the exact date of an earthquake, it can be expected that the frequencies and magnitudes of future earthquakes will be often and big, respectively. This unexpected shock raises the uncertainty of business environments in Japan and a temporal increase of Japanese FDIs in Korea can be observed whenever there is a natural disaster. This means that it is highly probable that there is a change of investment motives of Japanese FDIs around that time of a natural disaster. In the future, it will also be highly probable that a similar situation will be repeated frequently. This natural experiment can help us observe the effects of the profits on the location choice.

In lieu of the above, the location choice of Japanese FDIs in Korea considering the “East Japan Earthquake” of 2012 is analyzed as follows. First, this paper analyzes how the weights of important location factors of individual new Japanese FDIs changed from the estimation of location choice equation. Second, the concentration of both the industry groups and regions is analyzed, and the consistent interpretations between the first and second analyses are suggested. This provides an important policy implication for the regional governments in Korea intending to attract FDIs in their regions for their economic growth.

In Section 2, we explain the trend and current situation of the location of new Japanese FDIs in the manufacturing industry in Korea. In Section 3, literature surveys of location choice analyses are introduced shortly. The results of location choice by periods and industry groups are explained in Sections 4 and 5. Co-location index analyses are provided in Section 6 and the conclusions are presented in Section 7.

2. The location pattern of new Japanese FDIs in Korea

The Ministry of Trade, Industry and Energy of Korea releases data which includes the names of firms, industry classification, starting date of investment, and the location of FDIs². For this

¹The frequency of earthquake in Japan which is greater than or equal to a magnitude of 6, is two times from 1990 to 1999, 63 from 2000 to 2009 and 88 from 2010 to 2015 [1].

²This data reveals only the information on the nationality of major investors. There is no method to identify the type and size of investments, such as whether it is green field or merger.

research, data released in August 2016 is used. This data provides the number of new Japanese FDIs in the manufacturing sector in Korea from 1962 to 2015. **Figure 1** shows the time trend of the number of new Japanese FDIs in the manufacturing sector for the previously mentioned periods.

Some periods which show increasing trends are indexed with a number in **Figure 1**. The first period ranges from 1969 to 1974. This period is represented as the first boom time of economic planning in Korea. In this period, the Korean economy attempted to increase exports, particularly in the manufacturing sector. The second period ranges from 1985 to 1988. This period was known for increasing demand due to the 88 Seoul Olympics. Furthermore, in this period, there was an intentional appreciation of Japanese Yen known as the “Plaza Accord” in 1985. The third period was the year 1995, the “Great Hanshin Earthquake.” The fourth period ranges from 1998 to 2004. This was the recovery period from the “foreign currency crisis” in Korea. The last period ranges from 2012 to 2014, the time of “East Japan Earthquake.” The duration of FDIs increase in the third and fifth periods is very short in comparison to the other periods. These are candidates for the temporal FDIs increase. Increase in uncertainty on account of the unexpected disaster can draw temporal FDIs, which can drive decision makers to choose their location instantly.

When we focus on the regional distribution of new Japanese FDIs in Korea after the 1990’s, another observation can be made on the temporal location choice pattern on earthquakes. **Figure 2** shows the trend of the number of new Japanese FDIs in the capital metropolitan area (that is, Seoul, Incheon and Gyunggi-do) and other areas.

Figure 2 shows that from 2011 to 2015, the trend of new Japanese FDIs in the capital metropolitan area and other areas are similar. This pattern is also similar to that from 1994 to 1996. However, there is rather different observation for the other periods (such as from 1999 to 2009). In this case, their movements are contrary. Therefore, this co-movement pattern from 2011 to 2015 can be related to the effects of the unexpected shock on location choice.

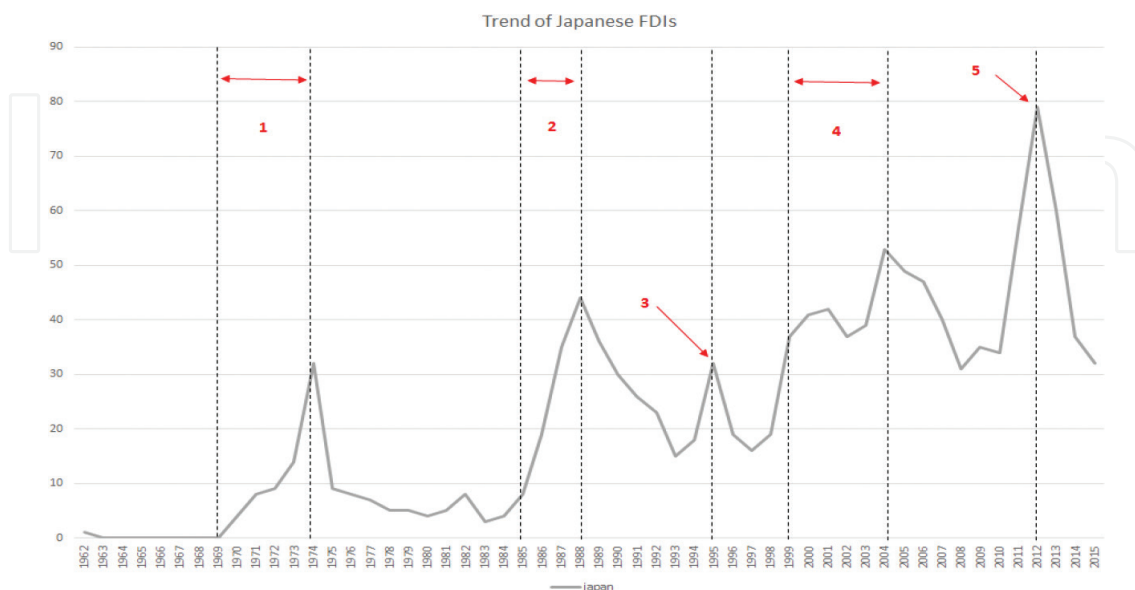


Figure 1. Trend of new Japanese FDIs in the manufacturing sector in Korea.

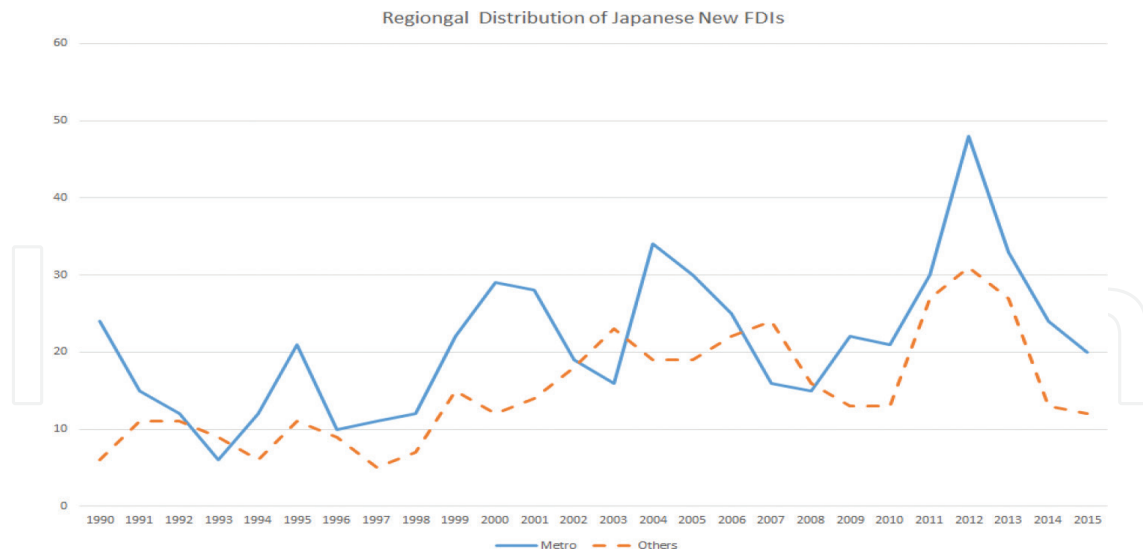


Figure 2. Regional distribution of new Japanese FDIs.

Year	Number of new Japanese FDIs
2008	31
2009	35
2010	34
2011	57
2012	79
2013	60
2014	37
2015	32

Table 1. Number of new Japanese FDIs in manufacturing sectors.

The number of new Japanese FDIs in manufacturing sector from 2008 to 2014 is reported in Table 1³.

3. Short literature surveys in FDI location choice study

One of the main factors in a decision on the location of FDIs is the agglomeration of same nationality and industry group in a region. Head et al. [2] show the importance of “geographical proximity and same origin country” in the location choice of FDIs. They regard these factors as the scope of externality, and they empirically find their importance from the estimation

³Fifty-seven firms invested in 2011 are omitted when the location choice equation is estimated. Because there are many missing data in explanatory variables at 2010, there is no way to estimate the choice equation at that year.

of Japanese FDIs location choice in United States of America (the U.S.) with conditional logit model suggested by McFadden [3].

He [4], Crozet et al. [5], Hilber and Voicu [6] and Spies [7] specify the attributes of regional and industrial characteristics in more detail. In contrast to Head et al. [2], they specify the attributes of alternatives, which reflect the production factor supply and demand in the region. Those variables are represented indirectly in the cumulative mass of domestic firms in the case of Head et al. [2]. Some of the above studies used nested logit as their estimation method. The adoption of this method is more reasonable in comparison to conditional logit because the nested logit considers the axiom of IIA (irrelevant independent alternatives) condition explicitly in the estimation process. In their estimation, they find the importance of agglomeration variables in the location choice estimation.

Hwang [8] and Lee and Hwang [9] undertook studies on the location choice of Japanese FDIs in Korea. They both adopted the nested logit estimation technique. Hwang [8] uses data from 1999 to 2005. He suggests that as Japanese firms have a historically long relationship with Korean firms, their location choice behavior is rather different to those from the U.S. and European Union (the EU). One of the main differences is that there is no statistically significant preference for a capital metropolitan area in Japanese FDIs' location choice. Lee and Hwang [9] extended the analysis of Japanese FDIs' location choice from 1998 to 2006 and empirically find the existence of industrially heterogeneous location choice behavior. However, the overall estimation shows results similar to Hwang [8].

4. Estimation of location choice by periods

As literature on FDIs' location choice suggests, agglomeration variables are chosen to analyze the location choice behavior of Japanese FDIs in Korea. There are three agglomerations; agglomeration of Japanese FDIs, agglomeration of other source countries except Japan, agglomeration of Korean (host country) firms. Each agglomeration term is calculated based on the number of firms located in the same region and classified as the same industry group. It is defined as follows:

$$AGJPN_{ijt} = \sum_{k=t-10}^t FD I_{ijk}^{JPN} \quad (1)$$

Here, i means industry group, j represents region, $FD I_{ijk}^{JPN}$: Number of new Japanese FDIs in i industry and j region at k year.

The above represents the stock level of FDIs of i industry in j region. As the exit information of FDIs in Korea is not available, 10-year span is chosen as an average life-span of FDIs.⁴

⁴Buckley et al. [10] found that the average lifespan of Japanese FDIs in the United Kingdom (the U.K.) was 13.9 years around the 1990s. As the distance between Japan and Korea is shorter than that between Japan and the U.K., the entry and exit of Japanese FDIs in Korea can be more frequent in comparison to that of the U.K. Thus, as a rule of thumb, we select 10 years as the average lifespan of Japanese FDIs in Korea.

The agglomeration of other source country FDIs are calculated similar to the calculation of AGJPN.

$$AGOTH_{ijt} = \sum_{k=t-10}^t FDI_{ijk}^{OTH} \quad (2)$$

Here, i means industry group, j represents region, FDI_{ijk}^{OTH} : Number of new FDIs from other country except Japan in i industry and j region at k year.

The regional accumulation of Korean firm in the specific year t , represented as EST_{ijt} , can be captured more accurately from the publicly released data in Korea.⁵ It is the total number of firms located in the same region and classified in the same industry group in a specific year.

When the location decision equation is estimated with the three variables, as Head et al. [2] suggests, EST_{ijt} is expected to capture the regional distribution of resources which affect the supply of the host country's production factors, regardless of their observability. As long as EST_{ijt} is included, the observed and unobserved effects of resource distribution and market environment in the host country can be controlled. Thus, the remaining FDI agglomeration variables can allow us to identify the pure agglomeration effects on the location choice.

Other researchers have suggested more specifications of host country's resource distribution. The typical suggestion is the unit labor cost per production by both region and industry group. This is specified to represent the level of production efficiency and is defined as follows:

$$ULABOR_{ijt} = \frac{Salary_{ijt}}{(Production_{ijt}) * (Employment_{ijt})} \quad (3)$$

Here, $Salary_{ijt}$ represents total payments to employments of i industry in j region at time t , $Production_{ijt}$ represents total production of i industry in j region at time t , and $Employment_{ijt}$ represents total number of employed of i industry in j region at time t .

A higher value of $ULABOR_{ijt}$ signifies that the production of the industry i in region j at time t is relatively more inefficient in view of labor productivity. In addition, the rent information to control land cost and the share of college or higher degree holder in the economically active population in region j at time t are included. The share of degree holders is used to capture the quality of labor in the region. Occasionally, the market size information is included. Regional gross domestic product discounted with the distances of each region is at times used to capture the market size in the estimation. All these variables control the regional and industry specific attributes that can be observed. Finally, regional dummies can be included in the location choice equation to capture the effect of unobserved regional attributes on the location choice. When these variables are added to the three agglomeration variables in the location equation, the estimated coefficient of EST_{ijt} can be expected to be unbiased in capturing the agglomeration effect of the host country's firms on the location choice.

⁵All publicly released Korean data are extracted from [11].

Variables ²	Cond. logit I with fixed effects	Cond. logit II with fixed effects	Nested logit I with fixed effects	Nested logit II with fixed effects
LAGJPN	-0.012 0.175	-0.015 0.175	0.046 0.185	0.047 0.186
LAGOTH	0.363** 0.146	0.358** 0.147	0.420** 0.162	0.417** 0.164
LEST	0.391** 0.069	0.400** 0.073	0.405** 0.072	0.419** 0.076
LULABOR		-0.005 0.031		-0.008 0.032
LRENT		-0.453 1.024		-0.160 1.100
LUNIV		-2.134 1.705		-2.375 1.682
CAP			0.773	0.747
(H ₀ : IV = 1)			(t-value: 1.293)	(t-value: 1.526)
Likelihood	-640.237 χ^2 (3) = 56.25** N = 308	-639.308 χ^2 (6) = 58.11** N = 308	-639.545 χ^2 (18) = 171.21** N = 308	-638.354 χ^2 (21) = 173.59** N = 308

** is significant at 5% significance level.

¹2011 data is omitted as certain explanatory data of 2011 from the public released data is missing.

²"L" means the variables are taken with the logarithm.

Table 2. Estimation results: 2008–2015¹.

Table 2 shows the estimation result of the location choice equation considering data from 2008 to 2015.⁶ In the table, conditional logit I includes only agglomeration variables to estimate the choice model with regional dummies. Conditional logit II includes other regional and industrial attributes with agglomeration variables in the estimation. Nested logit estimation is adopted to estimate the location choice with Seoul, Incheon and Gyunggi-do considered as an alternative group of capital-metro area. Model I includes only agglomeration variables with fixed effects and model II includes fixed effects with other regional or industrial attributes to the agglomeration ones in the explanatory variables. Note that when market size variable is used in the estimation with regional dummies together, the likelihood-function is not converged, which may be related to the multicollinearity problem. Thus, whenever regional dummies are included in the estimation, market size variable is omitted.

One of base estimations for the total period provides the following results:

⁶Summary statistics for the variables are provided at **Table A1** in Appendix A.

1. The method of nesting, which is the grouping of Seoul, Incheon and Gyunggi-do as an alternative, that is, capital-metro area, is not statistically meaningful. Inclusive variables (CAP) in the nested models I and II show no significance in the estimation results. Therefore, the null hypothesis which insists that Seoul, Incheon and Gyunnnggi-do are independent alternatives is accepted. In this case the conditional logit model itself is sufficient to use as the location choice estimation method.
2. The Japanese agglomeration variable is not statistically significant, regardless of the grouping of alternatives. This means that when new Japanese FDIs make a location decision in Korea, there is no tendency of following the pre-existing Japanese and same industrial companies' location choice. Further, it indicates that the new FDIs are not probable to have any connection with pre-existing companies in Korea. This is an exception when the location choice of other source countries is considered. Generally, new FDIs in the same industry group from the U.S. and EU in Korea tend to agglomerate ([9]; and [8]).
3. There are no explanatory powers of industrial and regional attributes in the location choice behavior. Only agglomeration variables of other source countries and domestic companies are statistically significant at 1% significance level. This means that there is an unobserved relationship between new Japanese FDIs and other source country's FDI stock, or domestic country's firm which can significantly affect the location decision of Japanese FDIs. In addition, the magnitude of these effects is similar.

These estimation results are not sufficient to explain the short-run location choice behavior of new Japanese FDIs. The time periods are decomposed into the prior periods of unexpected

Variables	Cond. logit I with fixed effects	Cond. logit II with fixed effects	Nested logit I with fixed effects	Nested logit II with fixed effects
LAGJPN	-0.169	-0.172	-0.056	-0.054
	0.295	0.296	0.185	0.317
LAGOTH	0.606**	0.583**	0.896**	0.868**
	0.246	0.252	0.302	0.311
LEST	0.217**	0.237**	0.266**	0.290**
	0.107	0.117	0.119	0.134
LULABOR		-0.023		-0.023
		0.057		0.060
CAP			0.364**	0.360**
(H ₀ : IV = 1)			(t-value: 3.011)	(t-value: 3.011)
Likelihood	-207.175	-207.092	-204.616	-204.544
	$\chi^2(3)=16.67^{**}$	$\chi^2(4)=16.83^{**}$	$\chi^2(18)=65.57^{**}$	$\chi^2(19)=65.71^{**}$
	N = 100	N = 100	N = 100	N = 100

**is significant at 5% significance level.

Table 3. Estimation results: 2008–2010.

shock and the post period: periods of 2008–2010 and 2012–2015. In the estimation of 2008 and 2010, the likelihood function is not converged with regional attribute variables, except the unit labor cost. Thus, unit labor cost and other agglomeration variables with regional dummies are used in the estimation of location choice.

From the above two period estimations, distinct changes are founded. Prior to the East-Japan earthquake, location choice behavior of new Japanese FDIs is more affected by the other source country FDI agglomeration. When we group Seoul, Incheon and Gyunggi-do regions into one alternative, this effect is clearly dominant (both inclusive variables in nested logit I and II in **Table 3** are statistically significant at 1% significance level). However, the estimation after the catastrophic disaster shows the effect of the other source country FDI agglomeration is gone. On the contrary, the effect of domestic company agglomeration is a statistically dominant effect on the location choice of new Japanese FDIs. Furthermore, location choices are independently made over all regions. That is, inclusive variables in **Table 4** show statistically insignificant. So this explains there is a change in location decision factor after the unexpected shock in Japan. One of possible explanations is that, because uncertain situation of Japanese firm according to the shock in the home country is raised, new Japanese FDIs may make location decision in quick. This decision in hurry can make them to follow the distribution of the

Variables	Cond. logit I with fixed effects	Cond. logit II with fixed effects	Nested logit I with fixed effects	Nested logit II with fixed effects
LAGJPN	0.067	0.076	0.047	0.047
	0.219	0.220	0.224	0.225
LAGOTH	0.021	0.210	0.199	0.197
	0.180	0.182	0.179	0.179
LEST	0.569**	0.559**	0.565**	0.550**
	0.097	0.101	0.098	0.102
LULABOR		0.007		0.009
		0.038		0.038
LRENT		1.668		1.437
		2.600		2.535
LUNIV		-6.252**		-6.354**
		2.694		2.718
CAP			1.075	1.103
(H ₀ : IV = 1)			(t-value: 0.340)	(t-value: 0.447)
Likelihood	-420.291	-417.287	-420.230	-417.180
	$\chi^2(3) = 48.49^{**}$	$\chi^2(6) = 54.49^{**}$	$\chi^2(18) = 135.04^{**}$	$\chi^2(21) = 141.14^{**}$
	N = 208	N = 208	N = 208	N = 208

**is significant at 5% significance level.

Table 4. Estimation results: 2012–2015.

host country's firm in investment destination country. This is so strong that the agglomeration of the host country firm can have a dominant effect on the location choice of them.

In the case of cost variables such as unit labor cost and rent, they show a positive effect on the location choice. However, as the table shows, they are not statistically significant. So the role of cost variable on the location choice is negligible in this period. The effect of labor quality measured with the proportion of college or more degree holder shows a negative effect on the location choice. It is exceptional result because traditional literature shows that there exists a positive relationship between labor quality and location choice. One possibility is that there can be some correlated relationship between regional dummies and that variable. But it cannot be a clear explanation. So the robustness of those estimations is required to be checked. In next section, the estimation results by industry are introduced and the robustness of the estimation is explained.

5. Estimation by industry group

The criterion of industry classification can be determined by the characteristics of industries. However, if the criterion depends on those of classification objects, that is determined endogenously. It is not appropriate to be criterion. Otherwise, it is determined exogenously, because it is not influenced by the characteristics of the classification objects, it is suitable as a criterion to classify industry consistently. In this respect, when classifying new Japanese foreign direct investments into industries, it is possible to provide relatively more consistent criterion depending on the characteristics of Korean industries than applying them according to the characteristics of Japanese companies.

This industry classification is grouped based on the shipments information. According to US census bureau, the manufacturers' shipments measure the dollar value of products sold by manufacturing establishments.⁷ The manufacturers' shipments give information about the economic condition in the domestic manufacturing sector and also indicate future business trends. Industries are classified into "above average shipments industry" and "below average shipments industry" based on the information of Korean industries. The above average shipments industry in Korea means the industry which shows high shipments value than the average shipment over the whole industry and tends to be main export industries of Korea. While those below average shipments tend to target domestic markets. Also, since Korean companies are well aware of the distribution of production factor and the market, the difference in their location may make a geographical difference. This may provide a clue for the change of Japanese FDIs' location choice pattern. Therefore, we classify new Japanese FDIs in Korea according to the average shipments of Korean industries (**Table 5**).

The same location choice model is estimated by period and industry. However, in this estimation, the number of samples in each period is decreased. It restricts the number of explanatory variables in the estimation. To reduce the number of explanatory variables, the fixed effects,

⁷[12].

Above average shipment	Below average shipment
11 Food and beverage products	13 Textiles, except apparel
12 Tobacco products	14 Wearing apparel, clothing accessories and fur articles
19 Coke, hard-coal and lignite fuel briquettes and refined petroleum products	15 Tanning and dressing of leather, luggage and footwear
20 Chemical products	16 Products of wood and cork except furniture
21 Pharmaceuticals, medicinal chemicals and botanical products	17 Pulp, paper and paper products
24 Basic metal products	18 Printing and reproduction of recorded media
26 Electronic components, computer, radio, television and communication equipment and apparatus	22 Rubber and plastic products
30 Motor vehicles, trailers and semitrailers	23 Other non-metallic mineral products
31 Other transport equipment	25 Fabricated metal products
	27 Medical, precision and optical instruments, watches and clocks
	28 Electrical equipment
	29 Other machinery and equipment
	32 Furniture
	33 Other manufacturing

Table 5. Industry classification (Korea Standard Industry Classification 2-digit).

that is, regional dummies are dropped. And only the conditional logit technique is adopted. The estimation results are show in **Tables 6** and **7**.⁸

In the estimation of below average shipment industry, domestic firm agglomeration and market size are statistically significant location choice factors before the disaster. This explains the location of companies in the below average shipment industry follows the domestic resource distribution and market potential of regions in the host country. They regard Korea as one of final consumption markets. However, after the earthquake, the new Japan FDI' location choice has changed as follows. First, the motivation to keep Korea as a source of their production factors became stronger. It is possible that the accumulation of Korean firms is highly related to the distribution of production factors.⁹ The above suggestion can be backed up by the fact that Japanese firms are more affected by the accumulation of Korean firms in the decision of location choice after the earthquake. Second, since land price is the price of production factor, it should show a negative relationship in the traditional location theory. However, the estimation results show that Japanese FDIs location choice have a statistically significant positive relationship with the land price after the earthquake. It suggests that Japanese companies may

⁸Refer to **Tables A2** and **A3** in Appendix A for summary statistics of variables. And the geographic distributions of new Japanese FDIs by periods and by industry groups are provided at Appendix C.
⁹This is explained more in detail in the section of colocation analysis.

Variables	2008–2010	2012–2015
LAGJPN	–0.077 0.398	–0.231 0.316
LAGOTH	0.356 0.392	0.060 0.255
LEST	0.400** 0.143	0.657** 0.119
LULABOR	–0.080 0.070	–0.020 0.048
LRENT	0.099 0.171	0.305** 0.137
LMSIZE	0.464* 0.285	0.195 0.202
N	53	120
Log likelihood	–116.896	–263.947

*is at 10%.

**is significant at 5% significance level

Table 6. Conditional Logit (w/o fixed effects) estimation results of the below average shipment industry.

perceive location as the nature of investment. In other words, since Japanese companies much worry about the maintaining the value of their assets in Japan after the earthquake, they can regard the real estate in neighboring country as an investment object that can preserve the value of assets in a stable region. Particularly, as land prices are higher, real estate value would be maintained. Therefore, it can be an alternative investment destination that maintains the value of its assets and this investment tendency can be reflected in the location decision.

In the case of the above average shipment industry, the firms in this group are affected more by the location of other source country agglomeration, that is the location where FDIs from other country origin are gathered, before the shock. Even though the effect of domestic resource distribution is statistically significant location factor, the magnitude of the estimated coefficient of this variable is much smaller than that of other country agglomeration. However, after the shock, the magnitude of effects of two variables are reversed each other. This will be explained in more detail in the next section. However, it is clear that the unexpected shock raises the importance of domestic firms' agglomeration on their FDIs location choice. And investment motive for the real estate is similar to that of the firms in the below average shipment industry.

Generally, these group estimation results confirm the robustness of overall estimation shown in **Tables 3** and **4**. The unexpected earthquake in Japan clearly changes the Japanese FDIs' the weight of location factors in their decision process temporarily. The effect of domestic resource distribution on the location choice plays a strong role of the location decision as shown in the overall estimation after the unexpected shock. However, still we do not know exactly the role of agglomeration in detail. So the co-location behavior is required to be more investigated. And this will be done in the next section.

Variables	2008–2010	2012–2015
LAGJPN	−0.148	0.403
	0.434	0.312
LAGOTH	0.827**	0.439**
	0.354	0.266
LEST	0.361**	0.571**
	0.191	0.150
LULABOR	0.008	−0.001
	0.092	0.061
LRENT	0.080	0.328**
	0.198	0.168
LMSIZE	0.309	0.394
	0.312	0.250
N	47	88
Log likelihood	−99.279	−163.705

**is significant at 5% significance level.

Table 7. Conditional logit (w/o fixed effects) estimation results of the above average shipment industry.

6. Estimation of co-location index

While the estimation result shows the importance of domestic agglomeration after the unexpected shock, the effect of that on the location choice is not clear. To clarify the effect, we calculate co-location index of industry and region, then use these indices to find out why the new FDIs gather together with domestic firms. Both co-location indices are defined as follows:

Co-location index of i industry at t :

$$CL I_{it} = \frac{\sum_{j=1}^{15} (TFD I_{ijt} \times TDF M_{ijt})}{\sum_{j=1}^{15} TFD I_{ijt} \times \sum_{j=1}^{15} TDF M_{ijt}} \quad (4)$$

Co-location index of j region at t :

$$CL R_{jt} = \frac{\sum_{i=1}^n (TFD I_{ijt} \times TDF M_{ijt})}{\sum_{i=1}^n TFD I_{ijt} \times \sum_{i=1}^n TDF M_{ijt}} \quad (5)$$

Here, $TFD I_{ijt}$: Total number of new FDI in i industry in j region at t and $TDF M_{ijt}$: Total number of domestic firms in i industry j region at t .

To calculate the industrial co-location index, two-digit level industry classification (KSIC) is used. In this case the number of industries is 33 and the number of region is 15 administrative local government regions. $CL I_{it}$ index measures the degree of regional concentration of a specific industry. The denominator in Eq. (4) is the potentially possible number of match between new

Japanese FDIs and all nationally distributed domestic firms in the same industry. The numerator is the realized number of match, that is, the number of realized pairs between new FDIs and domestic firms in the same region and industry. Therefore, the ratio such as CLI_{it} represents the degree of regional co-location in a specific industry. The calculation of CLR_{jt} is similar to that of CLI_{it} but the meaning of regional concentration of a specific industry is changed by the industrial concentration in a specific region. So while the variations of CLI_{it} come from the differences in industrial characteristics, those of CLR_{jt} come from the differences in regional characteristics. Each co-location index is regressed on the characteristics of industry or those of region. To explain regional concentration of industries, such variables as follows are used:

1. L500 above: the number of domestic firms which hire more than 500 employees. This variable captures the distribution of firm size in the same industry in a specific region. We expect that the higher the value is the less likely new FDIs gather together to avoid high competition with large firm in the market.
2. R&D: this is the size of R&D investment. This variable can capture the possibility of technological interaction or spillover benefits between new FDI and pre-existing domestic firms. The higher the size of R&D investment is, the more likely new FDIs gather together when they want to closely each other because of the easiness of technology transfer.
3. The power of dispersion index: this is one of indices in the induced production coefficient in input-output table. This index means that when there is one unit increase in final demand in an industry, how many increases in output of the entire system of industry are required. This is the measure of backward linkages. If an industry is close to manufacture type, the index is high. If an industry is close to primary industry type, then the index is low.
4. The sensitivity of dispersion index: this is also one of indices in the induced production coefficient in input-output table. This captures the output increase in an industry to produce one unit increase in final demand of every industry. This measures the forward linkages. If the index is high, then the industry is close to intermediate good production. If the index is low, then the industry is close to final good production.

In the case of industrial concentration in region estimation, following variables are used:

1. Regional exports: the export amount of a specific region.
2. Service establishments: the number of companies in service industry in the region.

We regress each co-location index of industry and that of region on those variables. One-way fixed panel estimation method with lag variable is adopted. The estimation equation is as follows:

$$(y_t - \bar{y})_t = \beta_0 + \beta_1 (x_{t-1} - \bar{x})_{t-1} + \beta_2 (y_{t-1} - \bar{y})_{t-1} + u_t \quad (6)$$

y_t : CLI or CLR at t , $\bar{y} = \frac{\sum_{t=1}^n y_t}{n}$, x_{t-1} : explanatory variables at $t-1$, $\bar{x} = \frac{\sum_{t=1}^n x_t}{n}$, u_t time error.

The estimation period is short from 2013 to 2015. However, we can explain the co-location behavior of Japanese new manufacture FDI with domestic, that is, the host country firm agglomeration

Variables	Total industry	Above average shipments	Below average shipments
Constant	0.0048	-0.0059	0.0087
	0.013	0.013	0.019
L500 above	-0.0182*	-0.0153*	-0.0212
	0.011	0.008	0.019
R&D	0.0172	0.0838	0.0239
	0.123	0.119	0.187
Power	0.9407**	0.4192	1.5919*
	0.474	0.361	0.917
Sensitivity	-0.3398*	-0.3544**	-0.4710
	0.190	0.125	0.478
Lag(-1)	-0.1993	-0.4377*	-0.1744
	0.124	0.221	0.169
R ²	0.1789	0.4779	0.1589
N	92	32	60

*is at 10%.

**is significant at 5% significance level.

Table 8. Regional concentration of industries 2013–2015: colocation index.

after the unexpected shock. The estimation is done by total, above average shipment industry and the below average shipment industry. The estimation results are shown as below tables.¹⁰

Table 8 shows the regional concentration of industry estimation result. The interest thing is R&D does not have any statistically significant factor in the estimation. This explains technological relationship is not the main factor of co-location of Japanese FDIs with domestic firm agglomeration. Maybe this estimation result explains why the share of college degree or above holder in a region cannot be an effective location decision factor for new Japanese FDIs or it affects negatively in the location decision of them.

Overall estimation explains the competitiveness in market, represented by firm size distribution, and each index of backward and forward linkages are important factors which make domestic firm agglomeration attractive to new Japanese FDIs after the shock. When we decompose industry group in to the above average shipment and the below one, the co-location factor is more clearly identified. In the case of the above average shipment industry, Japanese FDIs prefer not to gather together with large size domestic firms. And there is a negative relationship between the sensitivity of dispersion index and the tendency of Japanese FDIs' gathering together with domestic firms. That is, the lower the value of the index, the higher the tendency of Japanese FDIs' gathering with domestic firms. The fact that the index value is low means that the production quantity of this industry to be required to increase the one unit production of final good in every other industry is low. If this type of companies gather together, it is highly probable that they are looking for the location which is close to the market. Besides the effect of the power of dispersion index is not statistically significant. It means that it is not certain whether the Korean

¹⁰Summary statistics for the variables are shown in **Table B1** in Appendix B.

Variables	
Regional exports	-0.5479
	1.014
Service est.	1.8624*
	1.004
Lag(-1)	-0.3931**
	0.1544
R ²	0.7597
N	60

*is at 10%.
**is significant at 5% significance level

Table 9. Industrial concentration of region 2013–2015: colocation index.

industry is manufacture or primary industry type, that is, whether they are input chasers or providers. Therefore, it is likely that new Japanese FDIs prefer the place the Korean industry gathers together looking for their market. In summary, the new Japanese FDIs in the above average shipment industry group try to find the stable final good demander in Korea after the earthquake.

However, the new Japanese FDIs in the below averaged shipment industry group shows a different co-location pattern. To them, the power of dispersion index is the only statistically significant factor for co-location. The higher the index, the highly possible the new Japanese FDIs in this industry group gather together with domestic firms. When the Korean industry is manufacture type, that is, input chasers, the new Japanese FDIs gather together with Korean firms. In this case, it is not proven statistically whether the type of Korean industry is intermediate good producer or final good producers. This explains that it is highly possible that the Japanese FDIs in this group want to secure the intermediate good producers of Korea. Furthermore, this interpretation can be backed by the fact that, even though new Japanese FDIs are confronted with the high competition with Korean companies of same industry in the market, they do not afraid of this competition in the region.

Table 9 shows the results of industrial concentration of region. This explains the importance of the existence of service providers in regional co-location.¹¹

Finally, we can summarize the location behavior of new Japanese FDIs with unexpected shock as follows. First, the unexpected earthquake raises the uncertainty of business environment in Japan temporarily. This definitely increases the number of Japanese FDIs in Korea sharply from 2012 to 2015. Because of the unexpected shock, the location decision is quickly made. This explains why they just try to follow the location of domestic agglomeration more strongly than ever. And we can observe the investment motivation for keeping their asset in the relatively safe region. Second, however, the co-location patterns are different between industry groups. In the case of the above average shipment industry, they try to secure Korean final demander. In contrast with them, the new Japanese FDIs in the below average shipment industry group try to secure Korean intermediate good producers. So while Japanese FDIs in the above average

¹¹Summary statistics for the variables are shown in **Table B2** in Appendix B.

shipment industry group try to avoid competition with large size domestic firm agglomeration, those in the below average shipment industry group do not care about the large size domestic firm distribution. But the interest thing is that Japanese FDIs in both groups seem not to have interests with the R&D investments of Korean firms. The fact that this is the temporary decision making may be one explanation for this. Third, one of the main factors for industrial concentration in a region is whether new Japanese FDIs can get an easy access to business services.

7. Conclusions

The role of FDIs on regional economic development is not trivial because FDIs help economically depressed region increase income, production and employment. FDIs also choose their location where they can get the greatest benefits. The location choice is not an unilateral decision making process but interactive one with time consuming interaction between the regional key players (for example, regional government or local business owners) and decision makers. This can generate endogenous relationships among location choice factors. This explains why it is not easy to get unbiased estimators in the location choice estimation. However, if location decision must be made in quick without time consuming interactions, it can be expected that some biases in the estimation can be corrected.

A natural disaster which affects a restricted area such as an earthquake raises the uncertainty of business environment in the area. Furthermore, if the probability of the recurrence of earthquake is high then the uncertainty is piled up. In Japan, there are two large scale earthquakes after the 90's. First one is the "Great Hanshin earthquake" in 1994, and the second one is the recently occurred "East Japan earthquake" in 2012. These two unexpected earthquake increases the uncertainty of business environment in Japan. Besides, the frequencies and magnitude of earthquakes in Japan are sharply increased after the 2000s. That increases the temporal increase of Japanese FDIs into the neighboring country such as Korea. So it is highly probable that such temporal increase of FDIs drives the decision makers in hurry. The analysis of location choice under such a natural experiment as an earthquake may provide us with less biased estimators of regional or industrial attributes on the location choice. And it can give us a chance of our identifying why new Japanese FDIs are heading for Korea, too.

In this research, the location choices of new manufacturing Japanese FDIs into Korea from 2008 to 2015 are analyzed. The location of 308 Japanese new FDIs is investigated. In the location choice estimation results, two common things and different things between two industry groups are found. First common thing is that the propensity to follow domestic firm agglomeration in location choice of new Japanese FDIs in two industry groups is strengthened after the "East Japan Earthquake." Second is that, even though high rent affects the production cost, the propensity to choose a high rent area as their location is increased after the shock. The first different thing is that new Japanese FDIs in the industry group of the below average shipments is not affected by the potential market size of the region after the shock in the location choice. And a second, in the case of new Japanese FDIs in the industry group of the above average shipments, the effect of other source country FDIs in Korea on the location choice of them is smaller after the shock.

In the analysis of co-location index, the above average shipment industry, they try to secure Korean final demander. In contrast with them, the new Japanese FDIs in the below average

shipment industry group try to secure Korean intermediate good producers. So while Japanese FDIs in the above average shipment industry group try to avoid competition with large size domestic firm agglomeration, those in the below average shipment industry group do not care about the large size domestic firm distribution. However, Japanese FDIs in both industry groups prefer the place where they can easily access to the service industry.

Based on this estimation results, we suggest consistent interpretations as follows. AFTER the earthquake, the new Japanese FDIs in the above average shipment industry group regard the Korean market as final consumption place. This is backed by the fact that, after the shock, they do not prefer to choose the place as their location where there are large size domestic firms. It looks like that they try to avoid high competition in the place with large size domestic firms. So they start to look for the non-metro-capital area which has relatively smaller scale domestic firms agglomeration after the shock. Being contrasted with the above case, the new Japanese FDIs in the below average industry group, before the shock, regard the Korean market as final consumers. However, after the shock, they try to choose the location as their final destination where they can secure their intermediates goods supply like Korea firms do. After all, these all show that there are changes of various investment motives when there is an unexpected shock.

This analysis implies that regional governments in Korea need to reconsider the strategy of industrial specialization in the region or their free economic zones. That is, they must consider the neighboring FDI source country's change of natural environments. Since the frequency of disaster is higher and the magnitude of disaster is bigger, investment motives of firms in the country can change a lot. An inflexible industry-tailored policy cannot be appropriate for the region to attract FDIs from the country with frequent and big disasters in this case. Instead of specialization, the industry diversification strategy can be more suited for the region to attract FDIs from the country. In view of that, the regional governments need to focus on the general strategy for attraction, for example, the increasing the availability of service in the region. As a result, to be effective strategy, the strategy of regional economic development through the attraction of FDIs must be flexible with the sudden change of natural environments in the source countries of FDIs.

A. Summary statistics for location choice estimation

	2008–2015	2008–2010	2012–2015
JPN FDIs stock	5.5 (1.6)	6.0 (2.3)	5.1 (0.9)
Other FDIs stock	10.2 (3.6)	10.4 (5.7)	10.1 (2.2)
Domestic establishments	312.0 (89.0)	309.8 (150.8)	313.7 (25.8)
Unit labor cost	398.5 (53.6)	409.5 (50.9)	390.2 (61.8)
Rent	539.2 (24.6)	515.8 (17.8)	556.7 (6.3)
Number of college grad.	611.5 (67.6)	547.3 (26.9)	659.6 (38.0)
Market size	224,791.9 (18,407.8)	206,258.3 (3215.1)	236,691.8 (8348.4)
Number of observation	308	100	208

Note: (·) is standard deviation.

Table A1. Summary statistics of location choice estimation data.

	2008–2015	2008–2010	2012–2015
JPN FDIs stock	8.4 (3.8)	9.2 (6.0)	7.7 (1.8)
Other FDIs stock	16.9 (8.0)	17.1 (12.5)	16.8 (4.7)
Domestic establishments	300.5 (54.2)	265.5 (37.8)	326.7 (52.8)
Unit labor cost	282.7 (78.7)	289.3 (73.6)	277.7 (93.3)
Number of observation	135	47	88

Note: (·) is standard deviation.

Table A2. Industry group with above average shipments.

	2008–2015	2008–2010	2012–2015
JPN FDIs stock	3.0 (0.7)	2.8 (1.1)	3.1 (0.4)
Other FDIs stock	4.6 (0.9)	4.0 (0.5)	5.0 (0.9)
Domestic establishments	314.7 (140.0)	337.7 (232.1)	297.5 (48.9)
Unit labor cost	493.4 (58.1)	522.5 (82.6)	471.5 (26.7)
Number of observation	173	53	120

Note: (·) is standard deviation.

Table A3. Industry group with below average shipments.

B. Summary statistics for colocation index estimation

	Total	Above average shipments	Below average shipments
CLI	0.12 (0.14)	0.12 (0.13)	0.12 (0.15)
R&D	2472 (8128)	6205 (13,501)	482 (689)
I500	13.50 (18.72)	14.50 (15.48)	13.00 (20.74)
Power of disp. index	1.90 (1.51)	2.81 (2.24)	1.42 (0.60)
Sensitivity of disp. index	1.89 (1.39)	2.61 (2.09)	1.51 (0.64)
observations	92	32	60

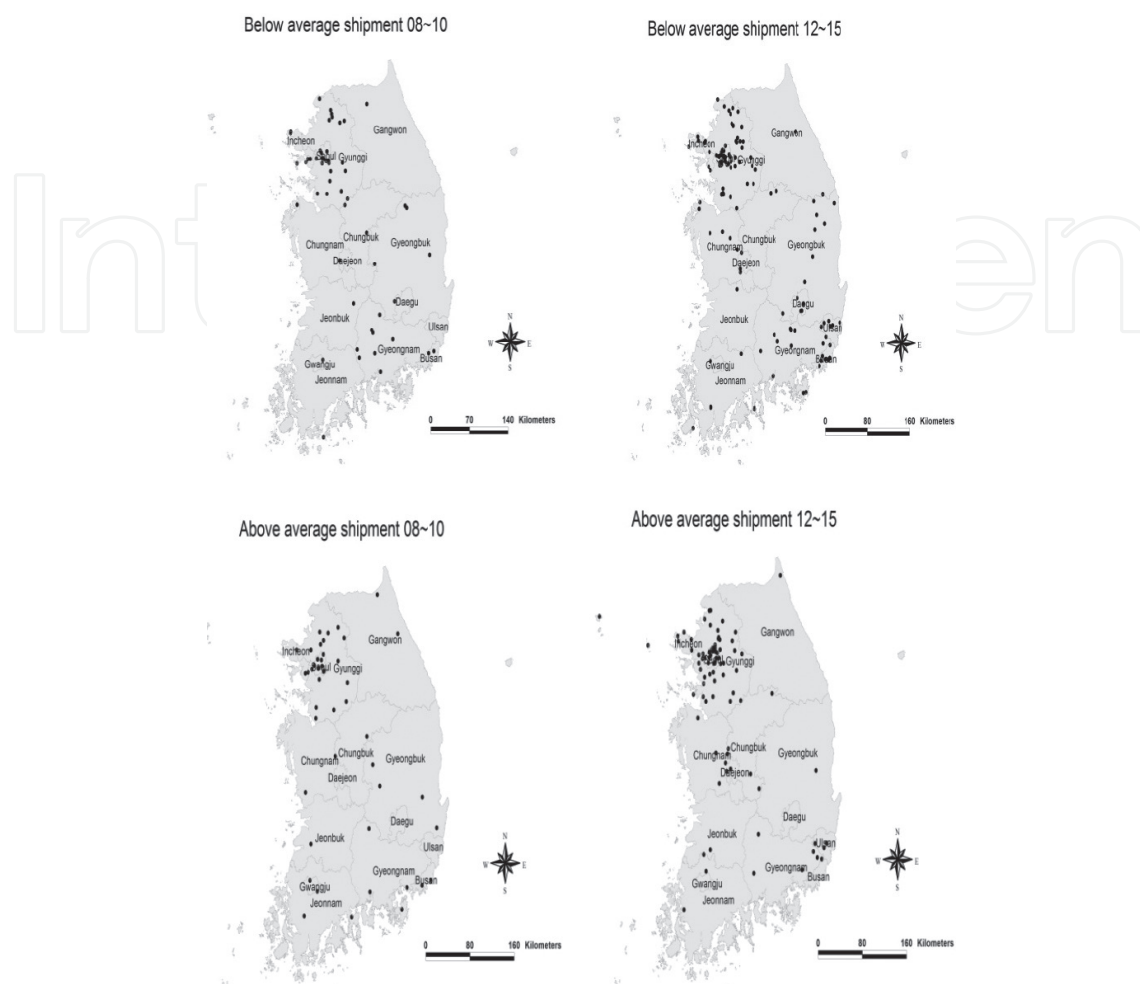
Note: (·) is standard deviation.

Table B1. Estimation of regional colocation of industries.

Variables	Average (Standard deviation)
CLR	0.063 (0.006)
Regional exports	37,270 (696)
Service establishments	22,695 (1514)
Observation	60

Table B2. Estimation of industrial colocation of region.

C. Regional distribution of new Japanese FDIs in manufacture



Before (2008–2010) and after (2012–2015) the East Japanese Earthquake

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