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Sachiko KAZEKAMI

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Sachiko KAZEKAMI※
(Chukyo University)

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Abstract

This paper examines the multiplier effect in which tradable sectors generate non-tradable sector jobs through an increased demand for local goods and services using a spatial econometric model, and it analyzes whether agglomeration economies increase this multiplier effect. To distinguish tradable and non-tradable sectors, including service industries, I use the Gini index. Tradable sector jobs generate non-tradable sector jobs. The concentration and variety of industries increase this multiplier effect, but population size does not appear to increase the effect. However, the concentration of industries in neighboring regions negatively affects the creation of non-tradable sector jobs when neighboring tradable jobs increase. The feedback effect of industrial variety, in which observations in region A affect observations in region B and vice versa and in which longer paths may go from observations in region A to region B through region C and back to region A, is positive but not strong.

Keywords: local multipliers; labor demand; agglomeration economies; tradable service sectors, spatial econometrics

JEL Codes: J23, J61

※ 101-2, Yagotohonmachi, Showa-ku, Nagoya, JAPAN sachikok@mecl.chukyo-u.ac.jp

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1. Introduction

Job creation is a major policy discussion topic in the present era of slow growth. By adding one additional job in a specific industry in a given city, additional jobs are generated in that city through increased demand for local goods and services, such as local restaurants, cleaning services and hospitals. This local multiplier effect is industry-specific (Moretti, 2010; Moretti and Thulin, 2013) because it is specifically the increased employment in high-wage industries that enables workers to consume more local goods and services. Moretti (2010) and Moretti and Thulin (2013) show that manufacturing has a large multiplier effect in non-manufacturing sectors but not in other manufacturing sectors.

Some service industries, such as internet-related industries and information services, however, are less affected by the size of local demand and tradable sectors. Such industries may be involved in national and international trade; they can supply the services to consumers from disparate locations to where consumers live, and they are potentially based both offshore and onshore. This paper divides industries into tradable sectors and non-tradable sectors by degree of local concentration using the Gini index rather than based on whether an industry is a manufacturing or service industry.

Of particular importance is in which industries or under what conditions (concentration or not, among others) one new job creates many additional jobs. Previous studies (Ellison and Glaeser, 1999; Greenstone et al. 2010; Moretti, 2010; Kline and Moretti, 2012) find that productivity increases in agglomeration economies. In Japan, the effect of agglomeration economies[1] on technical efficiency cannot be disregarded, particularly because light goods industries receive the benefit (Mitra and Sato, 2007). Increasing productivity results in higher wages, and higher wages might induce additional jobs. In addition, if the concentrated industries are manufacturing industries, increasing employment generates additional jobs among local suppliers. Therefore, this paper focuses on agglomeration economies and uses the concentration of industries index, the variety of industries index and population size as the agglomeration index. To

[1] In the study in Mitra and Sato (2007), the measurements of agglomeration economy are the proportion of the total manufacturing employment in both rural and urban areas and the population density.

capture agglomeration economies accurately, this paper uses commuting zones instead of administrative departments because economic clusters sometimes straddle administrative department lines. Furthermore, the agglomeration economies of neighbors affect a target region. Therefore, when there are effects due to neighboring regions, we must use spatial econometrics in addition to the basic fixed effect estimation method.

In my results, I observe that a 10 percent increase in the number of jobs in a tradable sector, in a given commuting zone, is associated with a 2.3 percent increase in employment in the non-tradable sector within that commuting zone. The concentration of industries and variety of industries increases this multiplier effect. Population size has a positive effect on the generation of non-tradable jobs, but it is not clear whether population size increases the multiplier effect, in which tradable jobs generate non-tradable jobs. Moran's *I*, a measure of spatial autocorrelation, is significant. It indicates that the employment numbers and agglomeration economies in neighboring commuting zones affect the creation of non-tradable sector jobs in the given commuting zone. In fact, a concentration of neighboring commuting zones has a positive effect on non-tradable sector jobs in the given commuting zone, but it decreases the non-tradable jobs in the given region when neighboring tradable sector jobs increase. Furthermore, the feedback effect of a given commuting zone's industrial variety through neighbors positively affects the creation of non-tradable sector jobs in that commuting zone.

The remainder of this paper is organized as follows. In the next section, I describe my conceptual framework and how to divide tradable and non-tradable sectors. Section 3 explains the three indices of agglomeration economies: concentration of industries, variety of industries and change in population size. Section 4 shows my empirical framework and the data. Section 5 presents the empirical results. Section 6 presents the results and my conclusions.

2. Conceptual framework

2.1. Conceptual framework

I have based the conceptual framework on Moretti (2010), who clarifies the economic meaning of the multiplier effect. Assume that each commuting zone is a competitive economy. Labor is mobile across sectors within a commuting zone. The marginal product of labor and wages are thus equal within a commuting zone. The prices of tradable goods are set in the national market, whereas the prices of non-tradable goods are determined locally. The local labor supply is upward sloping, and the slope depends on the distribution of residents' tastes for leisure and the degree of labor mobility.

Consider a positive labor demand shock in tradable sectors. For example, a new firm may open in a specific commuting zone, resulting in increased employment in the tradable sectors. This is a direct effect. There is also an indirect effect because the opening of a new firm or a positive labor demand shock in tradable sectors also affects local employment in other sectors. The magnitude of the multiplier effect depends on several factors. First, it depends on consumer preferences for non-tradable goods and on productive technology in the non-tradable sector. More labor intensive technologies result in larger multipliers. Second, it depends on the earnings of the new jobs. As higher earnings enable increased consumption of local goods and services, local labor demand increases. Therefore, *agglomeration economies* have larger multipliers under conditions of high productivity growth and increased wages. Agglomeration economies are discussed further in the next section. High-skilled jobs also have larger multipliers. Third, there are offsetting general equilibrium effects on wages and prices. Increased labor costs generated by the opening of a new firm or a positive labor demand shock leads to a decline in the supply of local services. Thus, additional jobs in one sector crowd out jobs in other sectors. If the local labor supply is highly elastic because of high labor mobility, this crowding out effect is more limited, and the increasing labor costs are small, making the multiplier larger. Moreover, increasing labor costs hurt employment in parts of some concentrated industries because increasing costs reduce their competitiveness. By contrast, the increased demand generated by the opening of a new firm or a positive labor demand shock increases local demand for intermediate goods as well as local services. This effect depends on the industry supply chain and on the strength of the agglomeration economies.

2.2 Tradable sectors and Non-tradable sectors

Existing literature suggests various methods for dividing industries into tradable and non-tradable sectors, e.g., using location quotients or the minimum requirement method (Moretti, 2010; Moretti and Thulin, 2013). Most manufacturing industries are tradable sectors. Additionally, some service sectors, such as internet-related industries and information services, are also tradable sectors. Such industries can supply the goods or services to consumers from disparate locations to where consumers live. Consequently, tradable sectors concentrate in particular regions. Therefore, this paper uses the Gini index to distinguish between tradable and non-tradable sectors. Jensen (2011) and Jensen and Kletzer (2005) clarify that industries of higher Gini index represent tradable sectors, even if these sectors are service industries[2].

$$G_i = \sum_r (S_{ri} - S_r)^2 \tag{1}$$

The measure is the index of comparing a region's share of industry employment, S_{ri} with the area's share of aggregate employment, S_r. When an area's share of employment in a specific industry is greater than an area's share of aggregate employment this indicates a concentration in the given region. Concentration is indicative of trade because local employment exceeds local demand and the difference is traded outside the area. Thus, industries with a higher Gini index are tradable sectors. This paper does not consider the Herfindahl index, which accounts for establishment size, because this paper is not interested in the colocation of different establishments in identical industries; it is interested in pure geographic concentration following Jensen and Kletzer (2005). Jensen and Kletzer (2005) confirm that the Gini index accurately captures tradability by comparing actual trading data. This paper assumes their

[2] In their paper, they modify this measure to look at the difference between the region's share of industry employment and the region's share of industry demand.

verification is true in Japan.

3. Agglomeration economies

This paper examines whether agglomeration economies have large multiplier effects because of increasing productivity and higher wages, with increased use of local supply chains leading to increased purchases of local goods. In this paper, I consider three agglomeration indices: concentration of industries, variety of industries and population size.

The externality of agglomeration economies has been discussed by Marshall, Jacobs, Porter and others (Glaeser et al., 1992). Glaeser et al. (1992) argue existing theories in detail and test those theories using data from large American industries. They argue the following. The Marshall-Arrow-Romer model focuses on knowledge spillover between firms within an industry. Monopoly is good because local monopoly restricts the flow of ideas to others, allowing the internalization of externalities. The Porter model also considers knowledge spillover between firms in an industry but local competition accelerates the innovator's ideas. Glaeser et al. (1992) use the ratio of the specific industry employment share in the given city, relative to the share of the entire industry in national employment, as the industry concentration in their empirical study, and the Marshall-Arrow-Romer and Porter models indicate that this industry concentration increases the knowledge spillover. This paper uses the Gini coefficient proposed by Ellison and Glaeser (1997) as explained below. In contrast to the Marshall-Arrow-Romer model and the Porter model, the Jacobs model considers that variety and diversity of geographically proximate industries, rather than geographical specialization, promote innovation and growth. Glaeser et al. (1992) use the fraction of the city's employment in the largest five industries; the lower this ratio, the more diverse the city is and the faster the economy will grow. This paper uses an inverse of the Herfindahl index, following Ostuka (2004) and Marrocu, Paci and Usai (2011), as explained below. Additionally, this paper considers population size as a substitute for local demand size. The concentration and variety of industries are measured by employment numbers, but non-employment such as the elderly, homemakers and children, also consume local goods and services. The population size accounts for the demand for local goods and services by the non-employment. However, previous studies, such as Moomaw, Segal, Shukla, observe that productivity is generally higher in large cities (Mitra and Sato, 2007). However, Carlino (1979) says that the population scale has a negative effect on productivity, reflecting diseconomies rather than economies of agglomeration.

First, I explain the concentration index using this paper indicated equation (3). One of the most important proposed concentration indexes is the locational Gini coefficient of Krugman (Krugman, 1991). Later, Ellison and Glaeser (1997) propose a simpler index that is calculated using the following equation:

$$G_r = \sum_i (S_{ri} - S_i)^2 \tag{2}$$

where S_{ri} is the employment share of industry i in commuting zone r in all industries of the commuting zone r, i.e., $S_{ri} = E_{ri} / TRE$, where E_{ri} and TRE are the employment in industry i in commuting zone r and total employment in all industries in commuting zone r ($\mathrm{TRE} = \sum_i E_{ri}$), respectively. Si is the employment share of industry i in aggregate employment in all industries, i.e., $Si=NEi/TNE$, where NE_i and TNE are the employment in industry i throughout the country and total employment in all industries throughout the country ($\mathrm{TNE} = \sum_i \sum_r E_{ri}$), respectively. If G_r =1, the industry composition in the given commuting zone is weighted in that specific industry.

The Gini index is not controlled by the establishment size. Ellison and Glaeser (1997) propose an index of industry concentration controlled by industry plant size. Lu and Tao (2005) propose a measurement of regional specialization in terms of the Ellison and Glaeser (1997) index as follows:

$$EG_r \equiv \frac{G_r - \left(1 - \sum_{i=1}^{N} S_i^2\right) H_r^*}{\left(1 - \sum_{i=1}^{N} S_i^2\right)\left(1 - H_r^*\right)} \tag{3}$$

where $\mathrm{H_r^*} = \sum_{\mathrm{k=1}}^{\mathrm{K}} \left(\mathrm{E_{rk}} / \sum_{\mathrm{k=1}}^{\mathrm{K}} \mathrm{E_{rk}}\right)^2$ is the Herfindahl index of commuting zone r, and E_{rk} is employment of establishment k in commuting zone r, and K is total number of establishments in commuting zone *r*. This paper calls this index the *EG index*. A higher EG index indicates a higher concentration of the specific industry in the given commuting zone.

Second, this paper uses an inverse of the Herfindahl index to measure the variety of industries, following Ostuka (2004) and Marrocu, Paci and Usai (2013).

$$JE_r = \frac{1}{\sum_i \left(E_{ri} / \sum_i E_{ri} \right)^2} \tag{4}$$

The denominator is the Herfindahl index. E_{ri} and $\sum_i E_{ri}$ are the employment in industry *i* in commuting zone *r* and total employment in all industries in commuting zone *r*, as mentioned above. A higher JE index indicates a greater variety of industries in the given region.

Finally, as for population size, I use the logarithm of population in the given commuting zone.

$$pop_r = \log\left(population_r\right) \tag{5}$$

4. Empirical framework and data

4.1 Empirical framework

The changes in local employment have the potential of effects from neighboring regions. Therefore, the local multiplier effects are estimated using the following spatial panel model:

$$\mathrm{y} = \rho \mathrm{Wy} + \mathrm{X}(\beta + \gamma) + \mathrm{WX}(-\rho\beta) + \mu \tag{6}$$

where *y* is the change over time in the log number of jobs in commuting zone *r* in non-tradable sectors, and *X* is the change over time in the log number of jobs in commuting zone *r* in tradable sectors, three agglomeration indices (i.e., the concentration of industries (EG index), the variety of industries (JE index) and the logarithm of the population) and three cross terms between X and the three agglomeration indices. *W* is a spatial weight matrix that is calculated from the inverse distance based on longitude and latitude. A spatial regression model expands the information set to include information from neighboring regions. To see the effect of this, I re-write equation (6) as follows:

$$
\begin{aligned}
&(\mathrm{I_n} - \rho\mathrm{W})\mathrm{y} = \mathrm{X}\beta + \mathrm{WX}\theta + \tau_\mathrm{n}\alpha + \varepsilon \\
&\mathrm{y} = \sum_{\mathrm{r}=1}^{\mathrm{k}} \mathrm{S_r(W)x_r} + \mathrm{V(W)}\tau_\mathrm{n}\alpha + \mathrm{V(W)}\varepsilon \\
&\mathrm{S_r(W)} = \mathrm{V(W)}(\mathrm{I_n}\beta_\mathrm{r} + \mathrm{W}\theta_\mathrm{r}) \\
&\mathrm{V(W)} = (\mathrm{I_n} - \rho\mathrm{W})^{-1} = \mathrm{I_n} + \rho\mathrm{W} + \rho^2\mathrm{W}^2 + \rho^3\mathrm{W}^3 + \cdots
\end{aligned}
\tag{7}
$$

To illustrate the role of Sr(W), consider the expansion of the data generating process in (7) as shown in (8).

$$
\begin{pmatrix} y_1 \\ y_2 \\ \vdots \\ y_3 \end{pmatrix} = \sum_{r=1}^{k} \begin{pmatrix} S_r(W)_{11} & S_r(W)_{12} & \cdots & S_r(W)_{1n} \\ S_r(W)_{21} & S_r(W)_{22} & & \\ \vdots & \vdots & \ddots & \\ S_r(W)_{n1} & S_r(W)_{n2} & \cdots & S_r(W)_{nn} \end{pmatrix} \begin{pmatrix} x_{1r} \\ x_{2r} \\ \vdots \\ x_{nr} \end{pmatrix} + V(W)\tau_n\alpha + V(W)\varepsilon \tag{8}
$$

The dependent variable of neighboring regions, i.e., the change over time in the log number of jobs in the neighboring commuting zone in non-tradable sectors, is represented by the spatial lag vector *Wy*. The characteristics of neighboring commuting zones (e.g., neighboring concentration of industries, variety of industries and population size) are captured by *WX*. $\partial y_p / \partial x_{pr} = S_r(W)_{pp}$ measures the effect on the dependent variable observation *m* from a change in x_{mr}. This effect includes the effect of feedback loops where observation *m* affects observation j and observation *j* also affects observation m as well as longer paths which might go from observation *m* to *j* through *k* and back to *m*. The dialog elements of the $n \times n$ matrix $S_r(W)$ contain the direct effects, and off-diagonal elements represent indirect effects.

This paper uses the spatial Durbin model (SDM) because the SDM is the only model that will produce unbiased coefficient estimates under all four possible data generating processes: spatial autoregressive model, spatial error model, spatial autoregressive model with auto regressive disturbances and SDM (LeSage and Pace, 2008). The model choice test results also indicate that the SDM model is the best model, as mentioned in the next section.

4.2 Data

This paper uses the Establishment and Enterprise Census[3] for 1996, 1999, 2001, 2004 and 2006, which covers all establishments in Japan. It provides a complete directory as the master sampling framework for various statistical surveys (e.g., the Basic Survey on Wage Structure by the Statistics Bureau) by the Ministry of Internal Affairs and Communications Statistics Bureau. The 2006 data are the latest actual data[4]. I examine the three years change of four periods. To ensure that the periods are comparable on a three year scale, the difference in the periods from 1999 to 2001 and from 2004 to 2006 is multiplied by a factor of 3/2. Furthermore, I convert the industrial classification for each period into the Japan Standard Industrial Classification at the small level in 2006. If the industrial classification is divided at 2006, this paper aggregates those industries for which data were recorded in 2006. This paper excludes the industries that existed only at the beginning or end of the study period when calculating the change over time in the log number of jobs.

To calculate the Gini index to separate the tradable and non-tradable sectors, I use the Establishment and Enterprise Census data for 2006. For the concentration of industries, variety of industries and logarithm of population, I use the beginning year of each period. I calculate the concentration and variety of industries using the

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[3] The author is grateful to the Ministry of Internal Affairs and Communications Statistics Bureau for providing the Establishment and Enterprise Census.

[4] Because the Establishment and Enterprise Census was changed to the Economic Census in 2009 and the survey techniques were also changed at that time, differences in the employment numbers between 2006 data in Establishment and Enterprise Census and 2009 data in Economic Census are not consistent with the actual differences in the employment numbers.

Establishment and Enterprise Census. The data based on the records of the Basic Resident Registration, which the mayor of each municipality is responsible for preparing, is used for population size.

To identify individual regions, this paper uses the commuting zones proposed by the Center for Spatial Information Science[5]. There are 113 commuting zones designated as Metropolitan Employment Areas and 156 commuting zones designated as Micropolitan Employment Areas, for a total of 269 commuting zones according to the 2000 code[6]. Several cities merged and new cities developed during the estimation period so I converted the data into the 2000 code. These 269 commuting zones account for 93.95% of the total employment[7] in 2006 in Japan.

Table 1 provides detailed descriptive statistics. Table 1 illustrates that the means of changes over time in the employment numbers in tradable and non-tradable sectors are negative; however, between 2004 and 2006 they are positive and the changes in the tradable sector jobs are greater than those in the non-tradable sectors. Table 1 also shows that the industry variety index is greater than the industry concentration index. The small estimation coefficient for variety of industries does not indicate the weaker effect rather than the effect from concentration of industries. The maximum value of industry variety is large, but it is not an outlier. When I illustrate the histogram, the variety of industries index has a twin peaks shape. Table 2 provides the correlation between variables. Table 2 shows that the high correlation between changes in the employment numbers in tradable sectors and the cross term in which industry variety multiplies changes in the employment numbers in tradable sectors. The correlation between changes in the employment numbers in tradable sectors and the cross term which logarithm of population multiplies changes in the employment numbers in tradable sectors also correlates strongly. Therefore, this paper cannot determine the effects of these cross terms[8].

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[5] Kanamoto, a researcher at the Center for Spatial Information Science, reported these data.

[6] I combined the commuting zones' code and the employment data, i.e., the Establishment and Enterprise Census data, because both the code and the dataset include administrative city-level department information.

[7] Excluding agriculture, forestry, fisheries and public service.

[8] I determined the effect of the change in the employment numbers in tradable sectors for comparing the estimation without cross terms.

5. Results

5.1 Tradable sectors, non-tradable and spatial economy

First, I divide the tradable and non-tradable sectors. Jensen and Kletzer (2005) illustrate their calculated Gini index in figures and separate tradable and non-tradable sectors. Therefore, I illustrate the calculated Gini index results based on equation (1) in Figure 1. Figure 1 shows that the Gini index for the manufacturing and service industries varies widely between industries. For example, in manufacturing, pottery and related products, tobacco manufacturers and manmade fiber industries have a large Gini index; bakery and confectionary products, paper containers and seasoning industries have a small Gini index. In service industries, performances, theatrical companies, non-profit cultural, science and art organizations and office machinery rental industries have a large Gini index; hair dressing and beauty salons, amusement and recreation facilities and photographic studios have a small Gini index. Computer programming and other software services, internet based services and sound information production, which are thought to be tradable non-manufacturing sectors, have large Gini indices of 0.08, 0.18 and 0.37, respectively. By contrast, "sushi" bars and Japanese noodles restaurants have small Gini indexes of 0.0006 and 0.0009, respectively. Most Gini indices for retail trade, insurance, real estate, eating and drinking places, accommodations, medical, health care, welfare, education and learning support are under 0.01; all Gini indices for insurance, real estate, medical, health care and welfare are under 0.02. Therefore, this paper separates the tradable and non-tradable sectors at 0.01 Gini index. Industries with a Gini index over 0.01 are tradable sectors and all others are non-tradable sectors. For a robustness check, I use a Gini index of 0.02; industries with a Gini index over 0.02 are tradable sectors.

Table 3 shows the Moran's *I* and rejects the null hypothesis that there are zero spatial autocorrelations present in all variables (the change over time in the number of tradable and non-tradable jobs, concentration of industries, variety of industries, population size during the periods from 1996 to 1999 and from 1999 to 2001 and three cross terms) at the 10 % significance level. Therefore, this paper uses the spatial panel model.

5.2 Estimation results

Table 4 shows the estimation results of model (6). The first part of Table 4 presents the estimation coefficients of X in model (6). A 10 percent increase in the number of jobs in a tradable sector in a given commuting zone is associated with a 2.3 percent increase in employment in a non-tradable sector within that commuting zone. The change in tradable sector jobs correlates strongly with a cross term between variety of industries and tradable sector jobs. It also correlates strongly with a cross term between population size and tradable sector jobs. Therefore, this paper shows the estimation result of model (6), without cross terms, in the next column in Table 4. The first row indicates that a 10 percent increase in the number of jobs in a tradable sector is associated with a 2.1 percent increase in employment in a non-tradable sector. This multiplier effect (tradable sector jobs generate non-tradable sector jobs) is increased as a result of the concentration and variety of industries[9]. The cross term between change in tradable sector jobs and concentration of industries and the cross term between change in tradable sector's jobs and variety of industries indicate positive estimated coefficients[10]. Although my data includes a period of shrinking employment, this paper can observe the increased multiplier effect from the concentration of industries. A comparison of the magnitude of the multiplier effect between periods of expanding and shrinking employment, which is discussed in the next section, is beyond the scope of this paper. The logarithm of population does not indicate a clear effect on the multiplier effect although logarithm of population itself generates non-tradable sector jobs. Carlino (1979) says that the population scale has a negative effect on productivity,

[9] This paper cannot compare the magnitude of these two effects because the scales of industrial concentration and variety are different.

[10] Because changes in tradable sector's jobs correlate strongly with the cross term between *variety* of industries and tradable sector's jobs, this paper cannot obtain separate effects, but both variables show positive estimation coefficients.

reflecting diseconomies rather than economies of agglomeration.

The second part of Table 4 shows the effect from neighboring commuting zone characteristics. Increasing tradable sector jobs in neighbor zones generates non-tradable sector jobs. However, if industries concentrate in the neighboring commuting zone, the increasing tradable sector jobs in that neighboring commuting zone decrease the non-tradable jobs in the target commuting zone shown the in cross term. The neighboring increase in tradable sector jobs results from the tight labor market in the target region. In the target region, employers in non-tradable sectors cannot attract workers, or workers in non-tradable sectors move from the target region to the neighboring zone.

The third part of Table 4 represents the effect on non-tradable jobs, including the effect through neighboring regions, i.e., the effect of feedback loops. Shown as an indirect effect, remarkably, the cross term between the change in tradable sector jobs and concentration of industries is negative. By contrast, the cross term between the change in tradable sector jobs and variety of industries is insignificantly positive. This represents that variety of industries positively affects cross-border commuting zones, but the effect of industrial concentration in the specific region offsets the economic activities in other regions. As for the direct effect, both concentration and variety of industries increases the multiplier effect, which is that tradable sector jobs generate non-tradable sector jobs.

The right column of Table 4 shows the estimation results of model (6) using the fixed effects panel model rather than the spatial panel model. Even with the fixed effects panel model, the multiplier effect can be observed and the concentration and variety of industries increases this multiplier effect.

Second, Table 5 shows the test results that compare several models. The Hausman test to compare the fixed effects SDM model and the random effects SDM model suggests that this paper should choose the fixed effects SDM model. In comparison to a spatial autoregressive model, the Chi test rejects the null hypothesis that θ is zero. The Chi test comparison with a spatial error model also rejects the null hypothesis that $\theta = -\beta\lambda$. To compare the spatial autoregressive model with auto regressive disturbances, I compare BIC and choose the fixed effects SDM model. In summary, the fixed effect SDM model is the most useful model.

Finally, this paper evaluates model (6) for robustness considering that industries with a Gini index over 0.02 as tradable sectors and otherwise as non-tradable sectors. Most retail trade, insurance, real estate, eating and drinking places, accommodations, medical, health care, welfare, education and learning support companies have a Gini index under 0.01, but all insurance, real estate, medical, health care and welfare companies have a Gini index under 0.02. Table 6 represents the results in this case. Although the criterion for a tradable sector becomes strict, tradable sector jobs generate non-tradable sector jobs; a 10 percent increase in the number of jobs in tradable sectors, within a given large commuting zone is associated with a 9.3 percent increase in employment in the non-tradable sectors in that commuting zone. The concentration of industries increases this multiplier effect, but the increased effect of industrial variety is not observed in the tradable sector with a Gini index over 0.02. The effects from the characteristics of neighboring regions are similar to the case of the tradable sector with a Gini index over 0.01. The feedback effects are weak. The effect of the tradable sector jobs on the non-tradable sector jobs through the neighboring commuting zones and the increased effect of industry variety are not observed. It may be because the criterion becomes stricter.

6. Conclusions

This paper examines how tradable sector jobs within the given commuting zones generate additional jobs in the non-tradable sector, such as local goods and service industries, in that commuting zone and whether agglomeration economies increase this multiplier effect. This paper considers the concentration of industries, variety of industries and population size as agglomeration indices, referencing Marshall, Jacobs, Porter and others. To separate the tradable and non-tradable sectors, I calculate the Gini index, which compares a region's share of industry employment with the area's share of aggregate employment; if the former is greater than the latter, local employment exceeds local demand and the difference is traded outside the region. The change over time in tradable sector jobs, concentration of industries, variety of industries and population in the neighboring commuting zones affect the target commuting zone. Therefore, this paper use a spatial econometric model, specifically, the spatial Durbin model.

The results indicate that a 10 percent increase in the number of jobs in tradable sector jobs, within a given commuting zone, is associated with an approximately 2 percent increase in employment in non-tradable sector jobs in that commuting zone. The concentration and variety of industries increase this multiplier effect that tradable sectors create non-tradable sector jobs, but population size does not show a clear increased effect. The concentration of industries in the neighboring commuting zone, by contrast, decreases the non-tradable sector jobs in the target commuting zone when tradable sectors grow in the neighboring region. The variety of industries affects non-tradable sector jobs through neighbors as well, but this effect is not strong. As for population size, this paper considers the size of demand for local goods and services to include non-workers, such as the elderly, but diseconomies rather than agglomeration economies are represented. These results are confirmed when using a stricter criterion for tradable sectors.

To expand this study, it must capture an expansion period of employment by adding more recent data because the data in this paper include a primarily shrinking period of employment. Furthermore, I would like to compare the multiplier effects of expanding and shrinking economic periods because Sato (2001) notes that if a region had a high concentration in a particular industry, then a sudden exogenous shock would lead to higher unemployment than in a more diversified region with many industries. Although these points remain, this paper describes the local multiplier of tradable sectors; demonstrates that the concentration of industries in the target region increases this multiplier effect, whereas the concentration of industries in neighboring regions decreases the creation of non-tradable sector jobs; and shows that the variety of industries in the target region and the feedback loops through neighboring regions increase this multiplier effect in Japan.

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Table 1 Descriptive statistics

Variable	Mean	Std. Dev.	Min	Max
d_T	-0.296	0.580	-2.103	1.439
d_NT	-0.069	0.149	-0.634	1.799
Concentration of industries index	0.007	0.009	0.000	0.100
Variety of industries index	43.483	21.128	8.314	102.693
Logarithm of population	11.971	1.103	9.684	17.436
Number of observations	1076			

d_T=the change over time in the log number of jobs in tradable sectors

d_NT=the change over time in the log number of jobs in non-tradable sectors

Table2 Correlation matrix

		(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1)	Change over time in the log number of jobs in tradable sectors	1.000						
(2)	Concentration of industries index	0.011	1.000					
(3)	Cross term between the change over time in the log number of jobs in tradable sectors and concentration of industries index	0.569	-0.363	1.000				
(4)	Variety of industries index	0.546	-0.390	0.373	1.000			
(5)	Cross term between the change over time in the log number of jobs in tradable sectors and variety of industries index	0.930	0.008	0.470	0.506	1.000		
(6)	Logarithm of population	-0.025	-0.253	0.159	0.280	0.004	1.000	
(7)	Cross term between the change over time in the log number of jobs in tradable sectors and population	0.994	0.028	0.529	0.540	0.923	-0.079	1.000

Table3 Moran's I

Variables	1996-1999 I	E(I)	sd(I)	z	p-value*	2001-2004 I	E(I)	sd(I)	z	p-value*
d_T	0.14	-0.004	0.012	12.194	0	0.058	-0.004	0.012	5.338	0
d_NT	0.052	-0.004	0.012	4.821	0	0.028	-0.004	0.011	2.894	0.002
Concentration of industries index	0.051	-0.004	0.011	4.912	0	0.057	-0.004	0.011	5.429	0
Variety of industries index	0.069	-0.004	0.012	6.176	0	0.043	-0.004	0.012	3.964	0
Logarithm of population	0.014	-0.004	0.012	1.489	0.068	0.009	-0.004	0.012	1.115	0.132
	1999-2001					2004-2006				
Variables	I	E(I)	sd(I)	z	p-value*	I	E(I)	sd(I)	z	p-value*
d_T	0.148	-0.004	0.012	12.825	0	0.038	-0.004	0.012	3.579	0
d_NT	0.2	-0.004	0.012	17.278	0	0.04	-0.004	0.011	3.926	0
Concentration of industries index	0.043	-0.004	0.011	4.189	0	0.078	-0.004	0.011	7.588	0
Variety of industries index	0.062	-0.004	0.012	5.611	0	0.055	-0.004	0.012	4.978	0
Logarithm of population	0.015	-0.004	0.012	1.55	0.061	0.011	-0.004	0.012	1.27	0.102

d_T=the change over time in the log number of jobs in tradable sectors

d_NT=the change over time in the log number of jobs in non-tradable sector

The calculations use the levels of concentration and variety of industries index and population in the beginning year of period.

*1-tail test

Table4 Local multipliers dependent variable: the change in the log number of jobs in non-tradable sectors

	Fixed effects SDM model						Fixed effects panel model		
	Coef.		Std. Err.	Coef.		Std. Err.	Coef.		Std. Err.
Main									
d_T	0.2251	***	0.0614	0.2130	***	0.0128	0.2206	***	0.0688
Concentration	-2.6481	*	1.5303	-6.3413	***	1.5788	-2.6876		1.8912
Concentration ×d_T	6.0043	***	0.8515				4.0998	***	0.9635
Variety	0.0013	***	0.0003	-0.0001		0.0003	0.0018	***	0.0002
Variety ×d_T	0.0058	***	0.0006				0.0055	***	0.0005
Population	0.0685	***	0.0261	0.0790	***	0.0277	0.0838	***	0.0322
Population × d_T	-0.0169	***	0.0043				-0.0241	***	0.0052
_cons							-1.1117	***	0.3858
Wx									
d_T	1.8751	*	1.0802	-0.3663	***	0.0314			
Concentration	46.2832	**	19.5098	26.8806		20.0910			
Concentration ×d_T	-23.0885	**	9.2857						
Variety	0.0028	*	0.0014	0.0014		0.0012			
Variety ×d_T	-0.0014		0.0026						
Population	0.3279		0.4340	0.6502		0.4290			
Population × d_T	-0.1662	*	0.0873						
Spatial									
rho	0.2582		0.2708	1.2376	***	0.1466			
Variance									
sigma2_e	0.0073	***	0.0003	0.0084	***	0.0004			
Direct									
d_T	0.2271	***	0.0514	0.2117	***	0.0108			
Concentration	-2.4677		1.6797	-5.9539	***	1.7715			
Concentration ×d_T	6.0338	***	0.8912						
Variety	0.0013	***	0.0003	0.0000		0.0003			
Variety ×d_T	0.0059	***	0.0006						
Population	0.0744	***	0.0262	0.0877	***	0.0270			
Population × d_T	-0.0174	***	0.0038						
Indirect									
d_T	1.0103	*	0.5715	-0.1283	***	0.0277			
Concentration	22.9572	**	10.0498	32.8514		30.4865			
Concentration ×d_T	-11.3846	**	5.2380						
Variety	0.0016	***	0.0006	0.0018		0.0013			
Variety ×d_T	0.0000		0.0009						
Population	0.1741		0.2297	1.0109		0.6205			
Population × d_T	-0.0888	*	0.0458						
Total									
d_T	1.2374	**	0.5665	0.0834	***	0.0257			
Concentration	20.4895	**	10.0090	26.8975		30.8586			
Concentration ×d_T	-5.3508		5.2071						
Variety	0.0029	***	0.0005	0.0017		0.0012			
Variety ×d_T	0.0059	***	0.0008						
Population	0.2485		0.2291	1.0985	*	0.6251			
Population × d_T	-0.1063	**	0.0458						
Number of obs	1076			1076			1076		
R-sq: within	0.6023			0.5008			0.5378		
between	0.1201			0.0811			0.0056		
overall	0.0497			0.0166			0.187		

d_T=the change over time in the log number of jobs in tradable sectors
~×d_T=cross term
Wx=the effect from neighboring commuting zone characteristics
***, ** and * denote 1%, 5% and 10% significance levels, respectively.

Table5 Tests for choosing a model

Hausman test to compare the fixed effects SDM model with the random effects SDM model

chi2(10)	27.4
Prob>chi2	0.0023

Test comparison with a spatial autoregressive model

chi2(7)	216.75
Prob > chi2	0.0000

Test comparison with a spatial error model

chi2(7)	36.07
Prob > chi2	0.0000

Test comparison with the spatial autoregressive model with auto regressive disturbances

Model	Obs	ll(null)	ll(model)	df	AIC	BIC
sdm_fe	1076	.	1120.29	16	-2208.6	-2128.9
sac_fe	1076	.	1100.31	10	-2180.6	-2130.8

N=1076 used in calculating BIC

sdm_fe=the fixed effects spatial durbin model (SDM)

sac_fe= the fixed effects spatial autoregressive model with auto regressive disturbances

Table6 Local multipliers :strict criterion of tradable sectors (tradable sectors=over 0.02 Gini index)

Dependent variable: the change in the log number of jobs in non-tradable sectors

	Fixed effects SDM model						Fixed effects panel model		
	Coef.		Std. Err.	Coef.		Std. Err.	Coef.		Std. Err.
Main									
d_T	0.9328	***	0.1204	0.3665	***	0.0208	1.4342	***	0.1541
Concentration	-3.0829		2.0308	-7.2779	***	2.0011	-4.8179	*	2.7133
Concentration ×d_T	6.0078	***	1.9250				-1.3940		2.3569
Variety	0.0041	***	0.0005	0.0027	***	0.0004	0.0012	***	0.0004
Variety ×d_T	0.0001		0.0010				-0.0094	***	0.0009
Population	0.1696	***	0.0337	0.1992	***	0.0350	0.1601	***	0.0453
Population × d_T	-0.0524	***	0.0090				-0.0414	***	0.0119
_cons							-1.9719	***	0.5428
Wx									
d_T	8.1525	***	2.1299	-0.4417	***	0.0624			
Concentration	60.4921	**	25.8910	52.2349	**	25.6589			
Concentration ×d_T	-40.2751	**	19.5673						
Variety	-0.0101	***	0.0017	-0.0054	***	0.0015			
Variety ×d_T	-0.0160	***	0.0038						
Population	0.9317	*	0.5566	0.3701		0.5328			
Population × d_T	-0.6171	***	0.1716						
Spatial									
rho	1.3888	***	0.1467	1.6490	***	0.0440			
Variance									
sigma2_e	0.0124	***	0.0005	0.0135	***	0.0006			
Direct									
d_T	1.1209	***	0.2285	0.3742	***	0.0174			
Concentration	-1.8564		2.6026	-4.8507		3.4613			
Concentration ×d_T	5.5684	***	2.1567						
Variety	0.0040	***	0.0004	0.0026	***	0.0004			
Variety ×d_T	0.0000		0.0009						
Population	0.1972	***	0.0351	0.2359	***	0.0620			
Population × d_T	-0.0670	***	0.0182						
Indirect									
d_T	23.8095		27.2523	1.0530		0.7413			
Concentration	134.5123		191.9958	297.5443		346.0839			
Concentration ×d_T	-72.6642		85.5976						
Variety	-0.0095	*	0.0050	-0.0064		0.0097			
Variety ×d_T	-0.0353	*	0.0205						
Population	2.5427		1.8140	4.7451		7.7251			
Population × d_T	-1.7647		2.1218						
Total									
d_T	24.9304		27.4573	1.4273	*	0.7436			
Concentration	132.6559		193.3207	292.6937		348.7525			
Concentration ×d_T	-67.0958		86.3765						
Variety	-0.0055		0.0050	-0.0038		0.0096			
Variety ×d_T	-0.0353	*	0.0205						
Population	2.7399		1.8239	4.9811		7.7773			
Population × d_T	-1.8317		2.1383						
Number of obs	1076			1076			1076		
R-sq: within	0.7634			0.5873			0.7835		
between	0.0668			0.0502			0.0041		
overall	0.0055			0.0034			0.4732		

d_T=the change over time in the log number of jobs in tradable sectors

~×d_T=cross term

Wx=the effect from neighboring commuting zone characteristics

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

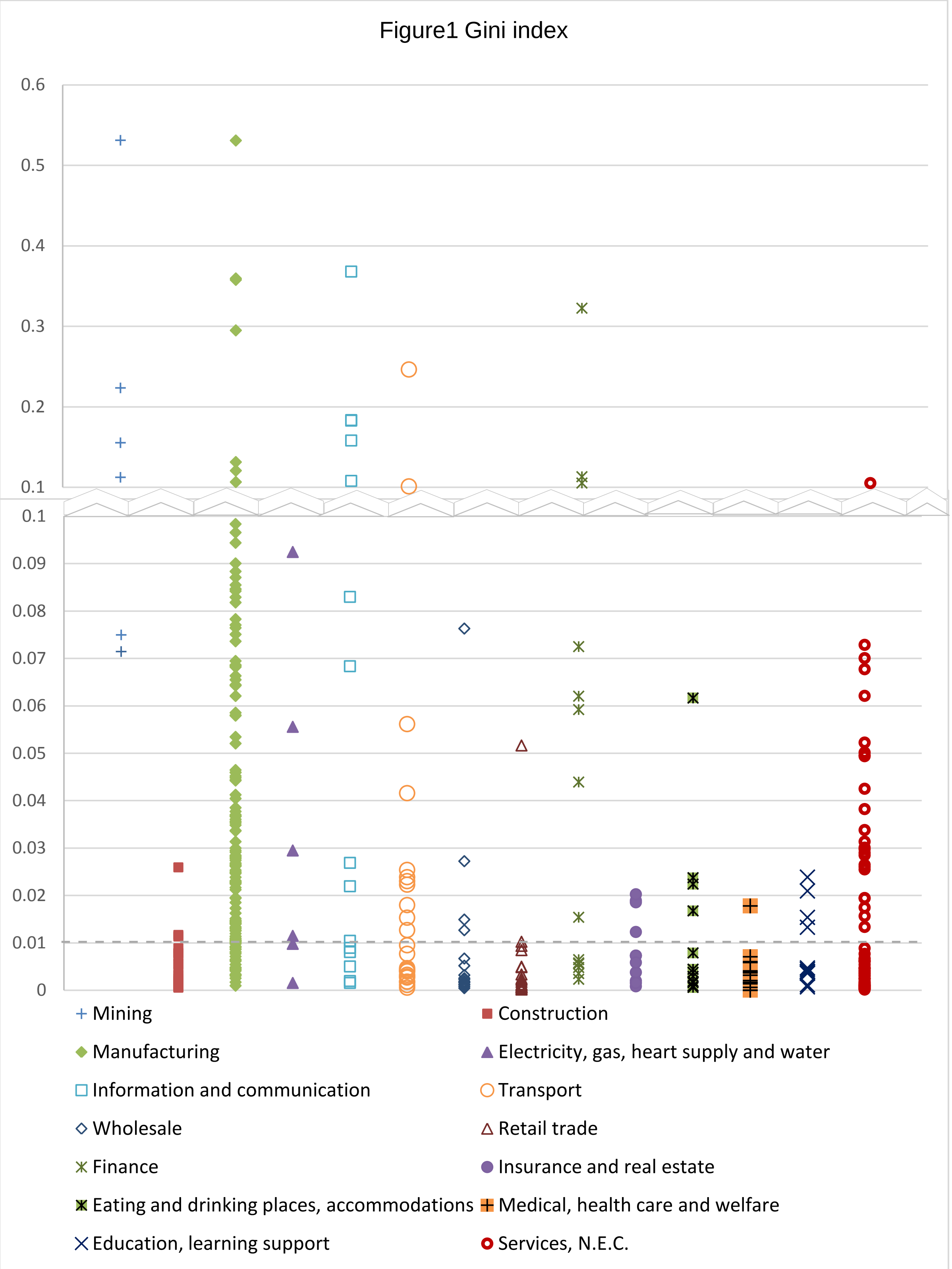

Figure1 Gini index
0.6
0.5
0.4
0.3
0.2
0.1
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Mining
Construction
Manufacturing
Electricity, gas, heart supply and water
Information and communication
Transport
Wholesale
Retail trade
Finance
Insurance and real estate
Eating and drinking places, accommodations
Medical, health care and welfare
Education, learning support
Services, N.E.C.