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Industrial Diversity and Metropolitan Unemployment Rate[*]

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[Abstract]: The main goal of our study is to evaluate whether or not industrial diversity helps reduce the unemployment rate of a metropolitan area. We used a data set from Japan's 118 metropolitan areas from the year 1995 and determined from our analysis that although industrial diversity might reduce the unemployment rate of a metropolitan area, it is only one of several factors and that other factors might have a stronger impact on unemployment rate. Second, it was found that for both the manufacturing and the construction industry, location quotient has a negative relationship with the unemployment rate of a metropolitan area. We also discovered that the more highly educated a metropolitan population is in terms of the percentage of graduates of institutions of higher learning, the lower will be its unemployment rate.

[JEL Classification]: J6, R1, R5

[Key Words]: Unemployment Rate, Industrial Diversity, Frictional Unemployment, Structural Unemployment, Location Quotient, Metropolitan Area

1. Introduction

Although it has for years had a lower unemployment rate than other industrialized countries, Japan has begun to see an increase in unemployment since its economy was hit by the recession of the late 90's. The level of a nation's unemployment is commonly seen as a barometer of its economy's health, so that Japan's increased unemployment has worried the government and prompted consideration of several policy options. Although previous studies analyze unemployment rate in general (e.g. Rosen (1984) and Partridge and Rickman (1997)),

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unemployment rate in Japan remains a topic of much interest because it varies so much by region, with large metropolitan areas such as Tokyo having lower unemployment rates than smaller cities, with the puzzling exception of the nation's second largest city, Osaka, which is suffering from a high unemployment rate. In October 2002, the Kansai region, including the Osaka metropolitan area, recorded an unemployment rate of 7.2%, much higher than the average rate of 5.5%. Theoretically, regional differentials of the unemployment rate are attributed to the friction resulting from adjusting for the mismatch between demand and supply of labor markets among regions. These structural factors consist of the costs of exchanging information, moving, conducting transactions related to housing, and dealing with psychological effects. These components are important, but they do not fully account for regional differentials in unemployment rate. Industrial structure surely affects unemployment rate, and this paper examines the relationship between the two, with the aim of testing the hypothesis that more industrially diversified metropolitan areas have lower unemployment rates.

This paper follows the theoretical justification of Simon (1988), who argues that industrial diversity attains a lower unemployment rate by assuming that the frictional component of employment fluctuations is a random variable and independent across industries. Simon's empirical analysis of 91 large U.S. SMSAs strongly supports the hypothesis. Although Simon's study makes important contributions to the study of the relationship between unemployment rate and industrial diversity, it fails to clarify the structural factors affecting unemployment rate. In the present study, by analyzing 118 metropolitan areas in Japan for the year 1995, we seek to make the relationship more clear.

What we hope to contribute can be stated as follows. While Simon does not clearly outline structural factors, we investigate the relationship between unemployment rate and industrial

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diversity by considering both frictional and structural factors. Second, we incorporate into our analysis of unemployment the location quotient of industries, a factor which has heretofore not been included in analyses of unemployment rate. Third, as for studies of metropolitan unemployment rate, ours is the first in Japan because there has up to now been no authoritative definition in Japan of a metropolitan area. We thus began our study by defining metropolitan areas and collecting data for each.

2. Unemployment, Industrial Diversity, and Location Quotient

2.1 Kinds of Unemployment

Before we present the points of argument concerning the relationships among unemployment rate, industrial diversity, and industry-specific factors, we will summarize kinds of unemployment. Based on labor economics literature (e.g. Ehrenberg and Smith (2003)), unemployment can be categorized into four types: frictional, structural, cyclical and seasonal.

Frictional unemployment occurs even in a full-employment labor market because labor markets are in a natural state of constant change, and because information about job opportunities is limited, so that it often takes considerable time for unemployed workers to locate employers who might be able to offer them suitable work.

Structural unemployment occurs when there is a mismatch between demand for and supply of workers in a given area. If wages were completely flexible and if costs of occupational or geographic mobility were low, market adjustments would eliminate this kind of unemployment, but the fact is that mobility costs between different occupations are generally not low because it requires time and money to change jobs. Geographical mobility is expensive because of the costs of job searches in unfamiliar territory and the concomitant necessary financial transactions such as the sale of a house or other property.

Cyclical unemployment occurs during fluctuations in the business cycle, when a decline in aggregate demand in the output market causes a decline in demand for labor. Seasonal unemployment, is similar to cyclical unemployment but fluctuations in seasonal unemployment can be regularly anticipated and follow a more systematic pattern over a period of time.

2.2 Industrial Diversity and Location Quotient

There have been studies about the effect of industrial diversity, such as one by Kort (1981), who investigates the relationship between industrial diversity and regional economic instability in U.S. cities. Kort finds that industrial diversity increases economic stability, although diversification is not the sole explanatory factor.

Simon (1988) more directly investigates whether or not industrial diversity reduces unemployment rate, by examining whether differences in frictional unemployment among cities is related to differences in industrial diversity, while assuming that labor mobility between cities is not free. Simon (1988) argues that industrial diversity attains a lower unemployment rate by assuming that the frictional component of employment fluctuations is a random variable and independent across industries. Because fluctuations are uncorrelated across industries, frictional hiring in some industries may coincide with frictional layoffs at others. Unemployed individuals can fill concurrently occurring vacancies.

Although his research is important in the study of the relationship between industrial diversity and unemployment rate, his study also has some weaknesses, in that while he succeeds in separating the frictional factor from the cyclical factor of unemployment, he fails to separate the structural factor. In his study, the effects on unemployment of each city's particular composition of output are based on each city's industry mix. He does not clearly pinpoint what kind of unemployment he means. In fact, the net separation rate, which is defined as the difference

between the job separation rate and the job accession rate in the city, is taken as a proxy variable of industry mix. As the net separation rate is often used as a measure of the degree of employment adjustment by the business cycle, the net separation rate of a given industry could be considered a measure of cyclical unemployment.

The Herfindahl index does not distinguish the components of industrial structure. Even if the index is the same in different metropolitan areas, the meaning could be different. For example, consider two metropolitan areas, A and B, which are identical in the composition of employment, except for two industries. Metropolitan area A has 10% of its employment in the manufacturing industries but 5% in the service industry. On the other hand, metropolitan area B has 5% in the manufacturing industry but 10% in the service industry. In this case, the two metropolitan areas have the same index value but in reality the industrial factor is completely different. In our study, we try to separate the structural factor by using the location quotient of an industry.

Although we define location quotient in the next chapter, we can say now it measures the extent to which a metropolitan area is providing employment in an industry compared with the national average. By evaluating what kinds of industries show a large reading in location quotient, we can delineate the characteristics of structural factors. Furthermore, this measure also includes the cyclical effect.

The meaning of location quotient of an industry can be elucidated by examining two industries: construction and manufacturing. The outstanding general characteristic of the construction industry is that, compared to other industries, it demands a great number of non-skilled laborers who need have no education or specialized training. Therefore, a metropolitan area, for example metropolitan area A, with a higher location quotient in the construction industry, could obtain workers easily at the business upturn in economic activities and could lay off workers easily at the business recession. The construction industry has a relatively strong buffer effect against the

business cycle. On the other hand, the fact that most laborers are non-skilled and non-specialized indicates that they are not easily employed by different industries. This is an important factor of the structural unemployment of a metropolitan area.

As another example, the automobile manufacturing industry consists of many kinds of parts industries and is comprised of many vertically arranged companies. Compared with the construction industry, the automobile industry requires skilled workers. In a metropolitan area with a large measure in location quotient, employed workers have more opportunities to change their jobs among manufacturing industries. On the other hand, in a metropolitan area with a lower value in this measure, there are fewer opportunities to get jobs for workers engaged in that industry. It is more costly to reduce structural unemployment. Furthermore, as the manufacturing industries with more competition might be immune to unemployment.

Thus, we consider the effects of both structural and cyclical unemployment by using the industry's location quotient, which reflects both effects.

3. Model

3.1 Empirical Model

In this study, our basic empirical model is specified as follows:

$$U_c = \alpha + \beta H_c + + \Sigma_i \eta_i s_{ic} + \gamma \ln CS_c + \mu Z_c + \delta D \qquad (1)$$

Where U_c: Unemployment rate of metropolitan area

H_c: Herfindahl index of industry

s_{ic}: Location quotient of an industry – i

CS_c: Size of metropolitan area

Z_c: Percentage of higher education graduates

D: Okinawa dummy (1 if metropolitan area in Okinawa, 0 for others)

First, one important goal is to evaluate whether or not industrial diversification can reduce unemployment rate. Herfindahl index (H_c) is used for this measure. Herfindahl index takes on a maximum of 1 if all employment of a metropolitan area is concentrated in only one industry. On the other hand, the index takes on a minimum of 1/N if employment in an industry is diversified equally among N industries. Therefore, as our hypothesis is that industrial diversity can reduce the unemployment rate, the Herfindahl index should show a positive relationship with the unemployment rate.

Second, the location quotient for industry - i (s_{ic}) mainly represents the factor of structural unemployment. The location quotient is defined as the percentage of total employment in a metropolitan area engaged in a particular industry divided by the corresponding percentage for the whole country (e.g. see McDonald, 1997). Therefore, if this variable of a particular industry is more than one, then the metropolitan area is considered as having this industry stronger or more specialized than in other areas. The Harfindarl index does not distinguish the differences among industries, even if the index is the same among metropolitan areas. But by including these variables, we can see the structural factor on unemployment. Furthermore, these variables also show the differences of the effects of the business cycle. If a metropolitan area specializes in the more employing industry, then the area's unemployment rate is lower. The expected sign of most industries is negative but some industries might show a positive relationship with the unemployment rate.

Third, as for the size of a metropolitan area, the larger city has more jobs so that the employment opportunities increase. However, at the same time it is necessary to consider that the demand for jobs also increase. According to Vipond (1974), as the larger cities have wider wage dispersion, job seekers have incentives to prolong the job search. As a result, if other conditions are held constant, larger metropolitan areas have larger unemployment rates. Furthermore, larger

cities might have more programs for unemployed workers so that the larger cities attract more unemployed workers. For these reasons, there is a positive relationship between this variable and the unemployment rate.

Fourth, an individual who has higher education tends to protect a job against unemployment pressures, compared with a less educated individual. A more educated individual could be more productive and skillful so that he/she should be prone to unemployment if other conditions hold the same.

Finally, in this model the Okinawa dummy is included because the unemployment rate in the metropolitan areas in Okinawa prefectures cannot be explained only by the variables mentioned above. The Okinawa dummy is expected to be positive. Table 1 summarizes the overall expected sign of coefficients for regression analysis.

Table 1 Expected Sign of Coefficients for Regression Analysis

Herfindahl index (H_c)	Location quotient for industry (s_{ic})	Size of metropolitan area (CS_c)	Percentage of higher education graduates (Z_c)	Okinawa dummy (D)
+	- / +	+	-	+

3.2 Relationship between Herfindahl Index and Location Quotient

An important characteristic of our study is that the location quotient for industry – i at a metropolitan area (s_{ic}) is included for the explanation of the difference of unemployment rate of a metropolitan area. The location quotient shows how concentrated a given industry of a metropolitan area is compared with the standard of whole country. As Herfindahl Index of the metropolitan area also shows the degree of diversification in the industry, someone might think that there is a linear relationship between these variables. In the empirical analysis, if there is a linear relationship between explanatory variables, the multicollinearity problem might arise. Therefore,

we will show that there is no linear relationship between these variables.

If we take the case that there are N industries, Herfindahl index of a metropolitan area is defined as follows:

$$H_C \equiv \sum_{i=1}^{N} w_{iC}^2 \tag{2}$$

Where $w_{iC} \equiv \dfrac{L_{iC}}{\sum_{i=1}^{N} L_{iC}}$

L_{ic} : Numbers of employment in industry – i

On the other hand, the location quotient is defined as follows:

$$s_{iC} \equiv \frac{\left(L_{iC} \Big/ \sum_{i=1}^{N} L_{iC} \right)}{\left(L_i \Big/ \sum_{i=1}^{N} L_i \right)} = \frac{w_{iC}}{\left(L_i \Big/ \sum_{i=1}^{N} L_i \right)} \tag{3}$$

Where L_i : Total number of employment in industry – i in whole country

Therefore, from the equation-(2) and (3), we can obtain the following relationship.

$$H_C = \sum_{i=1}^{N} w_{iC}^2 = \sum_{i=1}^{N} \left(s_{iC} \frac{L_i}{\sum_{i=1}^{N} L_i} \right)^2 = \left(\sum_{i=1}^{N} L_i \right)^{-2} \sum_{i=1}^{N} \left(s_{iC} L_i \right)^2 \tag{4}$$

From equation-(4), we can see that there is no linear relationship between the Herfindahl index and the location quotient of industry – i. Therefore, the multicollinearity problem would not occur between these variables.

4. Empirical Analysis

4.1 Definition of Metropolitan Areas

All variables used in this study are summarized based on metropolitan areas. Therefore, the observations used here, from which we estimate the unemployment rate function, are a data set

of 118 metropolitan areas for the fiscal year 1995. A metropolitan area used here is defined as an employment area by Kanemoto and Tokuoka (2001). Although in the U.S., statistical metropolitan areas are defined by the government, in Japan there is no authoritative definition of a metropolitan area so we follow the definition found in Kanemoto and Tokuoka's study.

4.2 Definition of Variables

The variables used in this study are defined as follows and the statistical information for the variables in summarized in Table 2. First, unemployment rate of a metropolitan area (U_c) is obtained by dividing the total number of unemployed workers by the total number in the labor force in a metropolitan area. Both total numbers of unemployed workers and total numbers of labor force are obtained from *the Population Census of Japan* by the Statistics Bureau, Management and Coordination Agency from 1995. These numbers are reported on a municipality basis so that we use the sum of these numbers for a metropolitan area.

As for a variable expressing industrial diversity, the Herfindahl (H_c) index is used. As shown in equation-(2), the Herfindahl index is defined as the sum of squares of each industry's numbers to total numbers of all industries. In this study, we calculated the Herfindahl index based on the numbers of employees for ten industries, which are (1) agriculture, forest and fishing industry, (2) mining industry, (3) construction industry, (4) manufacturing industry, (5) public utilities (electric power, gas, water supply and heat supply) industry, (6) transport and telecommunication industry, (7) wholesale and retail industry, (8) banking and insurance industry, (9) real estate industry, and (10) service industry. Therefore, we calculate the index based on ten industries. The data source of numbers of employees for ten industries is *the Establishment and Enterprise Census* by the Statistics Bureau, Management and Coordination Agency. As the Establishment and Enterprise Census was not reported in 1995, we estimate it by using two time periods, 1991 and 1997.

As for a variable of metropolitan size, we choose daytime population of a metropolitan area. Because daytime population shows more than a nighttime population the attractiveness of the economic activities of a metropolitan area, we use it to show the size of a metropolitan area. The data source for this variable is *The Population Census of Japan* by the Statistics Bureau, Management and Coordination Agency in 1995. In this study, we take a natural logarithm of this variable.

The location quotient of ten industries is used here to reflect the regional differences in competitiveness by industries. As shown in equation-(3), the location quotient is defined as a ratio of the given industry's percentage in a metropolitan area to the given industry's percentage in the whole country. In this study, we calculate the location quotient of each industry by the numbers of employees. The data source of the employees is *The Establishment and Enterprise Census*. First, we calculated the location quotient for all ten industries. But finally six industries such as (1) construction, (2) manufacturing, (3) public utilities, (4) transport and telecommunication, (5) wholesale and retails, and (6) real estate, are used for the analysis by considering the multicollinearity problem.

In order to distinguish the quality of workers, we define a variable of the percentage of higher education graduates. Higher education means junior colleges, technical colleges, universities, and graduate schools of universities. The percentage of the higher education graduates is defined by dividing population with higher education graduates by the total population of over 15-year-olds in a metropolitan area. This data is only available in *2000 Population Census of Japan* by the Statistics Bureau, Management and Coordination Agency. Therefore, we use it by assuming that the percentage is not much different from that of 1995. We assume that the number for the central city of each metropolitan area represents the number for the metropolitan area.

Finally, we use the Okinawa dummy variable in this study. In this analysis, there are

three metropolitan areas from Okinawa prefecture. The unemployment rate of metropolitan areas in Okinawa is much higher than that in metropolitan areas on the Japanese main islands. Okinawa is far away from main islands of Japan and there are many specific conditions. Therefore, we use the Okinawa dummy to reflect uncontrolled factors on the unemployment rate.

Table 2 Statistics of Used Variables

Variables	Mean	Standard Deviation	Minimum	Maximum
Unemployment Rate	4.105	1.380	2.181	13.077
Herfindahl Index	0.235	0.024	0.197	0.334
Log of Daytime Population	12.837	0.961	11.084	17.253
Location Quotient of Construction	1.144	0.241	0.609	1.810
Location Quotient of Manufacturing	1.126	0.462	0.268	2.435
Location Quotient of Public Utitities	1.076	0.433	0.389	3.475
Location Quotient of Transport & Telecommunication	0.916	0.210	0.311	1.879
Location Quotient of Wholesale & Retails	0.939	0.113	0.630	1.237
Location Quotient of Real Estate	0.619	0.252	0.233	1.593
Percentage of Higher Education Graduates	24.097	5.133	12.500	38.400
Okinawa Dummy	0.169	0.130	0.000	1.000

4.3 Empirical Results

We apply the regression for the unemployment rate function shown in equation-(1). The estimation method is the OLS method and a summary of estimation results is shown in Table 3. As the table shows, estimation results seem acceptable: adjusted R-squares are rather high, between 0.675 and 0.732 and coefficients of explanatory variables show the correct sign. Furthermore, the assumption of homoscedasticity of the variance of disturbance term is not rejected, based on the Koenkar test (see Koenkar (1981)). Although the Breusch-Pagan test is more commonly used, we used the Koenkar test because the Breusch-Pagan test is quite sensitive to the assumption of normality and the Koenkar test is a more robust test (see for example, Greene (2000, p.510). In summary, therefore, we decided to use these regression results to evaluate the unemployment rate and its factors.

Table 3 Estimation Results: Coefficients and Standard Errors

	Regression 1	Regression 2	Regression 3	Regression 4	Regression 5
Herfindahl Index	6.559	6.495	6.611	5.022	12.742***
	(4.618)	(4.589)	(4.372)	(4.340)	(4.362)
Log of Daytime Population	0.329***	0.325***	0.328***	0.352***	0.446***
	(0.117)	(0.115)	(0.098)	(0.098)	(0.104)
Location Quotient of Construction	-2.006***	-1.937***	-1.940***	-2.016***	
	(0.539)	(0.446)	(0.431)	(0.434)	
Location Quotient of Manufacturing	-1.528***	-1.423***	-1.424***	-1.572***	-1.121***
	(0.534)	(0.271)	(0.238)	(0.228)	(0.224)
Location Quotient of Public Utilities	-0.024	-0.018	-	-	-
	(0.173)	(0.107)			
Location Quotient of Transport & Telecommunication	0.716*	0.733*	0.733*	-	-
	(0.411)	(0.402)	(0.388)		
Location Quotient of Wholesale & Retailes	-0.374	-	-	-	-
	(1.636)				
Location Quotient of Real Estate	0.010	0.010	-	-	-
	(0.447)	(0.445)			
Percentage of Higher Education Graduates	-0.103***	-0.103***	-0.103***	-0.107***	-0.088***
	(0.019)	(0.018)	(0.018)	(0.018)	(0.019)
Okinawa Dummy	6.557***	6.542***	6.541***	6.492***	6.403***
	(0.612)	(0.606)	(0.606)	(0.593)	(0.644)
Constant	4.457	3.934*	3.864*	4.955**	-1.449
	(3.136)	(2.140)	(1.990)	(1.926)	(1.464)
Adjusted R-squares	0.725	0.727	0.732	0.726	0.675
Koenkar Test	11.354	11.034	7.594	5.564	3.081

(Note):
(1) Numbers in parenthesis are standard errors.
(2) These are statistically significant at 1% (***), 5% (**) and 10% (*).

Regression 1 represents a case using all explanatory variables. Because the coefficient of the Herfindahl index shows the positive sign, industrial diversity has a negative relationship with the unemployment rate. That is, the more diversified the industries in a metropolitan area, the lower the unemployment rate. This result is very similar to that in previous studies (see for example, Attran (1986)). However, the value of the variable is not statistically significant so that in Japan it is not as strong a factor as in the U.S.

On the other hand, the location quotient of some industries has a statistically significant effect on the unemployment rate. This means that individual industrial structure affects the degree of unemployment. The most significant industries are construction and manufacturing. The

coefficients of these variables show the negative sign so that the metropolitan areas which have more employment in these industries have lower unemployment rates.

The construction and manufacturing industries are generally considered to have job security. First, manufacturing, an example of which is the automobile industry, has a wide range of manufacturing and provides many kinds of job opportunities to its workers. As a result, metropolitan areas with strong manufacturing industries have low unemployment rates. The construction industry absorbs many redundant workers during recession. Therefore, metropolitan areas with strong construction industries have lower unemployment rates.

As the location quotient of the wholesale and retail industry is strongly correlated with the location quotient of the manufacturing industry (i.e. the correlation coefficient is –0.858), we apply the regression again excluding the location quotient of the wholesale and retail industry (see Regression 2). As seen in the result, estimated coefficients are not much different from those in Regression 1.

Third, we apply the regression again excluding both the location quotient of the public utilities and the location quotient of the real estate industry, which are not statistically significant in Regression 1. Again, this result (Regression 3) does not change much either.

However, if we exclude the location quotient of the transport and telecommunication industries (Regression 4), then the coefficient of the Herfindahl index becomes slightly smaller and the coefficients of the location quotients of both construction and manufacturing industries become larger negatively.

Finally, if we exclude the location quotient of the construction industry, the coefficient of the Herfindahl index becomes larger and has statistical significance. As the correlation coefficient between these variables is not large (i.e. –0.620), we cannot find a clear multicollinearlity problem. Although we need more detailed investigation, we think so far that the location quotient of the

construction industry, which shows the specific structure of the construction industry itself, is an important factor in explaining the difference in unemployment rate.

5. Conclusion

The main goal of our study is to evaluate whether or not industrial diversity helps to reduce the unemployment rate of a metropolitan area. We also investigate to what extent industry-specific factors affect the unemployment rate. The data set for this study is Japan's 118 metropolitan areas for the year 1995. From our analysis, our conclusion is summarized as follows:

First, industrial diversity might reduce the unemployment rate of a metropolitan area in Japan. This result certainly supports Simon's (1981) argument. However, industrial diversity is not as strong factor as others: the industrial diversity factor as measured by the Herfindahl index is not statistically significant in our analysis.

Second, according to the location quotient of each industry, the manufacturing industry has a negative relationship with the unemployment rate of a metropolitan area. In general, the manufacturing industry characteristically has vertical business connections among manufacturing companies and furthermore, the industry is widely dispersed so that job security is strong. In fact, another study by Mizuno (1992) shows that a higher ratio of manufacturing sectors to the service sectors lowers the unemployment rate.

Third, the location quotient of the construction industry also has a negative relationship with the unemployment rate. Because the public works projects have often been used for the employment promotion policy in Japan, the construction industry is considered as a buffer against unemployment.

Last, as for other findings, the higher the percentage of highly educated people there are in a population, the lower its unemployment rate will be. In our analysis, an increase in the ratio of

higher education by 10% contributes to a decrease in the unemployment rate by 1%. And the larger cities have higher unemployment rates.

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