Deternrinants Analysis of the Out-migration between Prefectures in Japan : From Socio-economic and Local Administration and Finance Standpoints

Determinants Analysis of the Out-migration between Prefectures in Japan : From Socio-economic and Local Administration and Finance Standpoints*

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ABSTRACT : It is often said that population inflow into cities in Japan has softened due to Japan's recession in recent years. Moreover, considering the migration trends for each region, Tokyo and Nagoya area continue to experience net in-migration, while Osaka region net out-migration. Therefore, in order to probe into the determinants of migration in Japan, we conduct a causality analysis of the out-migration (1985-1990, 1995-2000) from Osaka prefecture to other ones for young, middle and old-age generations. Gravity model is used as a theoretical model, and SUR as an analytical one. The results show that transportation distance and abundance of nature have a negative effect on demographic shifts, while life-safety net and old-age welfare service a positive one; this tendency is very remarkable for the old-age generation. In addition, since economic environment and state of local administration and finance aren't significant, people may take an only short-sighted view.

Keywords: Out-migration, Gravity model, SUR, Socio-economic Environment, Local Administration and Finance Status
JEL Classification Numbers: H70, J10, R00

1. Introduction

It is often said that population inflow into cities in Japan has stagnates as the Japanese economy is in recession at present.

With that as a backdrop, we study demographic shift from regional and time-series aspects using the "Report on the Internal Migration in Japan derived From the Basic Resident Registers (2008, 2009)" published by Ministry of Internal Affairs and Communications. With regard to the demographic shift in Japan, the following have come to light from this report.

First of all, let us touch upon the time-series changes of number of people migrating between prefectures[1]. The number of people migrating between pre-

fectures generally continued to decline between 1974 and 1985, while the number remained at almost constant level between 1986 and 1990; however, it has continuously declined for 14 years between 1996 and 2009.

Next, we talk about the time-series changes of excess inflow of people into three metropolitan regions of Tokyo, Nagoya and Osaka. This time-series changes are shown in Figure 1. When put together for all three large metropoli-tan areas, net in-migration of over 300,000 people continued until 1971, however, it declined after that. Also, for the first time in 1976, the situation turned into net out-migration. After that, except between 1993 and 1995, net in-migration has prevailed. However, in recent years, net in-migration had increased year on year between 2004 and 2007, it declined after that. From Figure 1, it is clear that Tokyo metropolitan area[2] experienced net in-migration except 1994 and 1995, while after 1985, Nagoya metropolitan area experienced net in-migration except 1996, 2000-2002 and 2009; however, Osaka metropolitan area continuously experienced net out-migration after 1974.

Finally, we will touch upon the time-series changes of net-migration in Tokyo metropolitan, Aichi prefecture and Osaka prefecture, which are at the heart of three large metropolitan areas. This time-series changes are shown in Figure 2. From Figure 2, we can conclude that Tokyo metropolitan and Aichi prefecture have consistently experienced net in-migration after 1997. On the other hand, Osaka prefecture has consistently experienced net out-migration.

Based on these observations of changes of demographic shift, it came light that the inflow of people into metropolitan areas has soften, moreover, on regional basis, the capability of Osaka metropolitan to attract people has weakened.

Also, based on the survey results of "Reasons of migration to present residence during past five years" shown in Table 1, we can understand that people migrate due to problems concerning, 1) residence, 2) employment, 3) marriage and divorce, 4) family etc. Moreover, among these four major reasons, it can be presumed that first two reasons are strongly related to social and economic environment.

Based on these observations of changes of demographic shifts and survey results of reasons of migration, we decided to study the social and economic factors that affect demographic shifts and we believe that the insights gained

as a result of this study would serve extremely useful information in formulating social policies, economic policies, national-land-use plans and regional policies in future.

Then we use gravity model for conducting our analysis. This model is used for analysis on determinants of flow variables between two regions, and the following previous studies use this model. Tinbergen (1962), Linnemann (1966), Hamilton and Winters (1992), Endou (1997), Ijiri (2006) and others analyzed bilateral trade flow[3], Eaten and Tamura (1994, 1996), Ijiri (2005) and others analyzed direct foreign investment (DFI), Umemura (2005) analyzed inflow of tourists, Tomkins and Twomey (2000) analyzed career choices, and Matsumoto and Matsushita (2002) analyzed selection of place of residence based on housing environment. In this study, we use this model for conducting a causality analysis of migration of population between prefectures of Japan.

Moreover, based on the previous research works on provision of public goods, the analysis conducted in this study can be positioned as follows. Tiebout (1956) argued that "Individuals will consider the public services and tax obligations in each municipality within a region, and they are expected to move to the most satisfying region". With regard to the validity of this "Tiebout hypothesis: Voting with one's feet", as the survey by Dowing (1994) shows, various empirical analyses have been conducted so far. In this context, the analysis conducted in this study embodies the verification of "Tiebout hypothesis" at prefecture level of Japan.

The rest of the paper is organized as follows. In Section 2, the contents of analysis are explained, and in Section 3, the method of analysis and data are discussed. In Section 4, we present the results of analysis and discuss about the reasons behind the demographic shift. Section 5 describes the concluding remarks and the future work.

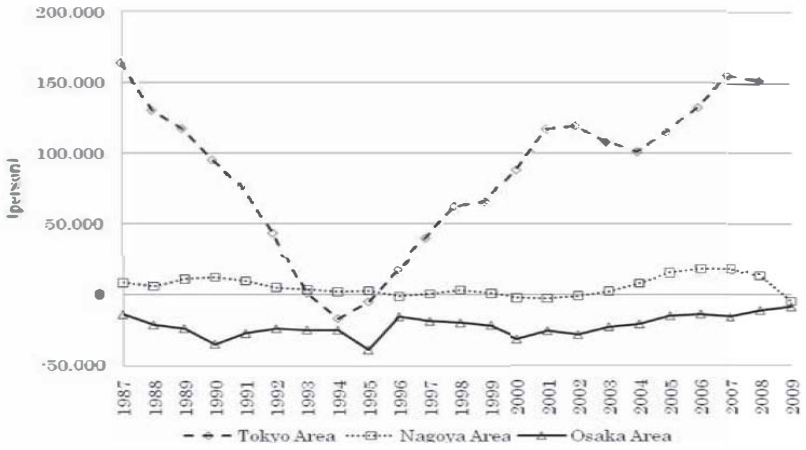

Figure 1 Net-migration for three large metropolitan areas

Notes: Tokyo Area consists of Tokyo, Kanagawa, Saitama and Chiba. Nagoya Area: Aichi, Gifu and Mie. Osaka Area: Osaka, Hyogo, Kyoto and Nara.

Source: Report on Internal Migration in Japan (Ministry of Internal Affaire and Communications, Government of Japan)

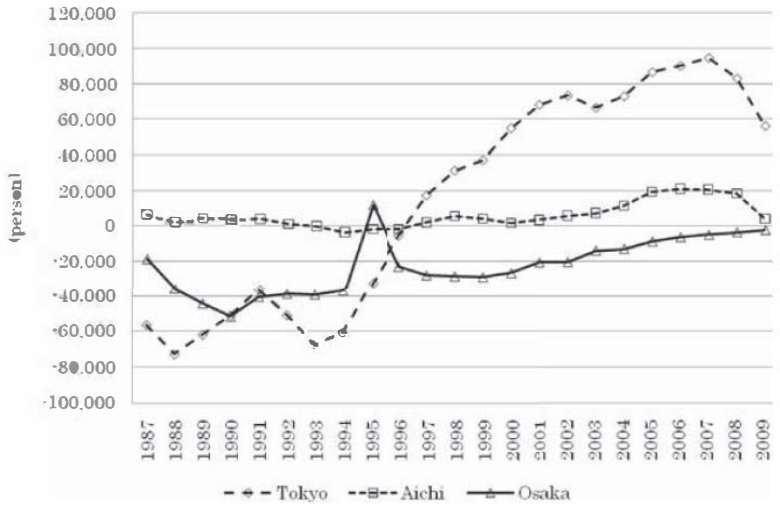

Figure 2 Net-migration of Tokyo metropolitan, Aichi and Osaka prefectures

Source: Report on Internal Migration in Japan (Ministry of Internal Affaire and Communications, Government of Japan)

Table 1 Reasons of migration to present residence during past five years

Total	School admission/ Higher education	Occupational reasons	Residence related reasons	Staying with or near by the parents and children	Relocation of parents or spouse	Marriage/ Divorce	Others	Unknown
100.0%	3.1%	13.0%	35.7%	7.4%	11.0%	15.7%	8.8%	5.3%

Source: The Fifth National Survey on Migration 2001 (National Institute of Population and Social Security Research)

2. Setting analysis subjects

2.1. Analysis subjects

As discussed in Section 1, throughout Japan, population inflow to urban areas has softened. Moreover, on regional basis, Osaka area and Osaka prefecture which it is at the heart of Osaka area have continuously experienced net out-migration since 1970s. Therefore, in order to shed light on the relationship between the demographic shift and its reasons, we analyzed the migration of population between prefectures mainly for Osaka preference, which has experienced the remarkable population outflow compared to other metropolitan areas. The details of our survey are as follows.

(1) Scope of analysis
: Out-migration from Osaka prefecture to 46 prefectures.
(2) Year of analysis
: Out-migration for 5 year periods between 1985 and 1990, and 1995 and 2000.
(3) Reasons for out migration
: Various social and economic reasons (see Section 3).

2.2. Gravity model and econometric model

In order to theoretically understand the causality of demographic shift, we use "gravity model". This model applies Newton's Law of Gravitation to socio-economic regional events.

Gravity model considers total amount of regional events instead of mass of body and force of interregional exchange instead of gravity in the Law of Gravitation. However, in socio-economic regional events, as seen in Law of

Gravitation, it can not be said that the force of interregional exchange be-comes smaller in exactly in proportion to the square of distance[4]. Therefore, the general form of gravity model would be as follows:

$$M_{ij} = \left(\frac{P_i P_j}{D_{ij}^{\alpha}} \right) k, \tag{1}$$

where (1), M_{ij} is the force of interregional exchange (the number of out-migrants in the case of out-migration), P_i is the total amount of regional events for region i (the population of region i : P_j is also the same as P_i , in the case of migration), D_{ij} is the distance between regions i and region j [5] , α and k are parameters inherent in the regional event, and i and j are indexes showing regions.

Then natural logarithmic conversion of expression (1) gives us the following expression:

$$\log\left(\frac{M_{ij}}{P_i P_j} \right) = -\alpha \log D_{ij} + \log k . \tag{2}$$

Next, we substitute the second term of the right side of Equation (2) with several variables showing socio-economic environment[6] and add a constant term. Hence, it will result in Equation (3) below, and we obtain the econometric model (regression model)[7] that explains the out-migration from prefecture j to prefecture i based on gravity model.

$$\log\left(\frac{Mg_{ij}^{t-(t+5)}}{Pg_i^t Pg_j^t} \right) = C + \alpha_d \log D_{ij} + \sum_{s=1}^{l} \alpha_l \log X_{si}^t + \alpha_e ED_i^t + \varepsilon_i^t, \tag{3}$$

$g = y$: young, m : middle, o : old, $i = 1, \ldots, 46$, $t = 1985, 1995$.

In Equation (3), i denotes the prefecture index for 46 prefectures except Osaka prefecture, j Osaka prefecture index, t the year index, g the generation-category index. Moreover, Mg_{ij} is the total out-migration over 5 years starting from year t from Osaka prefecture to i prefecture, Pg_i is the population of i prefecture, Pg_j is the population of Osaka prefecture, C is a constant term, D_{ij} is the distance between i prefecture and Osaka prefecture, X is the independent

variable showing socio-economic environment of each prefecture. *ED* is the Kobe-earthquake dummy variable which would be 1 for t =1995 and i =27 (Hyogo pref.);0 for other cases. Each α is the coefficient of each independent variable and ε^8 is the error term.

Moreover, in preparation for the parameter estimation after Section 3, here we would describe generation category, g. Regarding this analysis, further detailing the population segment of dependent variable in Equation (3) would lead to a higher accuracy analysis. Therefore, with the starting year of movement as a reference, we would categorize the population into the following three categories: 1) young-aged generation (henceforth "young generation"): 0-24 years old, 2) middle-aged generation (henceforth "middle generation"): 25-54 years old, 3) old-aged generation (henceforth "old generation"): 55 years old or more. Here, taking the marriage age[9] of females with over 2.0 child births as a reference, we set the boundary between the young generation and the middle one. Also, with the mandatory retirement age as a reference, we set the boundary between the middle generation and the old one.

Finally, as described above, we could obtain three regression equations from Equation (3) by classifying the population into three categories.

3. Econometric methods, variables and data

3.1. Econometric methods

Using the parameter estimation of Equation (3) derived in Section 2.2, we conducted the causality analysis with regard to the out-migration from Osaka pre-fecture to other prefectures. In addition, we had to consider the following points regarding our analysis. As described in Section 2.2, using Equation (3) we can derive three regression equations, viz. by generation category of young, middle and old age. However, many families may consist of members of different generations and they may migrate as a family. Therefore, theoretically, the correlations are likely to be observed between the error terms of each equation. Therefore, we conducted the parameter estimation as per the following procedure.

(1) First, we conduct OLS (Ordinary least squares) regression for each

generation. However, we use Backwards step-wise estimation proce-dure (where the significance level for removal from the model is pre-defmed at 0.1)[10] for the selection of independent variables. Moreover, the independent variables used in the estimation are explained in Section 3.2.

(2) Subsequently, we investigate the correlation of residuals of each re-gression equation

(3) Finally, if the correlations are found in (2) above, using three regres-sion equations simultaneously, we conduct SUR (Seemingly unrelated regression)[11] of Zeller (1962).

3.2. Variables and data

First of all, we explain the variables used in Equation (3). Apart from the independent variables of Equation (3) showing socio-economic environment, they are shown in Table 2. On the other hand, the independent variables showing socio-economic environment in Equation (3) were prepared from the categories such as natural environment, economy, technical infrastructure keeping in view of the future production, life-safety net, public finance of local government, and local public services, as shown in Table 3 (see this table for the details of these variables).

Moreover, the sources of data on the dependent and independent variables are shown in Table 4 and the descriptive statistics of those variables in Table 5.

Table 2 Dependent and independent variables expect X in Equation (3)

Variable	Dependet or Independent	Content	Unit
M	a factor of Dependent	Out-migration from Osaka prefecture to other prefectures	person
P	a factor of Dependent	Population of each prefecture	person
D	Independent	Transportation time from Osaka city to the prefecture capital of each prefecture (Faster of railway and air travel is adopted)	minute
ED	Independent	Kobe-earthquake dummy (When t=1995 and i=27(Hyogo pref.), ED=1; otherwise, ED=0.)	

Table 3 Independent variables on socio-economic environment as X in Equation (3)

Category	Independet Variable	Content	Unit
Environment	Forestr	Forest area/total area	%
	Naturalr	Degree of vegetation and nature	%
Economy	Ripc	Prefecture income (per capita)	1000 yen
Technical base	Colltr	Number of instructors in colleges and junior colleges / population	%
Finance condition on local governments	Debtr	Local governments debt service/Total expenditure (Average of last 10 years)	%
Life-safety net	Welr	Number of welfare recipients/population	%
Public services by local governments	Elderlypc	Expense of welfare of senior citizens (per capita: average of last 10 years)	1000 yen
	Childpc	Expense of child welfare (per capita: average of last 10 years)	1000 yen
	Edupc	Primary and secondary education expense (per capita: average of last 10 years)	1000 yen

Note: "Local governments" of this table consists of prefecture and municipalities governments in the concerned prefecture .

Table 4 Data source

Variable	Source
M	Population Census (1990,2000) / Bureau of Statistics,MIAC
P	Population Statistics of Japan(1975-2006) / Sinfonica
D	http://transit.map.yahoo.co.jp/
Each variable as X in (3)	Population Statistics & fundamental data files on prefectures (1975-2006) / Sinfonica

Note: MIAC and Sinfonica denote Ministry of Internal affair and Communications, Government of Japan and Statistical Information Institute for Consulting and Analysis, respectively.

Table 5 Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
My	92	6,976.6	10,762.6	233.0	63,870.0
Mm	92	6,514.5	11,172.9	224.0	71,008.0
Mo	92	1,170.4	2,216.7	27.0	15,190.0
Ms	92	14,661.5	23,873.7	533.0	144,103.0
Py	92	822,881.9	760,595.7	181,013.0	4,241,188.0
Pm	92	1,069,360.0	1,027,089.0	238,174.0	5,413,138.0
Po	92	596,943.4	474,830.4	162,659.0	3,007,026.0
Ps	92	2,489,185.0	2,236,501.0	614,800.0	11,800,000.0
D	46	183.3	70.6	32.0	299.0
Forestr	92	63.5	14.1	31.6	83.6
Naturalr	92	6.3	7.7	0.8	38.1
Ripc	92	2,412.8	545.2	1,537.0	4,149.0
Colltr	92	0.1	0.1	0.0	0.4
Debtr	92	7.7	1.6	3.7	11.4
Welr	92	0.9	0.6	0.2	3.7
Elderlypc	92	83.5	22.7	48.4	195.0
Childpc	92	64.8	24.6	27.6	144.0
Edupc	92	276.3	67.8	178.0	413.4

Note: Subscript y on M and P denotes young generation, m middle generation, o old generation and s the sum of three generations.

3.3. Expected effects of independent variables

Here we predict the positive or negative effect of coefficient of each independent variable in Equation (3). Prediction is shown in Table 6. In this table, "+" shows that the independent variable has a positive effect on out-migration, while "−" shows a negative effect.

Based on the theory of gravity model, D's effect is expected to be negative. With regard to Forestr and Naturalr as environment variables, we can presume that their effect would be decided by the balance of environment friendliness and convenience to lifestyle. The effect of each of Ripc and Colltr as economic-environment variables is respectively expected to be positive. With regard to Debtr, since high public-debt-service ratio shows unhealthy state of public finances, it is predicted negative. High scores on Welr, Elderlypc, Childpc, and Edupc show good quality of administrative services, therefore, the effect of each of these variables is expected to be positive. Prediction for ED is negative, as it can be presumed that it shows the effect that population who had moved from Hyogo prefecture to Osaka due to Kobe earthquake has

returned to Hyogo prefecture again.

Table 6 Expected effects of independent variables

Variable	Expected Effect	Variable	Expected Effect	Variable	Expected Effect	Variable	Expected Effect
D	−	Ripc	+	Welr	+	ED	−
Forestr	?	Colltr	+	Elderlypc	+		
Naturalr	?	Debtr	−	Childpc	+		
				Edupc	+		

4. Econometric Results

4.1. OLS results and correlation of residuals between regression equations

Table 7 shows the results of OLS estimation described in Section 3.1-(1) and Table 8 shows the results of correlation analysis of residuals between each regression equation explained in Section 3.1-(2)[12].

From Table 8, as predicted in Section 3.1, we could verify very strong positive correlation between residuals of each regression equation. Therefore, we conducted SUR estimation that simultaneously uses the regression equation of each generation.

Table 7 OLS results

Young generation			Middle generation			Old generation		
	Coef.	SE		Coef.	SE		Coef.	SE
ln D	-0.953 ***	0.066	ln D	-1.024 ***	0.066	ln D	-1.281 ***	0.089
ln Forestr	-0.555 **	0.247	ln Forestr	-0.796 ***	0.247	ln Forestr	-1.038 ***	0.335
ln Edupc	-1.004 *	0.527						
ln Welr	0.279 **	0.106	ln Welr	0.393 ***	0.106	ln Welr	0.4 **	0.167
ln Elderlypc	1.022 **	0.452	ln Elderlypc	0.75 ***	0.452	ln Elderlypc	1.242 ***	0.659
ln Cbildpc	0.570 *	0.316						
						ln Ripc	-1.766 ***	0.413
Constant	15.587 ***	2.366	Constant	14.88 ***	2.366	Constant	29.519 ***	6.752
Obs	92		Obs	92		Obs	92	
Adj-R^2	0.766		Adj-R^2	0.774		Adj-R^2	0.754	

Note: * significant at 10%; ** at 5%; * at 1% level.

Table 8 Correlation of residuals between regression equations

	Young	Middle	Old
Young	1.000		
Middle	0.951	1.000	
Old	0.906	0.927	1.000

4.2. SUR results

Table 9 shows the results of SUR estimation described in section 3.1-(3). Then the following came to light from Table 9 and Table 7.

(1) As per the theory of gravity model, D (Distance) has an extremely large negative effect on all the generations. Moreover, the higher the age of generation is, the larger the effect becomes.
(2) Forestr has a very large negative effect on all the generations. Moreover, the higher the age of generation is, the larger the effect becomes.
(3) Contrary to the prediction shown in Table 6, each of Ripc and Colltr as economic-environment variables doesn't have a positive effect on any generation.
(4) Contrary to the prediction shown in Table 6, Debtr, which shows the status of public finance of the region, doesn't have any effect.
(5) Welr has a positive effect for all generations. Moreover, the higher the age of generation is, the larger the effect becomes.
(6) Elderlypc has a positive effect for all generations. Moreover, the effect becomes larger for the middle generation, the young one and the old one in sequence.
(7) Significant independent variables differ by generation: Specifically, for the young generation, Edupc is significant, while for old generation, Ripc is significant.
(8) In OLS estimation, for the young generation, Childpc is significant at 10% level. However, it is not significant in SUR estimation.
(9) In the analysis of the young generation, the estimate of coefficient of Edupc is negative.
(10) Contrary to the prediction shown in Table 6, in the analysis of the old generation, the estimate of coefficient of Ripc is negative.

Table 9 SUR results

Young generation			Middle generation			Old generation		
	Coef.	SE		Coef.	SE		Coef.	SE
ln D	-0.953 ***	0.087	ln D	-1.024 ***	0.097	ln D	-1.281 ***	0.109
ln Forestr	-0.555 **	0.280	ln Forestr	-0.796 ***	0.273	ln Forestr	-1.038 ***	0.324
ln Edupc	-1.004 *	0.536						
ln Welr	0.279 **	0.122	ln Welr	0.393 ***	0.081	ln Welr	0.400 **	0.170
ln Elderlypc	1.022 *	0.525	ln Elderlypc	0.750 ***	0.167	ln Elderlypc	1.242 ***	0.436
ln Childpc	0.570	0.381						
						ln Ripc	-1.766 ***	0.668
Constant	15.587 ***	3.457	Constant	14.88 ***	2.903	Constant	29.519 ***	6.103
Obs	92		Obs	92		Obs	92	

Note: * significant at 10%; ** at 5%; *** at 1% level.

5. Concluding remarks

In our study, keeping all the aspects of social life in view (see Table 2 and Table 3), we conducted a causality analysis of out-migration from Osaka prefecture to other prefectures. And, based on the results obtained up to Section 4, the following came to light.

(1) As explained by the theory of gravity model, a transportation distance has an extremely large negative effect on out-migration. Moreover, this effect increases as the generation ages, and the old generation hardly undertakes a long distance movement.

(2) When relocating from an urban area, people don't take a natural environment into consideration (that is, there is a strong possibility that they might be considering the inconvenience of living in a location with an abundant natural ambience). Moreover, this trendency is the strongest in the old generation. That is, this result shows that the old generation is returning to urban areas.

(3) People don't consider the economic environment and the status of public finance of the local government where they are relocating. As a result, people don't seem to decide where to live based on the overall social viewpoint as well as the medium and long-term viewpoints but based on only the relatively short-term and personal viewpoint.

(4) On the other hand, people tend to relocate to regions with an adequate life-

safety net and administrative services for elderly people: especially they strongly prefer good administrative services for elderly people. Also, this trendency is very prominent in the old generation.

(5) On the contrary to our prediction, the young generation tends to avoid regions whose expenditures are high for the primary and secondary education, and the old generation tends to avoid regions with a high per-person in-come.

We believe that these insights would help central and local governments make social, economic and financial policies in the light of demographic shift. Also, as described earlier, the objective of this study is to find out the detailed reasons of out-migration, keeping all the aspects of social lifestyle in mind. However, we have not gone beyond shedding light on the present condition of various issues that need to be considered with regard to demographic shifts. Therefore, it is also necessary to analyze the influence of the perspectives that people take into account at the time of their decision making.[13] Hence, we will investigate this issue in another study.

NOTES

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1 This phrase of "prefectures" includes Tokyo metropolitan and 46 prefectures. It is similar as follows.

2 Tokyo Area consists of Tokyo, Kanagawa, Saitama and Chiba. Nagoya Area: Aichi, Gifu and Mie. Osaka Area: Osaka, Hyogo, Kyoto and Nara.

3 See Anderson (1979) and Bergstrand (1985, 1989) for microeconomic foundation of bilateral-trade-flow analysis.

4 See the footnote 2 in Endoh (1997) for the details of this.

5 For distance, not only actual distance, but transportation time and expense can also be used.

6 We followed Tomkins and Twomey (2000, p. 196) on the development of this formula.

7 α_d (in Equation(3)) $= -\alpha$ (in Equation(2)).

8 ε satisfies the assumption of $E(\varepsilon)=0$. However, we don't assume that homoscedasticity and independence on it.

9 See National Institute of Population and Social Security Research (2007) Cp. 3.

10 In order to avoid multicollinearity, the independent variables with Variance inflation factor of only below 10 were used.

11 See for example Zeller (1962) and Green (2003) Ch.14 for the details of this method.

12 In order to estimate the constant in a stable manner, the following has been applied to each variable: Foestr, Naturalr, Colltr, Debtr, Welr are multiplied by 102 before logarithmic conversion, and the dependent variable M/PP is multiplied by 10^{12}.

13 As a related problem to this, the problem of "Fiscal Illusion" is famous in the field of public finance. See for example Horiba(1999, Ch.15) for the introduction of fiscal illusion.

REFERENCES

Anderson, J. E. (1979). A Theoretical Foundation for the Gravity Equation. *The American Economic Review,* 69(1), 106-116.

Bergstrand, J. H. (1985). The Gravity Equation in International Trade: Some Microeconomic Foundations and Empirical Evidence. *The Review of Economics and statistics,* 67, 474-481.

Bergstrand, J. H. (1989). The Generalized Gravity Equation, Monopolistic Competition, and The Factor-Proportions Theory in International Trade. *The Review of Economics and statistics,* 71, 143-153.

Dowing, K., John, P., and Biggs, S. (1994). Tiebout: A survey of the Empirical literature. Urban Studies, 31(4), 767-797.

Eaton, J., and Tamura, A. (1994). Bilateral and Regionalism in Japanese and U.S. Trade and Direct Foreign Investment Patterns. *Journal of the Japanese and International Economies,* 8, 478-510.

Eaton, J., and Tamura, A. (1996). Japanese and U.S. Export and Investment as

Conduits of Growth. *NBER Working Paper 5457.*

Endoh, M. (1997). The Transition of Postwar Asia-Pacific Trade: A Simple Application of the Gravity Model. *The economic review (Otaru University of Commerce),* 48(1), 139-157.

Green, W. H. (2003). Econometric Analysis 5th edition. New Jersey: Prentice-Hall.

Hamilton, C. B., and Winters, L. A. (1992). Trade with Eastern Europe. Economic Policy, 14, 77 - 116.

Horiba, I. (1999). *Tiho Bunken no Keizai Bunseki,* Tokyo: Toyokeizai Shinposya. (in Japanese).

Ijiri, N. (2005). Market Size, Trade Costs, and Remoteness: Gravity Evidence for Japanese Outward FDI. *The Nihon University Economic Review,* 74(4), 165-177. (in Japanese).

Ijiri, N. (2006). An Estimation of the Border Effect in Japanese Economy. *The Nihon University Economic Review,* 75(4), 75-88. (in Japanese).

Linneman, H. (1966). *An Econometric Study of International Trade Flows,* Amsterdam: North-Holand.

Matsumoto, S., and Matsushita, K. (2002). Effects of Housing Environment on Household Location Choice: Examination of Tiebout Hypothesis by Poisson Gravity Model. *The economic review of Kansai University,* 51(4), 455-471.

Ministry of Internal Affairs and Communications, Government of Japan. (2008; 2009) Report on Internal Migration in Japan. (in Japanese).

National Institute of Population and Social Security Research. (2005) *The Fifth Na-tional Survey on Migration 2001.* (in Japanese).

National Institute of Population and Social Security Research. (2007) *Population Projections for Japan: 2006-2055.* (in Japanese).

Tiebout, C. M. (1956). A Pure Theory of Local Expenditures. Journal of Political Economy, 64, 416-424.

Tinbergen, J. (1962). *Shaping the World Economy,* New York: The Twentieth Century Fund.

Tomkins, J. M., and Twomey, J. (2000). Occupational mobility in England. *Applied Economics,* 32, 193-209.

Umemura, T. (2005). A Gravity model Analysis of the Domestic Tourists to Okinawa. Ryukyu University economic review, 69, 1-21. (in Japanese).

Zellner, A. (1962). An Efficient Method of Estimating Seemingly Unrelated

Regression and Tests for Aggregation Bias. *Journal of the American Statistical Association,* 57, 348-368.