Agglomeration and Institutional Effects on Dynamics in Regional Disparities: Experience from Poland and Japan

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1. Introduction*

Japanese central government is now thinking about the reformulation or consolidation of regional (local) governments, called prefectures. The main purposes of it are to construct a decentralized society through examining the European decentralization model and to enhance regional competitiveness in a global economy. However, the present plan still has a lot of problems involved and should be debated much further.

Turning to Poland, though it has quite different characteristics in terms of economic system from Japan, there were three large institutional changes in the state and the local administrative systems over the past 20 years. Polish government embarked on the administrative reform in 1990 (after the establishment of a non-communist government), which brought into existence autonomous and self-governing gminas (commune) as basic units of local government. The new system of local administration reducing the number of voivodeships (provinces) was introduced in 1998, and the laws came into effect on 1999. There had been 49 smaller voivodeships from 1975 to 1998. The reform in 1998–99 created 16 voivodeships and reintroduced powiats (counties). Poland currently has 16 voivodeships (NUTS2 level), about 380 powiats (including 65 cities with powiat status), and about 2,500 gminas. There are also 66 NUTS3 level subregions (podregiony), but it isn't the official administrative divisions. Establishment of Special Economic Zones (Specjalna Strefa Ekonomiczna: SSE), initiated by each local government, achieved the formation of industrial agglomerations and the job creation, especially in the south-west regions of Poland. But there were far less inflows of FDI in the north-east regions, and regional disparities increased.

At this point, it is worthwhile to examine dynamics in regional disparities of two countries by comparing quantitatively regional institutional systems as well as economic situations. Japan had attained high economic growth and high per capita income, and also showed regional convergence after the

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WW2. Recently, inter-regional income disparities are expanding while in 1990s Japanese economies were strongly suffered from the Bubble burst. On the other hand, Poland experienced three large institutional changes in the state and the local administrative systems over the past 20 years.

Convergence or divergence of per capita GRP/income in an inter-regional economic system is an essential topic to policy maker as well as scholars. In the long run, which implies more than thirty years, interregional income disparities tend to show marked convergence. This is confirmed in several countries including Japans by Barro and Sala-i-Martin [2004], and other researchers. However, the rate of decline in regional per capita income disparities is not constant over the period. Furthermore, convergence/divergence depends on and not only on the stage of development but also governmental institutions such as whether centralised or decentralised governmental system.

A number of papers have applied β-convergence model developed by Barro and Sala-i-Martin and also estimated structural convergence model proposed by Mankiw, Romer and Weil [1992] to regional disparities in many countries[1]. Although some earlier studies found regional convergence in the long run by applying β-convergence model, recent research is directed to explain non-convergence trend or even divergence trend in regional disparities and to extend the conditional convergence model. This is because of recent detection of increasing regional disparities shown in several countries. For examples, Funke and Strulik [1999] found increasing disparities of per capita income since 1990 for *Länder* (states) in West Germany, and Terrasi [1999] also verified divergence across Italian regions since 1975, and more recently Longhi and Musolesi [2007] found the convergence process of the national economies of the EU coexists with divergence process between regions in EU countries.

In order to overcome a shortcoming of the cross-sectional approach which neglects the dynamic effects of growth and incorporate divergence effect into conditional convergence model, several efforts have been done. Funke and Strulik propose an estimation model allowing for different convergence rate as well as different steady-states across regions and estimate by panel data[2]. Hammond [2006] suggests divergence of regional disparities due to the existence agglomeration economies created by knowledge spillovers and resulting increasing returns to scale regional production function.

In a historical point of view, the period when the nation is experiencing high economic growth, income disparities across regions tend to increase, and then the relatively higher income regions often accomplish higher growth rate of per capita income than lower income regions in such a period.

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[1] Crihfield and Panggabean [1995], Crihfield et al. [1995], Lall and Yilmaz [2001], Miller and Genc [2005] for US regions (states or metropolitan areas); Terrasi [1999] for Italian regions; de la Fuente [2002] for Spanish regions; Badinger et al [2003] for NUT 2 regions; Christopoulos and Tsionas [2004] for Greece; Carluer and Gaulie [2005] for French regions; Armstrong [1995] for EU regions; and Henley [2005] for regions in the UK.

[2] Wang and Ge [2003] applied their model to Chinese provinces.

The large metropolitan regions, which often exhibit relatively higher per capita income, are likely to yield endogenous growth and attract human capitals due to their agglomeration economies.

When we observe decreasing regional disparities, economic disparities across regions converge to a steady state level. On the contrary, in case of increasing or expanding regional disparities, the economy is in course of a transition to another steady state due to changing industrial structure.

There are many sources which could change inter-regional income disparities. In a dynamic context, migration is an important factor which can be the cause and/or result of regional disparities as well as regional difference of technological progress. Many empirical studies find agglomeration economies arising from population and industrial concentration will enhance regional productivity.

A regional income transfer by the national government is another important factor affecting income disparities. Income transfers are usually implemented by the national government to poor regions from richer ones in order to adjust differences in local public finances. The total amount of transfers, in case of Japan, is determined by the national tax revenue and political judgment.

In this paper we will focus on three factors; agglomeration, migration, and income transfers, for dynamics of regional GRP/income disparities and investigate whether those factors show different effects on regional convergence/divergence by institutional difference between Poland Japan. We start by comparing the contributions of those factors to regional disparities graphically and try to explain the effects of Polish and Japanese institutions. This is presented in the following section. The trends of regional per capita GRP (or income) disparities measured by the CV (Coefficient of Variation) are depicted with/without income transfers, and with/without Capital region[3]. The graphical relationships between per capita income growth and agglomeration, income transfers, migration are also exhibited. Section 3 provides a modified convergence model including agglomeration as a divergence factor and regional migration as a convergence factor. Specification of the model presented in Section 3 is estimated by using Polish and Japanese regional data and results are interpreted in Section 4. Concluding remarks are given in Section 5.

2. Fact Findings on Regional Disparities: Poland and Japan

In this section we will focus on the trend of regional disparities and examine some factors which are seemed to be related to the change in regional income disparities. The candidates for factors are agglomeration and migration, and income transfers. After graphically examining such factors, we proceed to construct the model explaining regional convergence/divergence.

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[3] Mazowieckie Voivodeship occupies 21.6% of the national GDP while Tokyo occupies 18.4% of the national GDP in 2006. Thus it is expected that both regions as a Capital ones have an substantial effect on regional disparities.

2.1 Trend of Coefficient of Variation

Figure 1a shows two lines of the regional CV (Coefficient of Variation) series of per capita GRP (gross regional product) for the Polish regions. One is a line for 16 NUTS 2 regions, and the other for the 15 regions, in which Mazowieckie Voivodeship (capital city Warszawa is included) region is excluded from the sample. By comparing the two lines, we find that the existence of Mazowieckie Voivodeship, in particular Warszawa, has a strong influence on the magnitude of regional disparities, and the strength of the influence of Mazowieckie Voivodeship on regional disparities has been increasing between 1995–2006. If we adopt the sample excluding Mazowieckie Voivodeship instead of 16 regions, the magnitude of the disparities becomes smaller. Also from this figure, it can be seen that regional disparities in per capita GRP gradually expanded in the late 1990s, and from 2000 onwards it indicates a slightly declining trend. However, it starts to increase in 2005. As a result, regional disparities in terms of per capita GRP have increased by 0.08 points over these eight years.

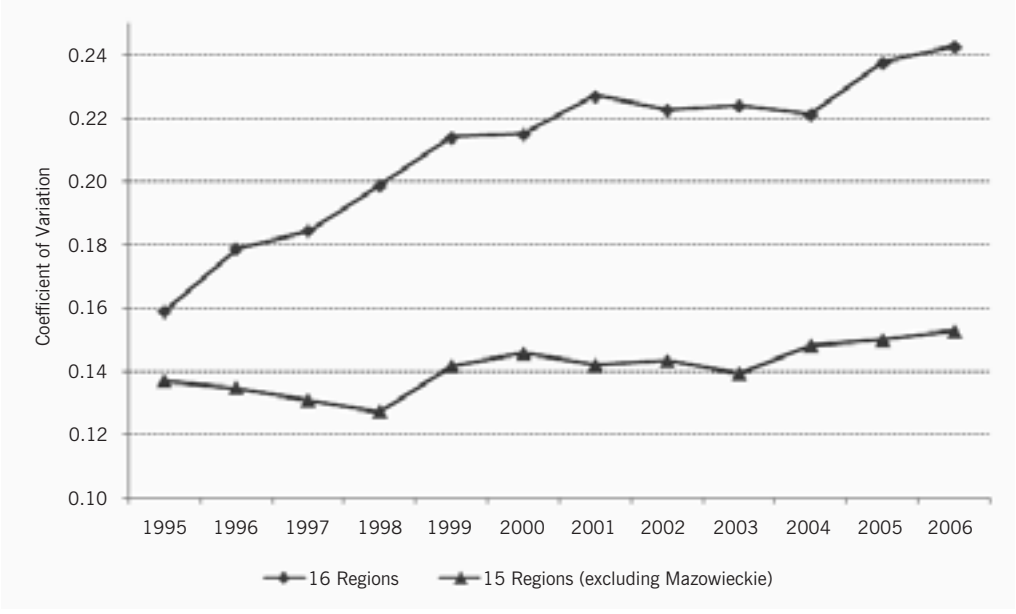

Figure 1a.

Trend of per capita GRP Disparities measured by the CV: Poland

Polish government embarked on the administrative reform in 1990 (after the establishment of a non-communist government). The new system of local administration reducing the number of voivodeships (provinces) was introduced in 1998, and the laws came into effect on 1999. This administrative reform will be reflected in the trend of CV during the period of 1999–2004 in Fig-

ure 1a, because regional disparities in terms of CV are not expanding. However, from 2004, Poland's Accession to the European Union, regional disparities restart to increase.

One of the reasons of such phenomena can be explained by the growth rate of GDP and the inflow of the FDI to Poland (see Appendix: Table A1). These two indicators show almost the same trend like Appendix: Figure A1. When the inflow of the FDI to Poland decreased in 2001–2003 and GDP growth has been relatively low in that period, disparities didn't increase. When the inflow of the FDI to Poland increased once again from 2004 and GDP began to grow rapidly, disparities began to increase again. It is remarkable that the inflow of the FDI is highest in Mazowieckie Voivodeship. The scale of inflow in Mazowieckie Voivodeship is four times bigger than Wielkopolskie or Małopolskie, ten times bigger than other main Voivodeships and even 50 times bigger than Lubelskie Voivodeship. Warsaw as a capital of Poland (Mazowieckie Voivodeship) attracts foreign direct investment in the financial sector, which subsequently raises incomes of labour. On the other hand, there are active FDI inflows in Wielkopolskie or Małopolskie Voivodeship, but these are the investments in industrial production. They don't affect directly to the rapid increase of incomes of labour force. At the same time, incomes aren't so high in production sector than the financial sector. So the trend of per capita GRP disparities of 16 regions including Mazowieckie Voivodeship shows the similar line as the FDI inflow, and the trend of 15 re-

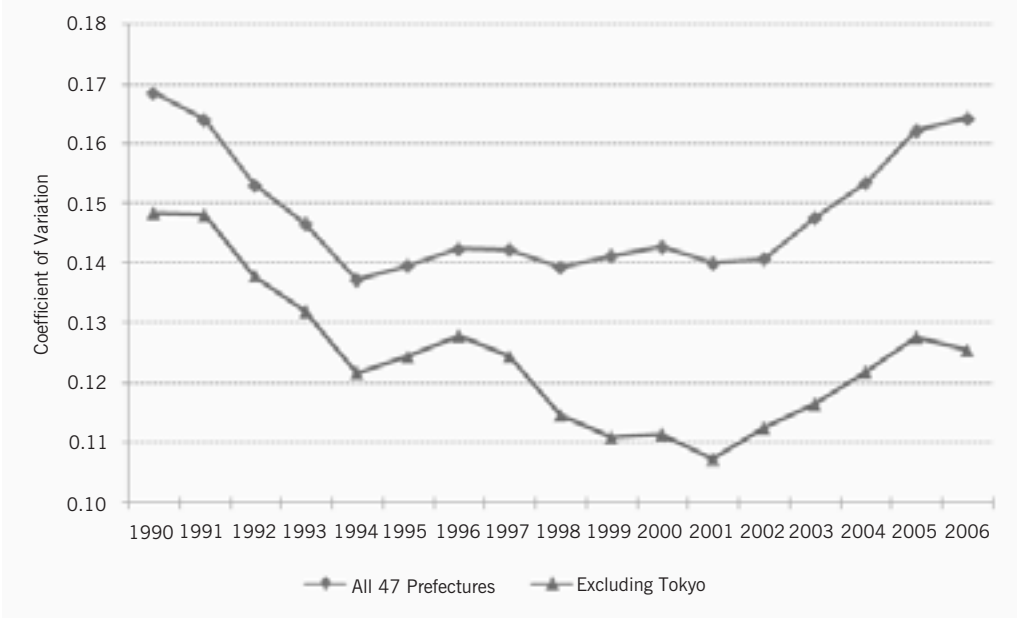

Figure 1b.

Trend of per capita Income Disparities measured by the CV: Japan

gions excluding Mazowieckie Voivodeship relatively unaffected the trend of the FDI inflow.

In Japan, a consistent series of regional income data are available from 1990 to 2006. Figure 1b shows the trend of per capita income, which is a similar value as per capita GRP, from 1990. By considering both figures, we can easily notice that there is an opposite tendency in regional disparities between Japanese and the Poland regions. In the late 1990's regional disparities were expanding in Poland whereas they were contracting in Japan. Post 1990, the Japanese economy had been suffering from the after-effects of remarkable increase in asset prices by the excessive speculation and has experienced a low economic growth, and even a deflationary recession in the late 1990s. This is one of the reasons for the decrease in regional disparities in Japanese CV[4]. Thus, in the 1990s the CV of Japanese prefectures decreased by percentage 0.03 points while the CV of Polish regions increased by 0.04 as shown in Figure 1a. In recent years, regional disparities have had a tendency to increase due to the effect of an economic recovery which has been led by the Tokyo metropolitan region.

In both countries effects of capital cities on regional disparities are increasing. In Poland the CVs for 16 NUT 2 regions are increasing whereas CVs for 15 regions excluding capital region is almost constant through the period. From the late 90s Japan is also experiencing a similar trend. In particular, regional disparities increase in 2006 while they decrease for 46 regions excluding Tokyo.

2.2 Convergence/Divergence

With regard to regional classification, the most relevant Japanese regional counterpart of NUTS 2 regions is 'prefectures' in Japan. There are 47 prefectures including the Tokyo Metropolis, which has 23 special wards, similar to inner London. Each prefecture is a local government and has its own governor. The average area over the 47 prefectural regions is approximately 7,930 km^2, which is quite smaller than the average of 16 NUTS 2 regions in Poland, which is 19,546 km^2.

From Figure 1a we can divide into three intervals while there are no clear convergence years in the period of 1995–2006 for Polish regions NUTS 2. Three periods are 1995–1999 and 2004–2006 as divergence and 2000–2004 as non-divergence.

It is obvious that Mazowieckie Voivodeship has a significant role on regional disparities. The first period 1995–99 and the third period 2004–06, both are divergence periods, Mazowieckie Voivodeship shows quite high growth rate in terms of per capita GRP. On the other hand, in the

[4] Of course, this reason arises from the trade-off concept between aggregate efficiency and interregional equalities.

non-divergence period 2000–2004 Mazowieckie Voivodeship experienced low growth rate.

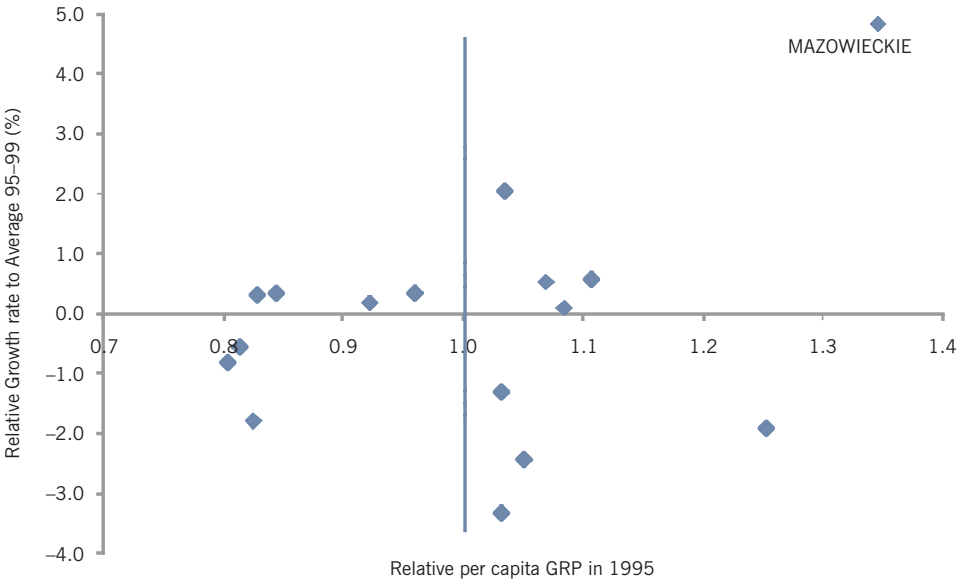

Figure 2a.

Divergence 1995–1999: Poland

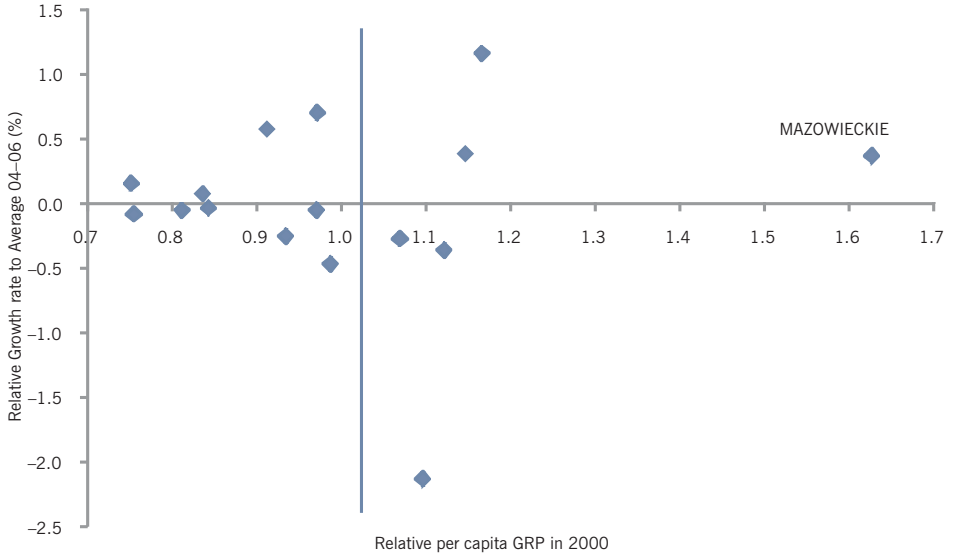

Figure 2b.

Non-divergence 2000–2004: Poland

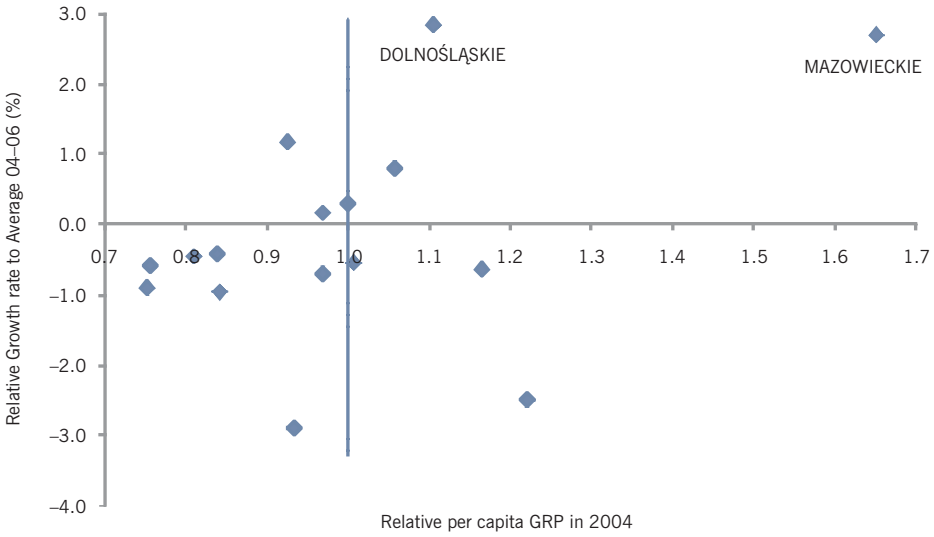

Figure 2c.
Divergence 2004–2006: Poland

As mentioned earlier in 2.1, the high concentration of FDI, especially in financial sector (about 25% of total FDI inflows to Poland) is observed in Mazowieckie Voivodeship (including Warsaw city). It is one of the reasons, which stimulated disparities of per capita GRP.

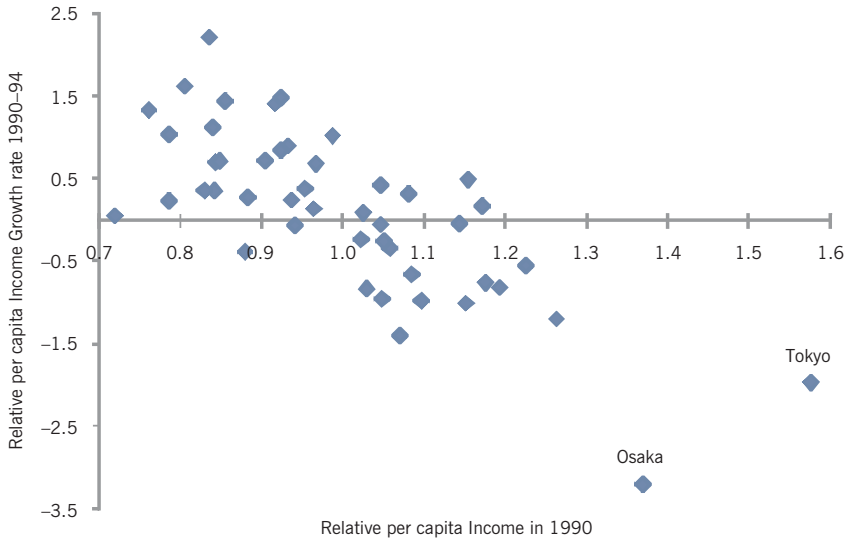

Figure 3a.
Convergence 1990–1994: Japan

Concerning regional convergence/divergence in Japan, as shown in Figure 3a, from 1990 to 1994, regional disparities exhibit clear convergence. In this period relatively higher income regions, particularly Tokyo and Osaka, experienced lower growth rate due to suffering from the after-effects of remarkable increase in asset prices by the excessive speculation. In recent years, 2001–2006, regional disparities have a tendency to increase due to the effect of an economic recovery which has been led by the Tokyo metropolitan region as in Figure 3c.

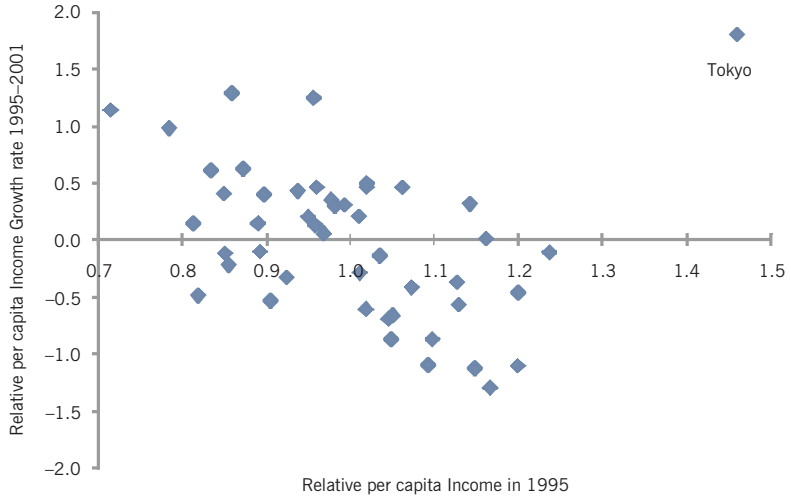

Figure 3b.

Non Divergence 1995–2001: Japan

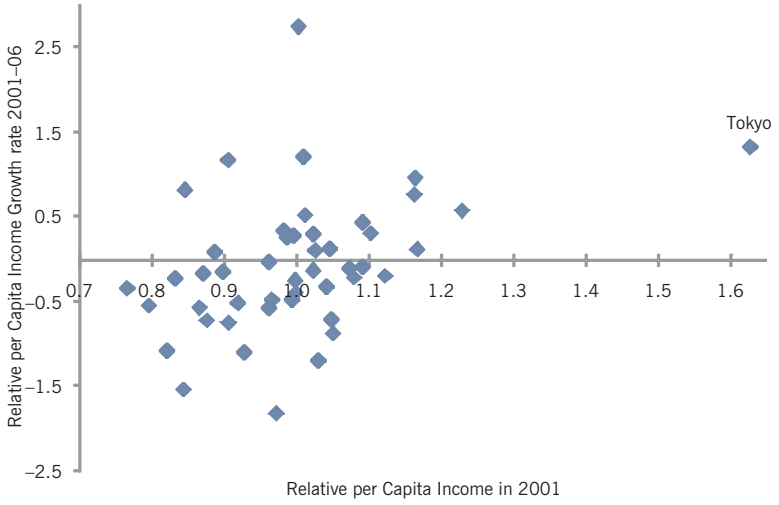

Figure 3c.

Divergence 2001–2006: Japan

2.3 Income Transfers

In general, factor mobility is not free between regions and also there certainly exist agglomeration economies both in production and consumption. These are factors opposite to convergence in the neoclassical growth theory. If it is not easy to move among regions for a certain factor in production, then regional disparities will be sustained. If agglomeration economies are substantial, then regional disparities may expand. Therefore, in order to try to equalize interregional economic disparities, income transfers by the national government are implemented as a policy instrument. As a result, the growth rates of poorer regions increase and catch up to the richer regions.

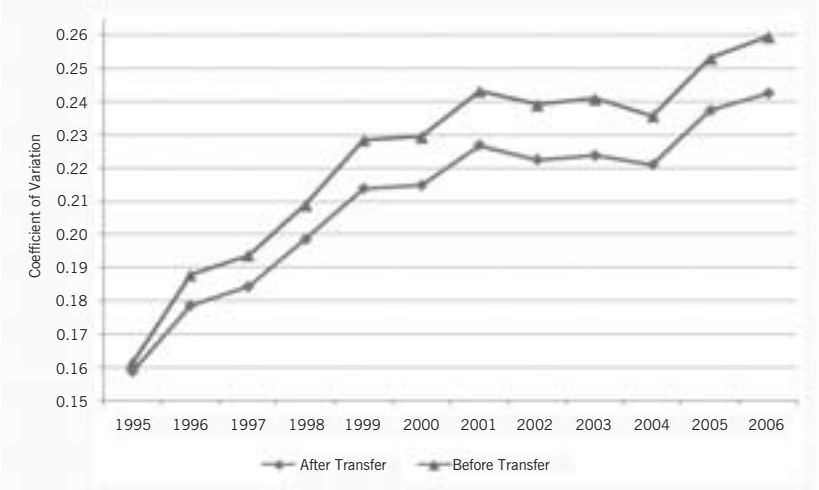

Figure 4a.

Trend of per capita GRP Disparities after/before Transfer: Poland

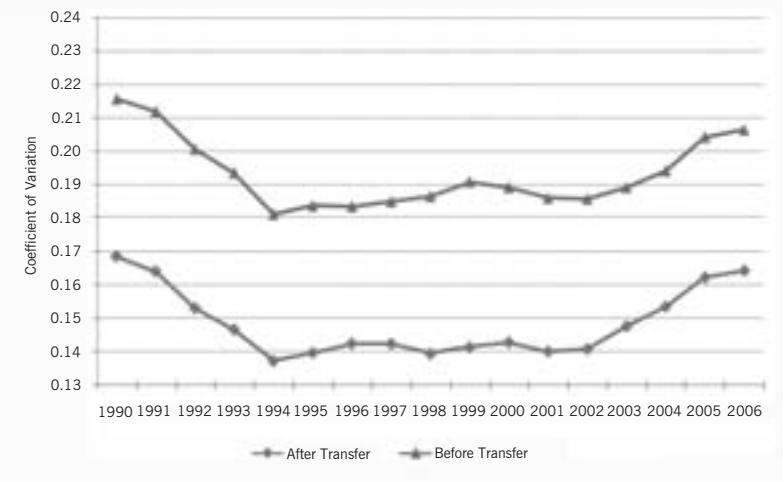

Figure 4b.

Trend of per capita Income Disparities after/before transfer: Japan

In Poland (Figure 4a) after the administrative reform of regional division, the effects of transfers on regional disparities became larger than the before. However, the effects are still smaller than regions in Japan (Figure 4b). The difference of the CV between after transfer and before transfer is around 0.045 for Japan while it is 0.015 for Poland in 2006.

2.4 Regional Size and Distribution

As we mentioned in section 2.1, capital regions in both countries have a significant role in the dynamics of regional per capita income/GRP disparities. Figure 5a shows regional size and its distribution in 2007 for Polish 16 NUTS 2 regions and Japanese 47 prefectural regions in terms of population size. In this figure we cannot identify the difference of regional primacy as a capital region in each country. The shapes of rank-size distributions of Poland and Japan are similar and the distribution of Polish regional rank-size seems to be slightly shifted down due to national population size. Thus, the population gap between capital region which has the largest population in the nation and the second rank region is not so large for both countries. However, as in Figure 5b, the shapes of rank-size distributions become different if we adopt NUTS 3 in Polish regional level and city level in Japanese region[5]. By taking a glance at Figure 5b, the largest city in Poland Warsaw has a strong primacy over other NUTS 3 regions. This is a quite interesting feature com-

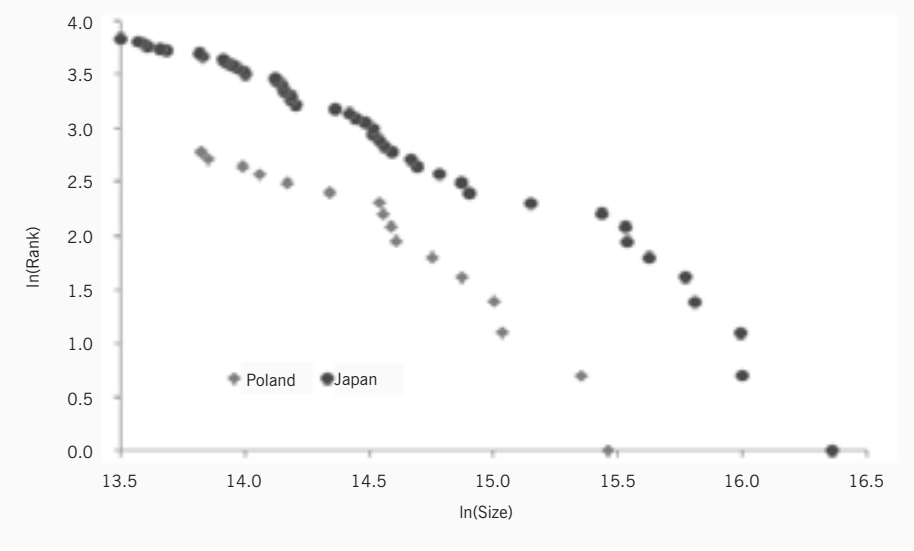

Figure 5a.
Regional Rank-Size Distribution in 2007
NUTS 2 and Prefectural region

[5] There are 66 NUTS 3 regions in Poland. With regard to Japanese cities, we chose 110 largest ones which are larger than 200,000 in populations.

pared to the rank-size distribution of Japanese cities. The population of Warsaw was 1,655,021 at the end of the communist period, and it increased to 1,709,781 at the end of 2008. It is rare case among the large cities in Poland, where the population is increasing. In almost cities population is decreasing in the consequences of the declining birth rate, high male mortality (40–60 years), and high emigration rate after the EU accession. But Warsaw absorbs population. One of the reasons of increasing population in Warsaw is a very low rate of unemployment. In Warsaw, the unemployment rate is only 1.9% in 2008 (in some rural cities the unemployment rate is about 30%–30,9% in Bartoszycki Province, 29,5% in Braniewski Province in Warmińsko-Mazurskie voivodeship).

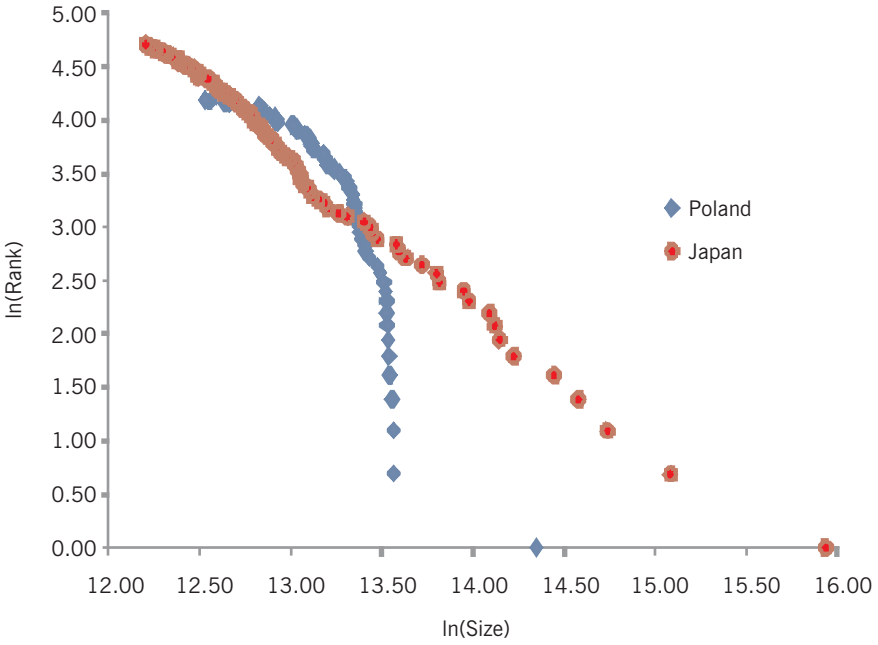

Figure 5b.

Regional Rank-Size Distribution in 2007
NUTS 3 and City

2.5 Migration and Relative Income Level

Migration causes a change of inter-regional income disparities whereas inter-regional income disparity is also a reason of migration. In a neoclassical regional growth model interregional population migration is assumed to respond to regional differences in factor prices, so that regions with relatively higher labour productivity attracts population and then marginal productivity will decrease due to diminishing returns. In this case regional income disparities will converge.

However, migration followed by human capital such as high skilled labour may raise the average income in in-migration region. This is another type of agglomeration in terms of human capital. In this case regional income disparities could diverge because of migration. The causality between migration and income differential are still now ambiguous.

Figure 6a and 6b depict the line exhibiting per capita GRP/income level relative to the average over 16 NUTS 2 regions in Poland and 47 prefectural regions in Japan, respectively, and draws the bar showing net migration in a region. By taking a glance at figures, we can realize that there exist a strong correlation between the net migration into a region and the relative per capita GRP/income difference. With regard to Tokyo, migration seems to lead relative change of per capita income in most of the period. In a neoclassical theory out-migration induces to raise marginal productivity of labour, so that per capita regional income will increase. This is well traced in the figure of Kagoshima Prefecture.[6]

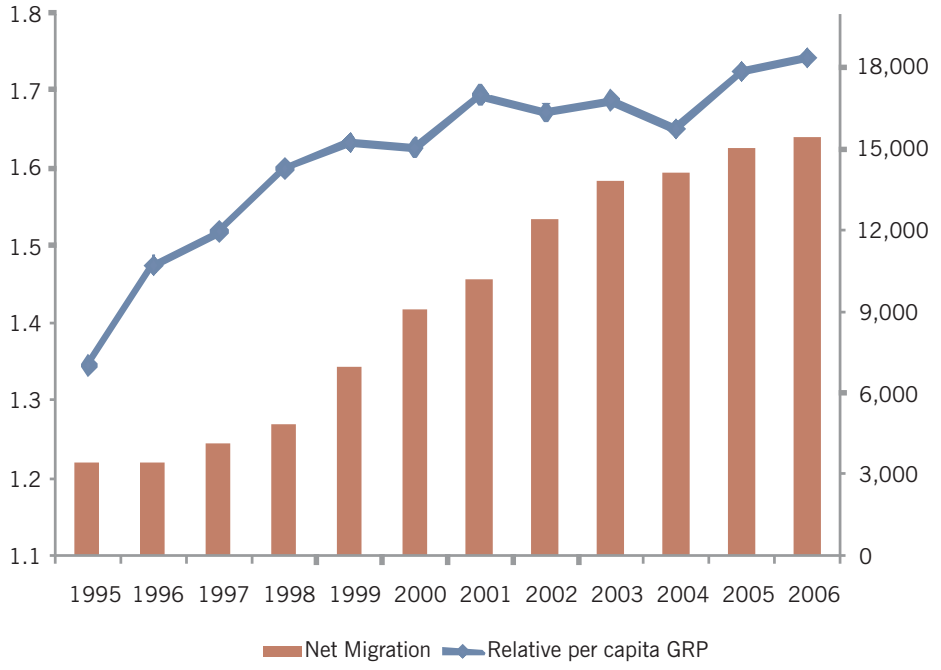

Figure 6a.

Migration and Relative per capita GRP: Mazowieckie

[6] Actually, there was much labour surplus in rural regions because of agriculture depending industrial structure. As a result, out-migration is directly linked to raising labour productivity.

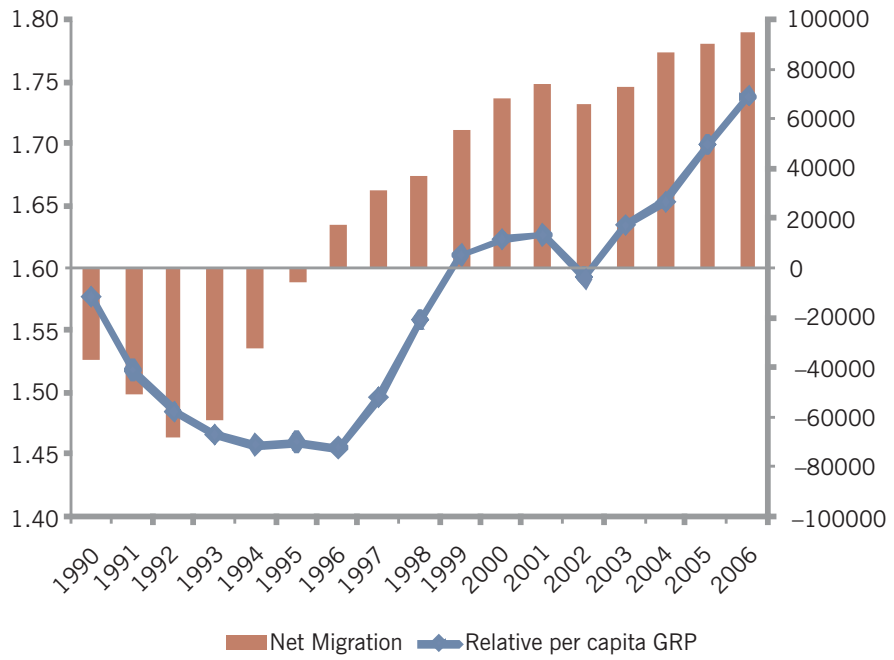

Figure 6b.

Migration and Relative per capita Income: Tokyo

3. Convergence Model in presence of Agglomeration Economies and Migration

In this section we try to formulate convergence model in presence of agglomeration and migration. First, we define per capita income producing function as

$$y_{it} = A(P_{it}) f(k_{it}; Y_{it}), \tag{1}$$

where y_{it} and k_{it} are respectively per capita income and per capita capital stock in region i at time t. These variables are defined as $y_{it} = Y_{it}/P_{it}$ and $k_{it} = K_{it}/P_{it}$, in which Y_{it}, K_{it}, and P_{it} are total income, capital stock, and population in region i, respectively. The existence of Y_{it} as an argument in function f implies the possibility of increasing returns to scale due to internalised agglomeration economies in a regional aggregated level. $A(P_{it})$ denotes Hicks neutral shift factor of production represented by regional population.

The change in capital stock, K_{it}, is given by

$$\dot{K}_{it} = I_{it} - d \cdot K_{it}, \tag{2}$$

where I_{it} is investment in region i and d is depreciation rate which is assumed to be constant over the period and region. By dividing both side of equation (2) by P_{it} the change in per capita capital, k_{it}, is derived as

$$\dot{k}_{it} = I_{it} - \left(d + \frac{\dot{P}_{it}}{P_{it}}\right)k_{it} = s_{K,\,it}\,y_{it} - \left(d + \frac{\dot{P}_{it}}{P_{it}}\right)k_{it}, \tag{3}$$

where $s_{K,it}$ is the proportion of investment in regional income.

In equation (3), unlike standard convergence model, population growth rate is variable over the period. The reason for this is that there is high frequency of interregional migration compared to international migration due to regional openness[7]. Population change is divided into natural change and social one. The separation of two factors is written as

$$\dot{P}_{it} = n_{it}P_{it} + M_{it}, \tag{4}$$

where *Mit* denotes net-migration (in-migration minus out-migration). The net-migration rate is defined by

$$m_{it} = \frac{M_{it}}{P_{it}}. \tag{5}$$

This rate also depends upon regional characteristics such as relative per capita income level. Thus, mi is rewritten as

$$m_{it} = m\left(y_{it}/\overline{y}_{t}\right), \tag{6}$$

where $\overline{y}_{it}$ is the average value of y_{it} over regions, and equation (6) is an increasing function with respect to relative per capita income level, i.e. $dm_i \big/ d\left(y_{it}/\overline{y}_{t}\right) > 0$.

Although at this point the causality between migration and per capita income level is ambiguous, in a neoclassical world for regions experiencing positive net-migration per capita income will decrease due to diminishing returns to scale with respect to labour. On the other hand, for regions accepting in-migration of skilled-labour per capita income level may increase due to immigrants' higher wages.

Thus steady-state of capital intensity level is given by the equation:

$$\frac{d\ln k_{it}}{dt} = \frac{\dot{k}_{it}}{k_{it}} = \frac{s_{K,\,it}A_i\left(P_{it}\right)f\left(k_{it},\,Y_{it}\right)}{k_{it}} - \left(n_{it} + d + m_{it}\right) = 0. \tag{7}$$

Let denote

[7] In their perspectives on regional economic growth, Niikamp and Poot [1998] formulate the endogenous growth model by considering labour migration.

$$G(k_{it}) = s_{K,\,it} A_{it}(P_{it}) f(k_{it}, Y_{it}) / k_{it} \tag{8a}$$

and

$$H(k_{it}) = d + n_{it} + m(k_{it}), \tag{8b}$$

where time subscript is added, and the use of $m(k_{it})$ instead of $m(y_{it}/\overline{y}_t)$ implies that is $y_{it} \propto k_{it}$ assumed. In equations (8a) and (8b), $H(k_{it})$ is an increasing function of k_{it} while $G(k_{it})$ is an decreasing function of k_{it}. The per capita capital at steady state k^*_{it} is given by the solution of $G(k_{it}) = H(k_{it})$. This steady state at time t is characterized by in Figure 7.

Even if region i is not on the steady state path at time t, per capita income of region i approaches to the steady state E^*_{it} under the conditions that G exhibits negative slope and H does positive slope, with respect to k_i, respectively. Thus, the adjustment to an equilibrium point $E^*_{it'}$ is dependent of the equation

$$\ln \frac{y_{it'}}{\overline{y}_t} - \ln \frac{y_{it}}{\overline{y}_t} = b\left(\ln \frac{y_{it'}}{\overline{y}_{t'}} - \ln \frac{y^*_{it'}}{\overline{y}_{t'}}\right), \tag{9}$$

where y_{it} is per capita income at period t in region i and y^*_{it} is its equilibrium solution at t, and $b (0 < b < 1)$ is adjustment parameter meaning speed of convergence, and $b = d + n + m$.

Now that we suppose the function $G(k_{it})$ shifts upward due to external economic structural change reflected in agglomeration effect such as $A_{it} < A_{it'}$. If this occurs in regions which are relatively higher per capita income, then income disparities will diverge. Then a temporary steady state point is given by $E_{it'}$ in the figure.

In this case, instead of the partial adjustment equation yielding convergence model (9), an approach to temporary steady state $E_{it'}$ can be expressed as

$$\ln \frac{y_{it'}}{\overline{y}_t} - \ln \frac{y_{it}}{\overline{y}_t} = b_1\left(\ln \frac{y^*_{it}}{\overline{y}_t} - \ln \frac{y_{it}}{\overline{y}_t}\right) + b_2\left(\ln \frac{A_{it'}}{A_{it}}\right)\left(\ln \frac{y_{it}}{\overline{y}_t}\right), \tag{10}$$

where b_1 and b_2 are adjustment parameters. Second term of the right hand side of equation (10) suggests the possibility of divergence of regional per capita income because of $A_{it} < A_{it'}$.

Although regions tend to move to new temporal steady state point $E_{it'}$, region i will experience population in-migration because of higher capital/labour ratio as shown in this figure. This will shift $H(k_{it})$ curve upward. This in turn generates convergence process of interregional disparities. The adjustment of this process is expressed as

$$m_{it'} = \lambda_0 + \lambda_1\left(\ln \frac{y^*_{it'}}{\overline{y}_{t'}} - \ln \frac{y_{it'}}{\overline{y}_{t'}}\right), \tag{11}$$

where λ's are parameters and the sign of λ_1 is expected to be negative because region i experiences net-immigration if per capita income of the region at $t'\left(y_{it'}\right)$ is higher than equilibrium level $\left(y^*_{it'}\right)$.

Combining equations (10) and (11) yields

$$\left(\ln\frac{y^*_{it'}}{\overline{y}_{t'}} - \ln\frac{y_{it}}{\overline{y}_t}\right) = Const + \frac{1}{\lambda_1} m_{it'} + \left(-b_1 + b_2 \ln\frac{A_{it'}}{A_{it}}\right)\ln\frac{y_{it}}{\overline{y}_t}, \tag{12}$$

where $Const = b_2 \ln\frac{y^*_t}{\overline{y}_t} - \frac{\lambda_0}{\lambda_1}$.

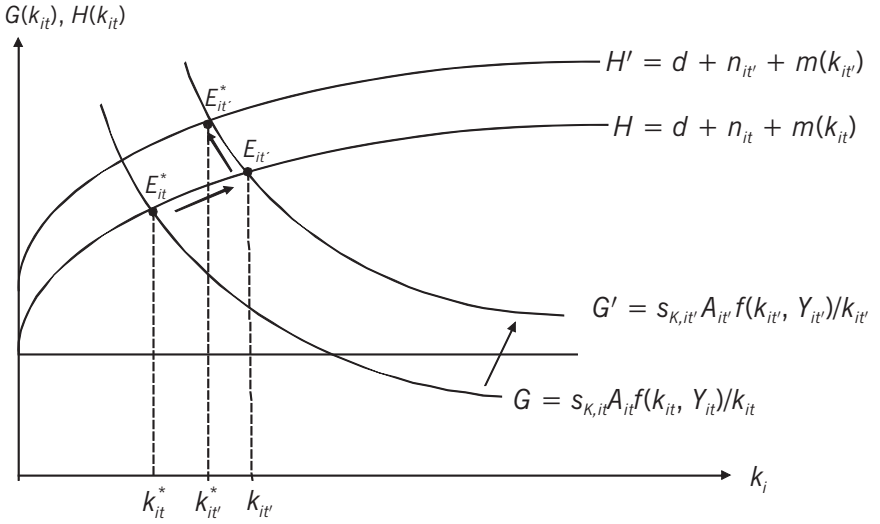

Figure 7.

Shift of Steady-state Point

The convergence equation which has been tested in many regions and countries is derived from equation (9) and the coefficient which is derived from solving difference-equation (9), as a function of λ, denotes a speed of convergence. The left hand side of the equation is approximately equal to the growth rate of per capita income in region i measured by the deviation from the regional average. The convergence equation is

$$\ln\frac{y_{it'}}{y_{it}} = \alpha + \beta \ln\frac{y_{it}}{\overline{y}_t}. \tag{9}'$$

In convergence model β is assumed to be constant over the period. If β takes the negative value, then regions deviating from the steady state in terms of per capita income would converge. However, regions with relatively higher per capita income may grow faster than the regions with relatively lower per

capita income due to agglomeration effects, and furthermore higher income level will attract human capital from lower regions, which in turn induces in-migration. Therefore, as shown in equation (12), we cannot deny the possibility of non-negativity of β as well as its constancy over the period[8].

In equation (11), it is expected that the effect of migration on convergence will be positive (parameter λ_1 is negative) because migration promotes to decrease inter-regional per capita income disparities by diminishing returns to labour in neoclassical model. On the other hand, the speed of convergence to new steady-state will decline due to the additional change of steady-state or high expectation of new steady-state may cause divergence.

4. Specification of the Model

First, we will define the Cobb-Douglas production function for firms with agglomeration economies. In a specification of a firm-level production function agglomeration economies are external to individual firms, and then the production function is expressed as

$$\widetilde{y} = \widetilde{\alpha}_0 P_i^{\eta} Y_i^{\gamma} \widetilde{k}_i^{\alpha} \widetilde{l}_i^{1-\alpha}, \tag{13}$$

and

$$\widetilde{y}_i = \frac{Y_i}{E_i}, \widetilde{k}_i = \frac{K_i}{E_i}, \widetilde{l}_i = \frac{L_i}{E_i},$$

where E_i is the number of firms, $\widetilde{y}_i$ is produced income per firm, $\widetilde{k}_i$ is capital stock per firm, and $\widetilde{l}_i$ is labour which is measured as employees per firm. Y_i is the total produced income in region i, and external to individual firms.

In aggregating into a regional level the production function is rewritten as

$$Y_i = \alpha_0 P_i^{\eta} K_i^{\alpha} L_i^{1-\alpha} Y_i^{\gamma} = \alpha_0 P_i^{\eta} K_i^{\alpha} \left(\kappa_i P_i\right)^{1-\alpha} Y_i^{\gamma}, \tag{14}$$

where labour is assumed to be the constant ratio of population, κ_i.

Rewriting Equation (14) in terms of per capita income gives the estimation form as

$$Y_i = \alpha_0^{1/(1-\gamma)} \kappa_i^{(1-\alpha)/(1-\gamma)} P_i^{(1-\alpha+\eta)/(1-\gamma)} K_i^{\alpha/(1-\gamma)}, \tag{15}$$

where $L_i = \kappa_i P_i$. Thus per capita income is expressed as

$$y_i = \alpha_0^{1/(1-\gamma)} \kappa_i^{(1-\alpha)/(1-\gamma)} P_i^{(\alpha+\eta)/(1-\gamma)} k_i^{\alpha/(1-\gamma)} \tag{16a}$$

or

[8] There are some papers which try to specify and estimate the changing convergence parameters in order to capture regional divergence.

$$y_i = \alpha_0 \kappa_i^{1-\alpha} k_i^{\alpha} Y_i^{\gamma} P_i^{\eta}, \tag{16b}$$

where $k_i = K_i/P_i$, and $y_i = Y_i/P_i$.

Equation (16a) indicates the industry-level production function in which agglomeration economies presented by regional aggregate income are internalised. Thus, the regional aggregate production function exhibits increasing to returns to scale when γ is positive, even given constant returns to scale at the firm level.

Adding time subscript t to all variables and substituting equation (16a) into (8a) gives

$$G\left(k_{it}\right) = s_{K,\,it}\alpha_{0t}^{1/(1-\gamma)}\kappa_{it}^{(1-\alpha/(1-\gamma))}P_{it}^{(\gamma+\eta)/(1-\gamma)}k_{it}^{(\alpha+\gamma-1)/(1-\gamma)} \tag{17}$$

The solution of steady state, k_i^*, is obtained by equating (17) and (8b):

$$k_{it}^* = \alpha_{0t}^{1/(1-\alpha-\gamma)}\kappa_{it}^{(1-\alpha)/(1-\alpha-\gamma)}\left(\frac{s_{K,\,it}}{\delta + n_{it} + m_{it}}\right)^{(1-\gamma)/(1-\alpha-\gamma)} P_{it}^{(1+\gamma)/(1-\alpha-\gamma)}. \tag{18a}$$

Therefore, per capita income at the steady-state is expressed as

$$y_{it}^* = \alpha_{0t}^{1/(1-\alpha-\gamma)}\kappa_{it}^{(1-\alpha)/(1-\alpha-\gamma)}\left(\frac{s_{K,\,it}}{\delta + n_{it} + m_{it}}\right)^{\alpha/(1-\alpha-\gamma)} P_{it}^{(\gamma+\eta)/(1-\alpha-\gamma)}. \tag{19a}$$

This equation implies that regional population has a role of shifting per capita income upward if agglomeration parameter γ is positive.

By applying equation (16b) to equation (8a) instead of (16a), we can drive another specification of steady-state like

$$k_{it}^* = \alpha_{0t}^{1/(1-\alpha)}\kappa_{\iota\tau}\left(\frac{s_{K,\,it}}{\delta + n_{it} + m_{it}}\right)^{1/(1-\alpha)} Y_{it}^{\gamma/(1-\alpha)}P_{it}^{\eta/(1-\alpha)} \tag{18b}$$

and

$$y_{it}^* = \alpha_{0t}^{1/(1-\alpha)}\kappa_{it}\left(\frac{s_{K,\,it}}{\delta + n_{it} + m_{it}}\right)^{\alpha/(1-\alpha)} Y_{it}^{\gamma/(1-\alpha)}P_{it}^{\eta/(1-\alpha)}. \tag{19b}$$

This specification explicitly presents agglomeration sources by aggregate income and regional population size and shows positive effect of agglomeration on per capita income while in-migrations have negative effect on per capita income of correspondent region. By combining equations (12) and (18a)/(18b), we can construct the estimation model.

5. Estimation of the Model

5.1 Data

With regard to regional classification, the most relevant Japanese regional counterpart of NUTS 2 regions is 'prefectures' in Japan. There are 47 prefectures including the Tokyo Metropolis, which has 23 special wards, similar to inner Lon-

don. Each prefecture is a local government and has its own governor. The average area over the 47 prefectural regions is approximately 7,930 km^2, which is less than half of the average of 16 NUTS 2 regions in Poland, which is 19,546 km^2.

Concerning Japanese regional data on income/GRP are from the Cabinet Office in Japan, 'Annual Report on Prefectural Income' (various issues) and data on population and job occupation by region are from Census of Population which is issued by each five year. In terms of statistical availability we can use data on the Regional System of Accounts (Annual Report on Prefectural Income). The data on income transfers by the national government are also available. Income transfer is called grant-in-aid from tax revenue; it is redistributed to local municipalities (cities, towns, villages, and prefectures) for which the amount of local financial demand exceeds local tax revenue.

About Poland regional data we obtain from regional statistical year books and via the web-site.

5.2 Estimation Model

By applying income-producing function (16b) to modified convergence model, equation (12), and also making use of equation (19b), we obtain estimate equation:

$$\ln \frac{y^*_{it'}}{y_{it}} = \beta_0 + \beta_m m_{it'} + \left(\beta_1 + \beta_2 \ln \frac{P_{it'}}{P_{it}}\right) \ln y_{it} \tag{20}$$

where β's are parameters to be estimated[9]. At this point we add a variable which will be significant to explain per capita income level by the investigation of graphs in section 2. The one is the income transfers conducted by the national government, which would help to converge income disparities across regions, denoted by S_{it}. Hence, the varying parameter model of convergence parameter β of equation (9)′ is rewritten as

$$\ln \frac{y^*_{it'}}{y_{it}} = \beta_0 + \beta_m m_{it'} + \beta_S S_{it} + \left(\beta_1 + \beta_P \ln \frac{P_{it'}}{P_{it}}\right) \ln y_{it}, \tag{12}$$

where the expected signs of parameters are $\beta_m < 0$, $\beta_S > 0$, $\beta_1 < 0$ and $\beta_P > 0$. The positive sign of parameter β_P means agglomeration economies have negative impact on convergence. Migration in general tends to converge regional disparities, i.e. $\beta_m < 0$, because of diminishing returns to labour. Finally, the sign of income transfers is expected to be positive since the role of transfers is to be implemented to equalize interregional income disparities.

5.3 Estimation Results

In the estimation some variables have endogenous characteristics which means a correlation to the error term, so that we use the two-stage least

[9] Recently, Kirdar and Saracoglu [2008] estimate migration effects on regional convergence in Turkey.

squares method with instrumental variables in order to deal this endogeneity problem. The candidates of instruments are lagged dependent variables.

By considering figures 1 to 5 we select three typical sub-periods which show increasing in terms of the CV; 1995–1999 and 2004–2006, non-increasing in the CV; 2000–2004 for Poland. With regard to Japan we also choose three sub-periods: 1990–1994 as convergence period, 1996–2001 as non-divergence periods, and 2001–2006 as divergence period. The reason we do not use the whole period is that the purpose of this paper is to investigate how agglomeration and migration economies affect change in regional disparities. The estimated results are presented in Table 1 for Poland and Table 2 for Japan.

In each table the first row in each period shows estimate of specification (a), i.e., absolute convergence model. With regard to Japanese regions, in the early 1990s simple regression model well captures convergence, in which estimated parameter of β_1 is negative and significant. The significance of convergence parameter does not disappear when additional explanatory variables are included such as specification (c) or (d). On the contrary, in the late 1990s convergence parameter is not negative in Poland as Polish economy experienced high growth, and also parameters of agglomeration (in the specifications (b)-(d)) exhibit quite high values and significant. Comparing before regional re-organisation and after re-organisation of the administrative division, convergence parameter β_1 has substantially decreased after regional re-organisation.

During divergence period agglomeration parameters are positive and most of them are significant in Poland and Japan. As described in Section 3, the positive sign of β_P means the economy is in course of transition to another equilibrium point, which is illustrated as a shift from point E^*_{it} to point $E_{it'}$ in Figure 7. This is also valid for the whole period including non-divergence period in Poland. Thus we can say that after accession to the EU in 2004 Polish regional economies are still in course of transition to new equilibrium locus. For 2001–2006 Japanese regional economies experience economic recovery and income disparities across regions exhibit divergence. The convergence parameters for 2001–04 are positive as well as agglomeration parameters in all specifications are positive. This will be related to the emergence of new Prime Minister in 2001, because he started to carry out privatization policy such as post service privatization.

Migration effects on the convergence are positive for the periods; 1995–1999 and 2000–2004 in Poland, and every period in Japan, which imply a decreasing in disparities of regional per capita GRP/income. However, the periods for the increasing disparities show positive sign which imply population net migration may induce divergence. Although the causality between migration and income disparity has been ambiguous, it can be said from our estimation results that population migration could support convergence for the period of decreasing disparities while it contributes to divergence due to transition to the new steady-state for the period in increasing disparities. In

recent years, after 2000, Japanese regional economies are experiencing increase in interregional income disparities, in particular compared to Tokyo metropolitan region. The estimated results for 2001–2006 imply that population migration into fairly high income regions represented by Tokyo would increase regional disparities accompanied by agglomeration economies.

Table 1.

Estimated Parameters: Poland

	1995–1999 Divergence Period				2000–2004 Non Divergence Period			
Specification	(a)	(b)	(c)	(d)	(a)	(b)	(c)	(d)
β_0	0.080 (1.78)	0.082 (2.35)	0.073 (1.11)	0.102 (0.14)	0.108 (4.65)	0.115 (4.46)	0.058 (2.36)	–0.026 (–0.24)
β_m			–0.017 (–0.17)	–0.019 (–0.17)			–0.048 (–3.12)	–0.075 (–2.72)
β_S				0.013 (0.04)				–0.225 (–0.28)
β_1	0.151 (1.21)	0.214 (2.13)	0.239 (1.35)	0.248 (1.85)	0.005 (0.15)	0.032 (0.81)	0.143 (3.12)	0.134 (2.28)
β_P		2.394 (3.05)	2.401 (2.94)	2.378 (2.19)		0.552 (1.70)	1.118 (3.68)	1.118 (3.60)
$\bar{R}^2$	0.094	0.473	0.474	0.475	0.014	0.183	0.561	0.580
	2004–2006 Divergence Period				1995–2006 Whole Period			
Specification	(a)	(b)	(c)	(d)	(a)	(b)	(c)	(d)
β_0	0.043 (1.63)	0.052 (2.21)	0.116 (4.45)	–0.063 (–0.44)	0.361 (6.25)	0.372 (10.31)	0.421 (6.97)	0.208 (1.47)
β_m			0.080 (3.40)	0.015 (3.23)			0.027 (1.03)	0.041 (1.58)
β_S				–0.115 (–1.27)				–0.423 (–1.64)
β_1	0.064 (1.71)	–0.036 (–0.64)	–0.082 (–1.88)	–0.129 (2.30)	0.237 (1.49)	0.546 (4.61)	0.318 (1.54)	0.049 (0.19)
β_P		1.799 (2.21)	1.191 (1.89)	0.572 (0.73)		2.056 (4.78)	1.501 (2.17)	1.465 (2.58)
$\bar{R}^2$	0.172	0.399	0.694	0.733	0.137	0.687	0.704	0.762

From Figure 4a and Figure 4b it is likely said that income transfers by the national government have a role of decreasing income disparities across regions.[10] The simple correlation coefficient between per capita transfers and per capita income growth rate are positive. It can be said that income transfers are effective for lower income regions in order to catch up higher per capita income regions in particular for convergence periods. However, the amount of per capita transfers and initial per capita income level are negatively and also highly correlated both for Poland and Japan. Therefore, due to the multicolinearity problem, parameter estimates in the specification (d) show negative sign and this is uncontrollable.

[10] Barro and Sala-i-Martin [1996] states that interstate transfers are not responsible for the long-run decline in income in spite of admitting transfers help reduce per capita income dispersion.

Table 2

Estimated Parameters: Japan

	1990–1994 Convergence Period				1996–2001 Non Divergence Period			
Specification	(a)	(b)	(c)	(d)	(a)	(b)	(c)	(d)
β_0	1.0510 (7.61)	1.052 (7.16)	1.147 (7.60)	1.173 (4.18)	0.593 (2.72)	0.574 (2.58)	0.864 (3.38)	1.687 (4.81)
β_m			–0.011 (–1.92)	–0.011 (–1.81)			–0.028 (–2.07)	–0.028 (–2.28)
β_S				–0.001 (–0.10)				–0.031 (–3.14)
β_1	–0.182 (–7.41)	–0.184 (–7.69)	–0.198 (–7.73)	–0.203 (–3.96)	–0.110 (–2.85)	–0.107 (–2.74)	–0.161 (–3.52)	–0.309 (–4.91)
β_P		0.004 (0.05)	–0.081 (–1.67)	–0.083 (–1.43)		–0.035 (–0.61)	–0.180 (2.01)	–0.211 (2.57)
$\bar{R}^2$	0.549	0.549	0.595	0.582	0.153	0.160	0.236	0.382
	2001–2006 Divergence Period				1990–2006 Total Period			
Specification	(a)	(b)	(c)	(d)	(a)	(b)	(c)	(d)
β_0	–0.616 (–2.61)	–0.463 (–1.93)	–0.623 (–1.96)	–0.197 (–0.48)	0.911 (3.04)	0.881 (2.77)	1.059 (2.74)	2.147 (3.63)
β_m			0.008 (0.78)	0.020 (1.63)			–0.058 (–0.82)	–0.007 (–1.03)
β_S				–0.024 (–1.65)				–0.041 (–2.35)
β_1	0.123 (2.91)	0.098 (2.33)	0.128 (2.25)	0.049 (0.66)	–0.142 (2.62)	–0.136 (2.38)	–0.168 (–2.42)	–0.357 (–3.44)
β_P		0.106 (2.15)	0.134 (2.19)	0.145 (2.41)		–0.010 (–0.31)	–0.048 (–0.85)	–0.067 (–1.21)
$\bar{R}^2$	0.158	0.238	0.249	0.295	0.134	0.135	0.148	0.247

6. Concluding Remarks

In this paper we have focused on the effects of institutional change as well as agglomeration and migration on the dynamics of regional disparities in terms of per capita GRP/income.

Although numerous empirical studies are conducted about regional convergence and its international comparison, there are few studies shedding light on the role of agglomeration and migration in the framework of neoclassical (new) growth theory. We extended the b convergence model into varying parameter version which allows divergence feature due to agglomeration as well as sources of convergence such as income transfers. Migration variable also is incorporated into the extended model as an adjustment factor of regional inequality.

The empirical implementation was conducted with Polish and Japanese regional data which cover from 1995 (1990 for Japanese regions) to 2006. While it is available to estimate long-run convergence, we have chosen typical periods which show increasing and decreasing disparities respectively.

The summary of the results are as follows.

As far as Polish regional economies, institutional changes which have occurred in 1999 and 2004 have significant effects on trend of regional disparities. Before the reform of regional organization regional disparities were expanding and agglomeration economies measured by regional population had a significant impact on regional disparities in divergence, which means a transition to new equilibrium locus. After 1995 regional disparities in Poland do not have a tendency to diminish whereas Japanese regional economies experience convergence as well as divergence since 1990. The most persuasive reason is that Warsaw and its surrounding areas still have strong attractiveness for (foreign) firms and households compared to Tokyo in Japan. So, Poland is more centralized in a city than Japan.

Transfers including subsidies from the national government have certainly positive effects on increase in per capita income for poorer regions. However, in the econometric estimation the effects are suffered from multicolinearity between initial income level and the amount of transfers. The effects of transfers on shrinking disparities are larger in Japan than in Poland.

Migration in general contribute regional convergence, but in the period of increasing disparities it is attracted to higher income regions due to agglomeration economies.

With regard to institutional change, in particular local administrative organization, Japanese government seeks to reform it in the near future. Thus experience of Poland will be suggestive to Japan. Also, for Poland Japanese policy of income transfer to lower income regions is effective to improve regional economic inequalities.

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Appendix

Table A1.

GDP and FDI inflow in Poland 2000–2008

	2000	2001	2002	2003	2004	2005	2006	2007	2008
GDP (bn PLN)*	744	780	809	843		983	1,060	1,175	1,266
GDP change (preceding year=100)*	104.3	101.2	101.4	103.9	105.3	103.6	106.2	106.7	104.8
FDI inflow (EUR million)**	10,334	6,372	4,371	4,067	10,237	8,330	15,741	16,674	10,970
Source: * Central Statistical Office (GUS), ** National Bank of Poland (NBP)									

Source: Polish Information and Foreign Investment Agency 'Poland in Figures'. (http://www.paiz.gov.pl/index/?id=a5e308070bd6dd3cc56283f2313522de)

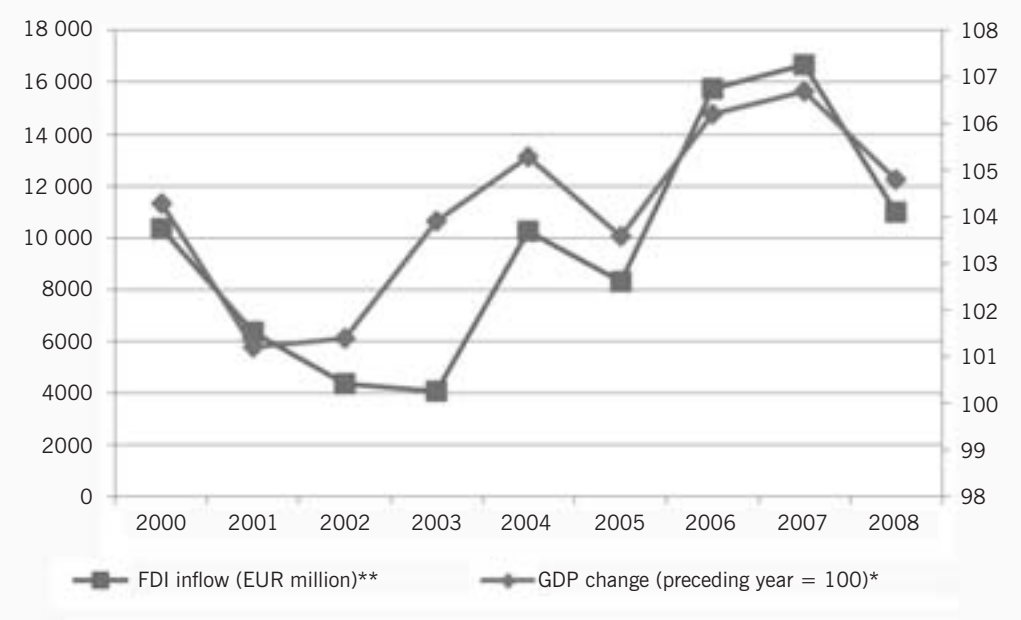

Figure A1.

Inflow of the FDI to Poland 2000–2008 (bln EUR)
Source: Compiled by authors, based on Table 1.

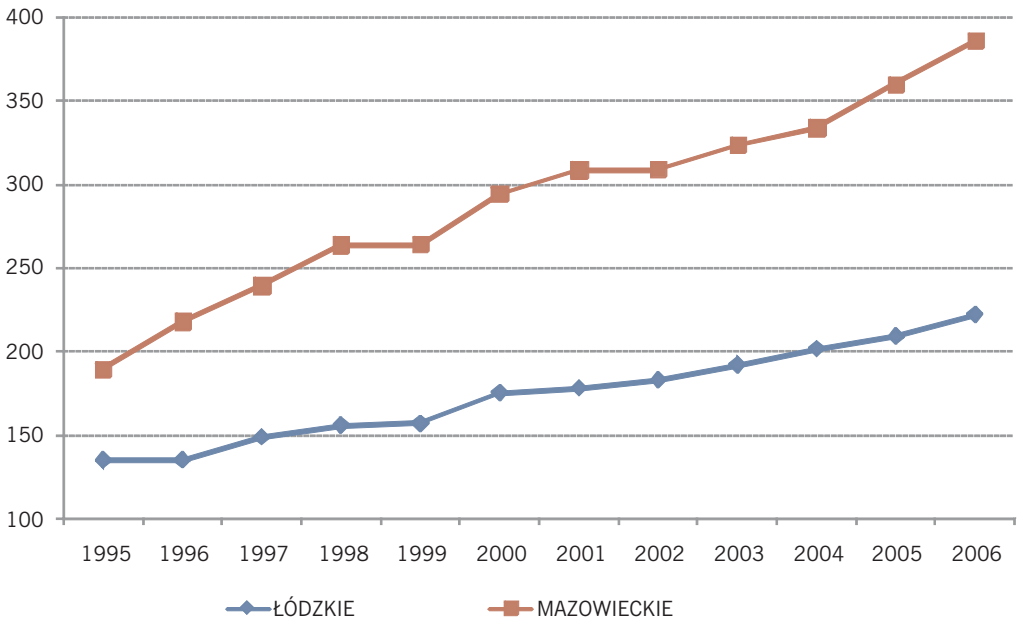

Figure A2a.

Trend of per capita real GRP: Central Region

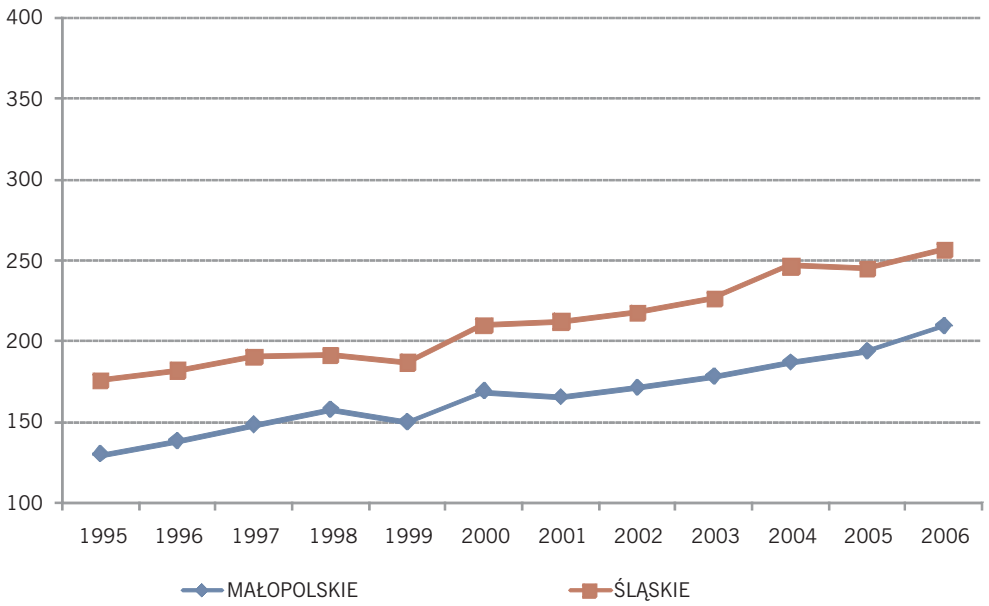

Figure A2b.

Trend of per capita real GRP: South Region

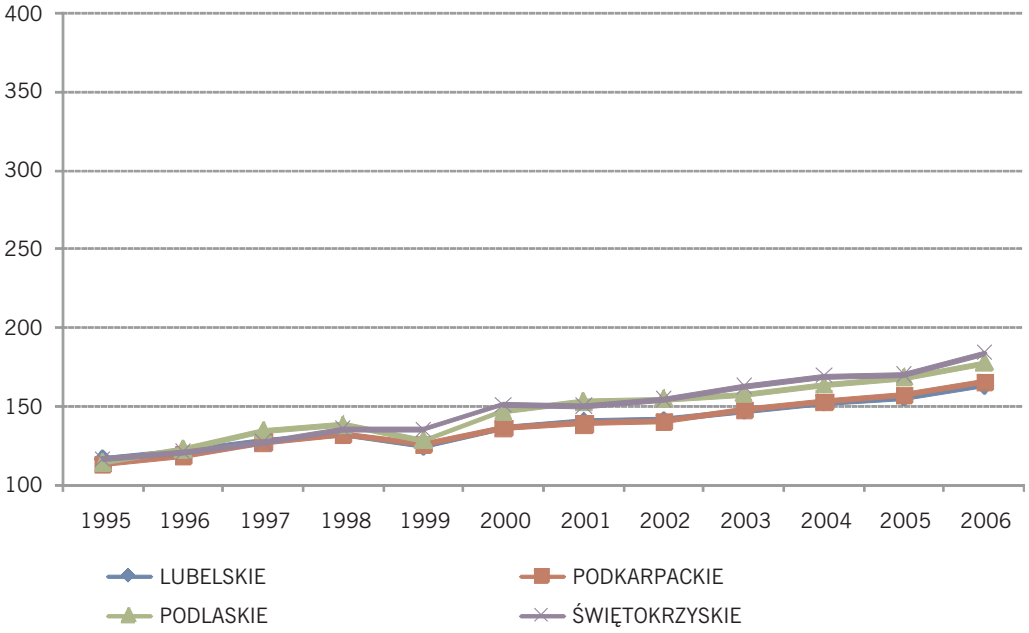

Figure A2c.

Trend of per capita real GRP: East Region

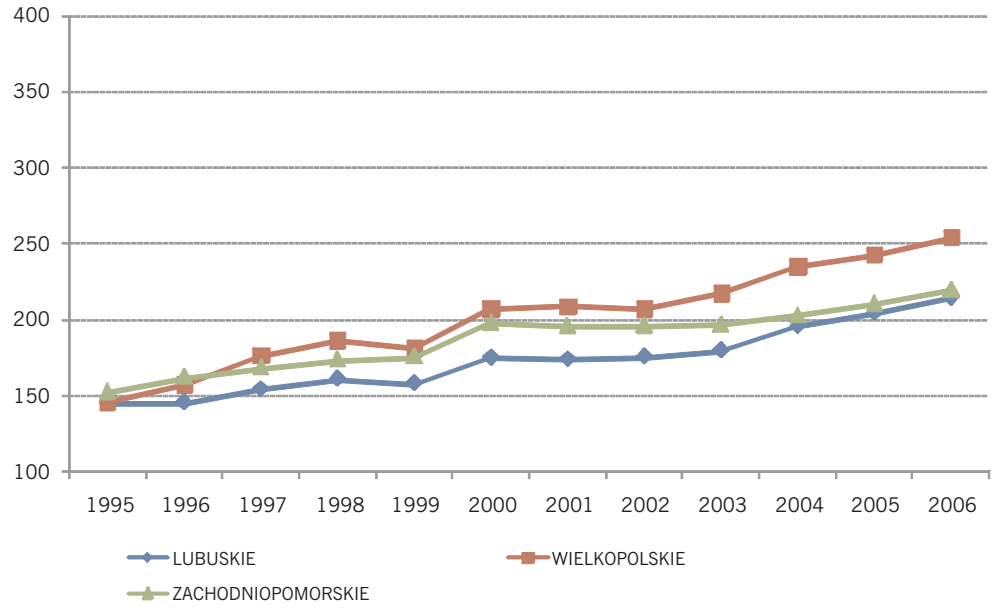

Figure A2d.

Trend of per capita real GRP: North West Region

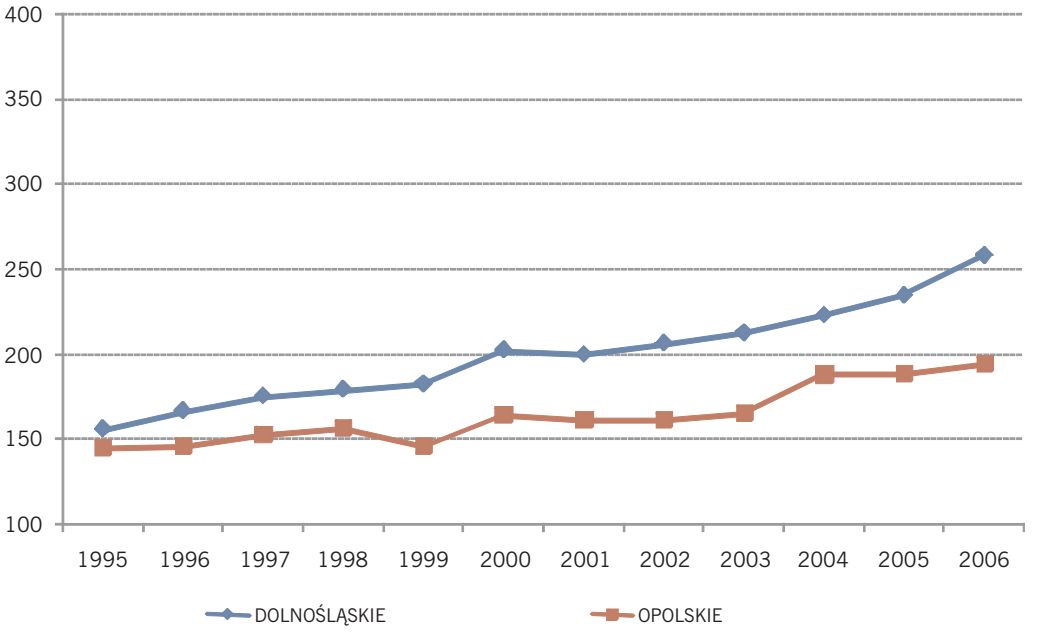

Figure A2e.

Trend of per capita real GRP: South West Region

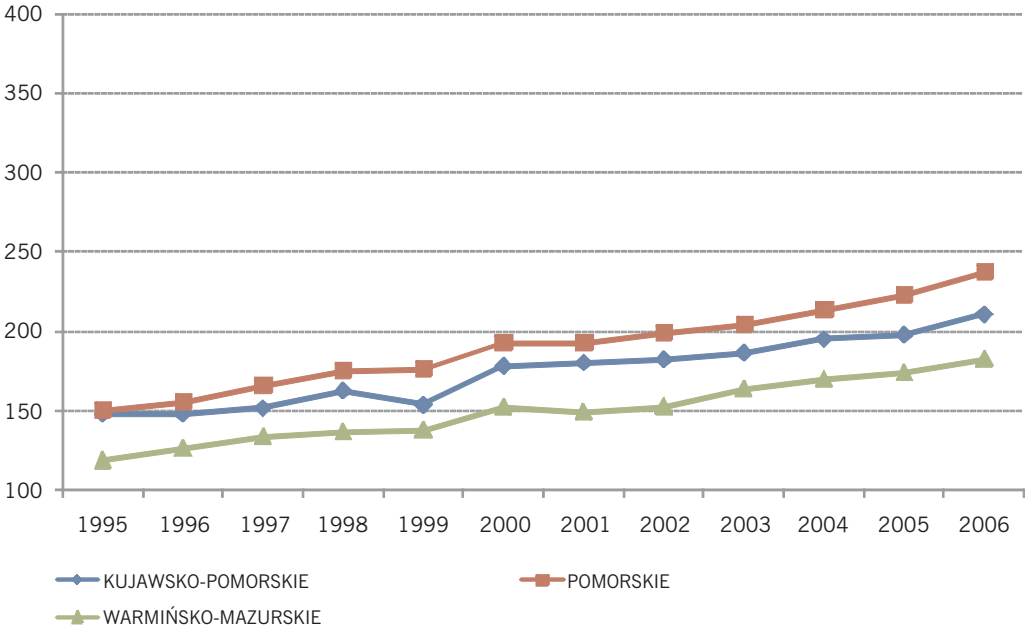

Figure A2f.

Trend of per capita real GRP: North Region

Abstract

Agglomeration and Institutional Effects on Dynamics in Regional Disparities: Experience from Poland and Japan

Poland and Japan, there were quite different characteristics in terms of economic system. Since drastic change of economic system in Poland in 1989, increase of economic disparities in terms of unemployment rates across regions was remarkable, probably due to the spatially deviated foreign direct investment. However, in recent years we can also observe a tendency of divergence in regional economic disparities in NUTS 2 level. Turning to Japanese regions, inter-regional income disparities is expanding since 2001 while in 1990s Japanese economies were strongly suffered from the Bubble burst. Japanese central government is now thinking about the reformulation of regional (local) governments, called prefectures. At this point, it is worthwhile to examine dynamics in regional disparities of two countries by comparing quantitatively regional institutional systems as well as economic situations. With regard to convergence/divergence model in the sense of Barro and Sala-i-Martin, there are few studies which incorporate agglomeration effects. We try to explain the dynamics of inter-regional disparities by institutional factors, which are different between two countries, as well as economic factors. The estimation model starts from defining regional production function, and we propose a new estimation model and implement estimation with regional time-series and cross-section data of Poland and Japan. Finally, we would like to refer to some policy implications for desirable regional economic system.