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Estimation of Spillover Effect of Social Capital on Regional Private Economy

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Abstract

This paper seeks to contribute to our understanding of a spillover effects of regional social capital on private economy from empirical point of view. A model is constructed, in which an external factor using neighboring capital and remote capital is taken into account. Public investment function in terms of regional expenditure, at the same time, is applied for simultaneous estimation in order to deal with an endogenous feature. Furthermore, the influence of regionally provided social capital on the private sector, located in other area, is examined. The result shows us relatively quite high spillover effect of economically developed regions.

1. Introduction

In the past decade, a great deal of work has considered the economic impact of social capital. Empirical framework was initially conducted in the United States. Some interesting findings regarding regional spillover effect emerged through the 1990s. Munnell [1] represented a cross-sectional analysis based upon estimated production function using regional social capital. Argument concerned with endogenous bias is still in controversy; however, the problem itself might be solved in some sense by simultaneous estimation with policy function such as regional public investment function. Duffy-Deno and Eberts [2] showed how to specify policy framework concerned with public investment within regional arena. A close study on Japan's case, on the other hand, was made by Yoshino & Nakano [3], Asako [4], and Mitsui & Ohta [5]. Those works revealed relatively lower effect of social capital when compared with the analysis on macro-based production function through the early 90s.

The purpose of this paper is to find the similarity and the difference from the former analyses by the use of current data covering post war period until 2000. Specification of the model is discussed in the paper, especially as to a form of impacts that regional social capital provides to other area.

2. Data and Prior Analysis

For the present, we shall confine our attention to observing data as a prior analysis. Most of the data are obtained from Annual Report on Prefectural Accounts.

Figure 1: Private GDP (Eastern Region : 2000)

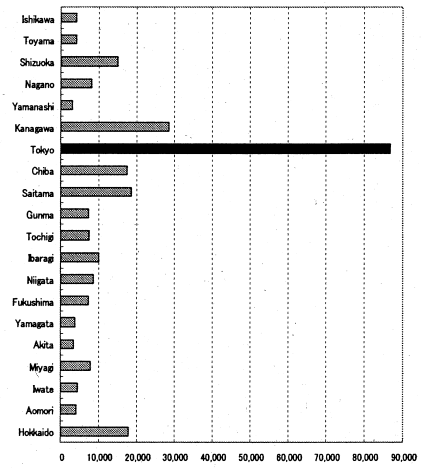
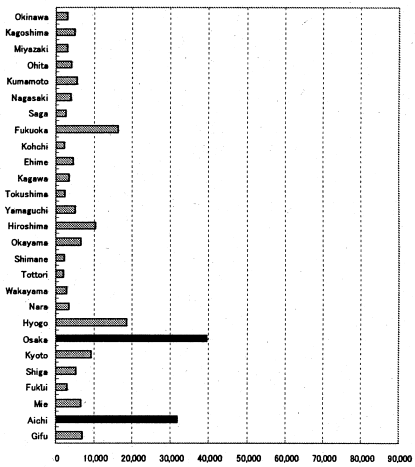


Figure 2: Private GDP (West : 2000)



Private GDP for all prefectures are shown above, eastern part of Japan and western area. Markedly higher degree of output level for Tokyo, Osaka, and Aichi can be observed here.

Figure 3: Regional Employment (2000)

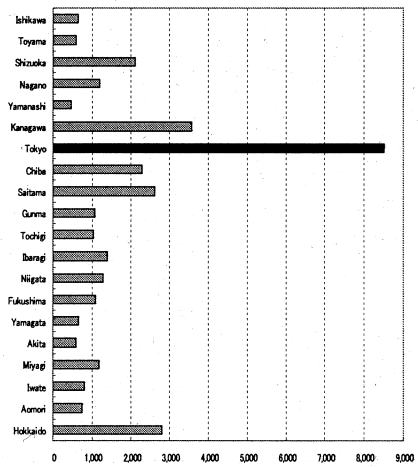
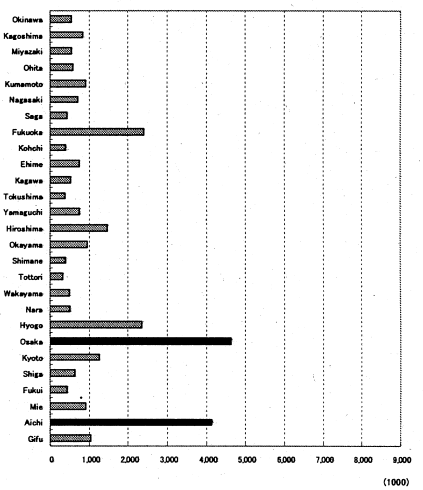


Figure 4: Regional Employment (2000)



Labor force, on the other hand, for each region is described in both Figure 3 and 4. It is obvious to show quite similar features with the one for regional output. Private capital is described in Figure 5 and 6. There is no need to go into details about the similar features for the private capital since all factors are proportional to the movement of regional private output.

Figure 5: Private Capital (2000)

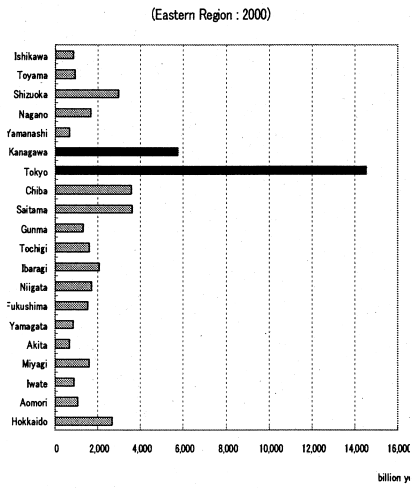


Figure 6: Private Capital (2000)

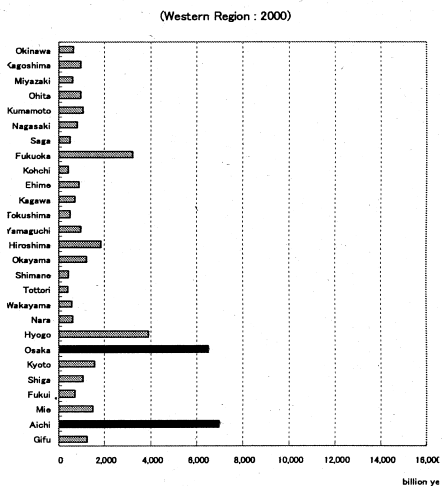


Figure 7: Social Capital (2000)

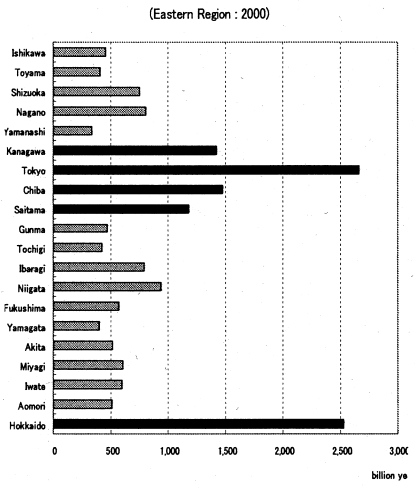
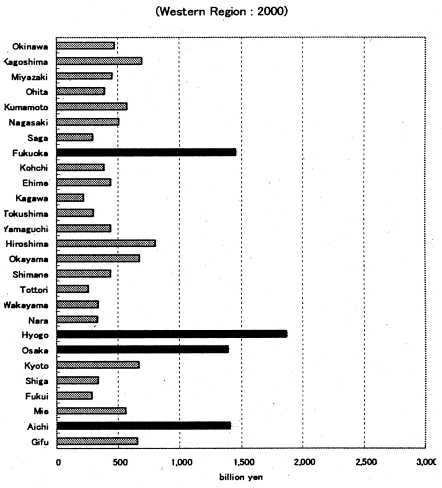


Figure 8: Social Capital (2000)



Let us now attempt to extend the observation into social capital that have been provided by regional financial policy. Investment in Hokkaido area can be marked by higher degree whereas its own output in private sector is quite lower. Similar features can be found for the case of Chiba, Saitama, Kanagawa, and Kyoto though such regions show not lower outputs.

3. Modelling the Structure of Regional Production Process

The first point to be discussed is a theoretical context concerned with the regional production process. Let us consider the subject from traditional point of view. Now we adopt a simple form of macro-based production function which can be written

$$Y = A(t)\, F(L,\ K_p,\ K_g)$$

where Y is private output, L is labor input, K_p is private capital, and K_g represents social capital. $A(t)$ is a time factor, playing a role to represent a continuous improvement of a technology. The production process is defined as an accumulation of regional sectors such as $Y = \sum y_i$, and then it can be represented as:

$$y_i = A(t)\, f(L_i,\ K_{pi},\ K_{gi}) \qquad (i = 1, 2, \cdots, n)$$

where n represents the number of regions (prefectures in case of this paper). In order to take spillover effect of the social capital factor into account, we need to prepare two types of variables; neighboring capital K_{g1i} and remote capital K_{g2i}. K_{g1i} indicates a complex of neighboring social capital for region i, and it can be written as:

$$K_{g1i} = \sum_{h=1}^{m} K_{gh} \qquad (h = 1, 2, \cdots, m)$$

where m is the number of prefectures surrounding the region i. Remote capital K_{g2i}, at the same time, is the social capital that belongs to economically developed centers such as Tokyo and Osaka networks. To describe the external impact of those major regions, remote capital is given by

$$K_{g2i} = \sum_{l=1}^{k} K_{gl} \qquad (l = 1, 2, \cdots, k)$$

Taking those variables covering both local and remote network into account, the model can be utilized for an estimation of spillover effect. Though the specification of the network still remains debatable, we would like to start the discussion from quite simple form.

Theoretical framework discussed above brings us to the second point. As many economists have emphasized so far, there might exist internal correlation between social capital K_{gi} and private output y_i. This is based upon a policy concerned with income redistribution, and the policy may creates endogenous dependency for those variables. Thus, simultaneous estimation of both

regional production function and regional public investment function is necessary to reduce a bias discussed above. According to Duffy-Deno and Eberts, level of publicly provided regional capital is assumed to depend upon regional income level and population. We adopt the same assumption for specifying public investment funtion. Then, the framework for public investment can be represented as:

$$K_{git} - K_{gi\,t-1} = g\,(y_i,\ P_i,\ t)$$

where P_i is a population of the region i. Since the former analyses, including Duffy-Deno and Eberts, have adopted several factors as decisive variables, agricultural production for instance; however, we would like to reduce the number of factors in order for the model to be simplified in the estimation process.

Within the framework discussed above, an allocation of regionally provided social capital has been regarded to satisfy the following condition

$$MP_{gi} = \frac{\partial y_i}{\partial K_{gi}} + \sum_j \frac{\partial y_j}{\partial K_{gi}}$$

where MP_{gi} indicates the sum of marginal productivities of the regional social capital. MP_{gi} must be equal in all regions

$$MP_{g1} = MP_{g2} = \cdots = MP_{gn}$$

only if the regional social capital has been allocated in the sense of optimal level. In other words, the production level in the whole society is maximized in this case under given regional capital.

Let us leave the argument concerned with the basic framework, and turn to the point on specifying the model. As mentioned above, we should start the analysis from quite simple specification. The basic form for the initial estimation is given by

$$\log y_{it} = \alpha_o + \alpha_1 t + \beta_1 \log K_{pit} + \beta_2 \log L_{it} + \gamma_1 \log K_{git} + \gamma_2 \log K_{g1it} + \gamma_3 \log K_{g2it} + u_{it}$$

As shown above, we adopt a separable form in which social capital factors are segregated by the distance from the region i. Publicly provided regional investment function, on the other hand, can be specified to the following log-linear form

$$\log I_{git} = \delta_o + \delta_1 t + \phi_1 \log y_{it} + \phi_2 \log P_{it} + \epsilon_{it}$$

where reginal dummy factors are likely to be added if necessary.

4. Estimated Results and Interpretation

We have tested two types of estimation processes; one is an estimation for the single regional function (Case Ⅰ) which is given by

$$\log y_{it} = \alpha_o + \alpha_1 t + \beta_1 \log K_{pit} + \beta_2 \log L_{it} + \gamma_1 \log K_{git} + \gamma_2 \log K_{g1it} + \gamma_3 \log K_{g2it} + \gamma_4 D_i t + u_{it}$$

The second type is to estimate the same model shown above with the public investment function:

$$\log I_{git} = \delta_o + \delta_1 t + \phi_1 \log y_{it} + \phi_2 \log P_{it} + \epsilon_{it}$$

for a respective region as a system of simultaneous equations (Case Ⅱ). Table 1 summarizes the estimates of the parameters of the two types of models already described above. Three estimates, including MP_{Kpi}, MP_{Li}, and MP_{Kgi}, for both cases are shown in the table. The results of both cases show just a slight difference in terms of the level of estimates. Therefore, we decide to choose the second type (Case Ⅱ) as a model for measuring the impact of both neighboring and remote capital on regional private economy.

Figure 9: Hokkaido and North-East

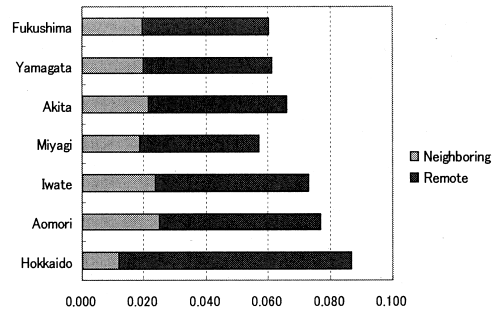


Figure 10: Kanto Region (Tokyo Area)

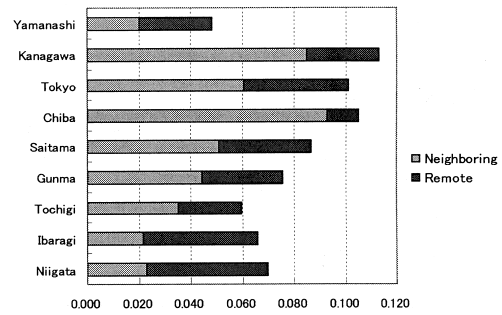


Figure 9 through 14 describe measured productivities of regionally provided social capital that are located outside of the focused region. In Figure 9, it is marked that the remote capital has given relatively higher level of impact to private sector in Hokkaido. Since Hokkaido is a geographically isolated area, neighboring capital seems not to possess high degree of influencial effect. Regional capital, accumulated in geographically remote area such as Tokyo, tends to affect the local economy of Hokkaido and north-eastern part of Japan; it has not been proved completely by the estimates though.

As to the second group, Kanto area where Tokyo plays a significant role as an economic center, we would like to lay special emphasis on two points. The first point is a relatively higher impact of remote capital on the economy of Tokyo. As can be observed from the diagram, it is quite unique in comparison with other prefectures within the same region. The second point to be noted is a higer degree of impact that neighboring capital provides to other prefectures such as Kanagawa, Chiba, and Saitama. It is likely that the accumulation of social capital in Tokyo creates a quite large amount of spillover effect to regionally close area.

Figure 11: Chubu Region (Nagoya Area)

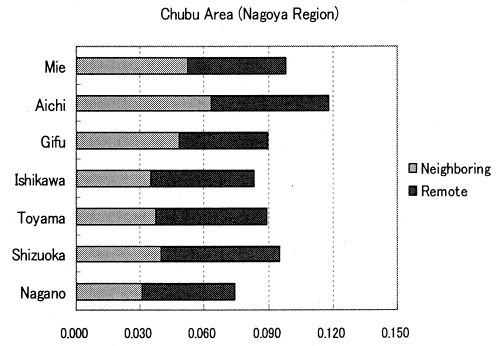
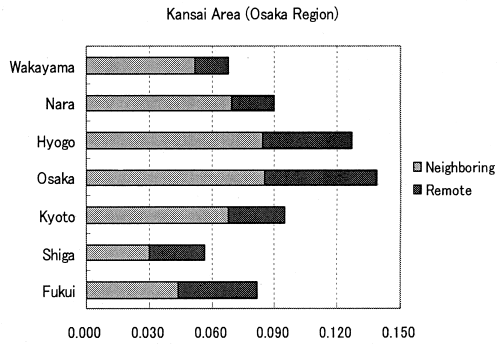


Figure 12: Kinki Region (Osaka Area)



We should notice that the local interdependence, found in Kanto area, might be unusual. From the result of Chubu area described in Figure 11, the economic dependency on remote region such as Tokyo is relatively high to a certain degree. The best account for the difference can be found in geographical characteristics of Chubu area that is located in between Tokyo and Osaka.

Figure 13: Chugoku & Shikoku Region

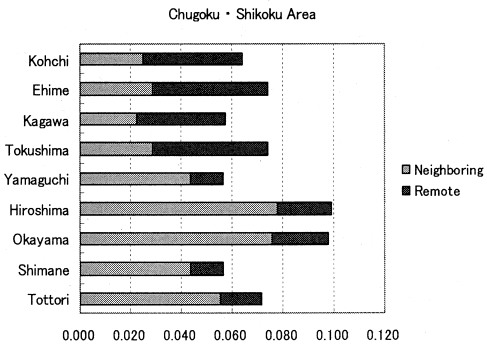
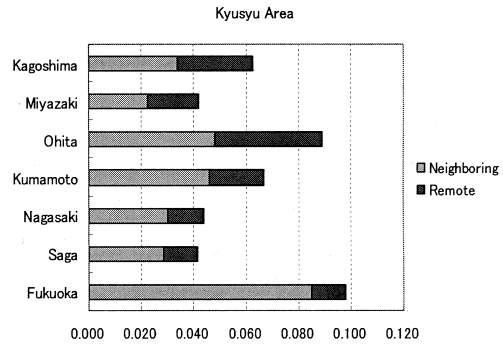


Figure 14: Kyusyu Region

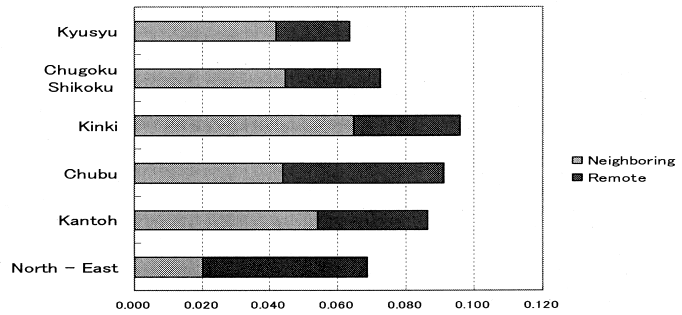


As to Kansai area, the impact of social capital is relatively higher than the one of the other region in terms of both neighboring and remote influences. High degree of total impact level is measured approximately in between 0.12 and 0.15. It is also marked by its dependency on local area network within Kansai economic zone.

Local dependence on the capital accumulated in either neighboring area or geographically remote places shows regional economic structure. Shikoku area, for instance, can be marked that its regional economy is highly dependent on remote economy such as Osaka that is geographically closer to Shikoku rather than Tokyo. The trend in Chugoku area might be opposite from the one in Shikoku, showing quite high impact of neighboring social capital.

Kyusyu area, located far from economic center such as Tokyo and Osaka, shows two types of opposite trends. Northern area such as Fukuoka can be interpreted as neighbor-dependent region on the ground that north Kyusyu is relatively closer to Kansai and Chugoku network. Southern area seems to possess opposite tendency, showing high impact of remote area.

Figure 15: Estimated Spillover Effect on Each Region



As a final analysis, we would like to focus on aggregated impact of regional social capital. Economic effect of regionally provided social capital on the whole area is shown in Figure 15. From what we are able to see in the diagram, economy in both north-eastern part of Japan and Chubu area tends to show high dependency on remote capital, that are concentrated in economically developed area such as Tokyo and Osaka. Other regions, on the other hand, are strongly related with neighboring economy within local network. One can safely state that the accumulation of regional social capital in both Tokyo and Osaka area create spillover effect on neighboring area to a greater degree. Estimated dependency of neighboring area on such a developed city serves as evidence of the point.

Table 1: Estimated Regional Productivity

	Case I			Case II		
	MP_{Kpi}	MP_{Li}	MP_{Kgi}	MP_{Kpi}	MP_{Li}	MP_{Kgi}
Hokkaido	0.102	0.304	0.087	0.013	0.374	0.067
Aomori	0.152	0.344	0.078	0.034	0.423	0.069
Iwate	0.131	0.298	0.074	0.029	0.367	0.065
Miyagi	0.151	0.355	0.058	0.033	0.395	0.051
Akita	0.185	0.322	0.067	0.041	0.358	0.059
Yamagata	0.201	0.354	0.062	0.044	0.394	0.054
Fukushima	0.178	0.267	0.061	0.039	0.297	0.054
Niigata	0.168	0.328	0.071	0.037	0.365	0.062
Ibaragi	0.189	0.341	0.067	0.042	0.379	0.059
Tochigi	0.248	0.289	0.054	0.245	0.321	0.047
Gunma	0.301	0.323	0.068	0.298	0.359	0.064
Saitama	0.394	0.402	0.078	0.390	0.373	0.074
Chiba	0.383	0.325	0.104	0.379	0.302	0.098
Tokyo	0.412	0.411	0.101	0.407	0.401	0.096
Kanagawa	0.395	0.377	0.113	0.391	0.350	0.107
Yamanashi	0.287	0.301	0.048	0.284	0.280	0.045
Nagano	0.174	0.287	0.074	0.172	0.267	0.070
Shizuoka	0.241	0.341	0.095	0.257	0.317	0.090
Toyama	0.211	0.304	0.089	0.225	0.282	0.084
Ishikawa	0.234	0.311	0.083	0.249	0.289	0.079
Gifu	0.297	0.314	0.089	0.316	0.294	0.084
Aichi	0.337	0.401	0.117	0.359	0.375	0.111
Mie	0.317	0.318	0.097	0.337	0.298	0.092
Fukui	0.134	0.314	0.081	0.143	0.294	0.077
Shiga	0.294	0.317	0.056	0.313	0.342	0.053
Kyoto	0.323	0.355	0.094	0.331	0.383	0.089
Osaka	0.347	0.472	0.137	0.368	0.509	0.130
Hyogo	0.324	0.325	0.129	0.300	0.350	0.122
Nara	0.278	0.316	0.089	0.339	0.341	0.084
Wakayama	0.275	0.322	0.067	0.336	0.347	0.063
Tottori	0.121	0.415	0.071	0.148	0.416	0.072
Shimane	0.119	0.313	0.056	0.145	0.314	0.057
Okayama	0.211	0.214	0.097	0.258	0.215	0.099
Hiroshima	0.231	0.362	0.897	0.282	0.317	0.052
Yamaguchi	0.181	0.287	0.056	0.221	0.251	0.057
Tokushima	0.211	0.310	0.074	0.185	0.271	0.076
Kagawa	0.199	0.332	0.057	0.175	0.290	0.059
Ehime	0.231	0.297	0.074	0.283	0.260	0.076
Kohchi	0.155	0.248	0.064	0.190	0.217	0.065
Fukuoka	0.304	0.337	0.098	0.372	0.311	0.051
Saga	0.266	0.279	0.041	0.326	0.244	0.044
Nagasaki	0.149	0.276	0.044	0.182	0.241	0.047
Kumamoto	0.224	0.311	0.067	0.274	0.272	0.072
Ohita	0.149	0.277	0.089	0.182	0.242	0.096
Miyazaki	0.172	0.266	0.042	0.211	0.233	0.045
Kagoshima	0.153	0.301	0.063	0.187	0.259	0.049

5. Concluding Remarks

The allocation of regionally provided social capital and its spillover effect to other area have been discussed in this paper. So far, we have seen the impact of both neighboring and remote capital which tends to be higher in economically developed area than the one in undeveloped area. It is not easy to evaluate the validity of the current regional policy. It; however, may be reasonable to recognize that continuous investment in developed area tends to expand the regional production level. Such an total effect as a macro-based contributor has been seen in author's former analysis described in Arai [6]. Thus, if the impact (total productivity) of region 2 is higher than region 1 as a following case:

$$\frac{\partial y_1}{\partial K_{g1}} + \sum_j \frac{\partial y_j}{\partial K_{g1}} < \frac{\partial y_2}{\partial K_{g2}} + \sum_j \frac{\partial y_j}{\partial K_{g2}}$$

then, such a regional policy will be interpreted to enlarge a production frontier level. Moreover, if region 2 is a quite developed area in terms of the economy, accumulation of regional social capital in the area will affect as a remote contributor through local and global network of the economy as we have seen from the estimated results.

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