The Effects of Public Finance System and Public Educational Expenditure on Human Capital Distribution in the Tokai Region: Simulation in a Six-Period Overlapping Generations Model*

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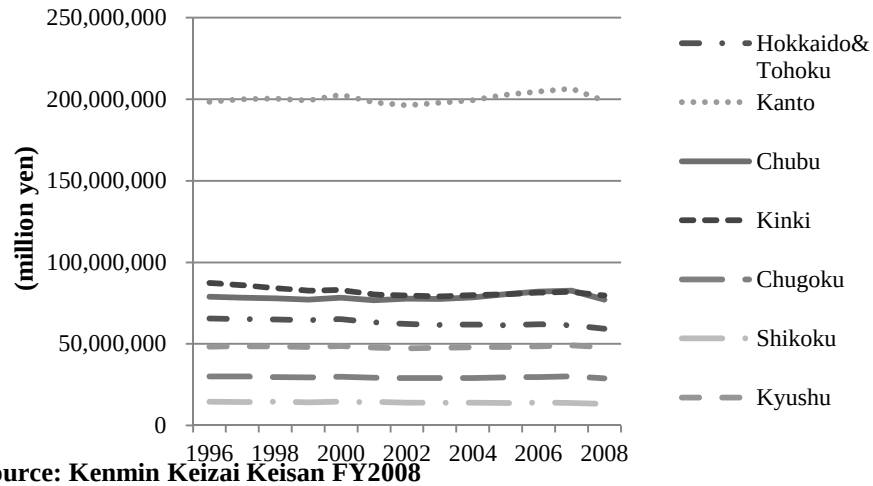
1. Introduction

This paper investigates the effects of public finance system and public education expenditure on economic growth in three prefectures in the Tokai region, Aichi, Gifu and Mie, in a six-period overlapping generations model of endogenous growth fueled by human capital accumulation.

Japan has experienced high economic growth from the 1970s to the early 1990s and prolonged economic recession to date. Figure 1 shows the GDP levels of Japan's seven regions, Hokkaido and Tohoku, Kanto, Chubu, Kinki, Chugoku, Shikoku, and Kyushu, from 1996 to 2008. There exists divergence among regions. The Kanto region has achieved the highest GDP level, while the Chugoku and Shikoku regions have caught relatively the low GDP levels. In addition, despite the severe economic recession since the mid-1990s, the Chubu region had benefited the remarkable economic performance for the last 10 years. The GDP level became very close to Kansai, the second largest region, by 2008.

Figure 1. Regional GDP (nominal)



Source: Kenmin Keizai Keisan FY2008

Per capita GDP in the three prefecture of Aichi, Gifu and Mie located in the Chubu region, which is often referred as the Tokai region, is shown in Figure 2. Per capita GDP of Aichi and Mie have grown faster than that of national average until the Lehman shock in 2008. The main reason for such success is mainly based on export-oriented automobile industry such as Toyota and its affiliated factories in Aichi and the growth of industrial complexes in Mie.

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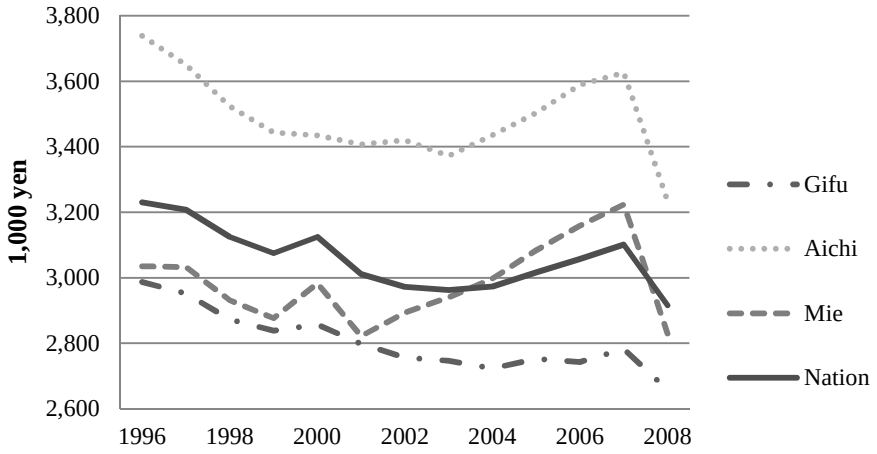
Figure. 2 Per capita GDP



Source: Kenmin Keizai Keisan FY2008

Table 1 shows the education expenditure and the college entrance rate of 2009 high school graduates in the Tokai region. Mie spends on education comparatively higher than other two prefectures. On the other hand, Aichi and Gifu have higher college entrance rate than the national average ratio. It is reasonable to say that the higher GDP levels in the Tokai region are derived from the higher levels of human resources in the prefectures.

Table 1. Ratio of education expenditure to local government expenditure in 2010 and college entrance rate in 2009

	Education expenditure	Ratio of persons who advanced to schools of higher grade	
		Male	Female
Gifu	25%	55%	55%
Aichi	25%	58%	60%
Mie	27%	50%	53%
Nation	N/A	52%	56%

Source: Japan Statistical Yearbook 2011& each prefectural government websites

Besides physical capital accumulation, human capital accumulation is assured to be one of the main sources of economic growth. This paper attempts to explain how the education expenditure affects the growth rate from a macroeconomic viewpoint by carrying out the calibration in Tokai's three prefectures. More concretely, we will analyze the growth paths in these prefectures. To capture the regional economy as realistically as possible, we use the six-period overlapping generations model of Shindo (2009) which is the extension of Bouzahzah et.al. (2002) and apply actual regional economic data to capture the heterogeneity of regions.

The initial application of the overlapping generations model to the numerical analysis is conducted by Auerback and Kotlikoff (1987) to study the effects of public policies. Later, Docquier and Michel (1999) and Fougère and Mérette (1999) analyze the effect of education on human capital accumulation or economic growth in European countries and in seven OECD countries, respectively. Uemura (2001), Sadahiro and Shimasawa (2002), Shimasawa (2004) and Tatibanaki, Okamoto, Kawade, Hatano, Miyazato, Shima and Ishihara (2006) among many others study Japanese policies including education.

However, except Ban (2007), there are only a few analyses which capture the heterogeneity of regions in the country.

Our main finding is that even though the efficiency in education and the education expenditure are not very high compared to other two prefectures, Mie achieves the highest growth in the long run. This attributes to the small amount of the debt issue.

2. The Model

The model is constructed based on Shindo (2009). The difference is the number of the region, that is, there are three regions in this paper. Each region has perfectly competitive markets of goods, labor and capital. We assume that all the markets are closed, that is, the goods, labor and capital are all immobile for analytical convenience. Please refer to the full paper for details.

3. Calibration

In this section, we set parameters and find the steady growth paths or long-run equilibria of Aichi, Gifu and Mie which replicate the actual data.

3.1 Parameter setting

First, we set parameters along the lines of Bouzahzah et al. (2002) and Shindo (2009). The data that we use are from 1998 to 2007. The parameter values are summarized in Table 2.

Based on these parameter values, we obtain equilibrium values in the steady growth paths of the three prefectures. To begin with, normalizing h_1 as one for analytical convenience, we obtain the capital stock levels per efficient labor unit in the initial period, k_0^*, as 1.176 for Aichi, 0.958 for Gifu and 1.069 for Mie. We then obtain the equilibrium values of the other endogenous variables and the human capital, or economic growth rates. These values are listed in Table 3 in the next subsection. Finally, we change the exogenous parameters of education investment, ψ, to check robustness.

Table 2. Parameter values

	Aichi	Gifu	Mie
Output elasticity of capital (α)	0.324	0.382	0.380
Technology parameter (A)	5.254	4.180	4.231
Capital depreciation rate (δ)	0.753	0.779	0.684
Time preference rate (γ)	0.840	0.840	0.840
Intertemporal elasticity of substitution (σ)	1.500	1.500	1.500
OJT/human capital depreciation in age group 2 (θ^2)	1.284	1.388	1.402
OJT/human capital depreciation in age group 3 (θ^3)	1.439	1.770	1.667

OJT/human capital depreciation in age group 4 (θ^4)	1.421	1.711	1.617
OJT/human capital depreciation in age group 5 (θ^5)	1.015	1.043	0.873
OJT/human capital depreciation in age group 6 (θ^6)	1.015	1.043	0.873
Human capital productivity (ξ)	0.245	0.159	0.219
Parameter for education investment (ψ)	0.128	0.221	0.041
Consumption tax rate (τ_c)	0.05	0.05	0.05
Wage income tax rate (τ_w)	0.379	0.444	0.399
Education subsidy rate (ν)	0.019	0.162	0.027
Pension payment (p)	2.081	1.927	1.944
Retirement ratio (ζ)	0.500	0.500	0.500
Other government expenditures (g)	0.270	0.054	0.324

3.2 Individual lifecycles on the steady growth paths

Figure 3 shows the consumption and asset level per effective labor unit in each age group. First, we can see on the left-hand side figure that the consumption per efficient labor unit increases with ageing in all prefectures. This is because individuals accumulate human capital and smoothen the utility levels throughout their lives. However, the consumption in Aichi is increasing faster than those in Mie and Gifu. This reflects the fact that the rate of return to capital in Aichi is the lowest among three prefectures, as shown in Table 3. The reason is that output elasticity of capital in Aichi is the smallest and thus the productivity of physical capital becomes low compared to those of other prefectures.

Assets are also increasing on the right-hand side figure until the individuals reach the fifth age group. Because they accumulate human capital with age, their wage income increases and so do their assets. In addition, they need to save assets to cover their consumption after their retirement in the middle of the fifth age group. To maintain the highest level of consumption in Aichi, its assets are also the highest among the three prefectures.

Figure 3. Individual lifecycles

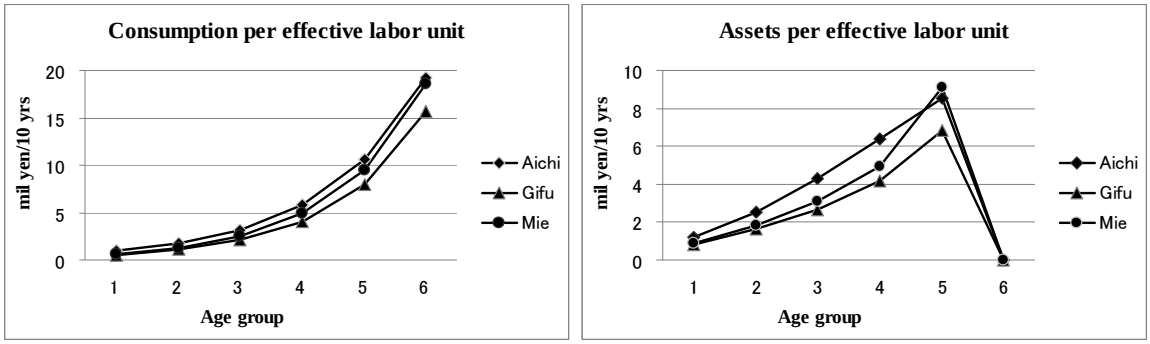


Table 3. Steady State Values

	Aichi	Gifu	Mie
Lifetime consumption per effective labor unit (mil yen/10 yrs)	41.637	31.571	22.987
Lifetime asset per effective labor unit (mil yen/10 yrs)	22.987	16.119	19.908
Human capital/economic growth rate (%/10 yrs)	1.158	1.075	1.183
Education subsidies per effective labor unit (mil yen/10 yrs)	0.001	0.008	0.001
Education time per capita (during 10 yrs)	0.033	0.033	0.012
Rate of return to capital (%/10 yrs)	0.773	0.860	0.858
Capital stock per effective labor unit (mil yen/10 yrs)	1.176	0.958	1.069
Assets per effective labor unit (mil yen/10 yrs)	2.740	2.066	1.996
Debt issues per effective labor unit (mil yen/10 yrs)	1.457	1.029	0.880

When we observe the effects of human capital/economic growth in the third row, Mie has the highest rate. Therefore, we can forecast that the prefecture will be able to catch up to the consumption and asset levels of Aichi in the long run although Mie is the lowest education time per capita among the prefectures in the initial steady growth path which is listed in the fifth row. On the contrary, the lowest growth performance in Gifu which lacks adequate physical capital and human capital will lead to the low growth performance.

The reason for Mie to achieve the highest growth rate is attributed from the smaller amount of the debt issue listed at the bottom although the efficiency for education and the education subsidy rate are not very high. This indicates that the debt issues by the local governments would crowd out the human capital accumulation as well as the physical capital accumulation.

The interesting result of this simulation is that depending on the initial configuration of physical capital and the growth rate, each prefecture takes different growth paths. Especially, there are various differences in exogenous variables such as output elasticity of capital and human capital productivity. Although the effects of exogenous parameters significantly affect the simulation results, our model offers some plausible explanations for the observed results.

4. Conclusion

The different public financial system and education expenditure lead to different growth paths in the three prefectures in the Tokai region. In particular, we clarify that the debt issue may crowd out the human capital accumulation as well as physical capital accumulation. In spite of the positive values of the efficiency in education and the education subsidy rate, the negative effect of the debt would dominate on the human capital accumulation. This indicates the importance of public financial management. Still, we do not deny that the initial structure of physical capital and the initial growth rate strongly affect the long-run growth path in each prefecture.

One of the limitations in our analysis is that we do not allow the factors of production to move across prefectures. We should modify the model more realistically. Another limitation is that we only analyze the three prefectures. We should examine entire prefectures or at least all regions to grasp the structure of economic growth in Japan.

Regardless of the limitations, this is a first step to capture the economic growth through education and to show the effect of governmental policy on the human capital accumulation.

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